

CENTER CITY CONNECTOR



Center City Connector Transit Study

Tier 1 Screening Report - *DRAFT*



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SEATTLE CENTER CITY CONNECTOR TRANSIT STUDY

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1 INTRODUCTION AND EXECUTIVE SUMMARY

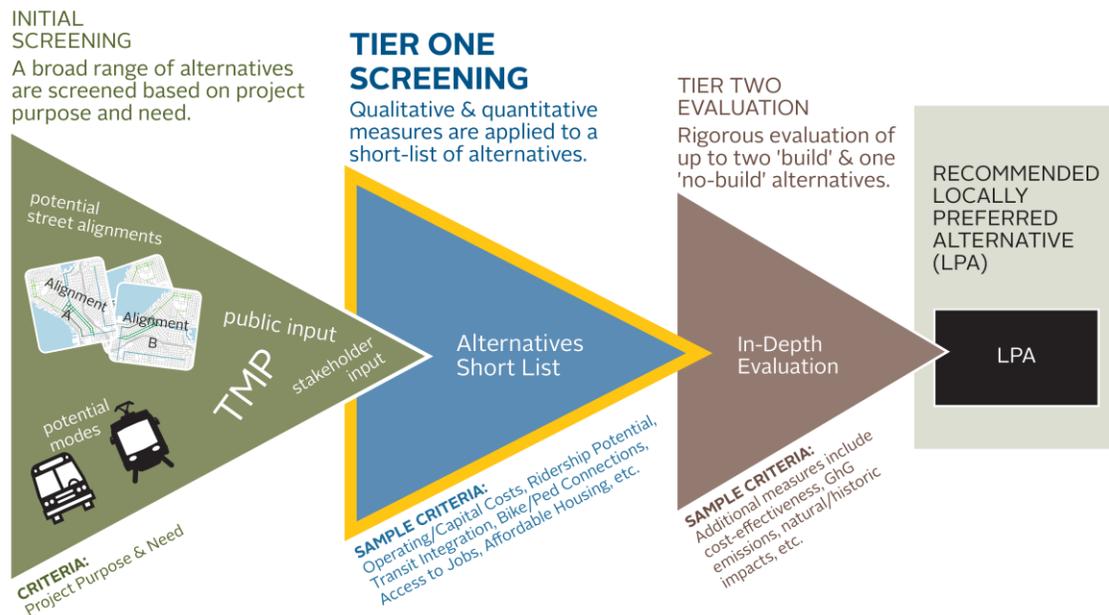
This report describes results of the Tier 1 screening of alternatives for the Seattle Center City Connector Transit Study. The purpose of the study is to evaluate a range of transit improvements in Seattle’s Center City, specifically focusing on connecting north and south downtown and the existing South Lake Union Streetcar line and the planned (currently under construction) First Hill Streetcar.

EVALUATION PROCESS

Figure 1-1 illustrates the evaluation process that was defined for studying and narrowing all reasonable alignment and mode options into a Locally Preferred Alternative (LPA), consistent with Federal Transit Administration (FTA) guidance.

The Initial Screening process concluded in April 2013 and resulted in the selection of mode and alignment alternatives for more detailed assessment in the Tier 1 Screening process, completed in June 2013. The Tier 1 Screening is highlighted in the graphic and is the focus of this report. An open house was held in June 2013 to present the Initial and Tier 1 Screening results and obtain public feedback.

Figure 1-1 Evaluation Process Overview



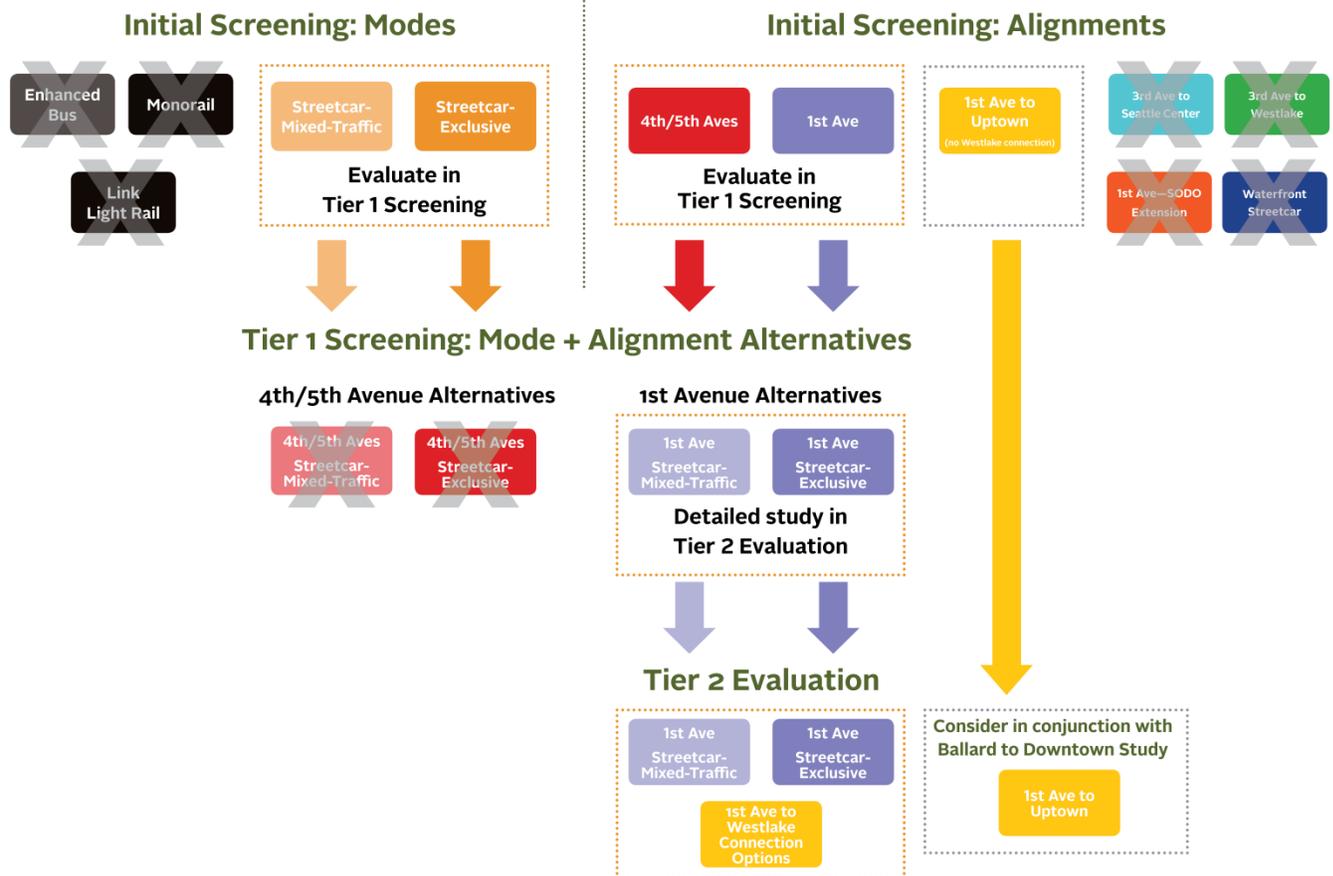
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INITIAL AND TIER 1 SCREENING OF ALTERNATIVES

Figure 1-2 shows the mode and alignment recommendations resulting from each step of the evaluation process that has been completed as part of the Center City Connector Transit Study. The outcome of the Initial Screening process was to narrow a wide range of potential mode and alignment options and to identify alternatives for further study in the Tier 1 Screening process. As shown in Figure 1-2, the Tier 1 alternatives were Mixed-Traffic and Exclusive Streetcar modes and 4th/5th Avenue and 1st Avenue alignments.

The intended outcome of the Tier 1 Screening is to determine the alternative(s) that best meet the project goals and objectives and recommend alternative(s) for more detailed study in the Tier 2 Evaluation process. High-level designs were developed for each Tier 1 alternative—4th/5th Avenue Mixed-Traffic Streetcar, 4th/5th Avenue Exclusive Streetcar, 1st Avenue Mixed-Traffic Streetcar, and 1st Avenue Exclusive Streetcar. The alternatives were evaluated using a set of criteria designed to measure how well each alternative met the project need and project goals. In addition to the technical analysis, public input from the two open houses held thus far was taken into account in rating the alternatives. Ultimately, 1st Avenue Exclusive Streetcar and 1st Avenue Mixed-Traffic Streetcar were recommended for more detailed study in the Tier 2 Evaluation. In addition, it was recommended that a potential extension of the 1st Avenue alignment to Uptown be considered in conjunction with the Ballard-to-Downtown Study, which is evaluating a range of transit options north of the Westlake area.

Figure 1-2 Center City Alternatives Screening Process and Outcomes



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SUMMARY OF TIER 1 SCREENING RESULTS

Evaluation Measures

Each Tier 1 alternative was evaluated based on a set of measures corresponding to the project goals and objectives, with each measure rated on a relative scale of Best-Good-Fair-Poor. Figure 1-3 summarizes the Tier 1 Screening results.

Figure 1-3 Tier 1 Screening Summary Matrix

Evaluation Measures		4th/5th Avenues		1st Avenue		
		Mixed-Traffic	Exclusive	Mixed-Traffic	Exclusive	
ENHANCE	Streetcar Travel Times	Fair	Good	Fair	Best	
	Bus Travel Time and Reliability Impacts: Aggregate Bus Delay	Poor	Fair	Best	Best	
	Bus Travel Time and Reliability Impacts: Aggregate Bus Passenger Delay	Poor	Fair	Best	Best	
CONNECT	Connections with Existing Transit/Multi-modal Hubs	Good	Good	Best	Best	
	Future Employment within Alignment	Best	Best	Good	Good	
	Future Population within Alignment	Good	Good	Best	Best	
	Multimodal Conflicts (Bike, Pedestrian, Bus, and Freight)	Fair	Poor	Best	Best	
	Auto Travel Times / Relative Traffic Diversion Impacts	Fair	Fair	Best	Fair	
	Ridership Potential	Good	Best	Good	Best	
	Annual Operating & Maintenance Costs	Fair	Good	Fair	Best	
	Capital Costs	Best	Good	Good	Fair	
	DEVELOP	Economic Development Opportunities	Good	Good	Best	Best
		On-Street Parking Impacts	Best	Fair	Good	Fair
THRIVE	Access to Jobs	Good	Good	Good	Good	
	Access for Vulnerable Residents and to Social Services and Affordable Housing	Good	Good	Good	Good	
	Access to Tourist Destinations, Civic and Cultural Assets, and Open Spaces	Good	Good	Best	Best	
	Public Support (Open House #1 and #2) and Stakeholder Support	Fair	Fair	Best	Best	
SUSTAIN	Urban Form and Placemaking Opportunities and Improvement Potential	Good	Good	Best	Best	

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1st Avenue offers good connections to transit hubs, has few conflicts with citywide bicycle, pedestrian, auto, and freight priorities, and serves a corridor with high population density and numerous cultural and tourist attractions.

Overall, the 1st Avenue Exclusive alternative scored “best” on 14 of the evaluation measures. 1st Avenue Exclusive had the fastest streetcar travel time as well as the lowest operating and maintenance costs.

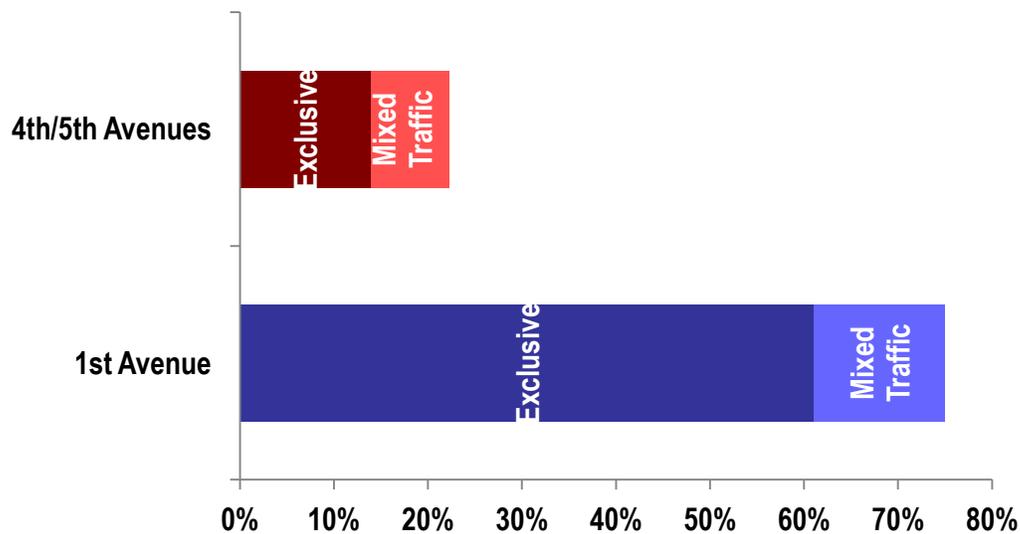
The 1st Avenue Mixed-Traffic alternative scored “best” on 12 of the evaluation measures, including the lowest impact to auto travel times.

In comparison, the 4th/5th Exclusive alternative scored “best” on only 5 measures, and 4th/5th Mixed-Traffic scored “best” on 6 measures. The 4th/5th corridor serves a greater employment and hotel density, but has a lower residential population, and a streetcar would have significant impacts on other modes including as many as 4,000 hours of additional peak-hour delay for passengers traveling on bus routes that use 4th or 5th Avenues. The high-level right-of-way design for 4th/5th Avenues included one-way cycle tracks on both streets, recognizing that cycle tracks are proposed for the corridor in the City’s Bicycle Master Plan update.

Public Support

Both alignment alternatives on 1st Avenue scored well and had strong public support. Figure 1-4 illustrates that 1st Avenue Exclusive had the strongest public support at the second project open house. Figure 1-5 summarizes advantages and disadvantages of 4th/5th Avenue and 1st Avenue alternatives, as identified by open house participants. These findings support previous public and stakeholder preferences for a 1st Avenue alignment.

Figure 1-4 Ranking of Alternatives, Open House #2: Top Choice



Over 60% of people ranked 1st Avenue Exclusive as their preferred alternative, with about 75% of completed comment cards favoring one of the First Avenue alternatives. In addition, the First Avenue alternatives received a majority of second-choice votes.

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Figure 1-5 Advantages and Disadvantages of 4th/5th and 1st Avenue Alternatives

Advantages	Disadvantages
4th/5th Avenues	
<ul style="list-style-type: none"> ▪ More direct/central to downtown retail core ▪ Large built-in ridership base ▪ Close to existing transit infrastructure ▪ Better connection to South Lake Union 	<ul style="list-style-type: none"> ▪ Serves CBD daytime ridership only ▪ Too close to I-5, too congested ▪ More redundant with existing transit infrastructure, already well-served by transit ▪ Requires couplet
1st Avenue	
<ul style="list-style-type: none"> ▪ Connects more public/cultural amenities ▪ Serves both locals and tourists, greater off-peak demand ▪ Possibility of a future extension to Uptown and other future opportunities ▪ Currently underserved by transit ▪ Better economic development opportunities 	<ul style="list-style-type: none"> ▪ Serves primarily tourists ▪ Uphill walk to destinations ▪ Too few lanes, too congested

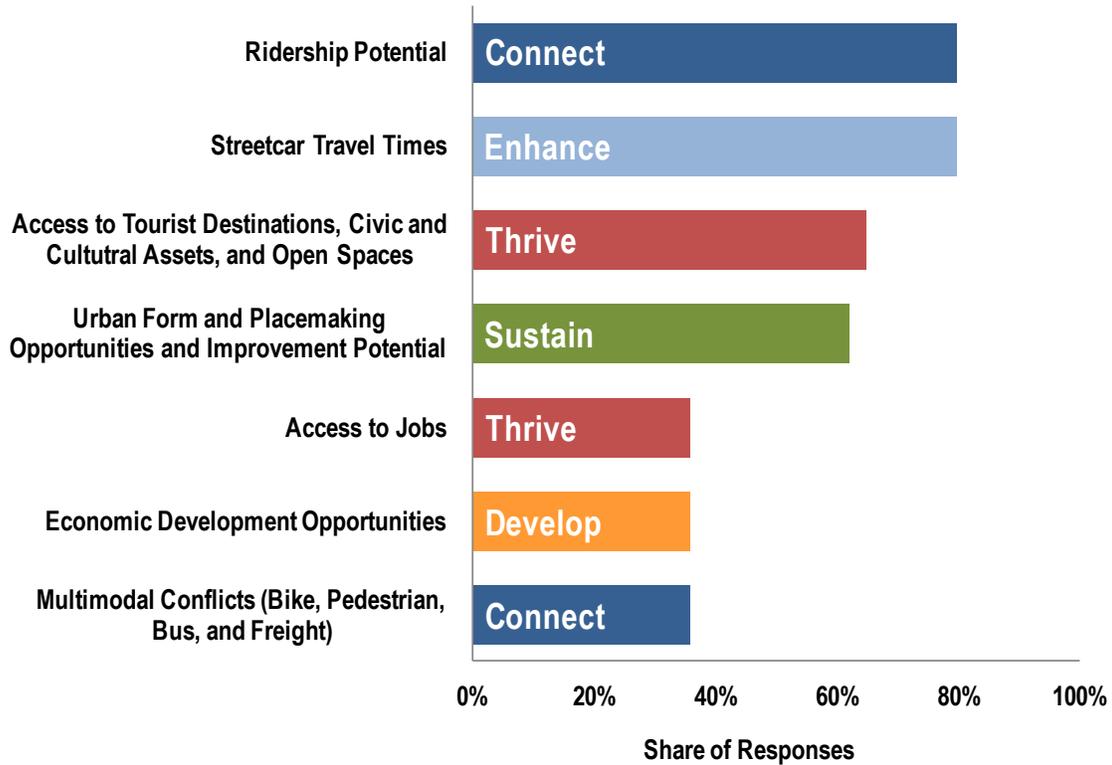
Source: Open House #2 Comment Cards (see Appendix H for a more complete summary)

Importance of Evaluation Measures

The open house presented a summary of 14 Tier 1 evaluation measures and asked participants to select the five measures that were most important to their overall ranking of the alternatives and allowed for additional comments on each measure. The measures that received more than 10 votes are shown in Figure 1-6. The top-ranked evaluation measures were Ridership Potential and Streetcar Travel Times, both of which favor an exclusive alignment. The 1st Avenue Exclusive alternative had the fastest streetcar travel times based on the Tier 1 analysis. Weighting the results by the most influential measures did not affect the overall result.

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Figure 1-6 Importance of Evaluation Measures based on Ranking by Open House #2 Participants



The evaluation measures identified by Open House participants as most important represent all five goal and objective themes (Enhance, Connect, Develop, Thrive, and Sustain).

Tier 1 Screening Recommendation

Based on the technical evaluation and strong stakeholder and public support in favor of 1st Avenue, the project team recommended to City Council that both the 1st Avenue Exclusive and 1st Avenue Mixed-Traffic alternatives be advanced for more detailed study in the Tier 2 evaluation. This recommendation was presented to the Seattle City Council Transportation Committee at an informational briefing on July 9, 2013. Council comments were supportive. No action was taken.

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TIER 1 REPORT OUTLINE

The following two chapters provide a more detailed description of the alternatives and present the evaluation results:

- Chapter 2 provides a description of the alternatives, including cross-section design and operating scenarios.
- Chapter 3 describes results from the evaluation of the Tier 1 alternatives.

A more detailed description of the evaluation methodology and/or results is provided in a set of appendices:

- Appendix A: Traffic Analysis
- Appendix B: Operating and Maintenance Cost Estimates
- Appendix C: Capital Cost Estimates
- Appendix D: Ridership Estimation
- Appendix E: Bus Operations Analysis
- Appendix F: Economic Development Analysis
- Appendix G: Urban Form Assessment
- Appendix H: Public Engagement
- Appendix I: Modal Conflicts

2 DESCRIPTION OF TIER 1 ALTERNATIVES

The wide range of mode and street alignment options considered in the Initial Screening were narrowed to the following mode and street alignment options, which are the basis for the Tier 1 alternatives described in this section:

- **Modes:** Mixed-Traffic and Exclusive Streetcar.
- **Alignments:** 4th/5th Avenues (couplet) and 1st Avenue, between Jackson Street and Westlake, illustrated in Figure 2-1.

