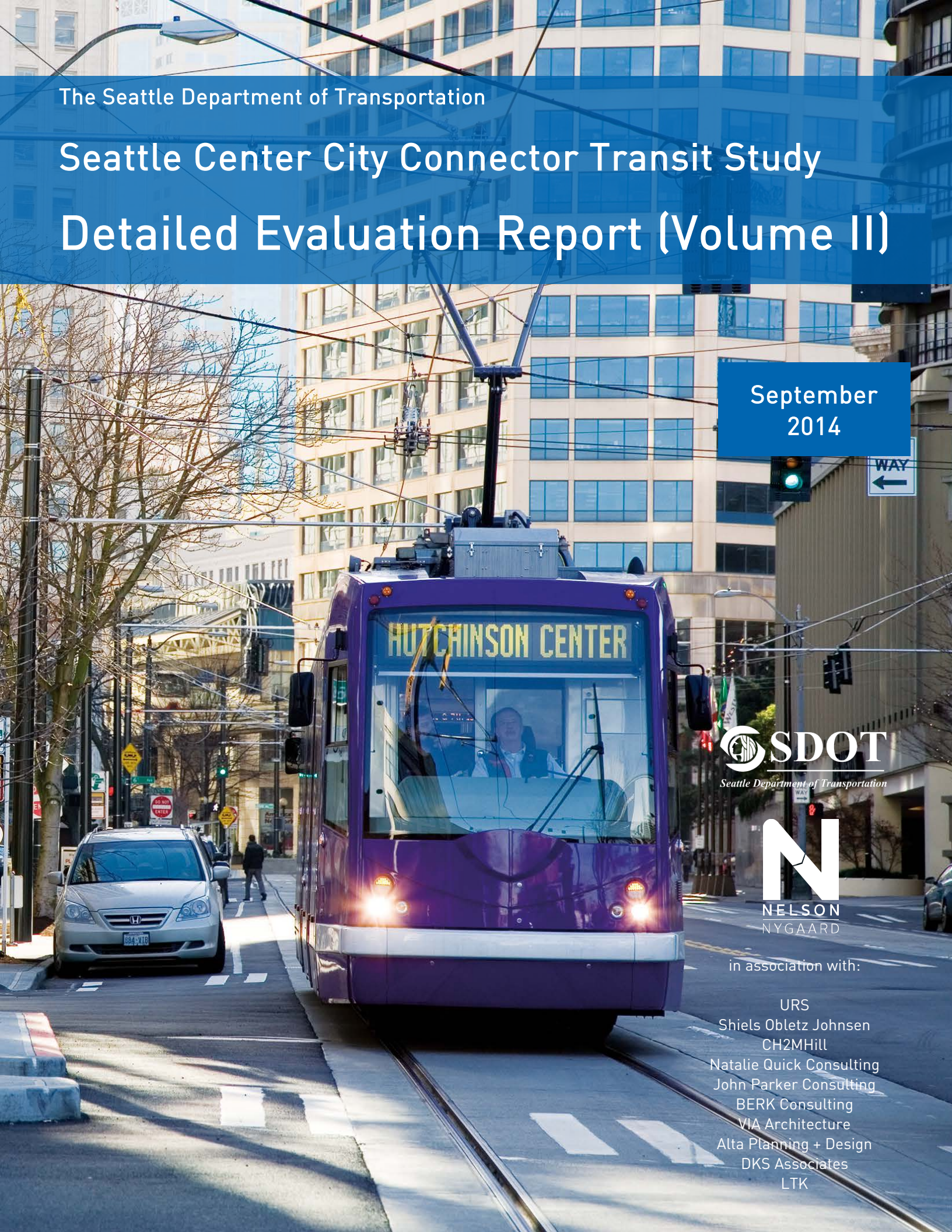
The Seattle Department of Transportation

Seattle Center City Connector Transit Study

Detailed Evaluation Report (Volume II)



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Seattle Department of Transportation

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Seattle Center City Connector Transit Study

Executive Summary

Volume I: LPA Report

1. Project Overview
2. Purpose and Need
3. Evaluation Framework
4. Evaluation of Alternatives
5. Summary of Tier 1 Screening and Tier 2 Evaluation Results and Public Input
6. Recommended Locally Preferred Alternative
7. Next Steps

Volume I

Appendix A: Project Purpose and Need

Volume II: Detailed Evaluation Report

1. Project Overview
2. Evaluation Framework and Public Outreach
3. Initial Screening of Alternatives (Purpose and Need)
4. Summary of Tier 1 Alternatives and Evaluation Results
5. East-West Connection Assessment
6. Description of Tier 2 Alternatives
7. Tier 2 Evaluation Results
8. Tier 2 Public Outreach Summary
9. Tier 2 Recommendation

Volume II Technical Appendices (Methodology and Detailed Results)

Appendix A: Ridership Projections
Appendix B: Additional Ridership Markets: Visitors and Special Events
Appendix C: Operating and Maintenance Cost Methodology and Estimates
Appendix D: Loading Analysis
Appendix E: Capital Cost Methodology and Estimates
Appendix F: Utility Impacts Assessment
Appendix G: Traffic Analysis
Appendix H Evaluation of Westlake and Jackson Priority Improvements
Appendix I: Parking and Loading Impacts Assessment
Appendix J: Bus Operations Analysis
Appendix K: Economic Development Analysis
Appendix L: Affordable Housing Assessment
Appendix M: Initial Screening (Purpose and Need)
Appendix N: Tier 1 Screening Report
Appendix O: East-West Connections Assessment
Appendix P: Tier 2 Public Outreach
Appendix Q: Stakeholder Outreach Summary
Appendix R: Additional Conceptual Drawings

Cover image from SDOT

Volume II: Detailed Evaluation Report – Table of Contents

Volume II Technical Appendices (Methodology and Detailed Results)

Appendix A: Ridership Projections
Appendix B: Visitor and Special Event Market Analysis
Appendix C: Operating and Maintenance Cost Methodology and Estimates
Appendix D: Loading Analysis
Appendix E: Capital Cost Methodology and Estimates
Appendix F: Utility Impacts Assessment
Appendix G: Traffic Analysis
Appendix H: Evaluation of Westlake and Jackson Priority Improvements
Appendix I: Parking and Loading Impacts Assessment
Appendix J: Bus Operations Analysis
Appendix K: Economic Development Analysis
Appendix L: Affordable Housing Assessment
Appendix M: Initial Screening (Purpose and Need)
Appendix N: Tier 1 Screening Report
Appendix O: East-West Connections Assessment
Appendix P: Tier 2 Public Outreach Summary
Appendix Q: Stakeholder Outreach Summary
Appendix R: Additional Conceptual Drawings

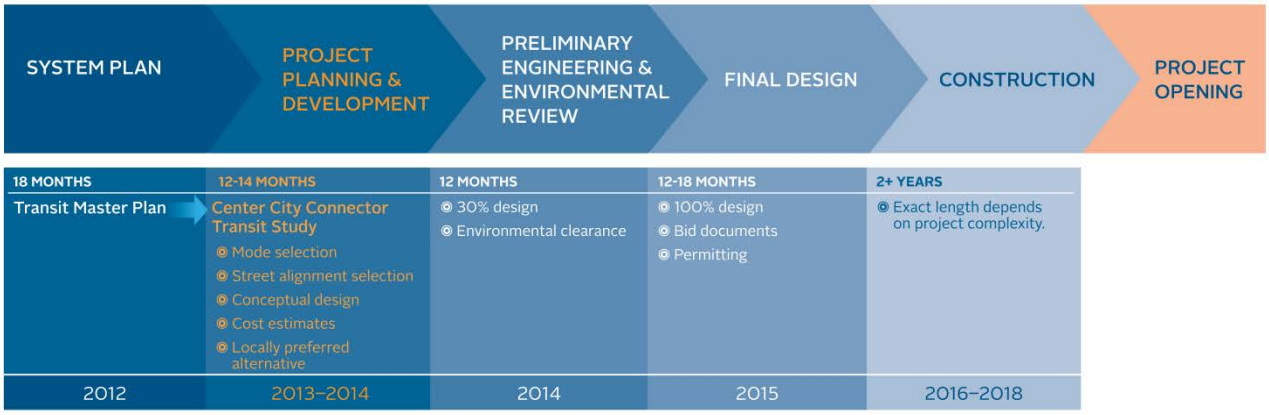
Volume II: Detailed Evaluation Report - Table of Figures

1 PROJECT OVERVIEW

Introduction

The City of Seattle's Transit Master Plan, adopted in 2012, identified four corridors with the highest ridership potential and the greatest need for higher capacity transit service. One of these corridors was the Center City Connector, which runs through downtown Seattle and connects the South Lake Union and First Hill Streetcar lines. The planning and project development timeline for the Connector is shown in Figure 1-1. The purpose of the Center City Connector Transit Study is to evaluate potential modes and alignments for the study corridor and select a Locally Preferred Alternative (LPA) with high community benefit, strong stakeholder support, and a viable financial strategy. The study was completed largely during 2013 and represents project planning and early development phases of the project. This report provides a detailed overview of the study, its technical evaluation, and the community outreach process.

Figure 1-1 Project Development Timeline



Study Corridor Description

Seattle's Center City area encompasses 10 neighborhoods—Uptown, South Lake Union, Capitol Hill, Belltown, Denny Triangle, Pike/Pine, Downtown Commercial Core, First Hill, Pioneer Square, and the Chinatown/International District. Figure 1-2 provides a map of the Center City, including the study area. The core of Seattle's Center City resembles an hourglass where a limited set of north-south arterial corridors carry people and goods through the downtown core—the narrow neck of the hourglass. There is limited ability to enhance surface street capacity through the downtown core. Several of the north-south arterials (2nd, 3rd, 4th, and 5th Avenues), and the Downtown Seattle Transit Tunnel (DSTT) carry transit through downtown, but high utilization, limited expansion capacity, and increased future demand limit the ability of existing transit modes to provide access between key Center City employment centers, retail, attractions, and residential populations.

The Center City Connector Transit Study evaluated potential north-south transit alignments west of I-5 between the Lower Queen Anne, Uptown, and South Lake Union neighborhoods to the north, and

the Chinatown-International District and South Downtown area including the King Street Intermodal Hub to the south. The study focused on leveraging existing City and regional partner investment in Center City streetcar lines by connecting existing termini at the north and south ends of downtown.

Figure 1-2 Center City Area Map

Policy Framework

High-quality, high-capacity transit connections between the downtown commercial core and other Center City neighborhoods provide residents, workers, and visitors access to goods, services, and cultural amenities. Further, sustainable transportation options will help Seattle's Center City continue to grow in a highly competitive global economy, while encouraging development that supports the human and environmental health of the region.