Figure 2-1 Street Alignments for Tier 1 Screening



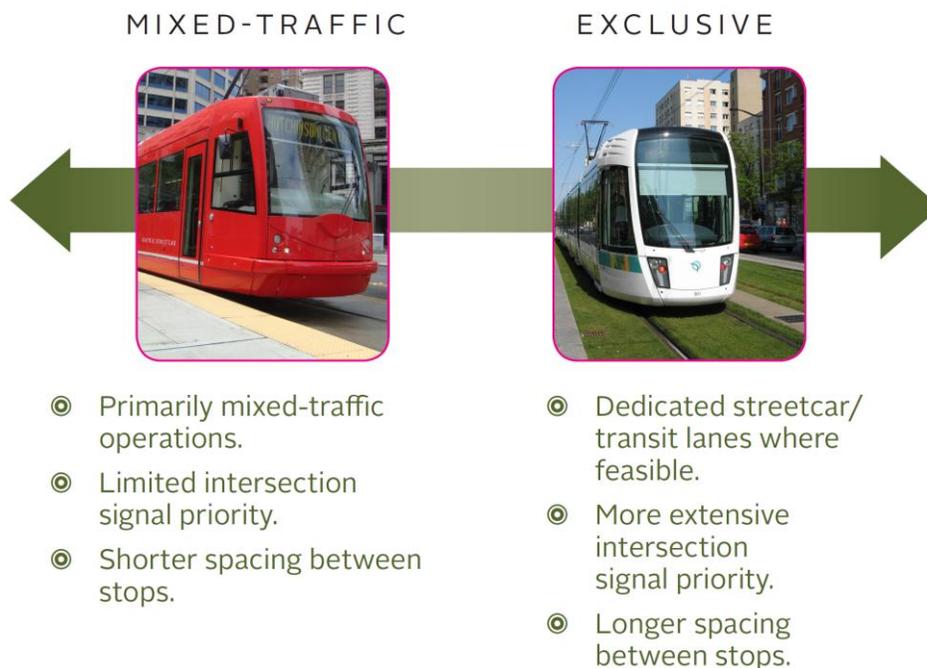
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MODES

The initial screening process recommended that Mixed-Traffic Streetcar and Exclusive Streetcar modes be evaluated in the Tier 1 process, based on public and stakeholder feedback about the importance of reliable and competitive transit travel times. As summarized in Figure 2-2, for the purposes of comparison in the Tier 1 analysis these modes are primarily distinguished through:

- **Right-of-Way Design.** Mixed-Traffic Streetcar running primarily in lanes shared with other vehicle traffic and exclusive streetcar running primarily in exclusive transit/streetcar lanes.
- **Signal Priority.** Limited signal priority for Mixed-Traffic Streetcar and more extensive signal priority for Exclusive Streetcar.
- **Stop Spacing.** Shorter spacing between stops/stations for Mixed-Traffic Streetcar and longer stop spacing for Exclusive Streetcar (as illustrated in Figure 2-4 and Figure 2-19 for the 4th/5th Avenue and 1st Avenue street alignments, respectively).

Figure 2-2 Typical Features of Exclusive Streetcar and Mixed-Traffic Streetcar Modes



The Tier 1 analysis of these mode alternatives primarily reflects the tradeoffs between potential travel time and capacity benefits and potentially greater impacts on other travel modes. These impacts are quantified through traffic analysis and other quantitative and qualitative analysis.

In the Tier 2 evaluation, mixed-traffic and exclusive streetcar characteristics will also be evaluated for the ability of the alignments under consideration to support longer vehicles or multiple-car trains (most often associated with the exclusive streetcar mode), compatibility of such vehicles with the existing South Lake Union (SLU) Streetcar and planned First Hill (FH) Streetcar, and potential integration with other potential exclusive streetcar implementations, such as the Downtown to Ballard Transit Study, which is also considering an exclusive streetcar mode.

STREET ALIGNMENTS

The Tier 1 Screening evaluated two alignments, each with mixed-traffic and exclusive design alternatives. This section defines the alternatives analyzed. **For both alignments, the Mixed-Traffic and Exclusive scenarios are intended to illustrate a range of potential benefits and impacts for the streetcar.** Tier 2 alternatives will be refined and analyzed in greater detail.

4th/5th Avenues

The 4th/5th Avenue alternatives assume:

- Streetcar runs northbound on 4th Avenue and southbound on 5th Avenue.
- Terminus on 5th between Main & Jackson, with a transfer to the First Hill streetcar at Jackson Street.
- A northbound connection from 4th to Westlake via Olive (additional options would be analyzed in the Tier 2 evaluation).
- Cycle tracks would be created on both 4th (northbound) and 5th (southbound).

Street Alignments

Figure 2-4 illustrates the 4th and 5th Avenue couplet alignment and various connection options, including conceptual stop spacing for both exclusive and mixed streetcar modes. The Tier 1 Screening assumes use of Olive Way as the connection from northbound 4th Avenue to the existing SLU streetcar. Figure 2-3 describes this connection and one other potential connection option that could be evaluated in additional detail as part of the Tier 2 evaluation, assuming that the 4th/5th Avenue couplet is identified as the preferred option in Tier 1.

Figure 2-3 4th/5th Avenues Alignment Westlake Connection Scenarios

Option	NB (To South Lake Union)	SB (To International District)
Option Assumed for Tier 1 Evaluation		
Olive	4 th – Olive – Westlake	Westlake – 5th
Additional Options for Potential Evaluation in Tier 2		
Pike	4 th – Pike – 6 th – Westlake	Westlake – 5th

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Figure 2-4 4th/5th Alignment Option for Tier 1 Screening



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Cross-Sections and Right-of-Way Design

The design alternative for 4th/5th Avenues assumes a side-running streetcar.¹ Figure 2-5 describes the cross-sections for both existing conditions and the two proposed alternatives.

Figure 2-5 Existing and Proposed Cross-Section Alternatives (Typical)

Scenario	Bike Facility	On-Street Parking	General Public (GP) Lanes	Exclusive Transit/Streetcar
4th Avenue				
Existing	5-foot bike lane (or sharrows during peak)	Peak-restricted in bike lane	3 GP (varies)	Bus-only lane
Mixed Traffic	8-foot cycle track (passing cycle track in some blocks)	Parking on west side of some blocks (between cycle track and Streetcar/GP lanes)	11 foot GP 11 foot GP/Streetcar	12-foot transit
Exclusive Lane	7-foot cycle track (e.g., 5-foot with 2-foot buffer)	Generally not present	10-foot GP 10-foot GP lane	11-foot GP/Streetcar 12-foot transit
5th Avenue				
Existing	Shared with GP	On-street parking in some blocks N. of Marion	3 GP (varies)	Shared with GP Contra-flow bus south of Cherry
Mixed Traffic	6 to 8-foot cycle track (passing cycle track in some blocks)	Eliminate on-street parking on some blocks N. of Marion	3 GP	Shared with GP Maintain contra-flow bus south of Cherry
Exclusive Lane	6 to 8-foot cycle track (passing cycle track in some blocks)	Eliminate on-street parking on some blocks N. of Marion	2 GP	1 transit lane (likely Spring-Cherry) Maintain contra-flow bus south of Cherry

Existing and Planned Facilities

Figure 2-6 and Figure 2-7 illustrate the existing cross-sections for 4th and 5th Avenues. The bullets below describe how the existing 4th and 5th Avenue cross-sections support transit, bicycle, and general-purpose (GP) vehicle traffic.

- **Transit:** Current mixed-traffic and regional buses use a transit lane on 4th Avenue for northbound travel; GP vehicles are allowed to use the lane for right-turns. On 5th Avenue, bus volumes are lower than on 4th Avenue and buses share the western curb lane with GP vehicle travel.
- **Bicycle:** Currently cyclists use a 5-foot bicycle lane on 4th Avenue for northbound travel in the corridor, or shared lanes when peak-hour parking restrictions are lifted. There is

¹ An internal SDOT cross-section workshop was conducted in March 2013 to obtain feedback on the viability of various design options.

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no designated facility on 5th Avenue but all lanes may be used for southbound travel, especially outside lanes. A separated bicycle facility, e.g., buffered bike lanes or cycle track, along this corridor has been envisioned as part of the City’s Bicycle Master Plan update.

- **General Purpose:** Three GP lanes are available on 4th Avenue. Three GP lanes are available on 5th Avenue. The outside lanes on 5th Avenue are wide and are used for on-street parking or for a contra-flow bus lane (south of Cherry) in portions of the alignment.

Figure 2-6 Existing 4th Avenue, Marion Looking North

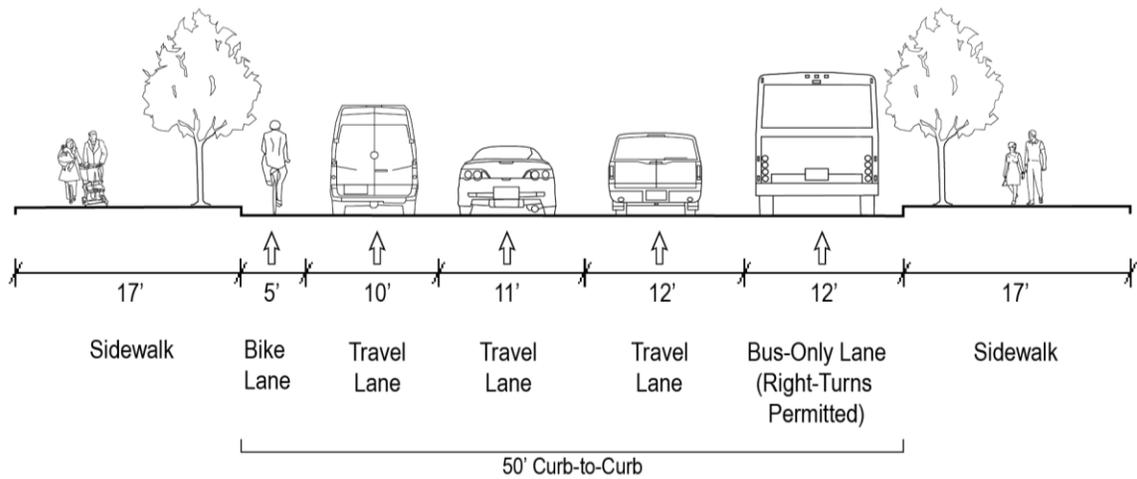
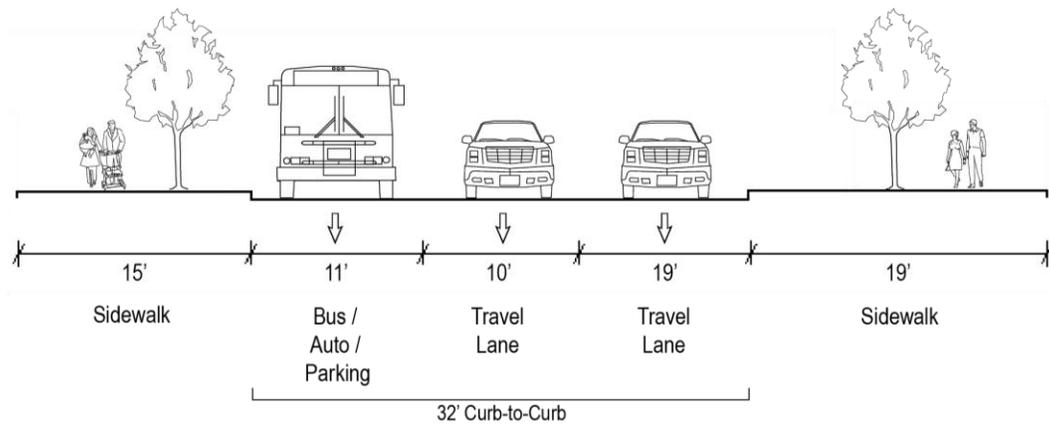


Figure 2-7 Existing 5th Avenue, Union Looking North



Note: Other parts of 5th Avenue have different cross-sections, e.g. approximately 46' curb-to-curb in the central and southern portions of 5th Avenue.

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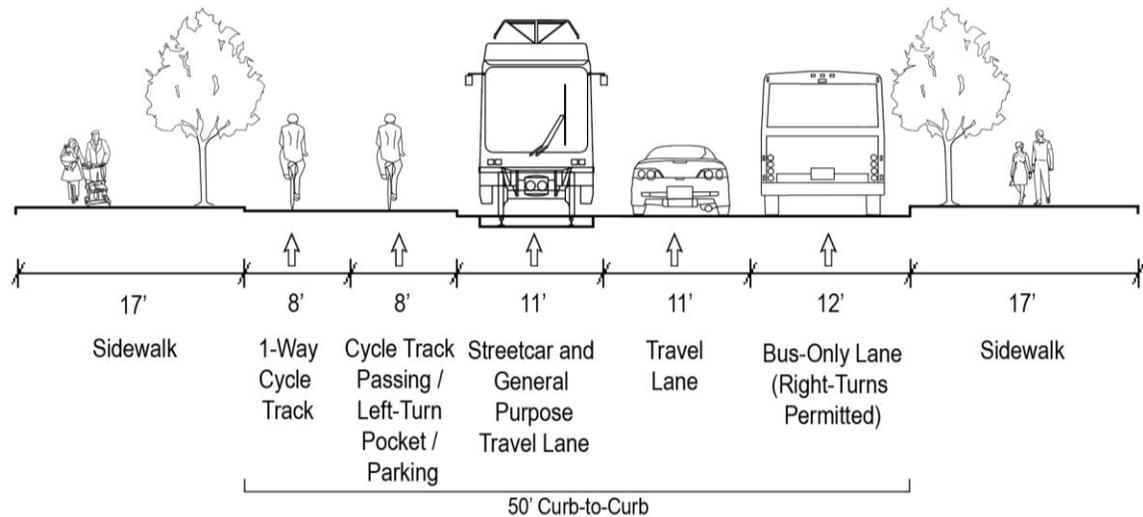
4th Avenue Mixed-Traffic Streetcar

Between Stations

The bullets below and graphics in Figure 2-8 and Figure 2-9 describe how the Mixed-Traffic alternative on 4th Avenue would support transit, bicycle, and general-purpose (GP) vehicle traffic.

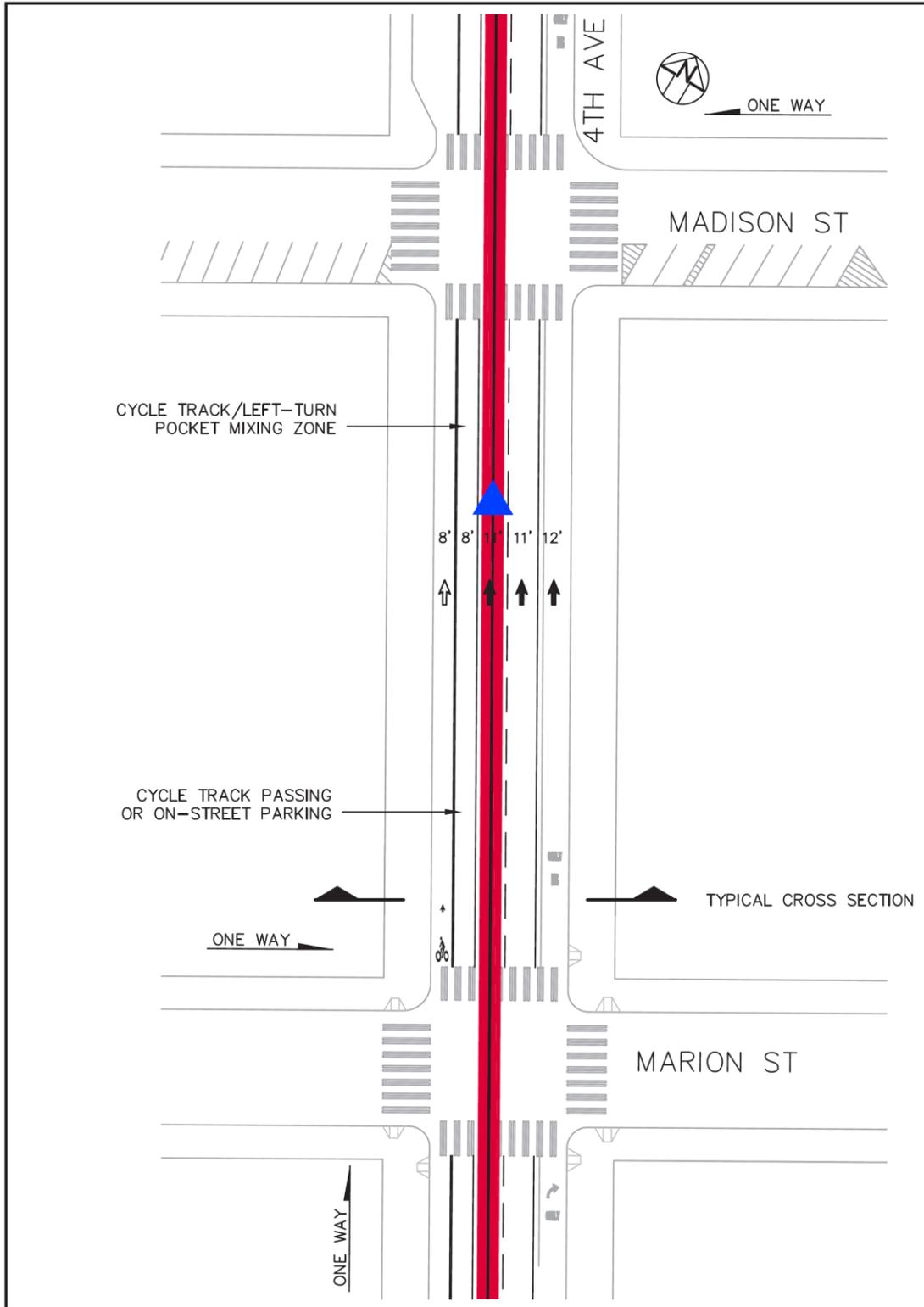
- **Streetcar.** The streetcar would share a general purpose lane on the west side of 4th, adjacent to a cycle track.
- **Transit.** Bus-only eastern curb lane would be maintained similar to existing conditions, with right-turns permitted for general purpose traffic.
- **Bicycle Treatment.** An 8-foot one-way raised cycle track would be located along the west side of 4th; this requires eliminating one existing general purpose travel lane. The cycle track could include passing lane segments.
- **General Purpose Vehicles.** Two general purpose lanes available including the shared streetcar lane. On-street parking or left-turn pockets could be located on the west side of 4th in some blocks, between the cycle track and general purpose lanes. A sidebar below (see the 5th Avenue section) provides an example of design treatments for left-turn movements across the cycle track.

Figure 2-8 4th Avenue Mixed-Traffic Cross-Section between Stations (Marion looking North)



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Figure 2-9 4th Avenue Mixed-Traffic Plan Diagram between Stations (Marion-Madison)



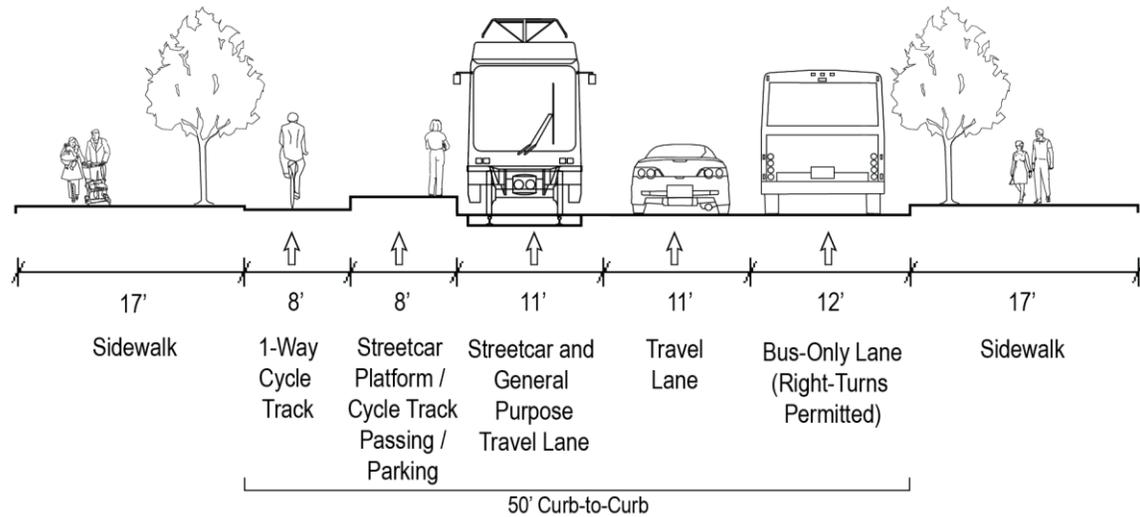
Source: URS

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At Stations

As illustrated in Figure 2-10 and Figure 2-11, station platforms would be located on the west side of 4th, between the streetcar lane and the cycle track. The sidebar below provides examples of transit platforms integrated with a cycle track.

Figure 2-10 4th Avenue Mixed-Traffic Cross-Section at Stations (Cherry looking North)



Integrating Streetcar Platforms and Cycle Tracks

When cycle tracks are routed on the curb side of streetcar station platforms, best practices include providing clearly defined transitions between the sidewalk and the platform, with “ladder” or raised crosswalks and signage. Formalizing the pedestrian crossing zone raises the visibility of pedestrians to bicyclists and ensures that pedestrians understand that they are about to cross a bicycle throughway.



Buffered bike lanes run on the curb side of bus islands on Dexter Ave.

Image from Flickr user rese.arch

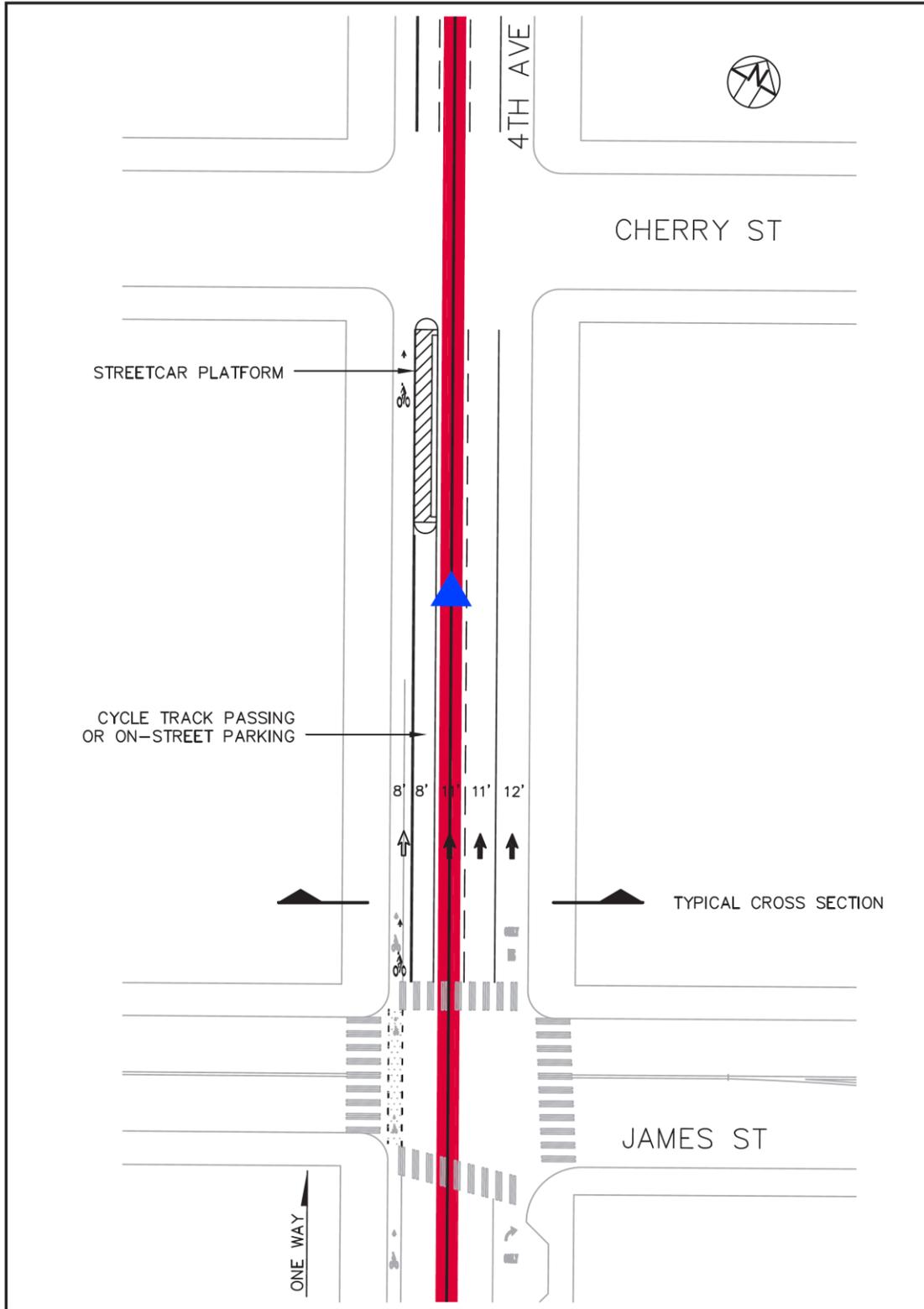


The Dunsmuir Bikeway in Vancouver BC has marked crossings between the transit boarding islands and the sidewalk.

Image from Flickr user Paul Krueger

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Figure 2-11 4th Avenue Mixed-Traffic Plan Diagram at Stations (James-Cherry)



Source: URS

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4th Avenue Exclusive Streetcar

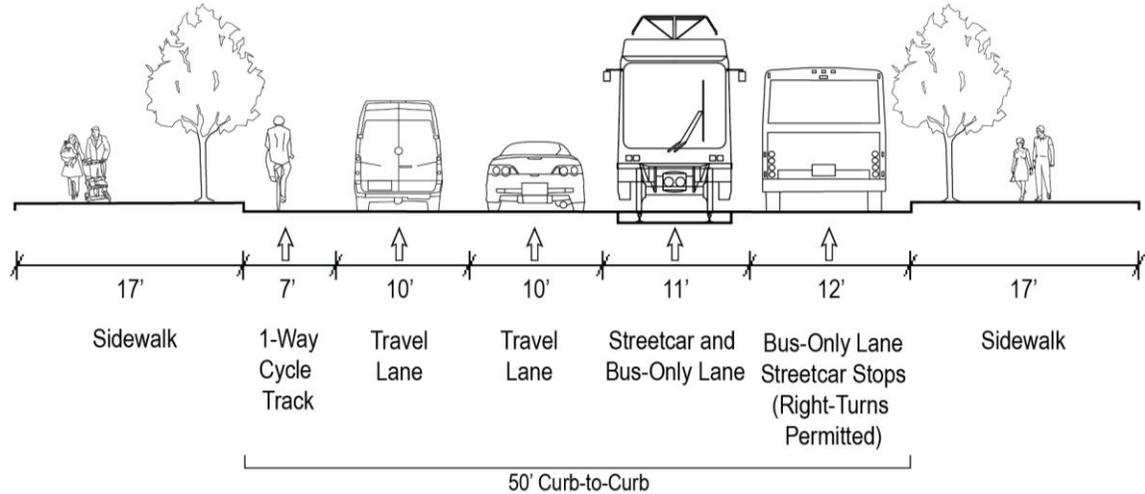
Between Stations

The bullets and diagrams below describe how streetcar would operate in the Exclusive scenario on 4th Avenue:

- The streetcar would run in the 2nd eastern lane, which would be transit-only. General purpose right-turns would typically still be permitted in the eastern lane.
- A raised cycle track (typically 7-foot including a 2-foot buffer) would be located on the west side of 4th.

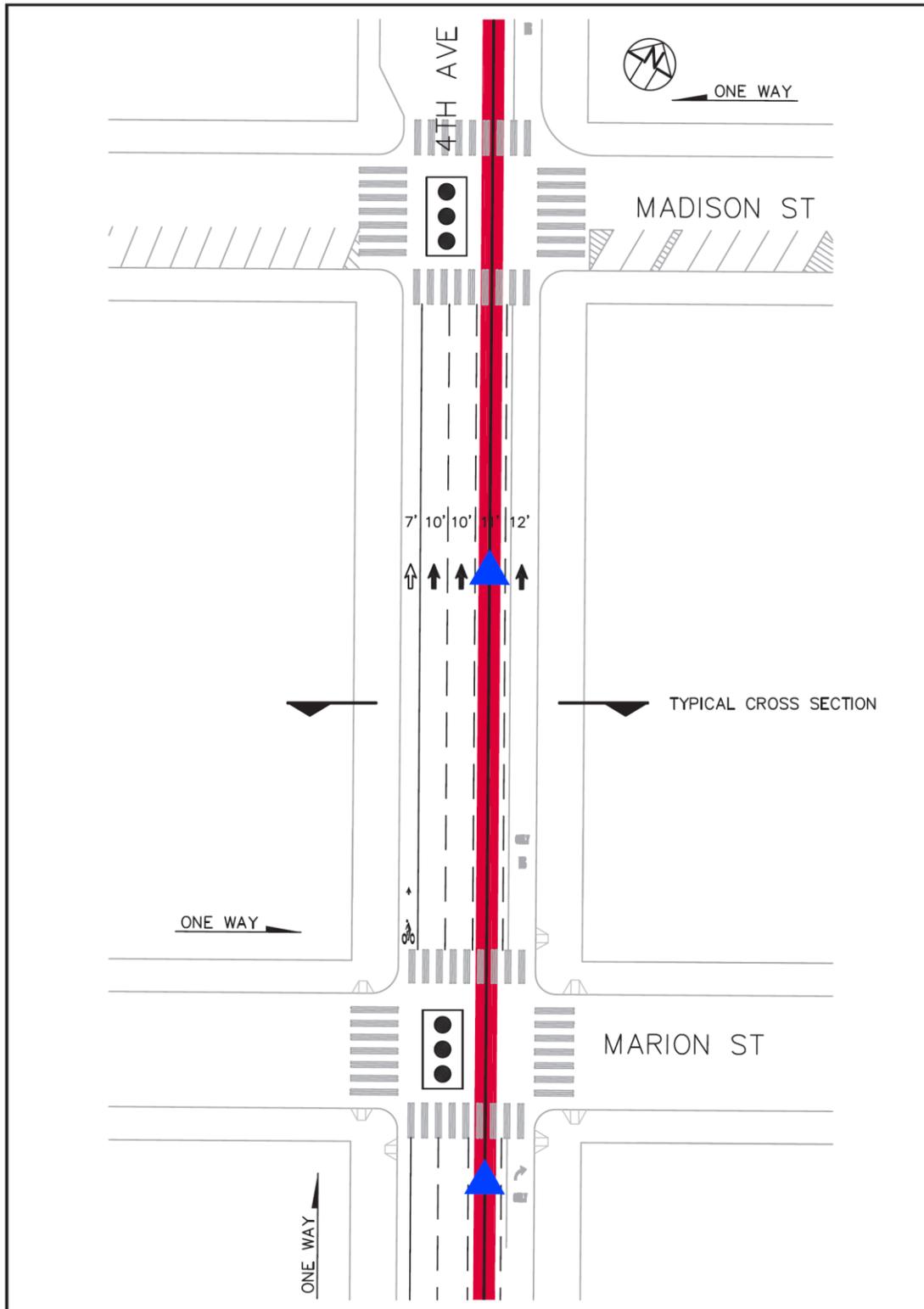
Figure 2-12 and Figure 2-13 illustrate a typical 4th Avenue cross-section and streetcar operations between stations.

Figure 2-12 4th Avenue Exclusive Cross-Section between Stations (Marion looking North)



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Figure 2-13 4th Avenue Exclusive Plan Diagram between Stations (Marion-Madison)



Source: URS

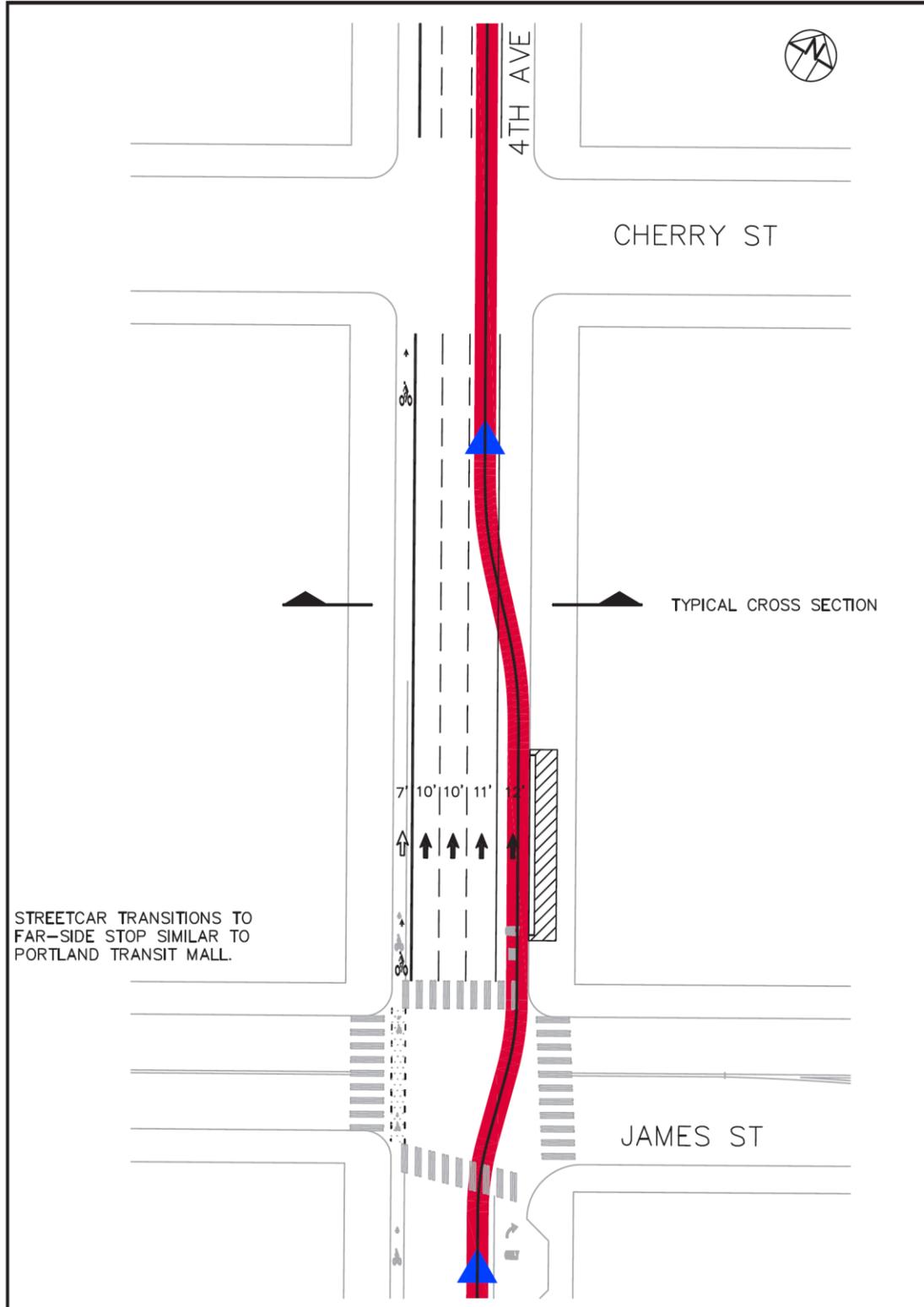
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At Stations

The streetcar would weave to the eastern curb (right) lane and typically have stops on the far-side of intersections. The streetcar would weave back to the 2nd eastern lane as it leaves the platform to reduce conflicts with stopping buses. Figure 2-14 provides a plan diagram of streetcar weaving operations at stops. Appendix E includes an analysis of the distance required for this weaving to occur, estimated at approximately 170 feet from the upstream intersection.

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Figure 2-14 4th Avenue Exclusive Plan Diagram at Stations (James-Cherry)



Source: URS

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5th Avenue Mixed-Traffic and Exclusive Streetcar

The bullets below describe how the Mixed-Traffic and Exclusive alternatives on 5th Avenue would support transit, bicycle, and general-purpose (GP) vehicle traffic. Figure 2-15 and Figure 2-16 provide cross-section diagrams for the central and northern portions of 5th Avenue, respectively.

- **Streetcar/Transit.** Streetcar would share the western travel lane with general purpose traffic and buses as follows:
 - Mixed-Traffic: lane is shared with buses and general purpose travel, similar to current conditions.
 - Exclusive: same as mixed, with a streetcar/transit-only lane from approximately Spring to Cherry.
- **Bicycle/Pedestrian Treatment.** A 6- to 8-foot one-way raised cycle track could be located on the western side of 5th in both the Mixed-Traffic and Exclusive alternatives. The cycle track could include passing lane segments. Currently cyclists use all lanes on 5th Avenue for southbound travel, especially outside lanes.
- **General Purpose Vehicles.** Two general purpose lanes would be available north of Spring and south of Cherry, including the streetcar lane. Three lanes would be available for general purpose travel between Spring and Cherry; one would be transit-only in the Exclusive alternative. Right-turns for general purpose travel would typically be permitted, with turn pockets at key intersections, e.g., Madison and Columbia. The sidebar below provides an example of design treatments for turn movements across the cycle track. On-street parking could be provided between the streetcar lane and cycle track in some blocks.

Cycle Tracks and Turning Vehicles: Managing Conflicts

Careful facility design is required to manage conflicts between cycle tracks and vehicles making turns across the cycle track. This example illustrates a mixing/yield zone with a left-turn pocket.



Image from New York City DOT

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Figure 2-15 Central Portion of 5th with Right-Turn Pocket (Columbia looking North) – Mixed-Traffic or Exclusive Streetcar

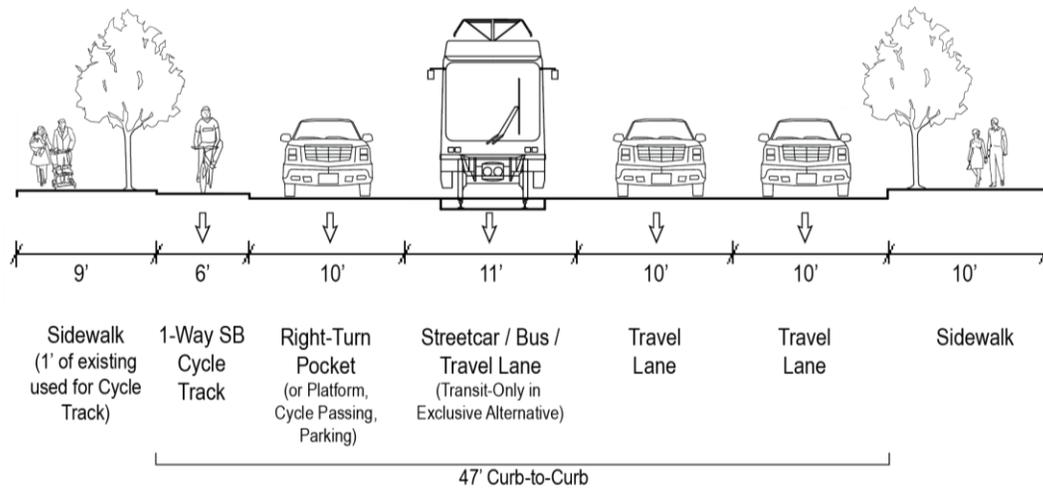
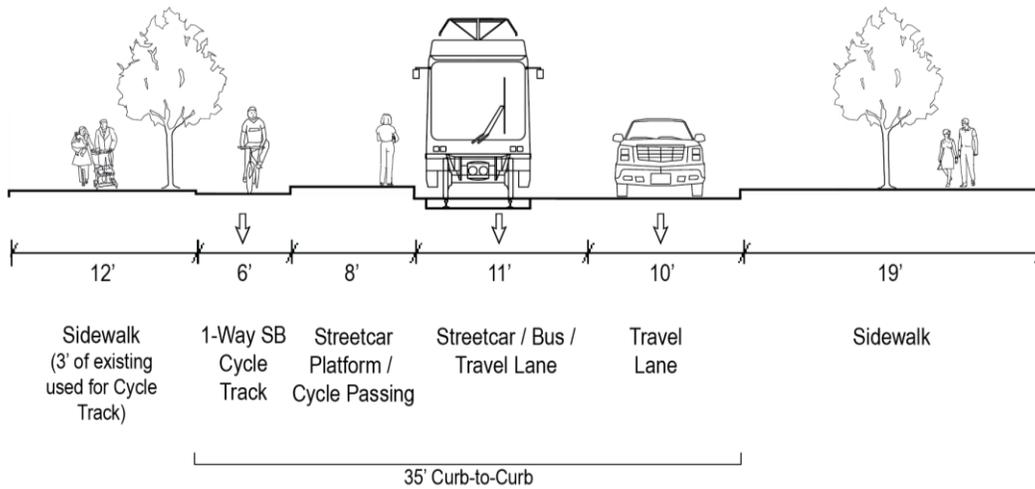


Figure 2-16 Northern Portion of 5th with Narrow Right-of-Way (Union Looking North) – Mixed-Traffic or Exclusive Streetcar



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1st Avenue

The design alternatives for 1st Avenue Avenues assume:

- Streetcar runs in the center lanes on 1st Avenue between Jackson Street and the Pike Place Market area.
- In the Exclusive scenario, the center-running lanes would be streetcar-only with extensive signal priority and fewer stations than the Mixed-Traffic scenario.
- Stewart Street and Olive Way are used between 1st Avenue and the existing SLU streetcar at Westlake. Additional 1st Avenue to Westlake connection options would be analyzed in the Tier 2 evaluation.
- A connection to Uptown could be considered in conjunction with the Ballard-to-Downtown project.