The transportation system in Seattle's Center City faces some of the most challenging geographic and topographic constraints of any city of its size in North America. To address these constraints, achieve City policy objectives, and allow for sustainable Center City growth, Seattle has developed a series of transportation planning and policy documents that help support sustained growth in the Center City. These documents include:

- Seattle Comprehensive Plan (2005)
- Transit Master Plan (2012) and Seattle Transit Plan (2005)
- Recommended Bicycle Master Plan (City Council to deliberate adoption in the 2nd quarter of 2014) and Bicycle Master Plan (2007)
- Pedestrian Master Plan (2009)
- Action Agenda (2012)
- Seattle Center City Circulation Study (2003)
- Seattle Center City Access Strategy (2004)
- Streetcar Network Plan (2008)
- Urban Mobility Plan (2008) (Alaskan Way Viaduct and Seawall Central Waterfront process)
- Central Waterfront Concept Design and Framework Plan (2012)
- Seattle Jobs Plan (2012)
- Climate Action Plan (2013)

In addition to the plans listed above, the City of Seattle is moving forward with planning and design of the proposed Broadway extension of the First Hill Streetcar north of the First Hill line's planned terminus at Denny Way. Several additional corridors recommended in the Transit Master Plan are also currently funded for initial study, including the Madison Street Corridor Bus Rapid Transit, University District-South Lake Union-Downtown Corridor, and Ballard-to-Downtown Corridor.[1]

Further detail on the plans and projects identified in this section can be found in Volume I, LPA Report, Appendix A.

[1] The Ballard-to-Downtown High Capacity Transit study, a partnership between the City of Seattle and Sound Transit, examines potential high-capacity transit alignments and station locations in the Ballard to downtown Seattle corridor, and was coordinated with the Center City Connector study regarding transit connections in downtown Seattle.

Report Organization

Volume I: Locally Preferred Alternative Report

The Center City Connector Transit Study Locally Preferred Alternative (LPA) Report (Volume I) summarizes key elements of the technical and public outreach process used to arrive at an LPA selection and describes the LPA. It includes the following chapters:

- **Chapter 2: Purpose and Need.** Describes the Purpose and Need for the Project. The full Purpose and Need statement is included as LPA Report Appendix A.
- **Chapter 3: Evaluation Framework.** Summarizes the multi-stage process used to evaluate project alternatives.
- **Chapter 4: Evaluation of Alternatives.** Summarizes the narrowing of mode and alignment alternatives at each stage of the evaluation (initial, Tier 1, and Tier 2).
- **Chapter 5: Summary of Evaluation Results and Input.** Summarizes the evaluation results and public input for each stage of the evaluation.
- **Chapter 6: Recommended Locally Preferred Alternative.** Summarizes the LPA decision process and describes the LPA.
- **Chapter 7: Next Steps.** Describes next steps in development of the Center City Connector Project.

Volume II: Detailed Evaluation Report

This document is Volume II of the Center City Connector Transit Study report and provides a detailed description of the technical evaluation and community outreach process. It includes the following chapters, supplemented by technical appendices that provide additional details on the evaluation:

- **Chapter 2: Evaluation Framework and Public Involvement.** Describes the multi-stage process used to evaluate project alternatives and summarizes public involvement activities at each stage of the evaluation.
- **Chapter 3: Initial Screening.** Describes the initial screening of mode and street alignment alternatives based on the Project Purpose and Need.
- **Chapter 4: Tier 1 Screening.** Summarizes the Tier 1 screening of Center City Connector alternatives on 4th/5th Avenues (couplet) and 1st Avenue based on the Project goals and objectives (the full Tier 1 Report is included as Appendix N).
- **Chapter 5: East-West Connections.** Describes the assessment of east-west connection options between 1st Avenue and Westlake (existing South Lake Union Streetcar) for 1st Avenue alternatives.
- **Chapters 6-9: Tier 2 Evaluation.** Chapter 6 describes the conceptual design of 1st Avenue streetcar alternatives for the Tier 2 evaluation, Chapter 7 summarizes the evaluation results, and Chapter 8 summarizes public outreach related to Tier 2. Chapter 9 summarizes the Tier 2 recommendation, which is primarily described in Chapter 6 of the LPA Report (Volume I).

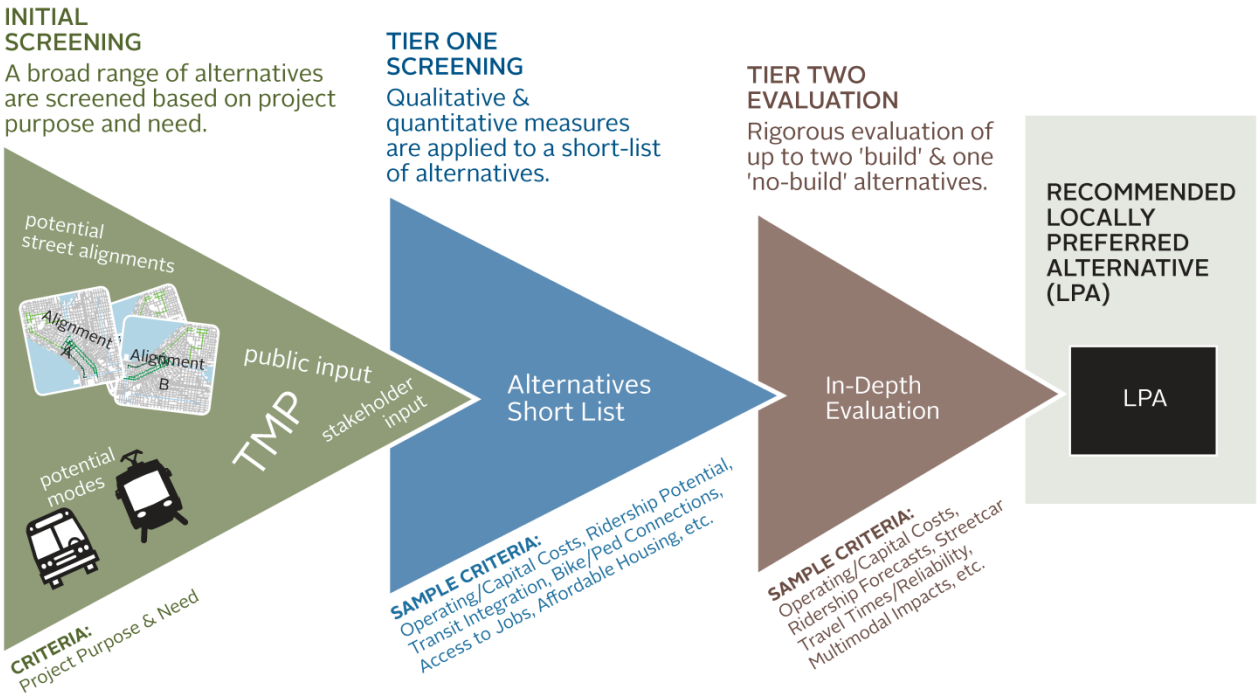
2 EVALUATION FRAMEWORK AND PUBLIC OUTREACH

In addition to technical analysis conducted in the Initial, Tier 1, and Tier 2 stages of evaluation, the evaluation process included extensive consultation and input from the public, stakeholders, and local, regional, and federal agencies. This chapter describes the evaluation process used to assess project alternatives, including a description of each phase of analysis, and provides an overview of public engagement activities.

Evaluation Process

Figure 2-1 illustrates the evaluation process that was defined for studying and narrowing all reasonable alignment and mode options into a Locally Preferred Alternative, consistent with Federal Transit Administration (FTA) guidance.

Figure 2-1 Evaluation Process Overview



Note: In the initial evaluation process, the use of the terms "screening" (Initial and Tier 1 screening) and "evaluation" (Tier 2 evaluation) was intended to differentiate the increasingly rigorous level of analysis planned at each stage of evaluation.

Summary of Evaluation Stages

Initial Screening against Purpose and Need

This early screening phase provided a qualitative review of a range of potential transit alternatives against the Project Purpose and Need (the Project Purpose and Need statement is included in Volume I: LPA Report, Appendix A). An initial list of mode and alignment alternatives included options identified in the Seattle Transit Master Plan (TMP) and input received from Center City stakeholders and the general public during the first Project open house. Alternatives that did not clearly meet the stated Project Purpose and Need were removed from further consideration. Key questions used to assess modes and alignments in the initial screening process included:

- Does the mode/alignment serve the Project purpose?
- Is the mode/alignment consistent with local and regional plans?
- Does the mode/alignment meet needs identified in the Project Purpose and Need statement (mobility/connectivity)?
- Does the mode/alignment serve key destinations and attractions?
- Does the mode/alignment have public and stakeholder support?
- What are the potential right-of-way impacts associated with the mode/alignment?

Chapter 3 summarizes the results of the initial screening process.

Tier 1 Screening

The intended outcome of the Tier 1 screening was to determine the alternative(s) that best met the Project goals and objectives (see Figure 2-2) and recommend alternative(s) for more detailed study in the Tier 2 evaluation process. As described in Chapter 4, Mixed-Traffic and Exclusive Streetcar alternatives on 4th/5th Avenues and 1st Avenue were considered in Tier 1. High-level designs were developed for each Tier 1 alternative. The alternatives were evaluated using a set of criteria (described in Figure 2-3) designed to measure how well each alternative met the Project need and Project goals. In addition to the technical analysis, public input from two open houses was taken into account in rating the alternatives. Each alternative was given a rating of "Poor," "Fair," "Good," or "Best." Two alternatives were recommended for consideration in the Tier 2 analysis.

Tier 2 Evaluation

The Tier 2 evaluation provided a more detailed evaluation of Mixed-Traffic and Exclusive Streetcar alternatives on 1st Avenue, including further refinement of the alternatives in terms of:

- Station locations
- Operating plans and costs
- Conceptual engineering
- Capital costs

- Ridership and cost effectiveness
- Transportation impacts

The alternatives were then evaluated using the same Poor/Fair/Good/Best rating system that was used in the Tier 1 screening. The results of the Tier 2 evaluation were used to develop a locally preferred alternative (LPA) recommendation.

Chapter 5 describes an assessment that was conducted to determine which east-west connection option(s) between 1st Avenue and Westlake to include in the Tier 2 evaluation. Chapters 6 through 9 describe the Tier 2 evaluation.