Street Alignments

Figure 2-19 illustrates the 1st Avenue alignment and various connection options, including conceptual stop spacing for both Mixed-Traffic and Exclusive Streetcar alternatives. The Tier 1 screening assumes use of Stewart Street and Olive Way to connect between 1st Avenue and the existing SLU streetcar. Figure 2-18 describes this connection and several other potential connections that could be evaluated in greater detail as part of the Tier 2 evaluation. In addition, as shown on the map (Figure 2-19), the Uptown – Pike Place segment of 1st Avenue could be considered as a potential future phase of the Center City Connector, assuming that 1st Avenue is identified as the preferred option in Tier 1.

Figure 2-18 1st Avenue Alignment Westlake Connection Scenarios

	EB/NB (To South Lake Union)	SB/WB (To 1 st Avenue)
Option Assumed for Tier 1 Evaluation		
Stewart/Olive	Stewart ¹ – Olive – Westlake	Westlake – Stewart ¹
Additional Options for Potential Evaluation in Tier 2		
Virginia/Stewart	Virginia – Westlake	Stewart - Westlake
Pike/Pine (via 4 th /Olive)	Pike – 4 th – Olive - Westlake	Westlake – 5 th - Pine
Pike/Pine (via 6 th)	Pike – 6 th – Westlake	Westlake – 5 th - Pine

Notes: (1) Bidirectional streetcar operations on Stewart between 1st and 3rd Avenue

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Figure 2-19 1st Avenue Alignment Options for Tier 1 Screening



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Cross-Sections and Right-of-Way Design

The design alternative for 1st Avenue assumes a center-running streetcar.² Figure 2-20 describes the cross-sections for existing conditions and the proposed alternatives.

Figure 2-20 Existing and Proposed Cross-Section Alternatives (Typical)

Scenario	Bike Facility	On-Street Parking	General Public (GP) (per direction except as noted)	Exclusive Transit/Streetcar (per direction except as noted)
Existing	None	Present in one direction in some blocks (typically peak-restricted)	2-3 lanes: <ul style="list-style-type: none"> ▪ 2 GP ▪ 1 GP/peak-restricted parking (in only one direction) 	None
Mixed Traffic	None	Parking (likely peak-restricted) in some blocks between stations and/or where not required for bus stops	2-3 lanes: <ul style="list-style-type: none"> ▪ 11 foot GP/streetcar ▪ 10 foot GP ▪ 10 foot GP/ peak-restricted parking (in only one direction) 	None
Exclusive Lane	None	Parking (likely peak-restricted) in some blocks between stations and/or where not required for bus stops	1-2 lanes: <ul style="list-style-type: none"> ▪ 10-foot GP ▪ 10-foot GP/peak-restricted parking (in only one direction) 	11-foot streetcar

² An internal SDOT cross-section workshop was conducted in March 2013 to obtain feedback on the viability of various design options.

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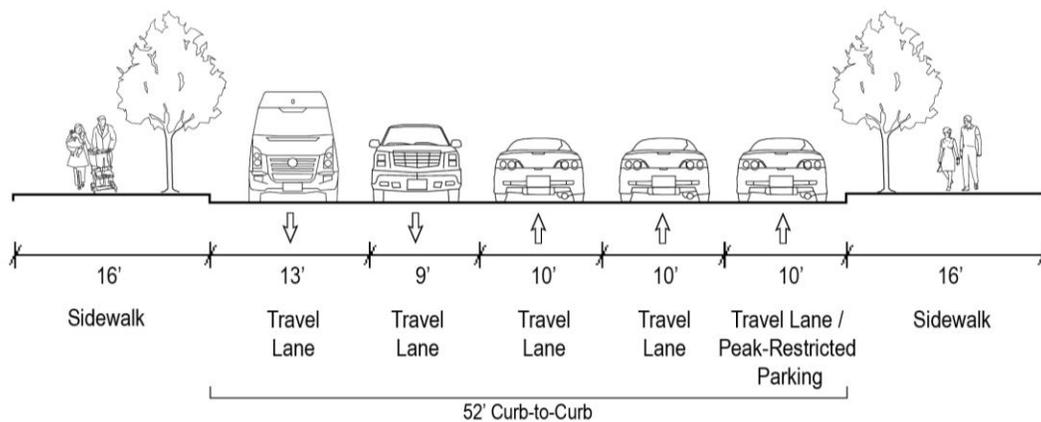
Existing and Planned Facilities

The bullets below describe how the existing 1st Avenue cross-section supports transit, bicycle, and general purpose (GP) vehicle traffic.

- **Transit:** There is limited local bus service on 1st Avenue.
- **Bicycle:** There are no existing or planned bike facilities on 1st Avenue.
- **General Purpose:** Between Virginia and Spring, three general purpose northbound travel lanes and two general purpose southbound travel lanes are available on 1st Avenue. On-street parking is present in some blocks, e.g., between University and Spring.

Figure 2-21 illustrates a typical existing cross-section for 1st Avenue.

Figure 2-21 Existing 1th Avenue, Madison Looking North



1st Avenue Mixed-Traffic Streetcar

Between Stations

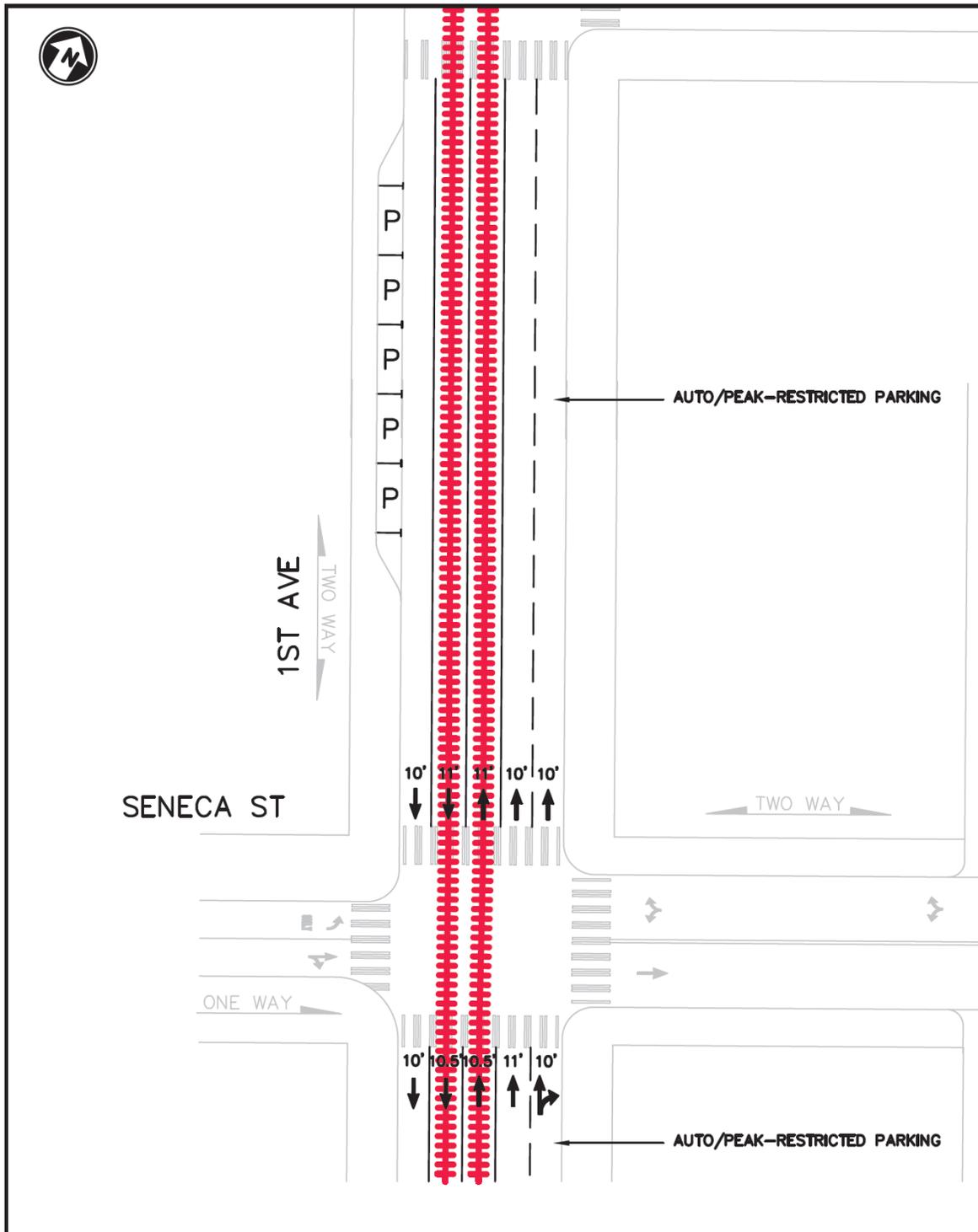
The bullets below describe how the Mixed-Traffic alternative on 1th Avenue would support streetcar and general-purpose (GP) vehicle traffic.

- Streetcar would run in center lanes shared with general purpose travel. The streetcar lanes would diverge to make room for station platforms. Stations could be staggered across intersections to allow more room for passengers.
- Southbound left-turns would typically be permitted.
- One curbside lane in each block could allow parking between stations.

Figure 2-22 illustrates mixed-traffic streetcar operations between stations.

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Figure 2-22 1st Avenue Mixed-Traffic Plan Diagram between Stations (Seneca)



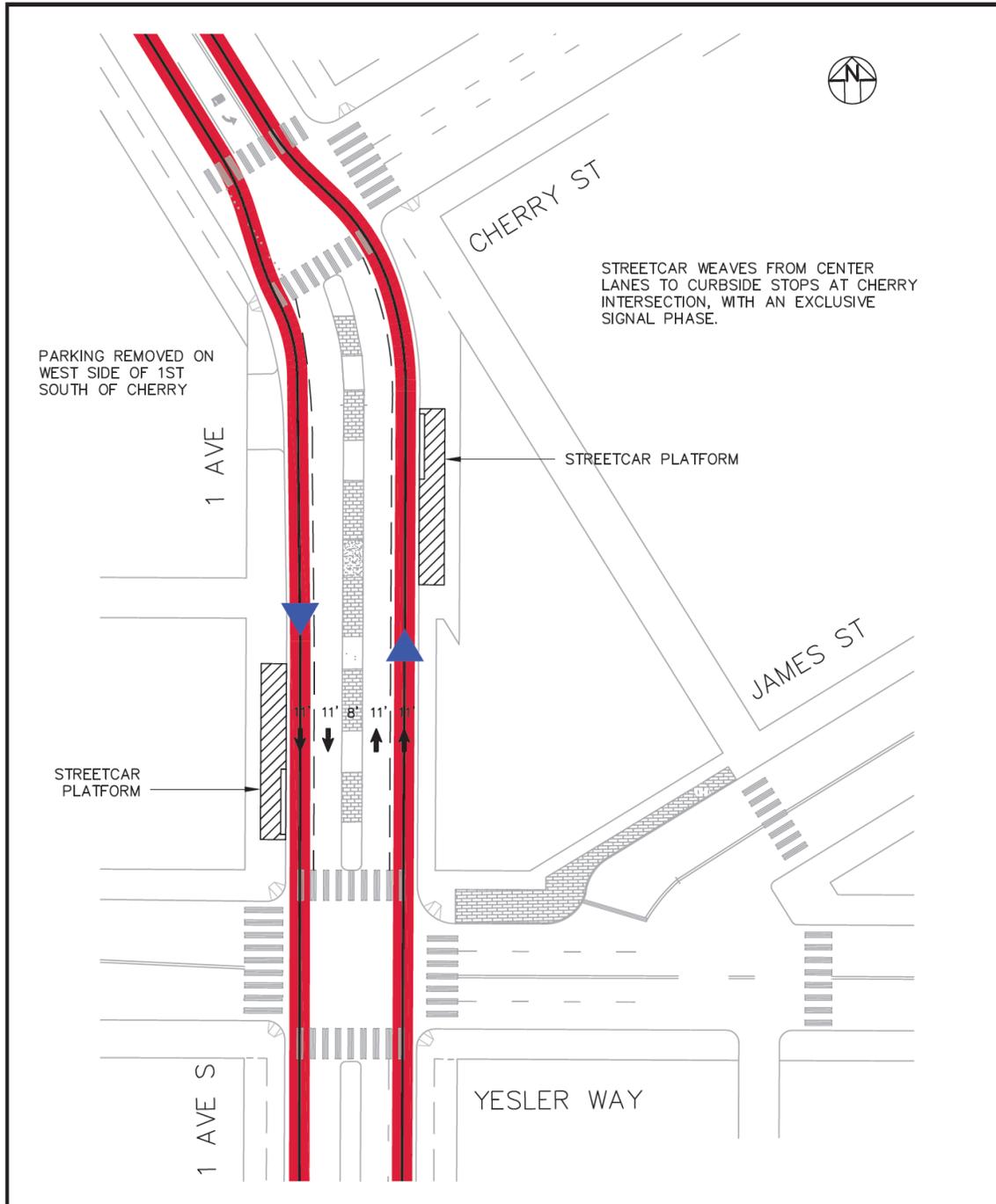
Source: URS

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Cherry-Yesler

As illustrated in Figure 2-23, due to median street trees this alternative assumes the streetcar would weave to curbside stops in this block. The streetcar would run curbside between Cherry and Jackson, requiring removal of on-street parking.

Figure 2-23 1st Avenue Mixed-Traffic Plan Diagram (Cherry - Yesler)



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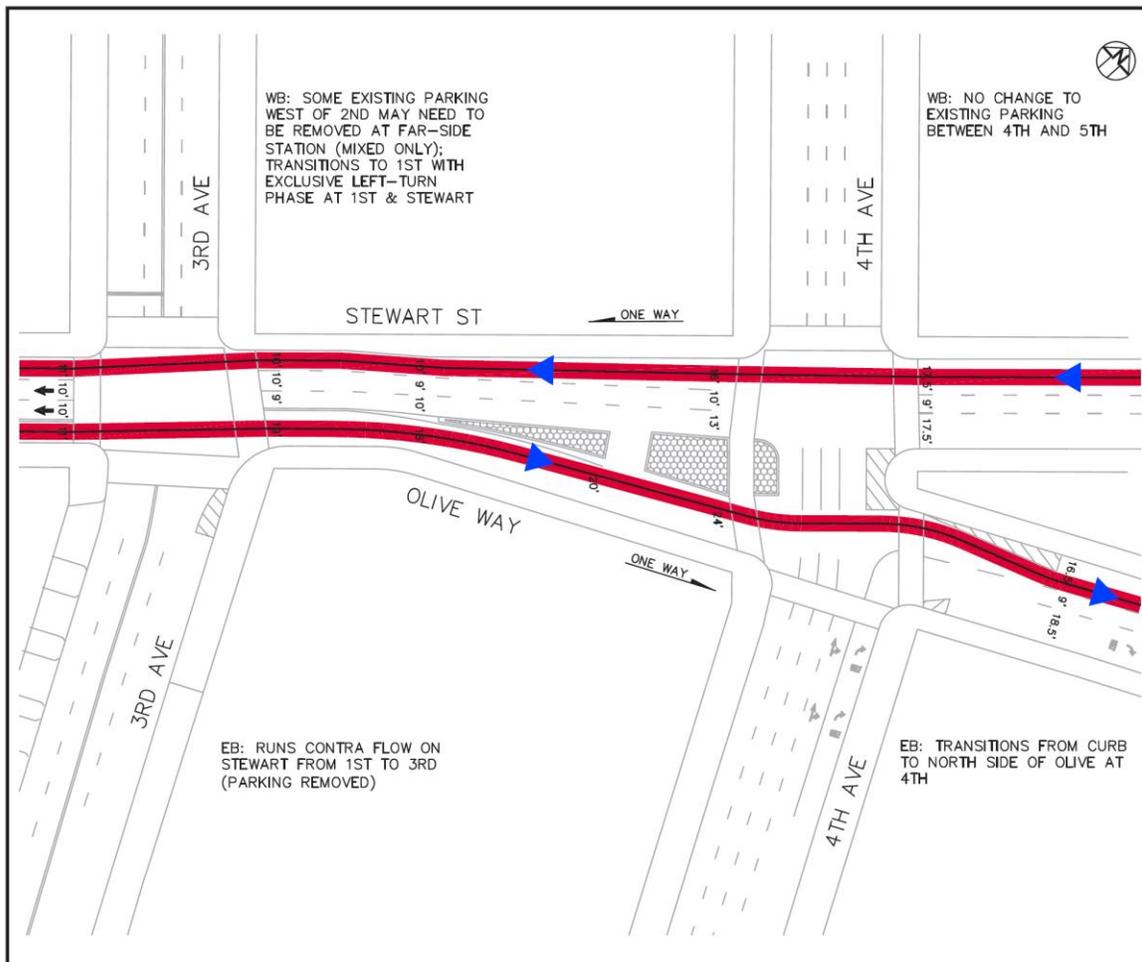
Stewart-Olive

As illustrated in Figure 2-24, the streetcar would operate in the curbside lane in both directions on Stewart Street and Olive Way:

- Stewart/Olive (NB/EB direction to Westlake): Streetcar would run contra-flow, switching to north-side along Olive Way at the 4th Ave intersection.
- Stewart (SB/WB direction to 1st Avenue): Streetcar would run along the curb with a curbside platform next to the Westin Hotel.

Additional 1st Avenue to Westlake connection options would be analyzed in the Tier 2 evaluation.

Figure 2-24 1st Avenue Mixed-Traffic and Exclusive Plan Diagram (Stewart-Olive)



Source: URS

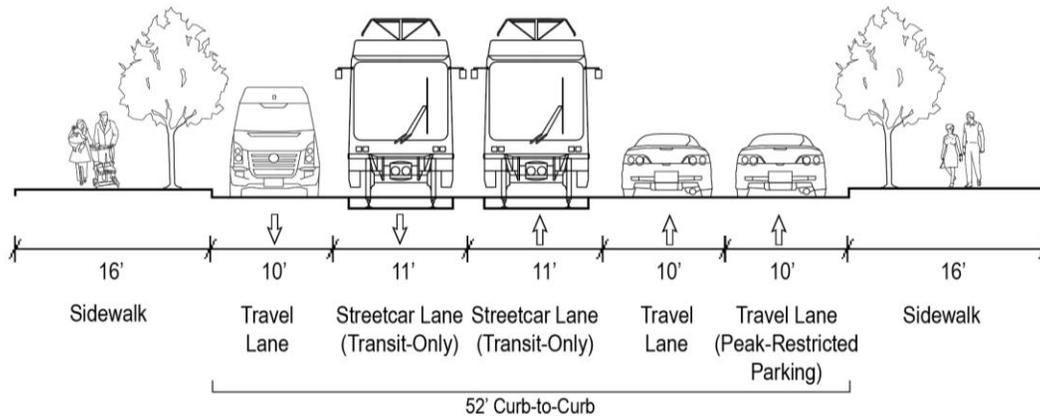
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1st Avenue Exclusive Streetcar

Between Stations

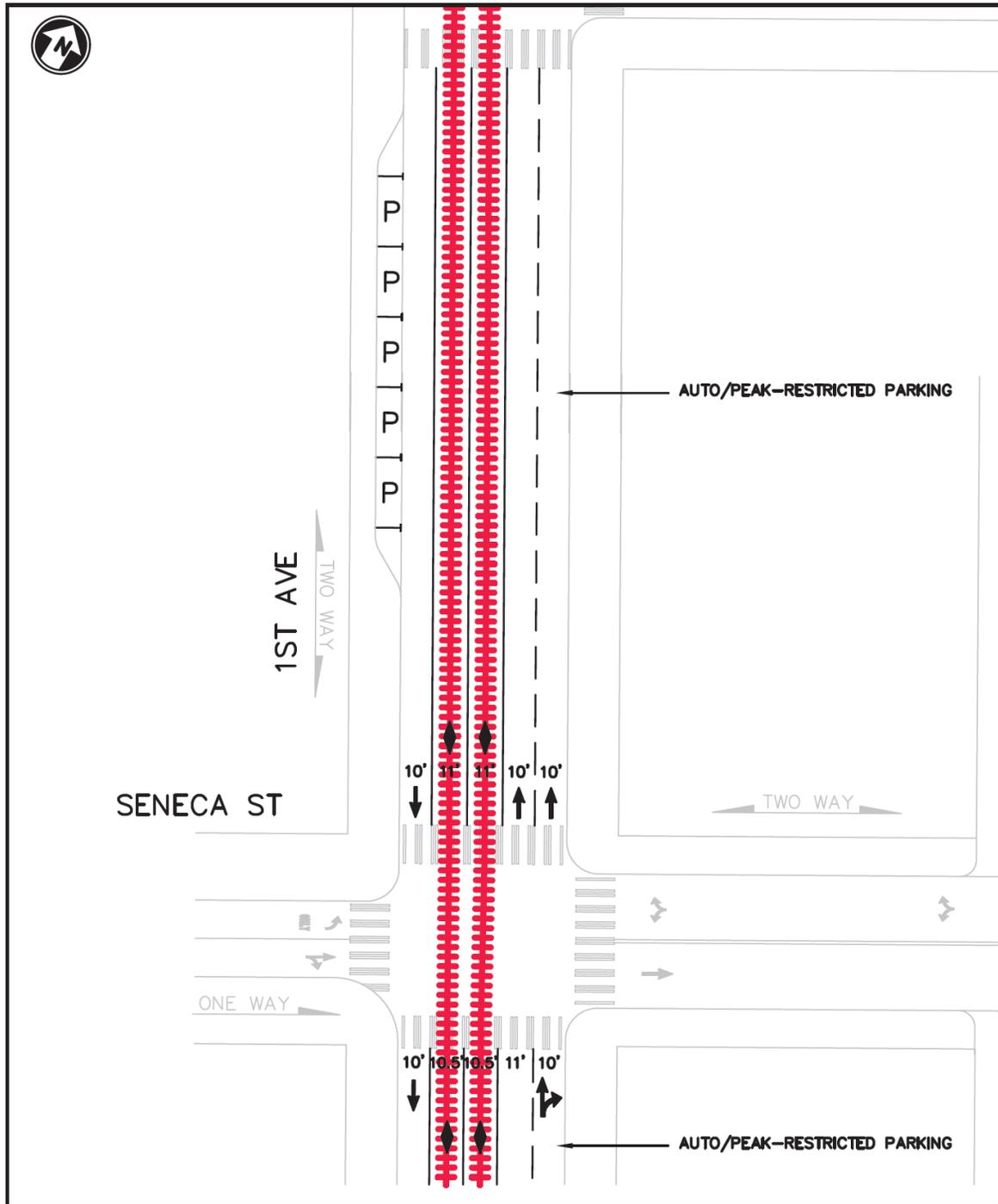
In this scenario, one general purpose travel lane would be maintained in each direction between stations. One additional lane, shown in the northbound direction, could be used for on-street parking (may be peak-restricted) or right-turns. Figure 2-25 and Figure 2-26 illustrate the cross-section and streetcar operations between stations in the Exclusive alternative.