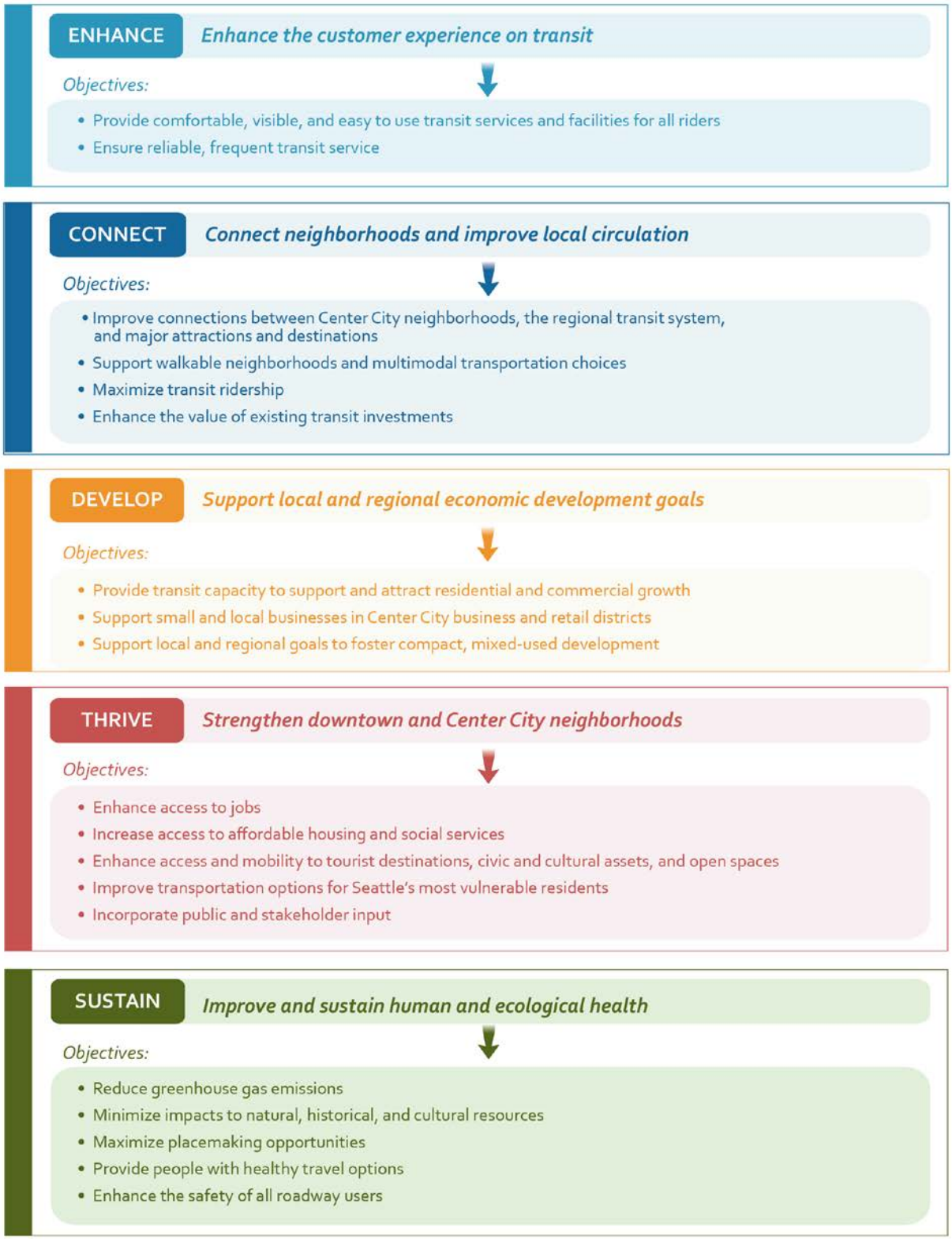
Goals and Objectives

The Center City Connector Project goals and objectives are shown in Figure 2-2. The screening and evaluation process builds on the Purpose and Need Statement and Goals and Objectives by focusing on the five themes and project goals identified based on the Project Purpose and Need:

- **Enhance:** Enhance the customer experience on transit
- **Connect:** Enhance connections between and access to Center City neighborhoods
- **Develop:** Support local and regional economic development goals
- **Thrive:** Strengthen downtown and Center City neighborhoods
- **Sustain:** Improve and sustain human and ecological health

The Project Goal statement includes a series of objectives. Draft Tier 1 and Tier 2 criteria were developed to address each of the objectives. The criteria are intended to further define each objective and support evaluation of the alignments against the stated goals in a transparent and understandable manner. The final evaluation measures used to measure and compare alternatives are included later in this chapter.

Figure 2-2 Goals and Objectives Graphic



Evaluation Criteria

Each phase of analysis included qualitative and quantitative evaluation measures designed to compare how well alternatives met the Project goals. Figure 2-3 shows the screening criteria used in the Tier 1 and Tier 2 stages of analysis and describes the evaluation measures that were used. Many of the Tier 1 criteria were also used in the Tier 1 evaluation, but in most cases based on more detailed modeling and design inputs. In some instances, different measures were used in the Tier 1 and Tier 2 analyses to reflect the design issues most relevant to the alternatives considered in each evaluation phase. Finally, since the Tier 2 alternatives had been narrowed to a single primary alignment (1st Avenue), several of the Tier 2 criteria did not differ from Tier 1, so the original rating for those measures was carried into the Tier 2 analysis.

Figure 2-3 Tier 1 and Tier 2 Evaluation Criteria

ENHANCE: Enhance the customer experience on transit			
Objective	**Stage**	**Screening Criteria**	**Measure**
▪ Provide reliable, frequent transit service	TIER 1 & 2	▪ Streetcar travel times	▪ End-to-end travel times for each alternative based on lane configuration and level of transit priority
	TIER 2	▪ Streetcar travel time reliability	▪ Variability of travel times for each PM peak period trip
	TIER 1 & 2	▪ Bus Passenger Delay	▪ Peak period minutes of bus and bus passenger delay based on estimated delay per vehicle
▪ Provide comfortable, visible, and easy to use transit services and facilities for all riders	N/A	▪ Incorporated qualitatively in initial screening process, but limited differentiation between Tier 1 and Tier 2 alternatives.	

CONNECT: Enhance connections between and access to Center City neighborhoods			
Objective	**Stage**	**Screening Criteria**	**Measure**
▪ Enhance the value of existing transit investments and transit service for Center City trips	TIER 1	▪ Connections with existing transit/multimodal hubs	▪ Number of hubs served; discussion of connections/integration
	TIER 1	▪ Future employment within alignment Future population within alignment	▪ Number and density of employment and population
▪ Support walkable neighborhoods and multimodal transportation choices	TIER 1 & 2	▪ Auto travel times	▪ End-to-end auto travel times for each alternative based on lane configuration changes
	TIER 1	▪ Conflicts with bicycle, freight, and transit priorities	▪ Evaluation of bicycle, pedestrian, transit, and freight impacts
▪ Maximize transit ridership	TIER 1 & 2	▪ Ridership potential	▪ Center City Connector projected ridership based on peer cities and expected service characteristics
	TIER 1 & 2	▪ Operating and maintenance costs	▪ Operating costs of Center City Connector alternatives (for identified operating scenarios)
	TIER 1 & 2	▪ Capital costs	▪ Capital costs of Center City Connector alternatives

DEVELOP: Support local and regional economic development goals			
Objective	**Stage**	**Screening Criteria**	**Measure**
▪ Promote new development where residents and workers have transportation options	TIER 1 & 2	▪ Capacity for new investment	▪ Tier 1: Vacant and redevelopable land and pipeline projects within 1/8 mile (2 blocks) of alignment ▪ Tier 2: Qualitative assessment of economic development potential
▪ Support small and local businesses in Center City business and retail districts	TIER 1 & 2	▪ Parking impacts	▪ Tier 1: Percent of block faces that retain on-street parking in each alternative relative to existing conditions ▪ Tier 2: Number of parking spaces and loading zones retained

THRIVE: Strengthen downtown and Center City neighborhoods			
Objective	**Stage**	**Screening Criteria**	**Measure**
▪ Enhance access to jobs	TIER 1 & 2	▪ Number of Center City residents with access to Center City Connector alignments (live or work), including connections to other lines	▪ Home and work locations of Center City residents who live or work within 1/8 mile of proposed alignment (by block)
▪ Improve transportation options for Seattle's most vulnerable residents ▪ Increase access to affordable housing and social services	TIER 1 & 2	▪ Access low-income, minority, elderly, and persons with disabilities with access to Center City Connector	▪ Assessment of transit-reliant populations, including low-income, minority, elderly, and persons with disabilities within 1/8 mile of proposed alignment
	TIER 1 & 2	▪ Access to social service sites	▪ Number of social service sites within 1/8 mile of proposed alignment
▪ Enhance access and mobility to tourist destinations, civic and cultural assets, and open spaces	TIER 1 & 2	▪ Access to tourist destinations and major attractions	▪ Number of attractions and number of annual visitors to attractions within 1/8 mile of each proposed alignment
	TIER 1 & 2	▪ Access to tourists and visitors	▪ Number of hotel rooms within 1/8 mile of each proposed alignment
▪ Incorporate public/stakeholder comments into decision-making	TIER 1 & 2	▪ Public support for each alternative	▪ Assessment of comments from Open House 1, 2 and 3, online survey results, and stakeholder input

SUSTAIN: Improve and sustain human and ecological health			
Objective	**Stage**	**Screening Criteria**	**Measure**
▪ Maximize placemaking opportunities ▪ Enhance the safety of all roadway users ▪ Provide people with healthy travel options	TIER 1	▪ Urban form assessment	▪ Assessment of corridor development form and character to support walking and transit travel: o Sidewalk paving o Pedestrian crossings o Transit facilities (bus stops with associated use patterns) o Adjacent uses (e.g. active storefront retail, blank walls, parking, etc) o Pedestrian lighting o Pedestrian amenities (benches, wayinding signs, trash receptacles, adjacent weather canopies along building edges, etc.) o Unique and/or public places and/or civic buildings
▪ Reduce greenhouse gas emissions	N/A	▪ To be conducted in Environmental Assessment Phase	
▪ Minimize impacts to natural, historical, and cultural resources			

Public Involvement

Public and stakeholder input was integral to decision making at each stage of the alternatives evaluation. Outreach strategies included a series of stakeholder interviews, three public open houses, comment cards, online materials and surveys, media events, and briefings with community organizations. Interviews were conducted with 40 stakeholders over the course of more than two dozen meetings between November 28 and November 30, 2012. Stakeholders included representatives from numerous local and citywide bodies such as community councils, chambers of commerce, major institutions, human service and housing organizations, local business leaders, and other cultural and community organizations. City staff distributed project materials and information to residents and businesses within the core study area. Open house invitations were translated into multiple languages (Chinese, Vietnamese, and Spanish), and targeted distribution of these materials included drop-offs at social service agencies, affordable housing sites, and offices throughout downtown.

Figure 2-4 Project Timeline

Project open houses were held in a range of locations to attract participation from a diverse set of stakeholders. Feedback from public involvement activities informed development of the initial screening alternatives and was considered as a criteria in the evaluation of each of the alternatives in the initial screening, Tier 1, and Tier 2 phases of analysis. SDOT briefed the Seattle City Council Transportation Committee on July 9, 2013 following the completion of the Tier 1 screening.

Open House #1: February 2013

The first open house for the Center City Connector Transit Study was held on February 6, 2013 at Seattle City Hall. The purpose of this open house was to introduce the Project to the public; collect comments on the Project purpose, need, goals, objectives, and evaluation process; and gather input on initial alignment and mode alternatives. Table-top maps were provided and participants were encouraged to draw new alignments and to indicate their support for both newly drawn and previously identified alignments. A total of 101 people signed in to the meeting. Meeting participants received a handout that described the Project and provided an opportunity for specific and open-

ended comments. Participants could also comment by leaving post-it notes on the display boards and maps. In total, there were 75 comments placed directly on the Project boards/maps and 30 completed comment cards.

Open House #2: June 2013

The second open house for the Center City Connector was held on June 6, 2013 at the South Lake Union Discovery Center. The open house presented findings from the initial screening and Tier 1 screening and solicited input on Mixed-Traffic and Exclusive Streetcar alternatives on 1st Avenue and 4th/5th Avenues. A total of 61 people signed in to the meeting. Participants received a handout, which provided a summary of the Tier 1 screening results and provided an opportunity for them to rank and comment on the four alternatives and to rank the importance of specific evaluation criteria.