Figure 2-25 1st Avenue Exclusive Cross-Section between Stations (Seneca looking North)



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Figure 2-26 1st Avenue Exclusive Plan Diagram between Stations (Seneca)



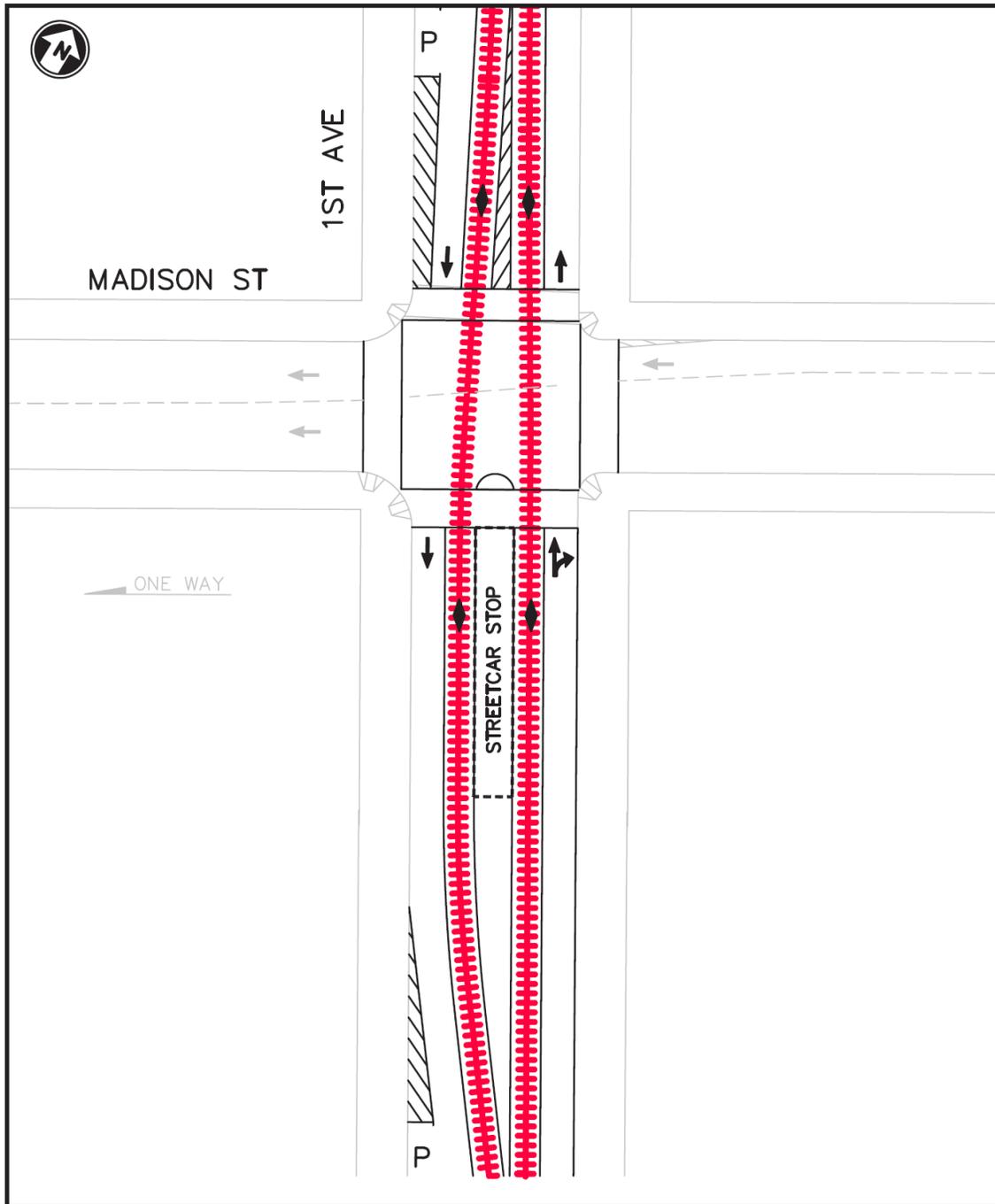
Source: URS

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At Stations

Figure 2-27 illustrates that on-street parking would terminate to accommodate station locations, which would be located in the street median.

Figure 2-27 1st Avenue Exclusive Plan Diagram (Madison)



Source: URS

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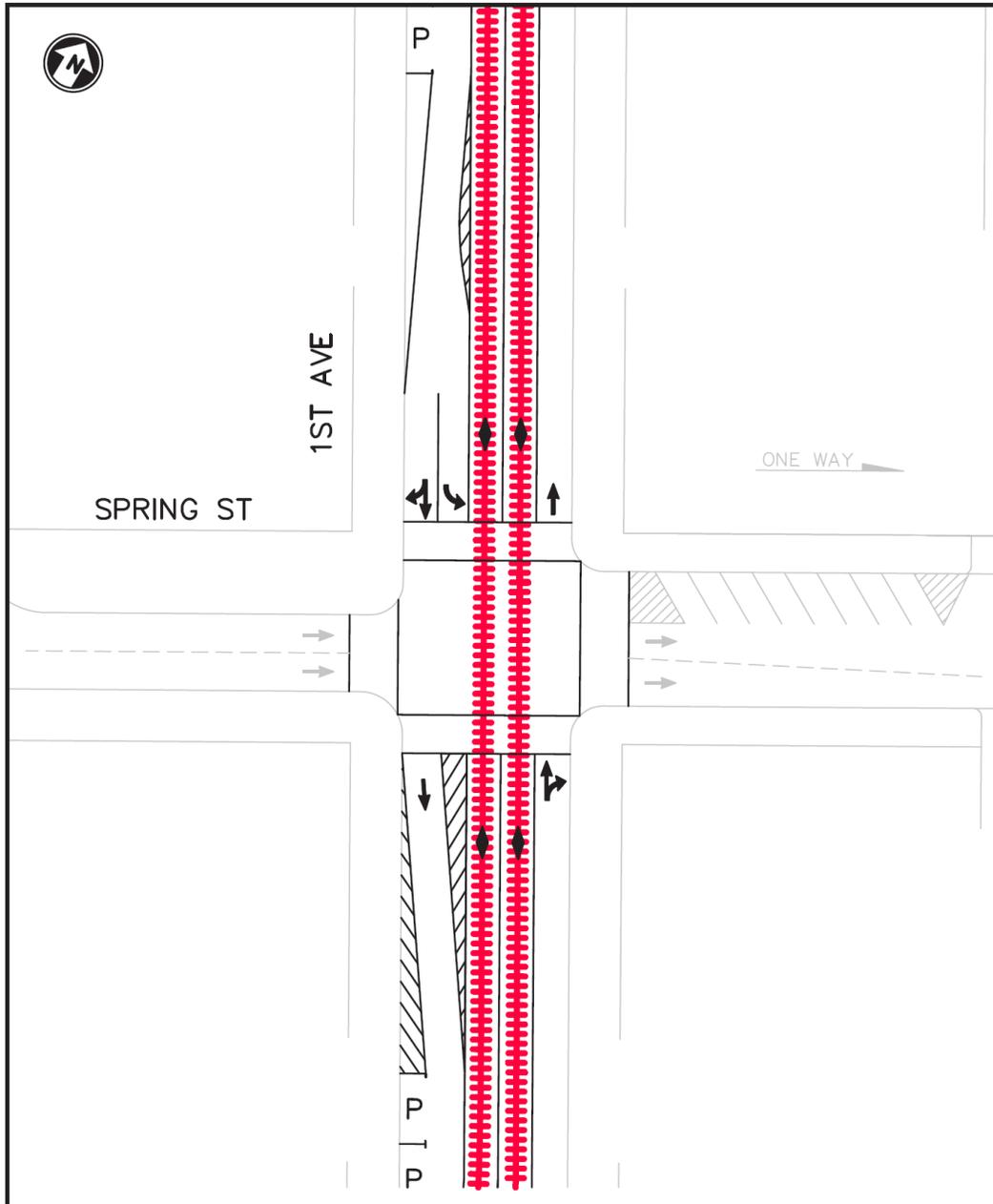
Critical Intersections

Turn pockets would enable left-turns at critical intersections connecting to the freeway or waterfront, as shown in Figure 2-28:

- Northbound: Madison and Pike
- Southbound: University, Spring, Cherry, and Jackson

Left-turns would not be permitted at other locations.

Figure 2-28 1st Avenue Exclusive Plan Diagram (Spring)



Source: URS

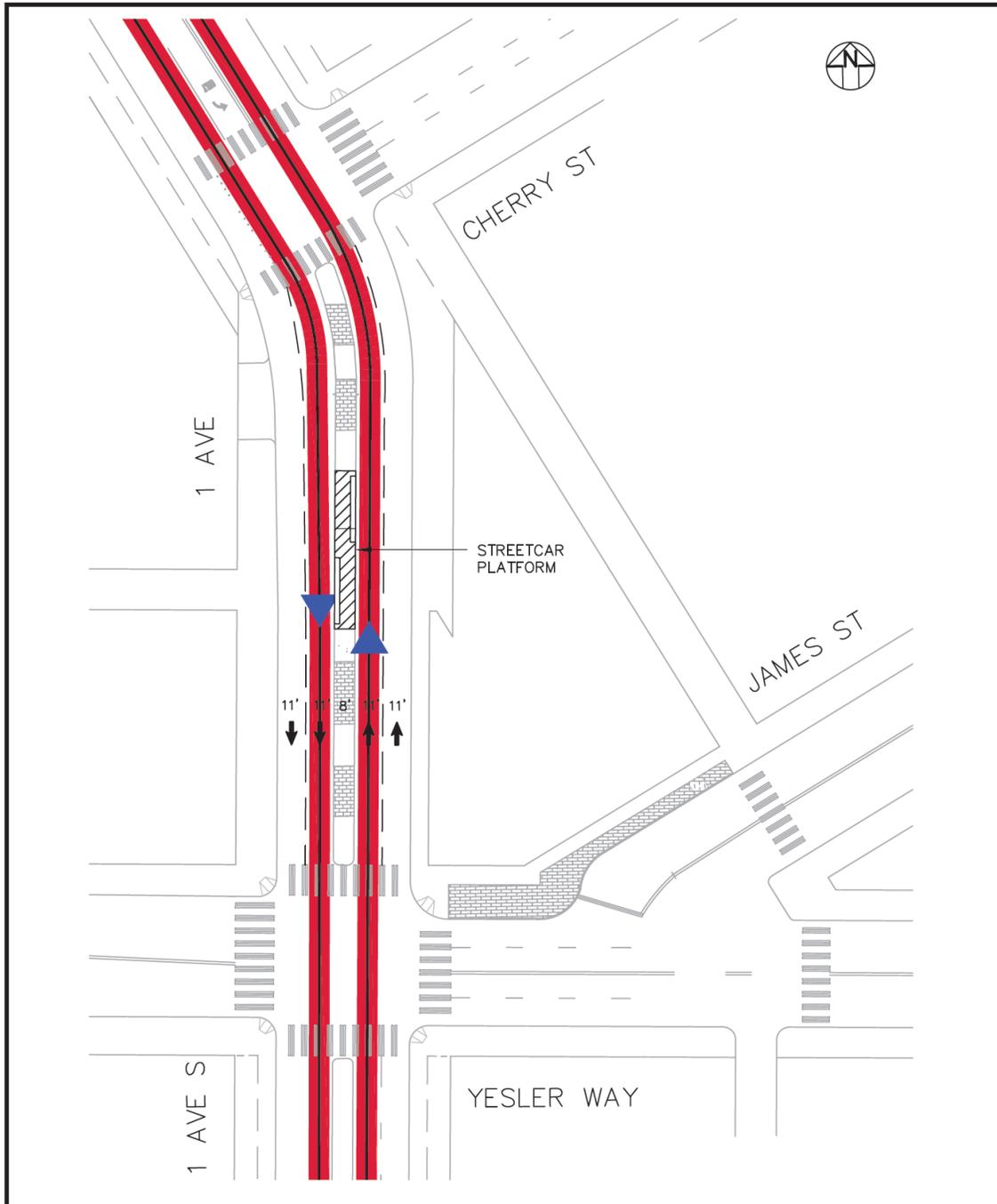
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Cherry-Yesler

As illustrated in Figure 2-29, in this alternative it is assumed that the streetcar would have median stops between Cherry and Yesler, which would require removal of median street trees.

The Mixed-Traffic alternative includes an option for curb stops that would not impact the median street trees.

Figure 2-29 1st Avenue Mixed-Traffic Plan Diagram (Cherry - Yesler)



Source: URS

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OPERATING SCENARIOS

Figure 2-30 (table) and Figure 2-31 (map) identify the primary operating scenarios that were evaluated as part of the Tier 1 screening process for a complete streetcar network that includes the South Lake Union line, Center City Connector line, and First Hill Streetcar line. Some scenarios analyze continuous, through-routed operation while others assume a transfer between the Center City Connector line and First Hill line.

Figure 2-30 Operating Scenarios for Tier 1 Screening (Table)

Map Color	Center City Connector Primary Street Alignment	Scenario Description
Operating Scenarios for Tier 1 Evaluation		
Red + Gold	4 th /5 th Avenues	South Lake Union line to Center City Connector line (via 4 th /5 th) to First Hill line (Transfer between First Hill and Center City Connector lines in International District)
Green	1 st Avenue	Continuous routing of South Lake Union line to Center City Connector line to First Hill line (No transfer required)
Blue + Gold	1 st Avenue	South Lake Union line to Center City Connector line to First Hill line (Transfer to between First Hill and Center City Connector lines in Pioneer Square)

Note: Additional scenarios could be evaluated as part of the Tier 2 evaluation.

For purposes of the Tier 1 analysis, operating scenarios for the complete streetcar network are assumed to be consistent with the First Hill Streetcar operations plan as of February 2012. That plan assumes a service span of 20 hours per day Monday through Saturday and 12.0 hours on Sunday for a total of 132.0 hours per week.³ Three service span categories were assumed—Peak, Off-Peak, and Sundays/Holidays—with the total number of annual revenue hours determined based on the following assumptions:

- **Peak.** Consists of 78 hours per week of operation (Monday – Saturday 6 AM -7 PM), 10-minute headways.
- **Off-Peak.** Early mornings (before 6 AM) and evenings (after 7 PM) Monday-Saturday, 15-minute headways.
- **Sundays/Holidays.** All hours (7 AM – 7 PM), 15-minute headways.

These assumptions are similar to those from the First Hill Streetcar 2012 operations plan, however the Tier 2 evaluation will use longer service span assumptions (see Appendix B for an example).

Figure 2-32 provides estimated operating and maintenance costs for each scenario and estimates the total number of vehicles required and the number of additional vehicles that would be

³ Service characteristics to be refined in the Tier 2 evaluation. Current plans for the First Hill Streetcar are for a 20-hour service span Monday-Saturday (5 AM – 1 AM) and 12 hour service span on Sundays and Holidays (7 AM – 7 PM); this is a total of 132 hours per week.

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required to operate the complete network, i.e., in addition to existing South Lake Union Streetcar and planned First Hill Streetcar vehicles.

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Figure 2-31 Operating Scenarios for Tier 1 Screening (Map)



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Figure 2-32 Tier 1 Estimated Operating and Maintenance Costs and Vehicle Requirements (Full Network)

Tier 1 Alternative	Map Colors	Tier 1 Operating Scenario Description	Annual Operating Cost Estimate ²	Total Number of Vehicles ³	Vehicles in Addition to South Lake Union and First Hill Lines ⁴	Vehicle Capital Costs ⁴
4th/5th Avenue Alternatives						
A1: Mixed-Traffic	Red Gold	SLU Line + CCC Line via 4th/5th Aves Transfer to First Hill Line at International District Station	\$12.3 M	13	3	\$13.5 M
A2: Exclusive (CCC Only) ¹	Red Gold	SLU Line + CCC Line via 4th/5th Aves Transfer to First Hill Line at International District Station	\$12.0 M	12	2	\$9.0 M
1st Avenue Alternatives						
B1: Mixed-Traffic	Blue Gold	SLU Line + CCC Line via 1st Ave Transfer to First Hill Line at Pioneer Square	\$12.3 M	13	3	\$13.5 M
B1: Mixed-Traffic	Red Gold	SLU Line + CCC Line via 1st Ave + First Hill Line (through-routed with no transfers)	\$12.3 M	13	7	\$23.5 M
B2: Exclusive (CCC Only) ¹	Green	SLU Line + CCC Line via 1st Ave + First Hill Line (through-routed with no transfers)	\$11.2 M	11	5	\$14.5 M

Notes: (1) Exclusive operating scenarios assume exclusive characteristics (e.g., exclusive lanes, fewer stops, more extensive signal priority) on Center City Connector (CCC) segment only. (2) Based on existing South Lake Union (SLU) and planned First Hill streetcar operating costs. (3) Total number of vehicles required to operate streetcar on the SLU, CCC, and First Hill lines, including spares. (4) Based on the ability to utilize the existing (SLU) and planned (First Hill) streetcar fleets and an assumed cost of \$4.5 million per vehicle. The vehicle capital cost reflects only the added cost to supply the additional vehicles required for the CCC line. If all three streetcar lines were operated as completely through-routed, it would require replacing existing SLU vehicles, which cannot operate off-wire. It is assumed that these vehicles could be sold (a resale value of \$2.0 million is assumed). (5) Additional dwell or layover time may be needed for transfer scenarios.

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KEY ANALYSIS ASSUMPTIONS

The technical analysis conducted for the Tier 1 Screening and planned for the Tier 2 Evaluation relies on a set of assumptions regarding service characteristics such as frequency and span, potential operating scenarios, right-of-way design, and other factors. These assumptions were initially described as part of the Seattle Center City Connector Methods Report; updated methodology is provided in the appendices to this report. Figure 2-33 summarizes key assumptions and identifies where each assumption is described in additional detail (if applicable).