Figure 2-5 Open House #2 Participants

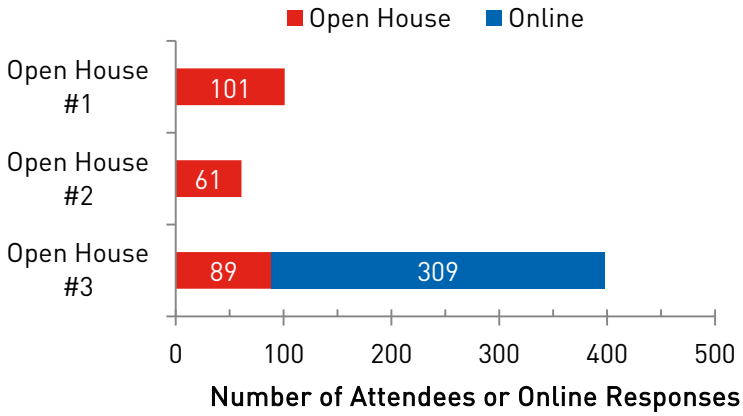
Open House #3: October 2013

The third project open house was held on October 29, 2013 at Pike Place Market. This open house presented findings from the Tier 2 analysis and solicited feedback on the Mixed-Traffic and Exclusive Streetcar alternatives on 1st Avenue. A total of 89 people signed in to the meeting and 40 attendees completed comment cards. Participants self-identified as a mix of residents, employees, and business or property owners.

The comment cards asked respondents to select their preferred alternative from the two mode and alignment alternatives evaluated in Tier 2 and rank the Tier 2 evaluation measures based on their importance to their preference. An online survey that asked similar questions to the comment card was made available for several weeks following the open house and received a total of 309 responses. An overview of the results from outreach related to Open House #3 can be found in Chapter 8.

Figure 2-6 summarizes the number of open house attendees who signed in and the number of online survey responses submitted following the third open house. A total of 560 people signed in to the open houses and/or submitted a response to the online survey.

Figure 2-6 Open House and Online Survey Participants



3 INITIAL SCREENING OF ALTERNATIVES (PURPOSE AND NEED)

The initial screening process considered a wide range of modes and alignments for the Center City Connector, including those recommended in the Seattle Transit Master Plan (TMP) as well as suggestions received through the public engagement process (stakeholder interviews and the first project open house on February 6, 2013). This chapter provides a summary of the initial screening of modes and alignments.

Additional detail on the initial screening process can be found in Appendix M.

Summary of Initial Screening Results and Input

Mode Screening Results (Initial Screening)

Based on input received at the February 6, 2013 open house and through stakeholder interviews, Mixed-Traffic and Exclusive Streetcar, Enhanced Bus, Light Rail (Sound Transit Link), and Monorail modes were screened against the Project Purpose and Need. These modes are shown in Figure 3-1. The identified modes were screened criteria tied to the Project Purpose and Need, including:

- **Consistent with local/regional plans.** The Streetcar modes rated "good" or "best" for this criterion. The Seattle Transit Master Plan (2012) recommended a streetcar mode for the Center City Connector corridor allowing for a fully connected streetcar system (to be confirmed through this study process). A Streetcar mode is also consistent with the Seattle Streetcar Network Plan (2008), which identified a streetcar line through downtown on 1st Avenue.
- **Meets identified needs (mobility/connectivity).** The Streetcar modes rated "good" or "best" for this criterion. The Project Purpose and Need identified providing mobility and connectivity through the Center City study area, including good connections to the South Lake Union and First Hill Streetcar lines, as important project purposes. Both streetcar modes would meet the project need in terms of improving downtown mobility and allowing for continuity between the two other streetcar lines.
- **Level of public/stakeholder support.** The Streetcar modes rated "good" or "best" for this criterion. Public and stakeholder comments emphasized the importance of selecting a mode that enables a seamless connection to both the South Lake Union Streetcar and First Hill Streetcar lines, which was stated in the Project purpose. Public input also emphasized the importance of speed and reliability to make the Center City Connector attractive and competitive with other modes. Although there was a small amount of support for an

enhanced bus alternative due to the lower project cost, the majority of respondents indicated that the benefits of modern streetcar outweigh potential downsides.

- **Potential right-of-way impacts.** Mixed-Traffic Streetcar and Enhanced Bus were rated "best" for this criterion. Both of these modes operate in a shared lane with general purpose traffic, and would therefore not require dedicated right-of-way.

Overall, the Mixed-Traffic and Exclusive Streetcar modes scored "good" or "best" in all evaluation categories, with the exception of a "fair" rating for Exclusive Streetcar for the potential right-of-way impacts criterion. Enhanced Bus, Monorail, and Link Light Rail were rated "fair" or "poor" on nearly all evaluation criteria. Figure 3-1 provides the overall rating for each mode.

Figure 3-1 Modes Screened in Initial Screening Evaluation

Alignment Screening Results (Initial Screening)

The TMP proposed potential Center City Connector street alignments on 1st and 4th/5th Avenues. The project team solicited public input on these and other potential alignments at the February 6, 2013 open house. Additional alignments identified by the public were included in the range of alignments considered, including two alignments on 3rd Avenue, one alignment on the waterfront, and an extension of the 1st Avenue alignment south towards SODO. All of the alignments included in the initial screening are shown in Figure 3-2. These alignments include:

- **A: 4th/5th Avenues (Couplet).** Runs from the existing South Lake Union Streetcar terminus at Westlake Intermodal Hub to the King Street Intermodal Hub/International District Station just south of Jackson Street.
- **B/C: 1st Avenue.** Two potential alignment alternatives run on 1st Avenue:
  - **B:** Westlake to Jackson Street, using one of several potential east-west connections to connect to the 1st Avenue portion of the alignment. The short east-west connection

alternatives were determined not to substantively change the rating of the alignment at this phase of the project.

  - **C:** Queen Anne to Jackson Street via 1st Avenue without a connection to Westlake.

- **D: 3rd Avenue.** Two potential alignments using 3rd Avenue through the Center City were identified:
  - **D1:** Seattle Center to Jackson Street.
  - D2: Westlake to Jackson Street with the option to connect to the existing South Lake Union Streetcar via Stewart Street/Olive Way.
- **E: SODO.** Extends the 1st Avenue alignment (C), or other potential alignments, south of Jackson Street to the Stadium District/SODO (approximately Lander Street).
- **F: Waterfront**. Runs along the central waterfront and is based on potential alignments recommended for further consideration in the Seattle Waterfront Streetcar Reactivation Study (2011).[2]

These alignments were screened against the project Purpose and Need using a similar set of evaluation criteria as was used to evaluate modes, including:

- **Consistent with local/regional plans.** The 1st Avenue alignment was identified in the TMP and Seattle Streetcar Network Plan and was rated "best". The 4th/5th Avenue couplet was identified in the TMP and was rated "good". Alignment C Alignments D1 and D2 (3rd Avenue) were rated "poor" due to impacts of a 3rd Avenue alignment on existing transit.
- **Meets identified needs (mobility/connectivity).** The alignments on 1st Avenue and on 4th/5th Avenue were rated "good" based on connectivity between the First Hill and South Lake Union Streetcars as well as providing mobility and connections for tourists, visitors, casual users, social service sites, and low-income workers who live in the Center City.
- **Serves key destinations/attractions.** Alignments A, B, C, D1, and D2 were rated "good" or "best" for this criterion.
- **Level of public/stakeholder support.** The alignment on 1st Avenue was rated "best" for this criterion based on support from the public in attendance at the February 6, 2013 open house.

  There was some public interest in alignments that could serve as extensions of the Center City corridor between the First Hill and South Lake Union Streetcars but that do not directly meet the Purpose and Need for the Center City Connector. These include Alignment C (1st Avenue alignment continuing north towards Uptown/Seattle Center) and Alignment E (extension south of Jackson Street to SODO). Comments from the public recognized these alignments would supplement rather than replace an alignment on 1st Avenue or 4th/5th Avenues. Alignment F (Waterfront) also received relatively limited support;

[2]A waterfront streetcar was evaluated as part of the Central Waterfront project. A technical analysis of the Seattle Waterfront Historic Streetcars was completed in June 2013.

the distance and grade between a waterfront alignment to the downtown core would impact its ability to meet the Project Purpose and Need.

Alignments A and B scored the highest on the evaluation criteria, with Alignment B (1st Avenue) scoring the "best" overall, and alignment A (4th/5th Avenues) rating "good." The bottom portion of Figure 3-2 summarizes the overall rating for each of the alignments screened.

Figure 3-2 Alignments Evaluated in Initial Screening

A	B	C	D1	D2	E	F
4th/5th	1st (w/Westlake connection)	1st to Uptown (no Westlake connection)	3rd to Seattle Center	3rd to Westlake	1st—SODO Extension	Waterfront Streetcar
Good	Best	Fair	Fair	Fair	Fair	Fair

Mode and Alignment Recommendations

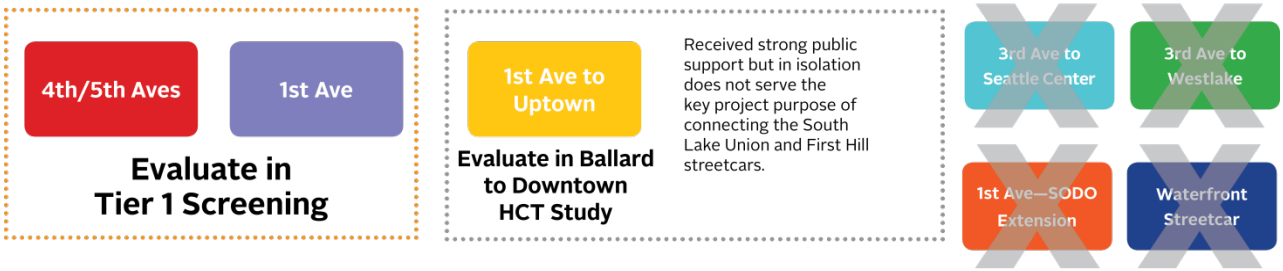
Based on public input and the screening of modes against the Purpose and Need criteria, the project team recommended that all modes other than streetcar be eliminated from further study and that both the Mixed-Traffic and Exclusive Streetcar modes be analyzed in the Tier 1 screening (Figure 3-3). The Tier 1 evaluation process was structured to include characteristics of both Mixed-Traffic and Exclusive Streetcar modes.

Figure 3-3 Initial Screening Results for Modes

Based on public input and the screening of alignments against the Purpose and Need criteria, the project team recommended that Alignment A (4th/5th Avenue couplet, Jackson Street to Westlake Hub) and Alignment B (1st Avenue, Jackson to Stewart Streets) be analyzed in the Tier 1 screening. Several other alignments including Alignment C and F were recommended for future or separate study as summarized in Figure 3-4:

- **Alignment C.** An extension of the 1st Avenue alignment to Uptown (Stewart Street to Seattle Center) was initially deferred to the Tier 2 evaluation, but it was ultimately determined that this alignment did not meet the Purpose and Need for the Center City Connector project (does not connect South Lake Union and First Hill Streetcars). However, this corridor is being evaluated for rapid streetcar and light rail modes in the Ballard-to-Downtown High Capacity Transit Study being jointly managed by Sound Transit and SDOT.
- **Alignment F.** The waterfront streetcar alignment was studied as part of the Central Waterfront Project concurrent with this study.

Figure 3-4 Initial Screening Results for Alignments



Additional detail on the initial screening process can be found in Appendix M.

4 SUMMARY OF TIER 1 ALTERNATIVES AND EVALUATION RESULTS

The purpose of the Tier 1 screening was 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. This chapter provides a summary of the Tier 1 screening of mode and alignment alternatives, which included Mixed-Traffic and Exclusive Streetcar modes on a 4th/5th Avenue couplet and on 1st Avenue.

The full report on the Tier 1 screening is provided in Appendix N.