Figure 2-33 Summary of Key Methodology Assumptions

	Tier 1	Tier 2	Supporting Tables/Graphics
Modes	<ul style="list-style-type: none"> ▪ Mixed-traffic and exclusive streetcar, differentiated based on cross-section design (mixed-traffic vs. exclusive lanes), stop spacing, level of priority 	<ul style="list-style-type: none"> ▪ To be determined based on Tier 1 	<ul style="list-style-type: none"> ▪ N/A2
Vehicles	<ul style="list-style-type: none"> ▪ Quantity based on headway goals (see below) and Tier 1 traffic model results 	<ul style="list-style-type: none"> ▪ More detailed analysis of vehicle needs based on ridership estimates 	<ul style="list-style-type: none"> ▪ N/A
Alignments and Right-of-Way Design	<ul style="list-style-type: none"> ▪ 4th/5th Ave with 4th/Pine connection to Westlake ▪ 1st Ave with Stewart/Olive connection to Westlake 	<ul style="list-style-type: none"> ▪ To be determined based on Tier 1 	<ul style="list-style-type: none"> ▪ N/A
Operating Scenarios	<ul style="list-style-type: none"> ▪ 4th/5th Ave: South Lake Union to Jackson St (transfer to First Hill Streetcar) ▪ 1st Ave <ul style="list-style-type: none"> – South Lake Union to First Hill (no transfer required) – South Lake Union to Jackson Street (Transfer to First Hill Streetcar) 	<ul style="list-style-type: none"> ▪ To be determined based on Tier 1 	<ul style="list-style-type: none"> ▪ N/A
Stops	<ul style="list-style-type: none"> ▪ Closer stop spacing for mixed-traffic streetcar and longer stop spacing for exclusive streetcar ▪ Assume 20 second dwell time at stops 	<ul style="list-style-type: none"> ▪ To be determined 	<ul style="list-style-type: none"> ▪ N/A
Transit Signal Priority (TSP)	<ul style="list-style-type: none"> ▪ No signal priority and full signal priority (range of impacts) 	<ul style="list-style-type: none"> ▪ Likely hybrid level of priority 	<ul style="list-style-type: none"> Appendix A
Traffic Analysis	<ul style="list-style-type: none"> ▪ High level analysis, focused on differentiating primary alignments ▪ 2030 traffic forecasts ▪ Synchro analysis ▪ Very high-level analysis of traffic diversion ▪ Track parking loss for each scenario evaluated 	<ul style="list-style-type: none"> ▪ More detailed analysis including sub-options ▪ Likely 2020 as proxy for opening year ▪ Synchro and vissim analysis (micro-simulation) ▪ More detailed analysis of traffic diversion 	<ul style="list-style-type: none"> Appendix A
Operating Plan / Headway Goals)	<ul style="list-style-type: none"> ▪ 10-minute weekday peak headways; 15-minute off-peak. 	<ul style="list-style-type: none"> ▪ To be determined 	<ul style="list-style-type: none"> ▪ Appendix B

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	Tier 1	Tier 2	Supporting Tables/Graphics
Operating Cost Estimates	<ul style="list-style-type: none"> ▪ At this level of analysis, cost per revenue hour of about \$200, based on 2012 SLU Streetcar actual costs 	<ul style="list-style-type: none"> ▪ No change 	<ul style="list-style-type: none"> ▪ Appendix B
Capital Cost Estimates	<ul style="list-style-type: none"> ▪ Capital cost per mile plus special considerations (based on First Hill cost data) 	<ul style="list-style-type: none"> ▪ Standard Cost Category approach 	<ul style="list-style-type: none"> ▪ Appendix C
Ridership Estimation	<ul style="list-style-type: none"> ▪ Sketch-level model based on peer data (similar to Seattle TMP approach) 	<ul style="list-style-type: none"> ▪ STOPS ridership model under development 	<ul style="list-style-type: none"> ▪ Appendix D ▪ Methods Report, Appendix C: Ridership Estimation

3 EVALUATION OF TIER 1 ALTERNATIVES

GOALS AND OBJECTIVES

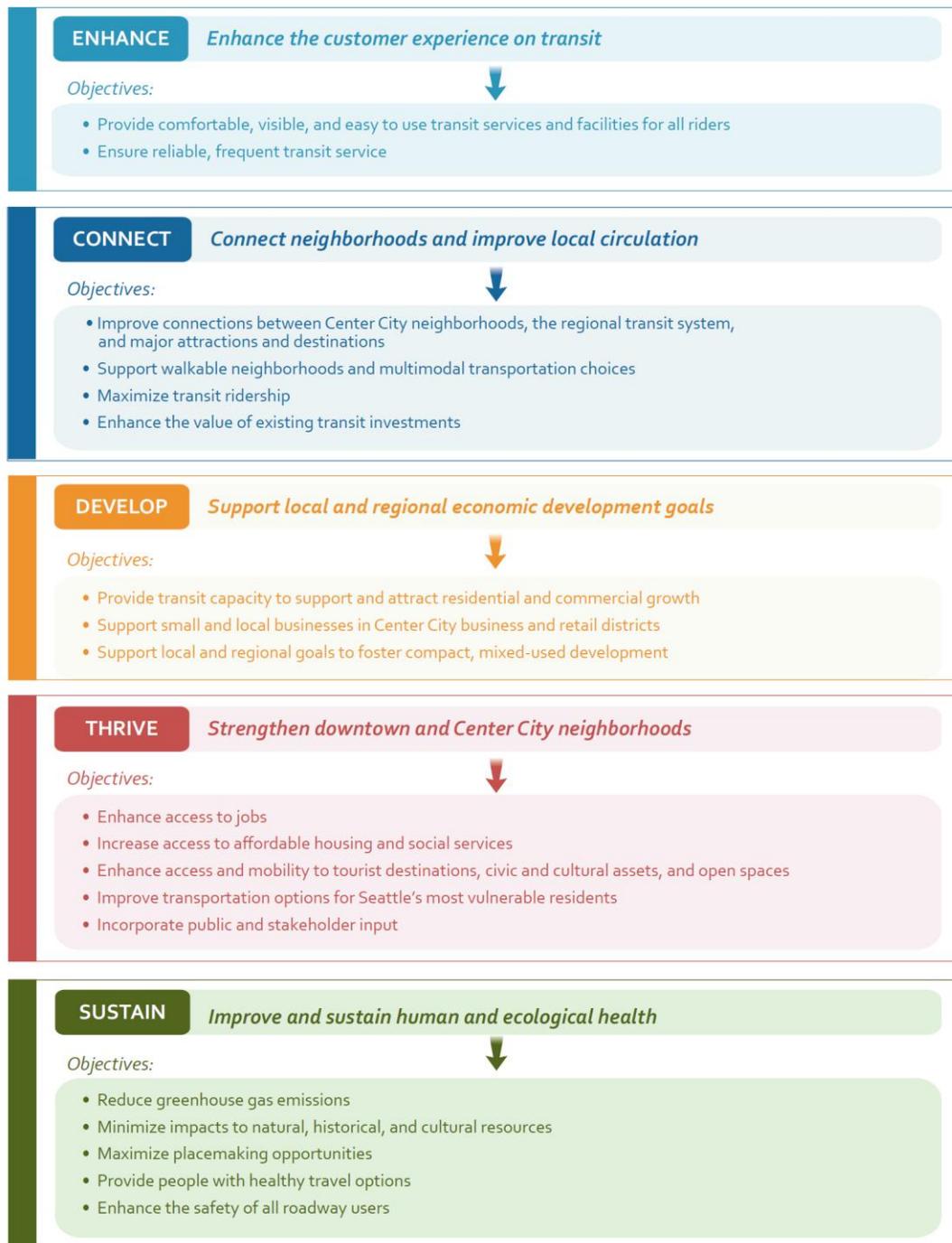
The goals for the Center City Connector project are captured in the following five themes: Enhance, Connect, Develop, Thrive, and Sustain, illustrated in Figure 3-1. Figure 3-2 identifies objectives that were developed to help evaluate how well each alternative supports the goals.

Figure 3-1 Project Goals



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Figure 3-2 Project Goals and Objectives



SCREENING CRITERIA

Figure 3-3 provides the evaluation criteria used in the Tier 1 evaluation. Where applicable, quantitative measures were normalized using 1/8-mile (approximately 2 block) buffers around the primary Tier 1 alignments. In some cases, the buffer was adjusted to capture major attractors that were slightly beyond an 1/8-mile distance but are within an 1/8 mile of alignment sub-options (which would be evaluated in Tier 2), e.g., the Aquarium and Convention Center. Where possible, quantitative data was analyzed using a natural breaks (4 category) method. Each objective was evaluated qualitatively using a Best-Good-Fair-Poor scale. The ratings for all objectives are summarized in single scorecard-style matrix (Figure 3-4).

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Figure 3-3 Tier 1 and 2 Evaluation Criteria

Objective	ID	Screening Criteria	Presentation	Analysis
ENHANCE: Enhance the customer experience on transit				
<ul style="list-style-type: none"> ▪ Provide reliable, frequent transit service 	E1a	<ul style="list-style-type: none"> ▪ Streetcar travel times 	<ul style="list-style-type: none"> ▪ End-to-end travel times for each alternative based on lane configuration and level of transit priority 	Quantitative
	E1b	<ul style="list-style-type: none"> ▪ Existing transit system impacts (reduction in corridor bus capacity and increased transit and bus passenger delay) 	<ul style="list-style-type: none"> ▪ Tables/map identifying key impacts, opportunities, and challenges ▪ Bus and Bus Passenger Delay 	Quantitative
	TIER 2	<ul style="list-style-type: none"> ▪ Capacity/potential for transit priority features 	<ul style="list-style-type: none"> ▪ None; used for Tier 2 evaluation 	
<ul style="list-style-type: none"> ▪ Provide comfortable, visible, and easy to use transit services and facilities for all riders 	TIER 2	<ul style="list-style-type: none"> ▪ Quality, comfort, ease-of-access, legibility of facilities ▪ Quality, comfort of vehicle technologies ▪ Quality of passenger amenities/infrastructure 	<ul style="list-style-type: none"> ▪ None; used for Tier 2 evaluation 	
CONNECT: Enhance connections between and access to Center City neighborhoods				
<ul style="list-style-type: none"> ▪ Enhance the value of existing transit investments and transit service for Center City trips 	C1a	<ul style="list-style-type: none"> ▪ Connections with existing transit/multimodal hubs 	<ul style="list-style-type: none"> ▪ Number of hubs served; discussion of connections/integration 	Qualitative
	C1b	<ul style="list-style-type: none"> ▪ Future employment within alignment ▪ Future population within alignment 	<ul style="list-style-type: none"> ▪ Number and density of employment and population 	Quantitative
	TIER 2	<ul style="list-style-type: none"> ▪ Potential connections to future high-capacity transit services (e.g., Link, Ballard, Eastlake) 	<ul style="list-style-type: none"> ▪ None; used for Tier 2 evaluation 	
<ul style="list-style-type: none"> ▪ Support walkable neighborhoods and multimodal transportation choices 	C2a	<ul style="list-style-type: none"> ▪ Conflicts with bicycle, freight, and transit priorities 	<ul style="list-style-type: none"> ▪ Evaluation of bicycle, pedestrian, transit, and freight impacts 	Qualitative
	C2b	<ul style="list-style-type: none"> ▪ Auto travel times 	<ul style="list-style-type: none"> ▪ End-to-end auto travel times for each alternative, based on lane configuration changes 	Quantitative
<ul style="list-style-type: none"> ▪ Maximize transit ridership 	C3a	<ul style="list-style-type: none"> ▪ Ridership potential 	<ul style="list-style-type: none"> ▪ Center City Connector Projected Ridership, based on peer cities and expected service characteristics 	Quantitative
	C3b	<ul style="list-style-type: none"> ▪ Operating and maintenance costs 	<ul style="list-style-type: none"> ▪ Operating costs of Center City Connector alternatives (for identified operating scenarios) 	Quantitative
	C3c	<ul style="list-style-type: none"> ▪ Capital costs 	<ul style="list-style-type: none"> ▪ Capital costs of Center City Connector alternatives 	Quantitative

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DEVELOP: Support local and regional economic development goals				
<ul style="list-style-type: none"> ▪ Promote new development where residents and workers have transportation options ▪ Support local and regional goals to foster compact and mixed-use development ▪ Provide transit capacity to support and attract residential and commercial growth 	D1a	<ul style="list-style-type: none"> ▪ Capacity for new investment 	<ul style="list-style-type: none"> ▪ Map showing vacant and redevelopable land and pipeline projects within 1/8 mile (2 blocks) of alignment 	Quantitative/ Qualitative
	D1b	<ul style="list-style-type: none"> ▪ Potential transit impact 	<ul style="list-style-type: none"> ▪ 	Qualitative
	D1c	<ul style="list-style-type: none"> ▪ Connection to jobs and housing 	<ul style="list-style-type: none"> ▪ 	Qualitative
	TIER 2	<ul style="list-style-type: none"> ▪ Housing Opportunity (total and affordable) 	<ul style="list-style-type: none"> ▪ 	
<ul style="list-style-type: none"> ▪ Support small and local businesses in Center City business and retail districts 	D2	<ul style="list-style-type: none"> ▪ Parking removal 	<ul style="list-style-type: none"> ▪ Percent of block faces that retain on-street parking in each alternative relative to existing conditions 	Quantitative
THRIVE: Strengthen downtown and Center City neighborhoods				
<ul style="list-style-type: none"> ▪ Enhance access to jobs 	T1	Number of Center City residents with access to Center City Connector alignments (live or work), including connections to other lines	Map(s) showing home and work locations of Center City residents who live or work within 1/8 mile of proposed alignment (by block)	Quantitative
<ul style="list-style-type: none"> ▪ Improve transportation options for Seattle's most vulnerable residents ▪ Increase access to affordable housing and social services 	T2a	Number of low-income, minority, elderly, and persons with disabilities with access to Center City Connector	Map of relative transit propensity, a measure that considers transit-related characteristics of key transit dependent populations	Quantitative
	T2b	Number of social service sites with access to Center City Connector	Map showing social service sites within 1/8 mile of proposed alignment	Quantitative
<ul style="list-style-type: none"> ▪ Enhance access and mobility to tourist destinations, civic and cultural assets, and open spaces 	T3a	Visitor attractions served and number of annual visitors	Map/chart showing number of annual visitors to attractions within 1/8 mile of each proposed alignment	Quantitative
	T3b	Number of hotel rooms	Map/chart showing number of hotel rooms within 1/8 mile of each proposed alignment	Quantitative
<ul style="list-style-type: none"> ▪ Incorporate public/stakeholder comments into decision-making 	T4	Comments from Open House 1 and 2 and stakeholder input	Summary memo	Quantitative/ Qualitative

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SUSTAIN: Improve and sustain human and ecological health				
<ul style="list-style-type: none"> ▪ Maximize placemaking opportunities ▪ Enhance the safety of all roadway users ▪ Provide people with healthy travel options 	S1	<ul style="list-style-type: none"> ▪ Urban form assessment 	<ul style="list-style-type: none"> ▪ Assessment of corridor development form and character to support walking and transit travel: <ul style="list-style-type: none"> – Sidewalk paving – Pedestrian crossings – Transit facilities (bus stops with associated use patterns) – Adjacent uses (e.g. active storefront retail, blank walls, parking, etc) – Pedestrian lighting – Pedestrian amenities (benches, way-finding signs, trash receptacles, adjacent bldg. edge weather canopies, etc) – Unique and/or public places and/or civic buildings 	Qualitative
<ul style="list-style-type: none"> ▪ Reduce greenhouse gas emissions 	TIER 2	<ul style="list-style-type: none"> ▪ Reduction in GhG emissions 	<ul style="list-style-type: none"> ▪ None; used for Tier 2 evaluation 	Quantitative
<ul style="list-style-type: none"> ▪ Minimize impacts to natural, historical, and cultural resources 	TIER 2	<ul style="list-style-type: none"> ▪ Impacts to natural, historical, and cultural resources 	<ul style="list-style-type: none"> ▪ None; used for Tier 2 evaluation 	Qualitative

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KEY FINDINGS

The following section provides an overview of the findings for each of the evaluation measures used to compare alternatives. A summary of the findings is shown below in Figure 3-4. Further detail on many of the evaluation measures and the methodology used to develop ratings can be found in the appendices of this report.

Figure 3-4 Tier 1 Screening Summary Matrix

Evaluation Measures	4th/5th Avenues		1st Avenue			
	Mixed-Traffic	Exclusive	Mixed-Traffic	Exclusive		
ENHANCE	Streetcar Travel Times	Fair	Good	Fair	Best	
	Bus Travel Time and Reliability Impacts: Aggregate Bus Delay	Poor	Fair	Best	Best	
	Bus Travel Time and Reliability Impacts: Aggregate Bus Passenger Delay	Poor	Fair	Best	Best	
CONNECT	Connections with Existing Transit/Multi-modal Hubs	Good	Good	Best	Best	
	Future Employment within Alignment	Best	Best	Good	Good	
	Future Population within Alignment	Good	Good	Best	Best	
	Multimodal Conflicts (Bike, Pedestrian, Bus, and Freight)	Fair	Poor	Best	Best	
	Auto Travel Times / Relative Traffic Diversion Impacts	Fair	Fair	Best	Fair	
	Ridership Potential	Good	Best	Good	Best	
	Annual Operating & Maintenance Costs	Fair	Good	Fair	Best	
	Capital Costs	Best	Good	Good	Fair	
	DEVELOP	Economic Development Opportunities	Good	Good	Best	Best
		On-Street Parking Impacts	Best	Fair	Good	Fair
THRIVE	Access to Jobs	Good	Good	Good	Good	
	Access for Vulnerable Residents and to Social Services and Affordable Housing	Good	Good	Good	Good	
	Access to Tourist Destinations, Civic and Cultural Assets, and Open Spaces	Good	Good	Best	Best	
	Public Support (Open House #1 and #2) and Stakeholder Support	Fair	Fair	Good	Best	
SUSTAIN	Urban Form and Placemaking Opportunities and Improvement Potential	Good	Good	Best	Best	

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Enhance

Objective E1: Provide reliable, frequent transit service

Screening Criteria	Evaluation Summary	4th/5th		1st Ave	
		Mixed-Traffic	Exclusive	Mixed-Traffic	Exclusive
Streetcar travel times (min)					
<p>The data at right is for one-way streetcar travel times between Jackson Street and Westlake. Figure 3-5 (4th/5th Avenues) and Figure 3-6 (1st Avenue) illustrate streetcar travel times relative to auto travel time (No-Build).</p>	<ul style="list-style-type: none"> Both Exclusive alternatives provide a faster streetcar travel time than driving. 1st Avenue Exclusive alternative provides the shortest streetcar travel time. Both Mixed-Traffic alternatives provide slower streetcar travel times (including stops) than driving. Transit receives the least benefit in the Exclusive alternatives on: 4th Avenue (Pike to Westlake), All of 5th Avenue, Stewart Street (westbound direction). Streetcar operates primarily in mixed-traffic in the above segments. 	12.8 min	8.9 min	11.6 min	6.1 min
		Fair	Good	Fair	Best
Aggregate bus vehicle delay (min)					
<p>The data at right is for change in aggregate bus delay during the 5-6 PM period in 2030 relative to No-Build. Figure 3-7 illustrates the change in delay.</p>	<ul style="list-style-type: none"> Mixed-Traffic: Aggregate bus delay increases by about 60% on 4th Avenue and by about 25% on 5th Avenue. Exclusive: Aggregate bus delay decreases by 25% on 4th Avenue, due to a second transit-only lane. On 5th Avenue the increase in aggregate bus delay is mitigated with a transit-only lane over part of the alignment. 	181 min	-62 min	N/A	N/A
		Poor	Fair	Best	Best
Aggregate passenger delay (hours)					
<p>The data at right is for change in aggregate bus passenger delay during the 5-6 PM period in 2030 relative to No-Build. Figure 3-8 illustrates the change in delay.</p>	<ul style="list-style-type: none"> Mixed-Traffic: Aggregate bus passenger delay increases by about 60% on 4th Avenue and by over 40% on 5th Avenue. Exclusive: Aggregate bus passenger delay decreases by 25% on 4th Avenue due to a second transit-only lane. On 5th Avenue, delay increases by 5% with a transit-only lane over part of the alignment. 	4,005 hours	297 hours	N/A	N/A
		Poor	Fair	Best	Best
<p>Overall Summary: Both 4th/5th Avenue Exclusive and 1st Avenue Exclusive offer faster travel times due to the use of exclusive right-of-way. With projected 2030 peak hour bus volumes on portions of 4th and 5th Avenue, both 4th/5th Avenue alternatives incur significant delay to buses and passengers due to impacts on bus operations. 1st Avenue Exclusive best meets this objective due to lower delay to buses and passengers and the fastest end-to-end travel time. 4th/5th Avenue Mixed-Traffic least meets this objective, as it would cause significant delay to buses and passengers and has the slowest end-to-end travel time. The Tier 2 evaluation will consider the potential for transit priority features in more detail, and the resulting impact on travel times.</p>					

SEATTLE CENTER CITY CONNECTOR TRANSIT STUDY

Figure 3-5 Average One-Way Travel Time, 4th/5th Aves

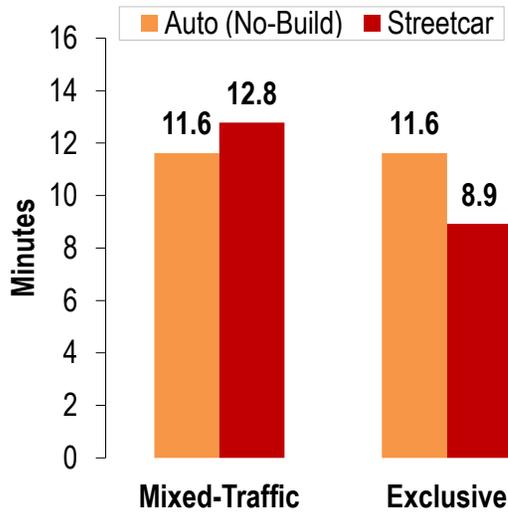


Figure 3-6 Average One-Way Travel Time, 1st Ave

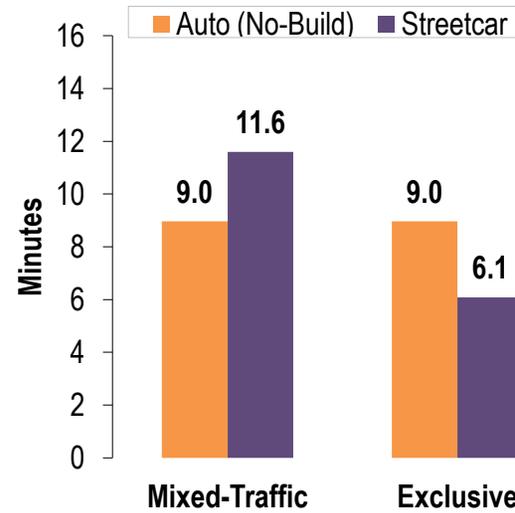


Figure 3-7 Change in Aggregate Bus Delay Compared to No-Build, 5-6 PM, Minutes

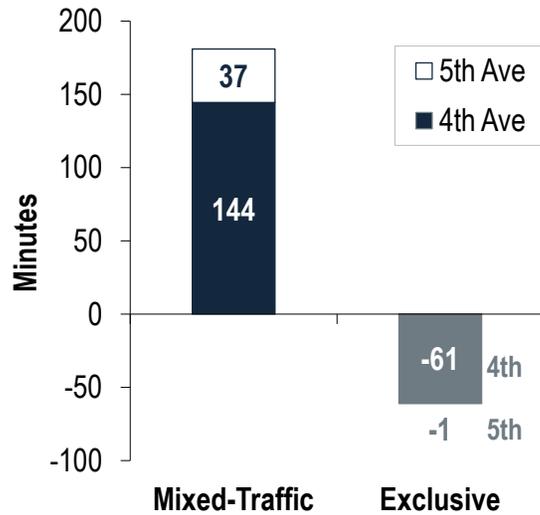
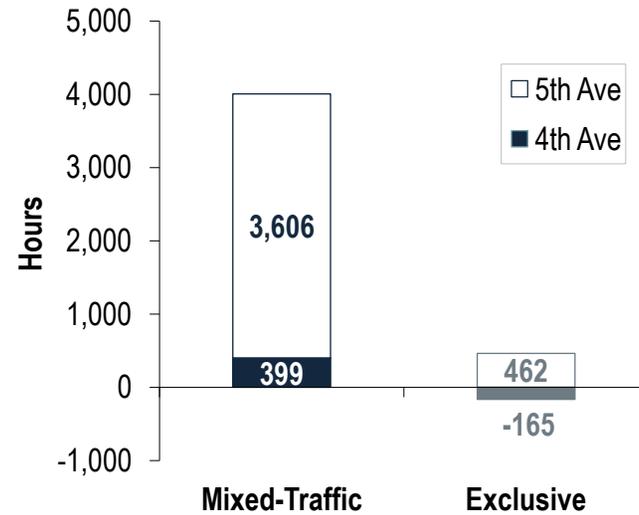


Figure 3-8 Aggregate Passenger Delay (based on average load), 5-6 PM, Hours



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Connect

Objective C1: Enhance the value of existing transit investments and transit service for Center City trips

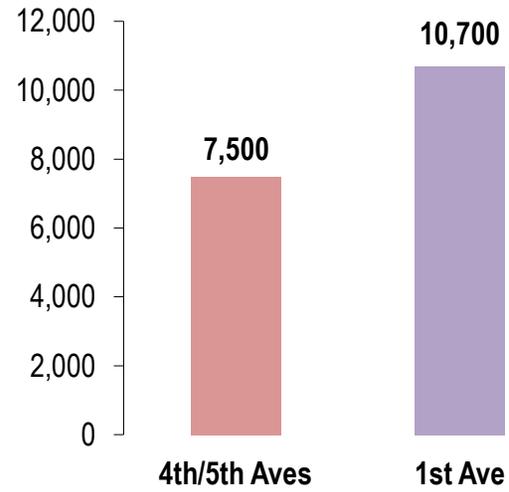
Screening Criteria	Evaluation Summary	4th/5th		1st Ave	
		Mixed-Traffic	Exclusive	Mixed-Traffic	Exclusive
Connections with existing transit/multimodal hubs					
Qualitative assessment of connections with multimodal hubs, connections to local bus service, and connections to regional bus service.	<ul style="list-style-type: none"> 1st Avenue alternatives provide potential connections between all three multimodal hubs while 4th/5th alternatives connect to the King Street and Westlake Hubs, but not to Colman Dock. 1st Avenue alternatives serve a corridor that is not served by regional transit, while 4th/5th Avenue alternatives serve a corridor with regional bus service. All alternatives increase connectivity to the 3rd Avenue transit spine and the Downtown Transit Tunnel, which runs underneath 3rd Avenue. 	Good	Good	Best	Best
Future employment within alignment					
The data at right shows the expected total 2030 employment and employment density per acre within 1/8 mile of each alignment. Figure 3-9 illustrates the number of employees projected in 2030.	<ul style="list-style-type: none"> Both corridors enhance access to employment, but the 4th/5th Avenue corridor is expected to serve a larger number and concentration of employees. 	132,000 employees 580.6 employees/acre		93,090 employees 433.0 employees/acre	
		Best	Best	Good	Good
Future population within alignment					
The data at right shows the expected total 2030 population and population density per acre within 1/8 mile of each alignment. Figure 3-10 illustrates the projected 2030 population.	<ul style="list-style-type: none"> The 1st Avenue corridor is expected to serve a larger population and higher residential density. 	7,540 persons 33.1 persons /acre		10,709 persons 49.8 persons/acre	
		Good	Good	Best	Best
Overall Summary for C1: The 1 st Avenue alternatives expand transit service to a corridor that is currently served by only one bus route and serve all three multimodal hubs, and are also expected to serve a greater population. The 4 th /5 th Avenue alternatives are expected to serve more employees.					

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Figure 3-9 2030 Employees



Figure 3-10 2030 Population



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Objective C2: Support walkable neighborhoods and multimodal transportation choices

Screening Criteria	Evaluation Summary	4th/5th		1st Ave	
		Mixed-Traffic	Exclusive	Mixed-Traffic	Exclusive
Conflicts with pedestrian, bicycle, freight, and transit priorities					
Qualitative evaluation of impacts to each mode.	<ul style="list-style-type: none"> ▪ Bicycles: Assuming a streetcar and planned cycle tracks on 4th/5th Avenues, there are constraints given limited right-of-way. There are no planned bicycle facilities for 1st Avenue. ▪ Pedestrians: Potential conflict between cycle tracks and streetcar platforms and sidewalk use on 4th/5th Avenues. On 1st Avenue streetcar development has the potential to improve pedestrian conditions, e.g., sidewalks, street crossings, etc. ▪ Bus: A second transit lane with a 4th Avenue Exclusive alternative would reduce bus delay overall, though it would negate this potential benefit by reducing bus stop capacity at key shared bus stop zones in the north part of the corridor. Curbside stops and operations on 5th Ave could increase bus delay. There are limited opportunities to provide exclusive transit lanes on 5th Avenue given a cycle track. No bus routes operate on the full extent of the 1st Avenue alignment. ▪ Freight: Minimal impacts on 4th/5th Avenues. Potential for local delivery conflicts on 1st Avenue. None of the potential streets are designated freight routes. 	Fair	Poor	Best	Best
Auto travel times (min)					
The data at right shows the change in end-to-end auto travel times relative to a 2030 No-Build condition. Figure 3-11 and Figure 3-12 illustrate the average one-way travel time for each alternative.	<ul style="list-style-type: none"> ▪ 1st Avenue Exclusive increases auto travel time the most and may cause up to 50% of traffic to divert to other streets. ▪ The 4th/5th Avenue alternatives have comparatively lower impacts to auto travel times yet still are estimated to cause up to 25% and 30% of traffic to divert, respectively. ▪ 1st Avenue Mixed-Traffic fares the best on this measure; it slightly decreases auto travel times and would cause only minimal diversion to other streets. 	+1.6 min	+1.3 min	-0.2 min	+2.8 min
		Fair	Fair	Best	Fair
Overall Summary for C2: The 4 th /5 th Avenue alternatives have greater conflicts with pedestrian, bicycle, and transit modes, but lower impacts on auto travel. 1 st Avenue Mixed-Traffic has the lowest impact on all modes due to the mixed-traffic design and low impact to auto travel. 4 th /5 th Avenue Exclusive does not have significant conflicts with pedestrian, bicycle, or freight modes but has the greatest impact to auto travel times and traffic diversion.					

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Figure 3-11 Average One-Way Auto Travel Time, 2030, 4th/5th Avenues, Minutes

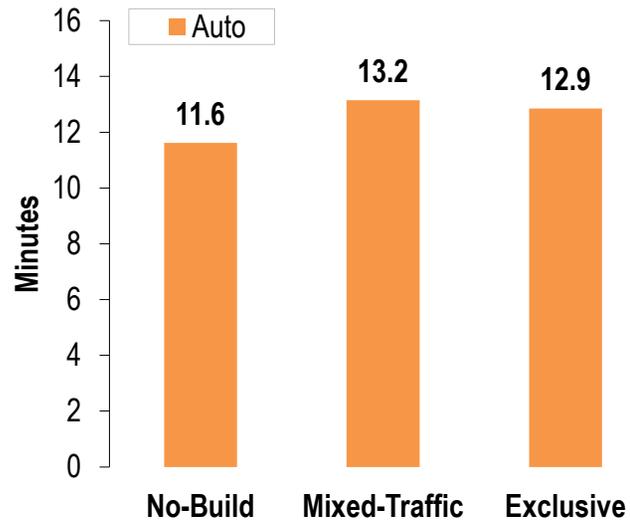
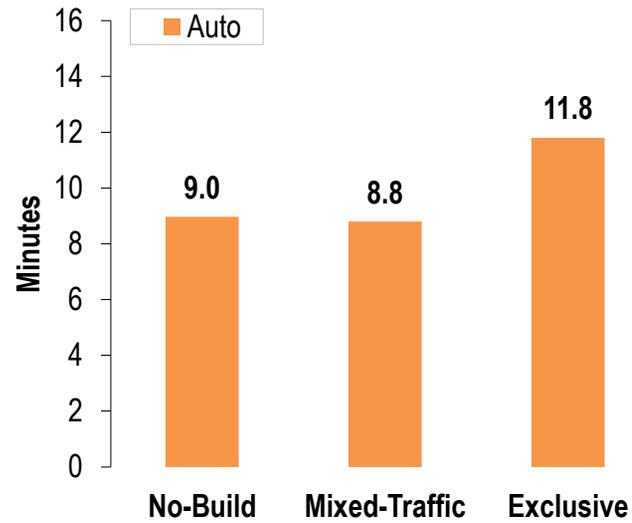


Figure 3-12 Average One-Way Auto Travel Time, 2030, 1st Avenue, Minutes



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Objective C3: Maximize transit ridership

Screening Criteria	Evaluation Summary	4th/5th		1st Ave	
		Mixed-Traffic	Exclusive	Mixed-Traffic	Exclusive
Ridership potential					
<p>The data at right shows estimated average weekday riders for the streetcar system including SLU, Center City Connector, and First Hill. Figure 3-13 illustrates high, low, and average estimates.</p>	<ul style="list-style-type: none"> Ridership estimates for 4th/5th Avenue and 1st Avenue alternatives are comparable at this level of evaluation. An Exclusive alternative would be expected to attract higher ridership than a Mixed-Traffic alternative. A significantly more detailed ridership forecast will be developed in the Tier 2 evaluation, based on the FTA STOPS ridership model. 	7,500 riders	8,500 riders	7,500 riders	8,500 riders
		Good	Best	Good	Best
Operating and maintenance costs (millions of dollars)					
<p>The data at right is for combined operating and maintenance costs for the SLU, Center City, and First Hill streetcar lines (in 2012 dollars). Figure 3-14 illustrates the costs for each alignment.</p>	<ul style="list-style-type: none"> Exclusive streetcar alternatives achieve the highest speeds on each alignment, e.g., via longer stop spacing. This reduces operating costs and vehicle requirements compared to the Mixed-Traffic alternatives. 1st Avenue Exclusive alternative has the lowest annual operating costs. 	\$12.3 M	\$12.0 M	\$12.3 M	\$11.2 M
		Fair	Good	Fair	Best
Capital costs					
<p>Capital costs per mile are shown at right (in 2013 dollars). The total costs for 4th/5th Avenue alternatives include a 16" water line on 4th and cycle tracks on both streets. The route distances are 1.13 miles for the 4th/5th couplet and 1.21 miles for 1st Avenue. Figure 3-15 shows capital costs per mile. Figure 3-16 shows high and low estimates of the total capital costs for each alignment.</p>	<ul style="list-style-type: none"> It is generally less expensive to construct a streetcar on two one-way streets due to increased flexibility in accommodating existing utilities, potential to modify rather than replace traffic signals, and reduced construction footprint. Higher cost of exclusive alternatives accounts for extra traffic signal treatments, reconfiguring parking, and channelization. Bicycle facility costs represent about \$3.0 million (about 5%) of overall 4th/5th Avenue capital costs. More detailed estimates will be produced as part of the Tier 2 evaluation. 	\$50.7 M	\$56.8 M	\$54.7 M	\$58.1 M
		Best	Good	Good	Fair
<p>Overall Summary for C3: Exclusive alternatives attract more riders to the system and have lower operating costs due to gains in travel time. The Exclusive alternatives have the highest ridership potential. 1st Avenue Exclusive also has the lowest operating costs. However, exclusive alternatives also have higher capital costs due to more extensive traffic signal treatments and other right-of-way reconfiguration. 4th/5th Avenues Mixed-Traffic has the lowest capital cost, while 1st Avenue Exclusive has the highest capital cost.</p>					

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Figure 3-13 Estimated Average Daily Riders (SLU, Center City Connector, and First Hill)

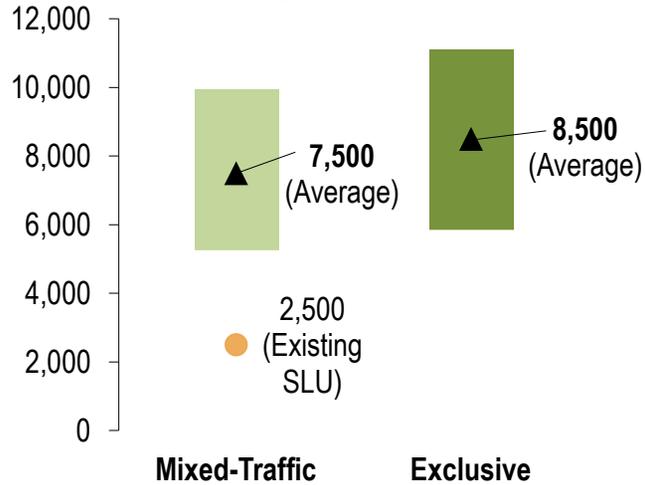


Figure 3-14 Operating and Maintenance Costs

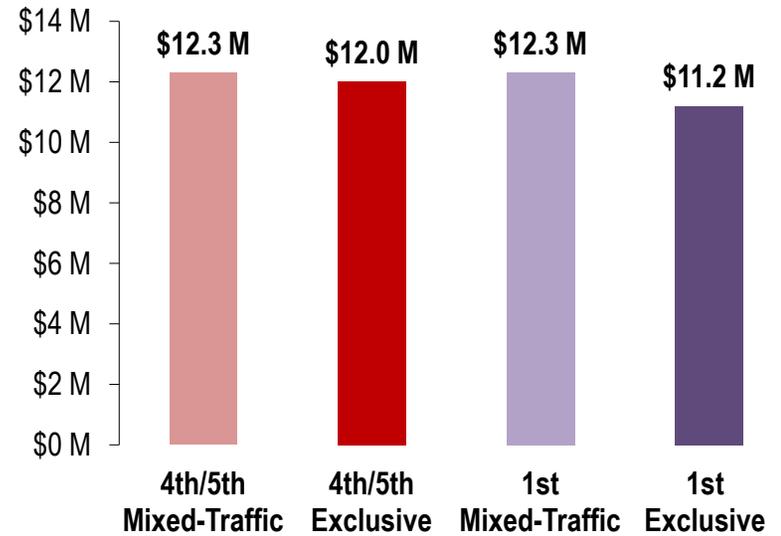


Figure 3-15 Capital Costs per Mile

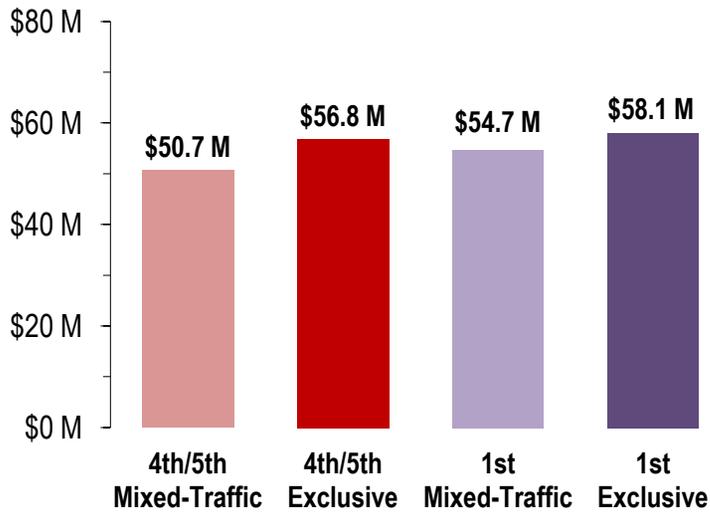
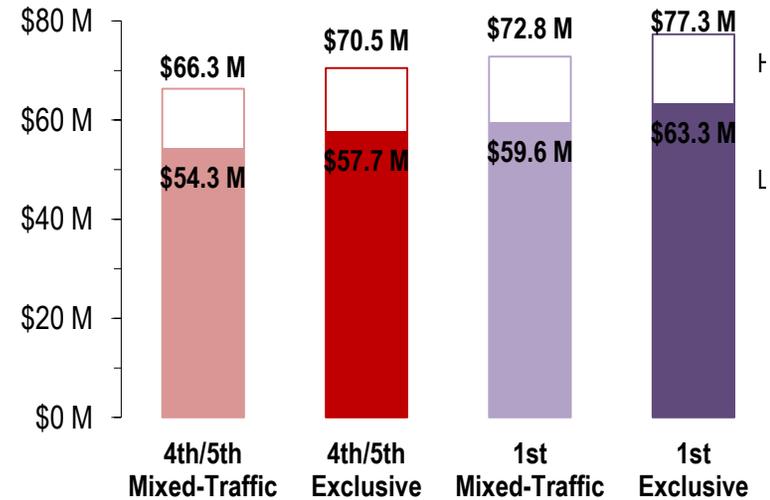


Figure 3-16 Total Capital Costs



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Develop

Objective D1: Promote new development where residents and workers have transportation options; Support local and regional goals to foster compact and mixed-use development