Tier 1 Modes: Mixed-Traffic and Exclusive Streetcar

The initial screening process recommended that Mixed-Traffic Streetcar and Exclusive Streetcar modes be evaluated in the Tier 1 screening. The Exclusive Streetcar mode was intended to respond to public and stakeholder feedback about the importance of reliable and competitive transit travel times. The primary features of each mode are shown in Figure 4-1. 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.

Figure 4-1 Mixed-Traffic and Exclusive Streetcar Mode Characteristics

Feature	Mixed-Traffic Streetcar	Exclusive Streetcar
		
Right-of-way design	Operates primarily in mixed traffic	Operates primarily in transit-only or exclusive streetcar lanes
Signal priority	Limited signal priority	Extensive signal priority
Stop spacing	Shorter stop spacing	Longer stop spacing
Travel speeds	Slower travel speeds	Faster travel speeds due to transit priority features and longer stop spacing
Vehicle capacity	Typical modern streetcar vehicles, although higher capacity vehicles could be used	Higher passenger capacity if longer articulated or coupled vehicles are implemented
Station amenities	Lower volume shelters; typical amenities include real-time passenger information, level boarding, and off-board fare payment	Enhanced station amenities and access including high volume shelters, real-time passenger information, level boarding, and off-board fare payment

Tier 1 Alignments: 1st and 4th/5th Avenues

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 Streetcar alternatives are intended to illustrate a range of potential benefits and impacts for the streetcar. Figure 4-2 shows the alignment alternatives included in the Tier 1 screening.

Figure 4-2 Street Alignments for Tier 1 Screening

4th/5th Avenues

The Tier 1 design alternatives for 4th/5th Avenues assumed:

- Streetcar runs northbound on 4th Avenue and southbound on 5th Avenue.
- Terminus on 5th Avenue between Main and Jackson Streets, with a transfer to the First Hill Streetcar at Jackson Street.
- A northbound connection from 4th Avenue to Westlake and the existing South Lake Union (SLU) streetcar via Olive Way. Figure 4-3 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.
- Cycle tracks would be created on both 4th Avenue (northbound) and 5th Avenue (southbound).

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

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

1st Avenue

The Tier 1 design alternatives for 1st Avenue assumed:

- Streetcar runs in the center lanes on 1st Avenue between Jackson Street and the Pike Place Market area.
- In the Exclusive Streetcar alternative, the center-running lanes would be streetcar-only with extensive signal priority and fewer stations than the Mixed-Traffic alternative.
- Stewart Street and Olive Way are used between 1st Avenue and the existing SLU streetcar at Westlake. Figure 4-4 describes this connection and several other potential connections between 1st Avenue and Westlake that could be evaluated in greater detail as part of the Tier 2 evaluation. This assessment is described in Chapter 5.
- As shown on the map in Figure 4-2 (page 4-3), the Uptown to 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. This connection was planned for further consideration in the Tier 2 evaluation but was ultimately evaluated in the Ballard-to-Downtown High Capacity Transit study.

Figure 4-4 1st Avenue Alignment Westlake Connection Scenarios

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

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

Tier 1 Operating Scenarios

Figure 4-5 identifies 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 analyzed continuous, through-routed operation (e.g., green-colored line), while others assumed a transfer between the Center City Connector line and First Hill line. (Additional details are included in the Tier 1 report provided as Appendix N).

For purposes of the Tier 1 analysis, operating scenarios for the complete streetcar network were assumed to be consistent with the First Hill Streetcar operations plan as of February 2012, which assumed a service span of 20 hours per day Monday through Saturday and 12 hours on Sunday for a total of 132 hours per week. Service characteristics for the streetcar network were refined in the Tier 2 evaluation.

Figure 4-5 Tier 1 Operating Scenarios

Summary of Tier 1 Screening Results

Each Tier 1 alternative was evaluated based on a set of measures corresponding to the project goals and objectives, and rated on a relative scale for each measure. Figure 4-6 and Figure 4-7 summarize the evaluation measures and qualitative ratings for the Tier 1 alternatives.

Figure 4-6 Tier 1 Screening Results

4TH/5TH AVENUES		EVALUATION MEASURES	1ST AVENUE	
MIXED-TRAFFIC STREETCAR	EXCLUSIVE STREETCAR		MIXED-TRAFFIC STREETCAR	EXCLUSIVE STREETCAR
12.8 minutes	8.9 minutes	**Streetcar Travel Time, PM Peak** Jackson - Westlake, average north/south-bound, including stops, 2030	11.6 minutes	6.1 minutes
4th: +60% 5th: +40%	4th: -25% 5th: +5%	**% Change in Aggregate Bus Passenger Delay, 5-6 PM** Daily Hours Compared to No-Build	N/A	N/A
13.2 minutes	12.9 minutes	**Auto Travel Time, PM Peak** Jackson - Westlake, avg. north/southbound, 2030; "No-Build": 4th/5th 11.6 min; 1st 9.0 min.	8.8 minutes	11.8 minutes
$12.3 million/year	$12.0 million/year	**Annual Operating & Maintenance Costs** Integrated CCC, First Hill, SLU lines, 2013$	$12.3 million/year	$11.2 million/year
$54-$66 million	$58-$71 million	**Total Capital Costs** Center City Connector, including vehicles (with end-to-end operating plan), 2013 $	$60-$73 million	$63-$77 million
100%	58%	**On-Street Parking Impacts** % of Block Faces that Retain On-Street Parking	71%	42%
	132,000	**Number of Employees, 2030** Within 1/8 mile	93,000	
	7,500	**Population, 2030** Within 1/8 mile	10,700	
	6,595	**Number of Hotel Rooms, 2012** Within 1/8 mile	4,260	
	1.3 million	**Number of Annual Visitors, 2011** Within 1/8 mile	12.6 million	

Figure 4-7 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
	Auto Travel Times / Relative Traffic Diversion Impacts	Fair	Fair	Best	Fair
	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	Multimodal Conflicts (Bike, Pedestrian, Bus, and Freight)	Fair	Poor	Best	Best
	Ridership Potential	Good	Best	Good	Best
	Annual Operating & Maintenance Costs	Fair	Good	Fair	Best
	Capital Costs	Best	Good	Good	Fair
DEVELOP	On-Street Parking Impacts	Best	Fair	Good	Fair
	Economic Development Opportunities	Good	Good	Best	Best
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 (based on first Open House) and Stakeholder Support	Fair	Fair	Best	Best
SUSTAIN	Urban Form and Placemaking Opportunities and Improvement Potential	Good	Good	Best	Best

Overall, the 1st Avenue Exclusive Streetcar alternative rated "best" on the most evaluation measures compared to the other alternatives, including streetcar travel time. The 1st Avenue Mixed-Traffic Streetcar alternative rated "best" on the next highest number of evaluation measures, including the lowest impact to auto travel times. The 4th/5th Exclusive and Mixed-Traffic Streetcar alternatives scored "best" on fewer measures and "fair" or "poor" on more measures than the 1st Avenue alternatives.

Both of the Exclusive Streetcar alternatives (1st or 4th/5th Avenues) performed better than either Mixed-Traffic Streetcar alternative on measures of streetcar travel time, ridership potential, and annual operating and maintenance costs.

Figure 4-8 illustrates the most important of the criteria presented at the second open house as identified by open house 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). Related to these measures:

- High-level, peer-based ridership estimates for the Mixed-Traffic and Exclusive alternatives at this stage of evaluation indicated that ridership is comparable for the 4th/5th Avenue and 1st Avenue alignments, but that the faster and more reliable travel times in the Exclusive alternatives attract more riders. Detailed ridership estimates based on the FTA STOPS (Simplified Trips on Project Software) model were prepared in the Tier 2 evaluation (see Chapter 7 and Appendix A); the newly developed STOPS ridership model was not released by the FTA in time for use in preparing the Tier 1 analysis.
- Results for streetcar travel time, which participants identified as one of the most important criteria, are shown in Figure 4-9 and Figure 4-10 in relation to No-Build auto travel times. The 1st Avenue Exclusive Streetcar alternative had the fastest streetcar travel time.
- As shown in Figure 4-6 (page 4-7), the 1st Avenue corridor has higher annual visitation to major attractions and a higher residential population, while the 4th/5th Avenue corridor serves a greater employment and hotel room density.
- 1st Avenue presents greater placemaking/urban form improvement opportunities and greater economic development potential than 4th/5th Avenues. Stakeholders emphasized throughout the process that their preference was for streetcar to support economic success for small and local businesses in established business districts rather than large-scale development or redevelopment.
- The 4th/5th Avenue alternatives rated "fair" or "poor" in terms of modal conflicts. Introduction of a streetcar increases peak-hour delay for passengers traveling on regional bus routes that use 4th or 5th Avenues. Cycle tracks are proposed for the 4th/5th Avenue corridor in the City's Bicycle Master Plan update, and with the one-way cycle tracks included in the high-level right-of-way design for each street, there were limited opportunities to provide exclusive streetcar right-of-way particularly on 5th Avenue. The intensity of streetcar, bus, bike, and pedestrian use increases modal conflicts on 4th/5th Avenues.

Figure 4-9 and Figure 4-10 provide a sample of the graphics used to present the data from the analysis.

Figure 4-8 Ranking of Evaluation Measures by Importance, Open House #2

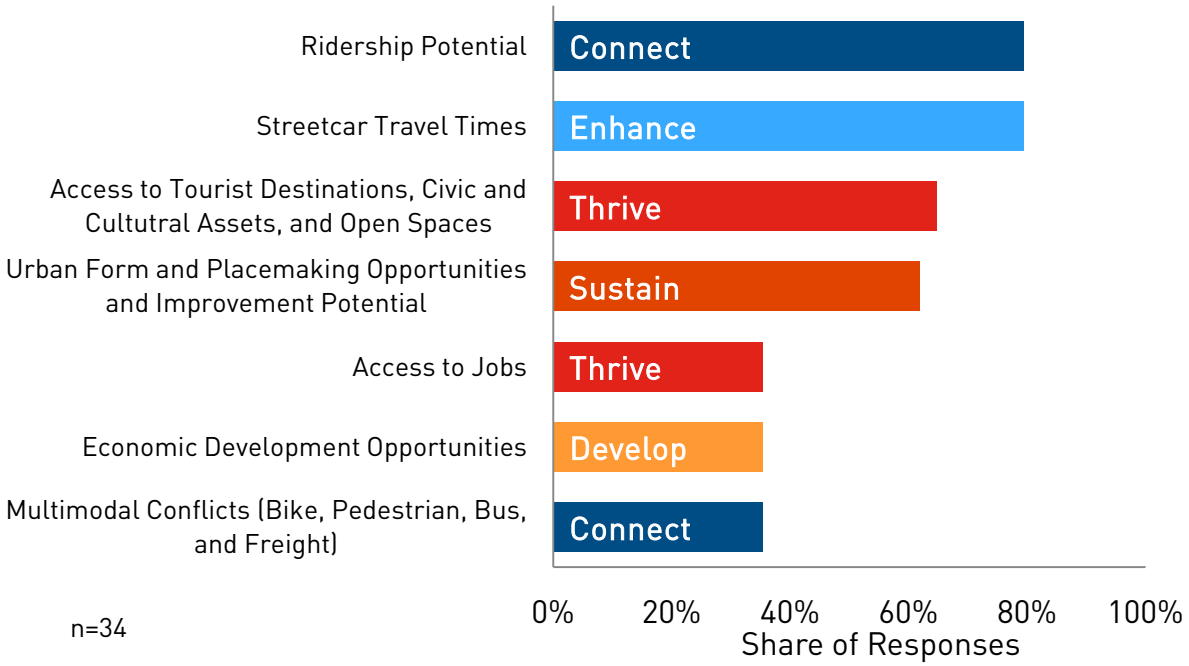


Figure 4-9 Average One-Way Travel Time, 4th/5th Ave, 2030, PM Peak

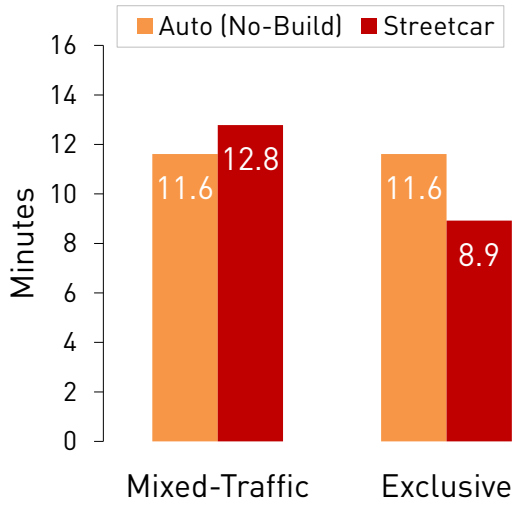
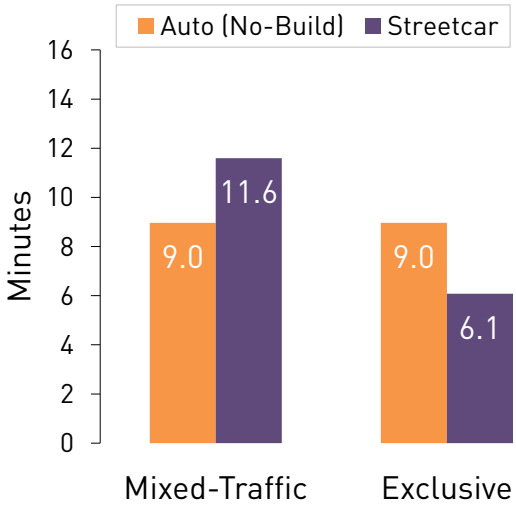


Figure 4-10 Average One-Way Travel Time, 1st Ave, 2030, PM Peak

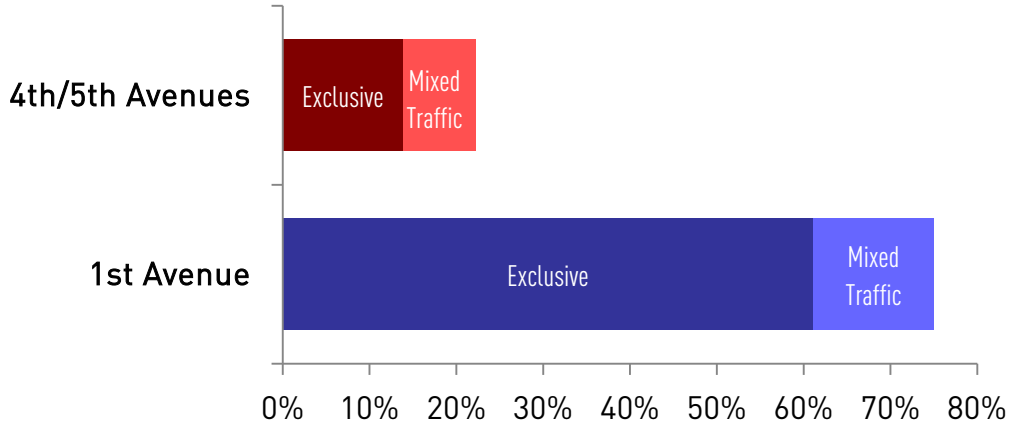


Source: Synchro traffic model analysis for 2030 PM Peak period.

Summary of Public Feedback

Attendees at the June 6, 2013 open house were asked to rank the four Tier 1 alignment alternatives according to preference. Figure 4-11 shows the outcome of the ranking exercise. The 1st Avenue Exclusive alternative received by far the strongest support. The 1st Avenue Mixed-Traffic and 4th/5th Avenue Exclusive alternatives received similar levels of support, while the 4th/5th Mixed-Traffic alternative received very little support. Additional feedback from the open house indicated that for those who preferred the 1st Avenue Exclusive alternative, streetcar speed and reliability were the most important evaluation criteria.

Figure 4-11 Ranking of Tier 1 Alternatives, June 6, 2013 Open House: 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 1st Avenue alternatives. In addition, the 1st Avenue alternatives received the majority of second-choice votes. N=36.

Recommendation

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

The full report on the Tier 1 screening is provided in Appendix N.

5 EAST-WEST CONNECTION ASSESSMENT

This chapter describes an assessment of east-west street alignment options that are needed to connect a 1st Avenue streetcar alignment with the existing South Lake Union Streetcar alignment on Westlake Avenue. This assessment was conducted following the Tier 1 screening and the resulting recommendation to carry 1st Avenue into the Tier 2 evaluation. The Tier 1 screening assumed a Stewart Street/Olive Way east-west connection between 1st Avenue and Westlake for the purpose of comparing 1st Avenue and 4th/5th Avenue alternatives. The initial purpose of the assessment was to determine which east-west connection option(s) should be included in the Tier 2 evaluation. Additional analysis of key issues in the assessment was conducted concurrently with the rest of the Tier 2 evaluation, and this analysis was used in developing the LPA recommendation at the conclusion of the Tier 2 evaluation.

East-West Alternatives Considered

A total of five connection alternatives were evaluated. With the exception of 6th Avenue, all of the streets utilized in these alternatives were included of the Seattle Transit Master Plan concept for the Center City Connector. Figure 5-1 describes each of the connection alternatives. Figure 5-2 and Figure 5-3 describe and illustrate the alignments.

- **Alignment A** would operate two-way on Stewart Street between 1st and 4th Avenues and one-way on Stewart (WB) and Olive (EB) between 4th and Westlake Avenues.
- **Alignment B** would operate as a couplet using Stewart (WB) and Pine (EB) Streets connecting to Westlake via 5th Avenue.
- **Alignment C** would use a Pike/Pine Street couplet between 1st and 4th Avenues and then use 4th Avenue and Olive Way (NB/EB) and 5th Avenue and Pine Street (SB/WB).
- **Alignment D** would use Stewart (WB) and Virginia (EB) Streets as a couplet between 1st and Westlake Avenues.
- **Alignment E** would use a Pike/Pine couplet between 1st and 5th/6th Avenues, connecting to the South Lake Union Streetcar via 5th and 6th Avenues.

Figure 5-1 Description of East-West Connection Alternatives

	A Stewart/Olive	B Stewart/Pine	C Pike/Pine	D Virginia/Stewart	E Pike/6th
EB/NB	Stewart/Olive	Stewart/Olive	Pike/4th	Virginia	Pike/6th
SB/WB	Stewart	5th/Pine	5th/Pine	Stewart	5th/Pine

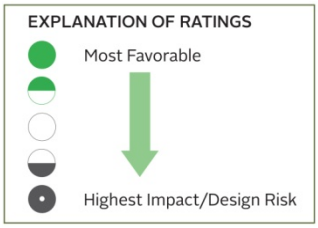
Figure 5-2 East-West Alternatives A, B, and C

Figure 5-3 East-West Alternatives D, E

East-West Connection Assessment Results

Each east-west alternative was evaluated using a simplified set of criteria related to the design challenges and opportunities applicable to the east-west alternatives. Figure 5-4 shows the results for each alignment alternative. The criteria included impacts to the Downtown Seattle Transit Tunnel (DSTT), impacts to brick intersections along Pine Street, utility conflicts, access to key destinations, urban form opportunities, and multimodal conflicts such as impacts to transit operations, traffic operations, parking and access, planned bicycle facilities, and pedestrian facilities. Public stakeholder support was also considered.

Figure 5-4 Summary of East-West Connection Alternatives Assessment



Key Considerations:	Potential East-West Connections				
	A STEWART/ OLIVE	B STEWART/ PINE	C PIKE/ PINE	D VIRGINIA/ STEWART	E PIKE-6TH/ PINE
Impacts DSTT Membrane	●	◉	◉	●	◉
Impacts Brick Intersections	●	◒	◒	●	◒
Major Utility Conflicts	◓	◓	◒	◉	◒
Connects Key Visitor and Civic Destinations	○	◓	●	○	●
Urban Form/ Urban Design Opportunity	○	◓	●	○	●
Multimodal Conflicts	○	○	○	○	◒

All of the alternatives evaluated have unique benefits as well as drawbacks. For example, all alternatives that use Pine Street carry a risk of impacting the waterproof DSTT tunnel membrane and would impact brick intersections. The following sections describe the evaluation of each alternative and describe why each was either eliminated or recommended for inclusion in the LPA.

East-West Connection Alternatives Eliminated

Alignment B: Stewart/Pine Streets

Alignment B would create few bicycle and pedestrian conflicts. Traffic operational impacts were perceived to be relatively minimal or easily mitigated, similar to Virginia Street/Stewart Street alignment (see below). Option B offers some opportunities that Option D would not, including better connections to visitor and civic destinations and urban form/urban design opportunities. However Alignment B shares many of the disadvantages of Alignments C and E, including faring poorly with regard to potential impacts to the DSTT membrane, brick intersections, and vaults under the sidewalk. Utility conflicts include water mains on Olive Way and Pine Street and a gas main on Stewart Street. Given these disadvantages, this option was eliminated from consideration.

Alignment D: Virginia/Stewart Streets

Alignment D was originally considered because the bicycle and pedestrian conflicts and traffic operational impacts were perceived to be relatively minimal or easily mitigated (similar to Stewart/Pine alignment). However, Alignment D performed poorly on several measures. Puget Sound Energy identified a major utility conflict with gas mains on Virginia Street. An overhead pedestrian walkway on Virginia Street was also identified as a design challenge. Perhaps more importantly, this alignment offers the most distant connections to the Westlake Intermodal Hub, including access to the DSTT, and was perceived by the public as too far away. Alignment D performed well in terms of other design risks such as impacts to the DSTT membrane and brick intersections, but given the significance of its other drawbacks, was eliminated from consideration.

Alignment E: Pine/Pike Streets/6th Avenue

Although Alignment E performed well in terms of urban form opportunities and connections to destinations, due to the direct connection to the DSTT and good access to the convention center, it has several design challenges and other issues. On Pine Street, the alignment would run over the DSTT, impacting the membrane. This option would also impact various brick intersections. The use of 6th Avenue would present challenges for streetcar operations including traffic congestion, particularly during the holiday season. Multimodal impacts include removal of parking spaces on Pike Street and 6th Avenue, high pedestrian volumes at several locations, and a planned cycle track on Pike Street. Ultimately, this alignment was eliminated from consideration.

Aerial photos and illustrations of these alignments can be found in Appendix O.

East-West Connections Carried Forward

Of the five original options, two alternatives were carried forward for more detailed study. Alternative A (Stewart Street/Olive Way), which was included in the Tier 1 design concepts and did not have perceived design risks affecting the DSTT membrane and brick intersections, was also included in the Tier 2 design concepts. Concurrently with the Tier 2 evaluation, additional analysis was conducted of the design risks affecting Alternative C (Pike/Pine Streets). These alternatives are discussed in more detail below.