Screening Criteria	Evaluation Summary	4th/5th		1st Ave	
		Mixed-Traffic	Exclusive	Mixed-Traffic	Exclusive
Capacity for new investment					
Qualitative assessment of economic and property characteristics, including average building and parcel size, building age and quality, and percent of space built or renovated since 1990. Figure 3-17 and Figure 3-18 show locations of recent investment and development opportunities.	<ul style="list-style-type: none"> The First Avenue corridor is generally characterized by older, smaller, and somewhat lower value and quality buildings as compared to the 4th/5th Avenue corridor. The 4th/5th Avenue corridor has experienced substantially greater development than the First Avenue corridor over the past 60 years, with more than three times more space added since 1950. This investment pattern is partly a function of zoning where height limits are greater in the 4th/5th corridor. 	Good	Good	Good	Good
Potential transit impact					
The ratings at right are based on a qualitative evaluation of the potential of transit investment to influence future development within each corridor.	<ul style="list-style-type: none"> The potential for transit investment to influence future development is rated only fair for 4th/5th, due to the already strong market preference and the relative proximity of the transit tunnel stations. 1st offers greater potential for transit investment to influence development, given existing development capacity and distance from other transit service. 	Fair	Fair	Best	Best
Connections to Jobs and Housing					
The ratings shown at right reflect quantitative data (current population, housing units, employees) and qualitative evaluation of potential for new mixed use development to serve residents and employees.	<ul style="list-style-type: none"> 4th and 5th Aves present a number of significant development opportunities and provides the best connection to existing jobs, however there are fewer housing units in the corridor. This corridor offer good connections to existing jobs and housing. 	Housing: Fair	Housing: Fair	Housing: Good	Housing: Good
		Employees: Best	Employees: Best	Employees: Good	Employees: Good
Overall Summary for D1:		Good	Good	Best	Best
<ul style="list-style-type: none"> 4th and 5th Avenues present significant development opportunities and provide the best connection to existing jobs. The potential for transit investment to influence future development is rated only fair due to the already strong market preference and the relative proximity of the transit tunnel stations. 1st Avenue has a somewhat greater number of reinvestment and redevelopment opportunities, however due to lower height limits total development capacity is less than the 4th/5th corridor. 1st offers good connections to 		Good	Good	Best	Best

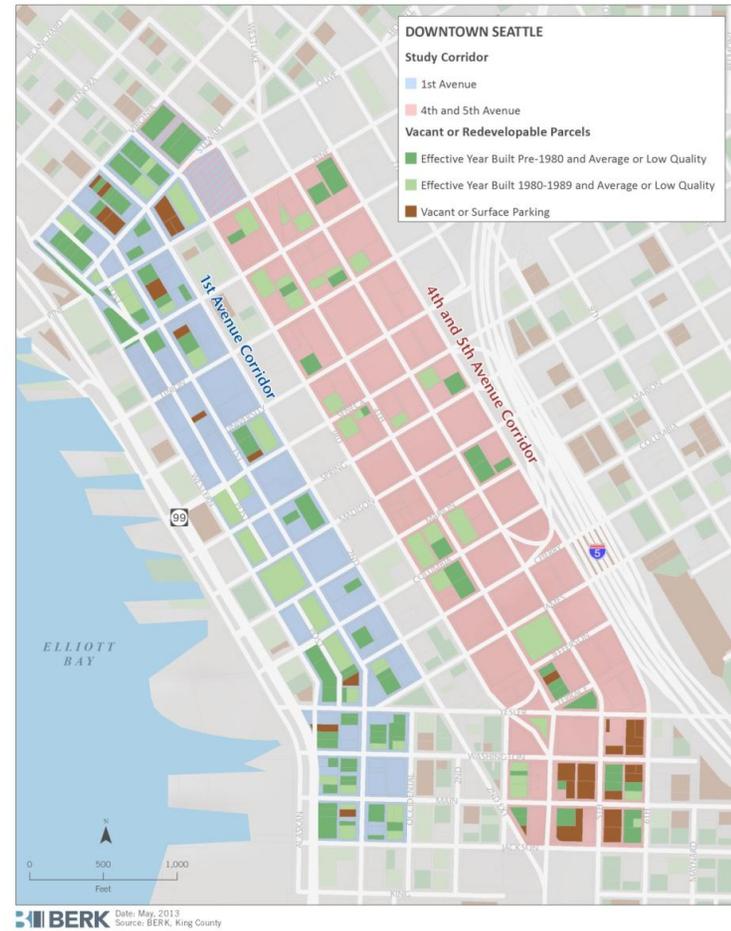
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existing jobs and housing and much better opportunity for transit investments to have a material impact on future development decisions.

Figure 3-17 Recent Investment/Reinvestment



Figure 3-18 Vacant and Redevelopable Parcels

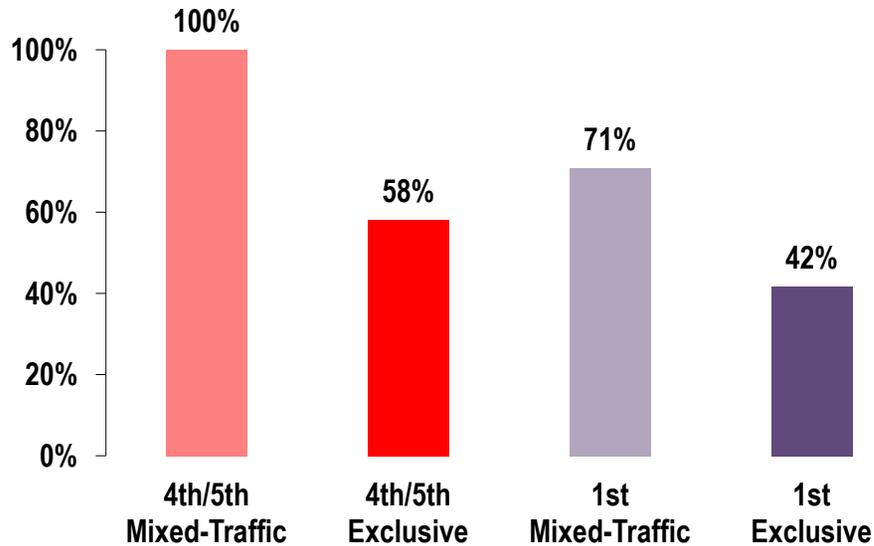


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Objective D2: Support small and local businesses in Center City business and retail districts

Screening Criteria	Evaluation Summary	4th/5th		1st Ave	
		Mixed-Traffic	Exclusive	Mixed-Traffic	Exclusive
Parking removal					
<p>The data at right shows the percent of block faces that would retain on-street parking in each design alternative. Net impacts are based on the number of block faces with existing parking (including peak-restricted parking) minus the number of block faces where parking is assumed in each alternative. Figure 3-19 shows the comparison for each alignment.</p>	<ul style="list-style-type: none"> On-street parking supports small and local businesses in Center City business and retail districts. There are 24 existing block faces with on-street parking along the 4th/5th Avenue alignment and 31 existing block faces with on-street parking along the 1st Avenue alignment. High-level assumptions were developed in the traffic analysis for net parking impacts in each alternative. On-street parking and access to off-street parking will be assessed in greater detail in the Tier 2 evaluation. 	100%	58%	71%	42%
		Best	Fair	Good	Fair

Figure 3-19 Percent of block faces that retain on-street parking



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Thrive

Objective T1: Enhance access to jobs

Screening Criteria	Evaluation Summary	4th/5th		1st Ave	
		Mixed-Traffic	Exclusive	Mixed-Traffic	Exclusive
Access to Jobs					
<p>The data at right shows the number of low- to moderate income workers who live within 1/8 mile of each corridor. Figure 3-20 shows home locations for low and moderate income workers by Census block.</p>	<ul style="list-style-type: none"> Residential locations of low-to-moderate income workers in the study area are concentrated in the southern portion of the 4th/5th Avenue corridor and the northern portion of the 1st Avenue corridor, including Belltown. 	2,666		2,931	
					

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Figure 3-20 Home Locations of Low-to Moderate-Income Workers, 2010



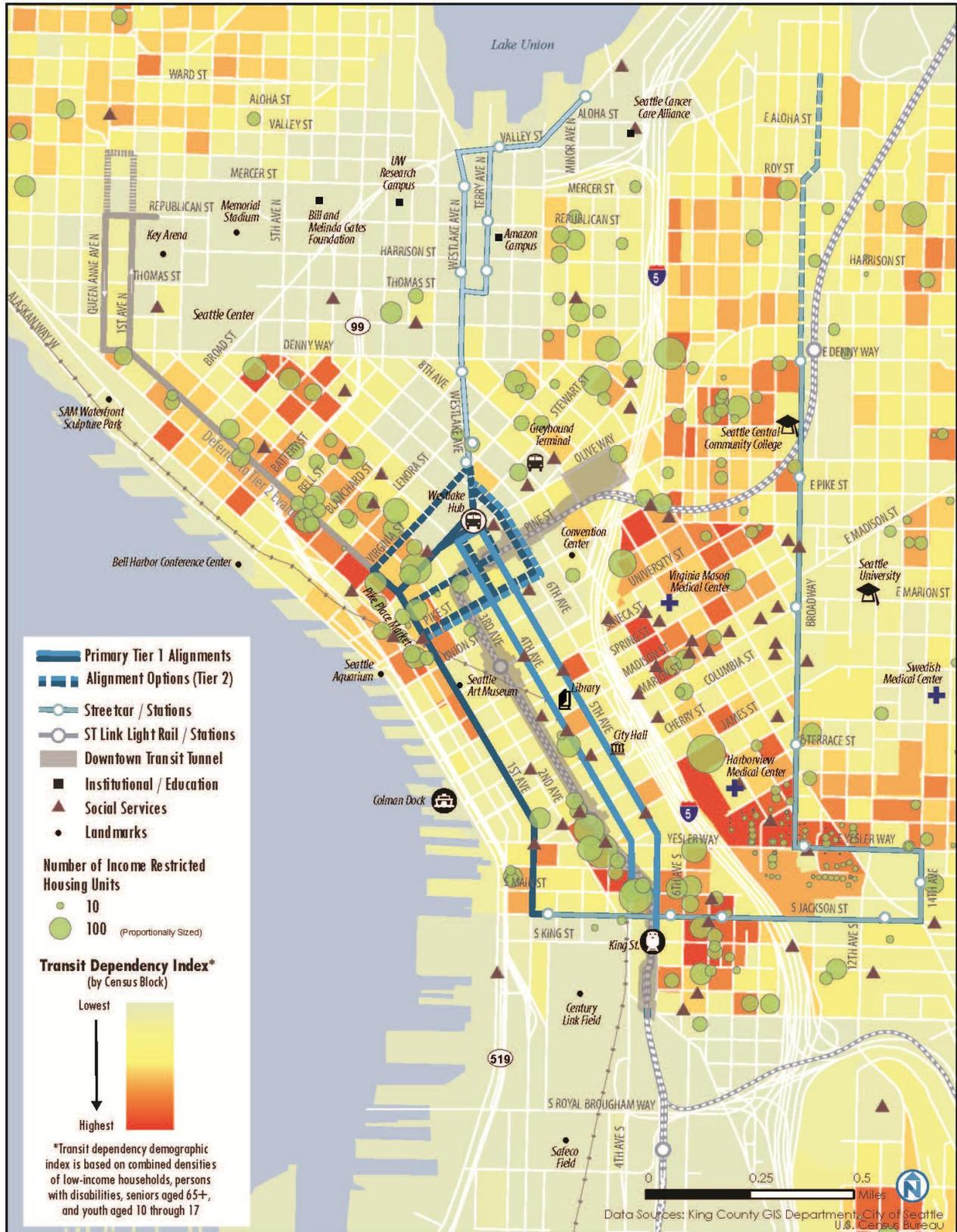
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Objective T2: Improve transportation options for Seattle's most vulnerable residents; Increase access to affordable housing and social services

Screening Criteria	Evaluation Summary	4th/5th		1st Ave	
		Mixed-Traffic	Exclusive	Mixed-Traffic	Exclusive
Number of low-income, minority, elderly, and persons with disabilities with access to Center City Connector					
The relative distribution of transit-reliant populations, including low-income, minority, elderly, and persons with disabilities, is shown in Figure 3-21.	<ul style="list-style-type: none"> Both corridors serve populations who rely on public transportation (including low-income households, persons with disabilities, seniors, and youth). 				
Number of social service sites with access to Center City Connector					
The location of social service sites is also shown in Figure 3-21.	<ul style="list-style-type: none"> Transit-reliant populations, social service sites, and affordable housing locations are concentrated in the southern portion of 4th/5th Avenues and the northern portion of 1st Avenue, including Belltown. Both corridors serve different populations and housing sites, with some overlap. Similarly, some social service sites are served uniquely by each alignment while some sites are served by either alignment. 				
<ul style="list-style-type: none"> Overall Summary: Both corridors serve transit-reliant populations, social service sites, and affordable housing locations. Alternatives B1 and B2, which offer the possibility of a future extension through Belltown, would have the potential to serve additional transit-reliant populations and social service locations. An extension through Belltown to Lower Queen Anne will be considered in conjunction with the Ballard to Downtown study. 		Overall: 	Overall: 	Overall: 	Overall: 

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Figure 3-21 Transit-Reliant Populations, Social Service Sites and Affordable Housing



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Objective T3: Enhance access and mobility to tourist destinations including civic and cultural assets and open spaces

Screening Criteria	Evaluation Summary	4th/5th		1st Ave	
		Mixed-Traffic	Exclusive	Mixed-Traffic	Exclusive
Activity centers and number of annual visitors served					
Figure 3-22 shows the volume of annual visitors for each corridor, in millions. Figure 3-24 shows the location of landmarks and attractions relative to each alignment.	<ul style="list-style-type: none"> 4th/5th Avenues serve primarily governmental/institutional locations including Seattle/King County/Sound Transit offices, Seattle City Hall, and Seattle/King County/US District courthouses. Visitor attractions include Seattle Central Library and the Convention Center. The 1st Avenue corridor serves more special event sites and a larger number of attractions that draw more annual visitors. Primarily cultural/tourist attractions served by the 1st Avenue corridor, include the Seattle Art Museum, the Seattle Aquarium, Central Waterfront attractions, and Pike Place Market. Via an east/west connection to Westlake, the alignment also serves the US District Court and the Convention Center. 	1.3 M visitors		12.6 M visitors	
		Fair	Fair	Best	Best
Number of hotel rooms					
Figure 3-23 shows the number of hotel rooms for each corridor. Figure 3-24 shows the location of hotels relative to each alignment.	<ul style="list-style-type: none"> The 4th/5th Avenue alignment has somewhat more hotel rooms and is in closer proximity to the primary hotel area in Seattle's Center City area. 	6,595 rooms		4,260 rooms	
		Best	Best	Good	Good
<ul style="list-style-type: none"> Overall Summary for T3: 4th/5th Avenues serve a greater number of institutional attractions and have more hotel rooms. However, 1st Avenue has a greater concentration of tourist-oriented and cultural attractions, and a much higher volume of annual visitors. 		Overall: Good	Overall: Good	Overall: Best	Overall: Best

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Figure 3-22 Number of Annual Visitors (Millions)

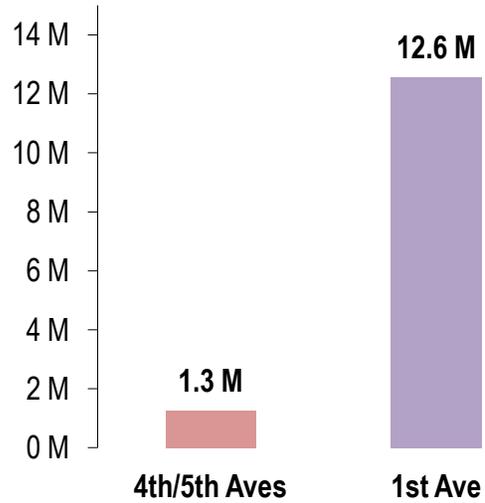
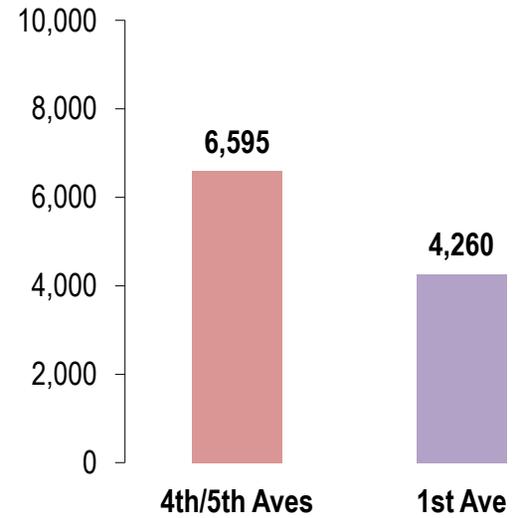


Figure 3-23 Number of Hotel Rooms



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Figure 3-24 Landmarks and Attractions

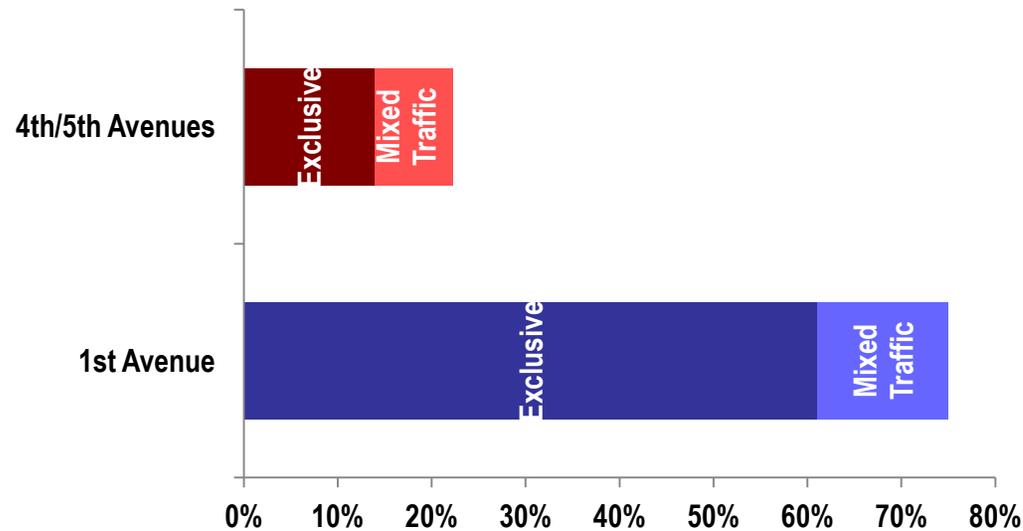


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Objective T4: Incorporate public/stakeholder comments into decision-making

Screening Criteria	Evaluation Summary	4th/5th		1st Ave	
		Mixed-Traffic	Exclusive	Mixed-Traffic	Exclusive
Stakeholder support					
Qualitative evaluation based on stakeholder interviews conducted in November-December 2012, the February 2013 open house, and the June 2013 open house.	<ul style="list-style-type: none"> The vast majority of stakeholders interviewed and participants at the February open house preferred a streetcar mode. Reasons included a desire for a seamless connection between the two streetcars. A number of comments at the February open house emphasized the importance of fast and reliable service. In a prioritization exercise, participants placed nearly three times as many dots in support of 1st Avenue street alignments (about 60) as did for 4th and 5th Avenue alignments (about 20). Figure 3-25 illustrates preferences for the 1st Avenue Exclusive Tier 1 alternative based on feedback provided at the June open house. Many of the stakeholders interviewed identified specific benefits from a 1st Avenue alignment, including potential for future extensions to the north and south. They also expressed concerns about conflicts between streetcar and other modes on 4th and 5th Avenues. 	Fair	Fair	Good	Best

Figure 3-25 Ranking of Alternatives, Open House #2



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Sustain

Objective S1: Maximize placemaking opportunities; Enhance the safety of all roadway users; Provide people with healthy travel options

Screening Criteria	Evaluation Summary	4th/5th		1st Ave	
		Mixed-Traffic	Exclusive	Mixed-Traffic	Exclusive
Sidewalks and pedestrian amenities					
	<ul style="list-style-type: none"> 1st Avenue has wide sidewalks with many covered sections, street-front retail, and numerous outdoor restaurants and bar patios. The 4th/5th Avenue corridor has wide sidewalks through most of the alignment. 	Good	Good	Best	Best
Pedestrian crossings					
	<ul style="list-style-type: none"> 5th Avenue has several mid-block pedestrian crossings Most crossings on 1st Avenue are at block ends. 	Fair	Fair	Good	Good
Transit facilities					
	<ul style="list-style-type: none"> 1st Avenue provides connections to Seattle's three multimodal hubs and to destinations that currently are not well-served by transit. 4th/5th Avenues offer direct access to a variety of transit facilities. 	Fair	Fair	Good	Good
Placemaking					
	<ul style="list-style-type: none"> 1st Avenue is a two-way street with a partial boulevard and medians, lowering travel speeds and improving placemaking opportunities. 4th/5th is a one-way couplet with three travel lanes in each direction for much of the corridor. 	Good	Good	Best	Best
Small business opportunities					
	<ul style="list-style-type: none"> More retail frontages on 1st Avenue than on 4th/5th Two-way traffic on 1st increases storefront visibility 	Good	Good	Best	Best
	<ul style="list-style-type: none"> Overall Summary for S1: Both corridors offer opportunities for a good pedestrian experience and could be further developed to provide the amenities needed by transit users and other pedestrians. 4th and 5th Avenues have pedestrian and transit facilities that are currently more developed and in better condition. 1st Avenue offers more existing and potential placemaking opportunities and has greater potential for improvement. 	Overall: Good	Overall: Good	Overall: Best	Overall: Best

APPENDICES