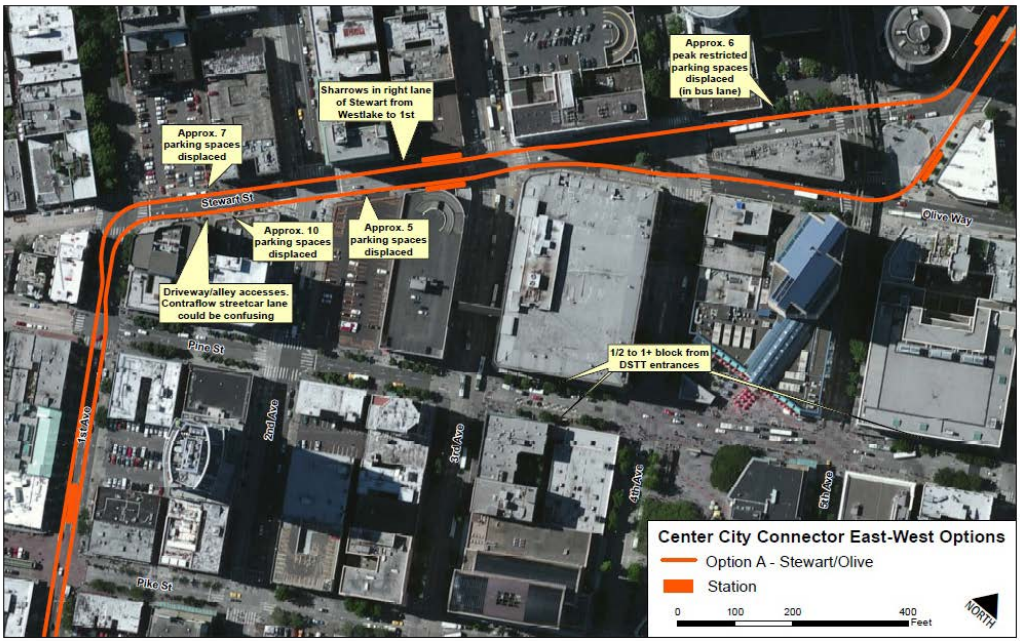
Alignment A: Stewart Street/Olive Way

Alignment A avoids significant design risks found with other options, including impacts to the DSTT membrane and brick intersections on Pine Street. Moreover, this option offers the potential for good legibility because it is almost entirely bidirectional.

The primary drawback to Alignment A is that it does not provide a direct DSTT connection (about a half-block walk along 5th Avenue), and pedestrian wayfinding in this area is challenging. Public input therefore included some concern about legibility. Stewart Street and Olive Way are also used by King County Metro, Sound Transit, and Community Transit buses, particularly during peak periods. Although there are potential conflicts, transit priority treatments in this area could improve some aspects of bus operations. Other multimodal impacts include the removal of 28 parking spaces on Stewart Street, changes to driveway access on Stewart Street between 1st and 3rd Avenues, and impacts to bike sharrows on Stewart Street.

Figure 5-5 shows the alignment and the location of these impacts.

Figure 5-5 East-West Alignment A: Stewart Street/Olive Way



Alignment C: Pike/Pine Streets

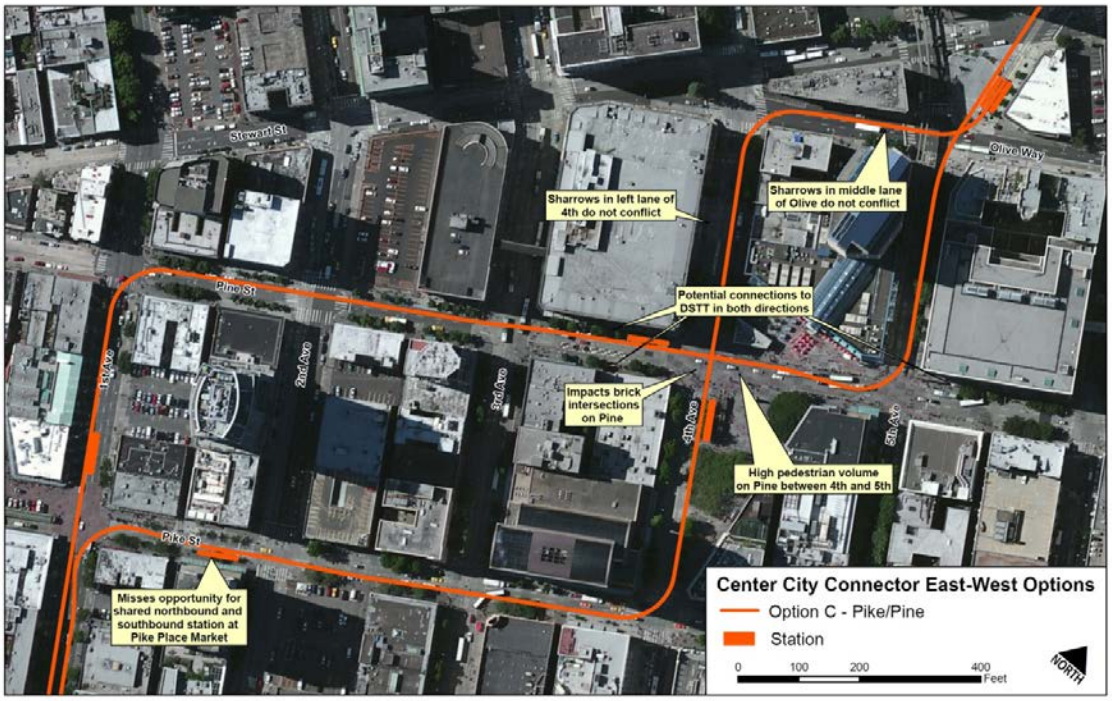
The primary advantages of Alignment C are that it offers the strongest connections between visitor and civic destinations and to the DSTT. This option also offers the greatest urban form/urban design opportunities and has minimal parking and access impacts.

Multimodal conflicts with this alignment include high pedestrian volumes at 1st Avenue and Pike Street and transit conflicts include Metro routes along Pike/Pine Streets and Community Transit, Metro, and Sound Transit regional routes along 4th and 5th Avenues.

As with the other alignments that use Pine Street, the primary issues with this alignment were potential DSTT membrane impacts and impacts to the brick intersections on Pine Street. These issues were considered to be significant design risks. Further investigation of the DSTT membrane impacts was conducted concurrently with the Tier 2 evaluation; a cross-section diagram illustrating streetcar tracks in relation to the DSTT tunnel membrane at Pine Street and 5th Avenue is provided in Appendix R (Additional Conceptual Drawings). Additional investigation is still underway related to methods for cutting and reinstalling granite pavers adjacent to the streetcar track slab. This is also discussed in Appendix R.

Figure 5-6 shows the alignment and highlights the locations of the primary design issues.

Figure 5-6 East-West Alignment C: Pike/Pine Streets



Note: Multiple variations using Pike and Pine Streets are possible and will be considered in the environmental review process.

Recommendation

The Stewart Street/Olive Way alignment was evaluated in both the Tier 1 screening and Tier 2 evaluation. This alignment has several drawbacks, including less direct connections to the Westlake Hub and potential conflicts with regional transit routes that use Stewart Street and Olive Way. However it scores highly on other metrics and has the lowest design risk.

The Pike Street/Pine Street alignment has strong stakeholder support and the best connections to Westlake Hub. Of the options with the DSTT membrane and brick intersection design risks, it scored the highest in the assessment of options. Analysis conducted concurrently with the Tier 2 evaluation demonstrated that it is likely possible to utilize Pine Street without impacting the DSTT membrane. Investigation of techniques for mitigating brick intersection issues is still underway.

Both the Stewart/Olive and Pike/Pine/4th/5th alignments were recommended for inclusion in the LPA, and both will be evaluated as part of the subsequent environmental review process. Multiple variations using Pike and Pine Streets are possible and will be considered in the environmental process.

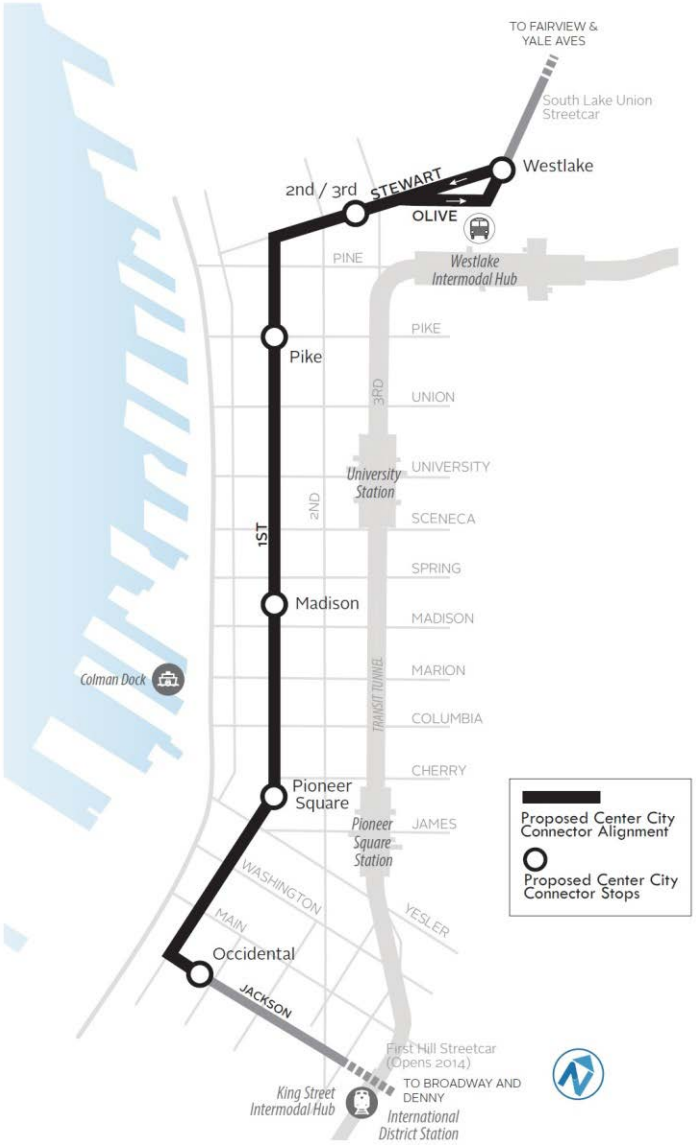
Additional details related to the east-west connection assessment can be found in Appendix O.

6 DESCRIPTION OF TIER 2 ALTERNATIVES

The purpose of the Tier 2 evaluation was to provide a more in-depth analysis of a narrowed set of alternatives for the Center City Connector and determine the alternative(s) that best meet the Project goals and objectives, leading to a recommended locally preferred alternative (LPA).

As described in Chapter 4, the Tier 1 screening process narrowed the Center City Connector alternatives to two—Mixed-Traffic Streetcar and Exclusive Streetcar—along the 1st Avenue street alignment shown in Figure 6-1. As discussed in Chapter 5, the Tier 2 evaluation assumed a Stewart Street-Olive Way east-west connection between 1st Avenue and the South Lake Union Streetcar at the Westlake Intermodal Hub. (Design risks of a Pike-Pine east-west connection were investigated concurrently with the Tier 2 evaluation. Evaluation and conceptual design for additional east-west connections using Pike and Pine Streets will be performed in the environmental review process.)

Figure 6-1 Tier 2 Alignment Overview



This chapter describes the conceptual design of the alternatives evaluated in Tier 2 and the two operating scenarios considered: an "End-to-End" scenario and a "Hub-to-Hub" scenario. The Hub-to-Hub scenario emerged as the preferred Center City Connector operating scenario.

1st Avenue Streetcar Alternatives

This section provides a detailed description of the Mixed-Traffic and Exclusive Streetcar alternatives. The design alternatives assume that the streetcar runs in the center lane on 1st Avenue between Jackson Street and the Pike Place Market area. The Mixed-Traffic Streetcar operates in a lane shared with general-purpose vehicles with limited priority at traffic signals, whereas the Exclusive Streetcar

primarily operates in an Exclusive transit travel lane with extensive signal priority. Figure 4-1 (page 4-2) compares the two modes as defined for the Center City Connector Project. The Tier 2 design alternatives assumed the same stops for both the Mixed-Traffic and Exclusive Streetcar alternatives, although longer spacing is one possible characteristic of an exclusive streetcar mode.

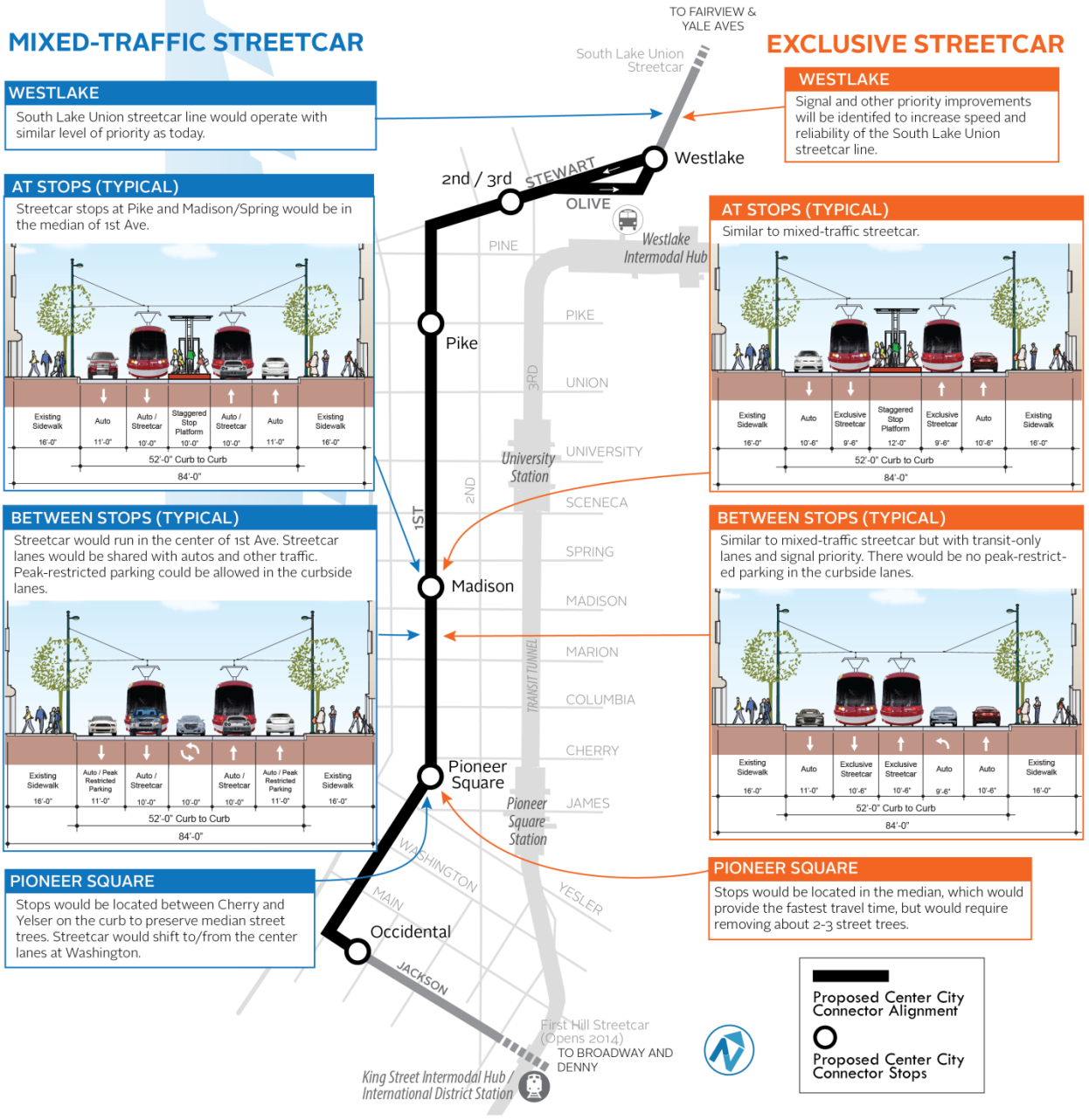
Figure 6-2 summarizes key differences between the existing and proposed Mixed-Traffic and Exclusive Streetcar cross-sections along 1st Avenue. Figure 6-3 illustrates typical cross-sections along the alignment at stops and between stops. Stop platforms are similar in both alternatives, but in the Mixed-Traffic alternative center-turn pockets are located between the streetcar tracks. In the Exclusive Streetcar alternative, streetcar tracks are side-by-side and left-turn pockets are in an adjacent lane. Peak-restricted parking (in one direction) is typically maintained in the Mixed-Traffic Streetcar alternative, except for blocks with streetcar stop platforms, but removed in the Exclusive alternative. There are no existing or planned bike facilities on 1st Avenue and limited bus service along the corridor. Appendices G and I provide additional detail on traffic operational changes and on-street parking and loading impacts based on the Tier 2 conceptual designs.

Figure 6-2 Existing and Proposed 1st Avenue Cross Section Alternatives (Typical)

Alternative	Bike Facility	On-Street Parking	General Public (GP) Lanes (per direction)	Exclusive Streetcar / Transit Lane
Existing	None	Present in one direction in some blocks (typically peak-restricted)	2-3 lanes: ▪ 2 GP ▪ 1 GP/peak-restricted parking (one direction)	None
Mixed-Traffic Streetcar	None	Peak-restricted parking maintained in some blocks, but removed to accommodate stop platforms	2 -3 lanes: ▪ 11-foot GP/streetcar ▪ 10-foot GP ▪ 10-foot GP/ peak-restricted parking (one direction)	None
Exclusive-Streetcar	None	No peak-restricted parking in curbside lane. Parking pockets (non time-restricted) available in some blocks between stations	1-2 lanes: ▪ 10½ to 11-foot GP ▪ Turn-pockets	11-foot streetcar

Appendix G provides additional detail on traffic operational changes assumed in the design concepts (see Figure G-4, page G-6). Appendix I provides additional detail on parking impacts.

Figure 6-3 Typical 1st Avenue Cross-Sections for Tier 2 Alternatives



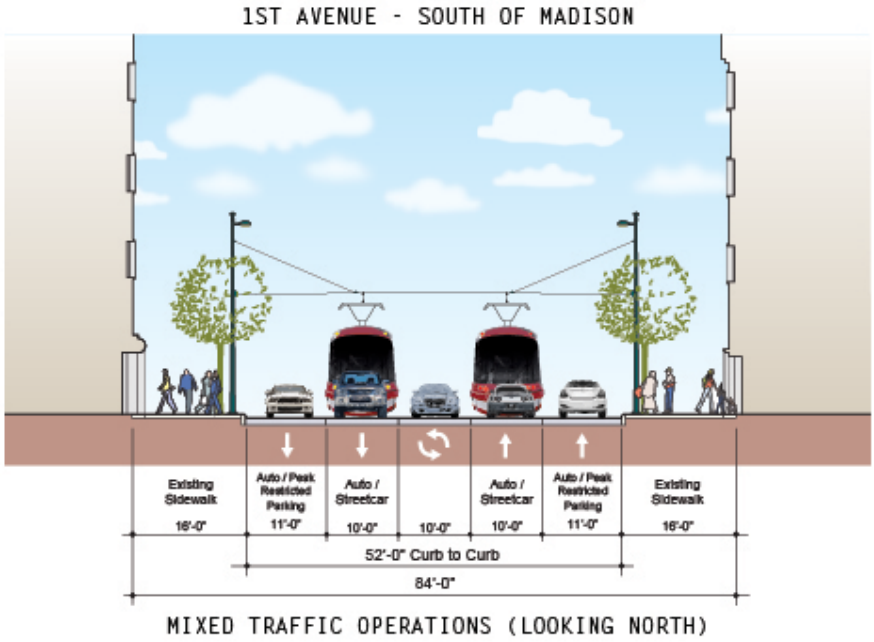
Typical Cross Sections between Stops

Figure 6-4 contrasts the typical right-of-way design between stops for the Mixed-Traffic and Exclusive Streetcar alternatives. In the Mixed-Traffic Streetcar alternative, the streetcar would run in the center of 1st Avenue in lanes shared with autos. Left-turn pockets would typically be located between the streetcar/auto lanes in the street median. Peak-restricted parking could be allowed in the curbside lanes, except on blocks with streetcar stops. In the Exclusive Streetcar alternative, the streetcar would run in dedicated lanes in the center of 1st Avenue. Turn lanes would typically be

located on the outside of the streetcar lanes. Pockets of parking (not time-restricted) could be provided on some blocks.

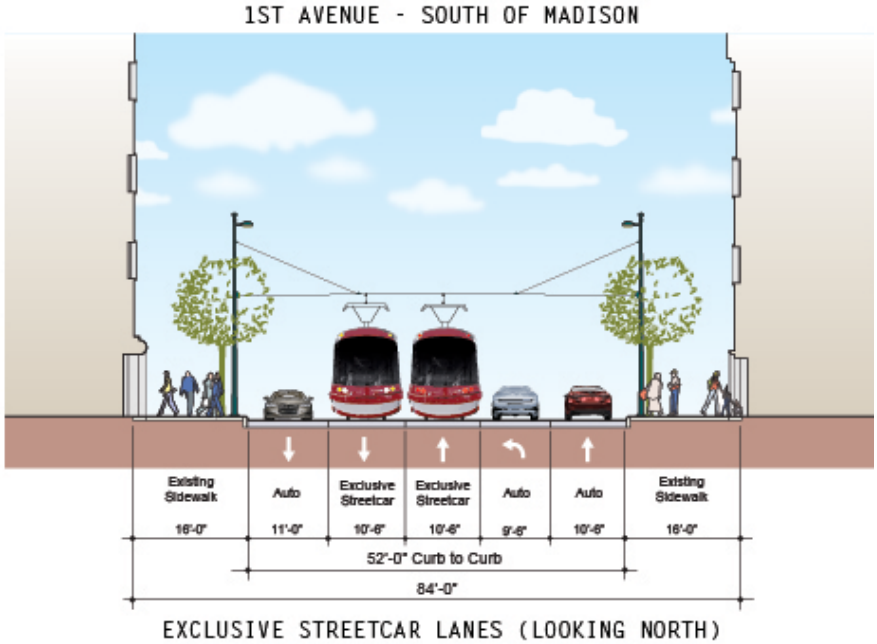
Figure 6-4 Typical 1st Avenue Cross Section between Stops

Mixed-Traffic Streetcar



MIXED TRAFFIC OPERATIONS (LOOKING NORTH)

Exclusive Streetcar



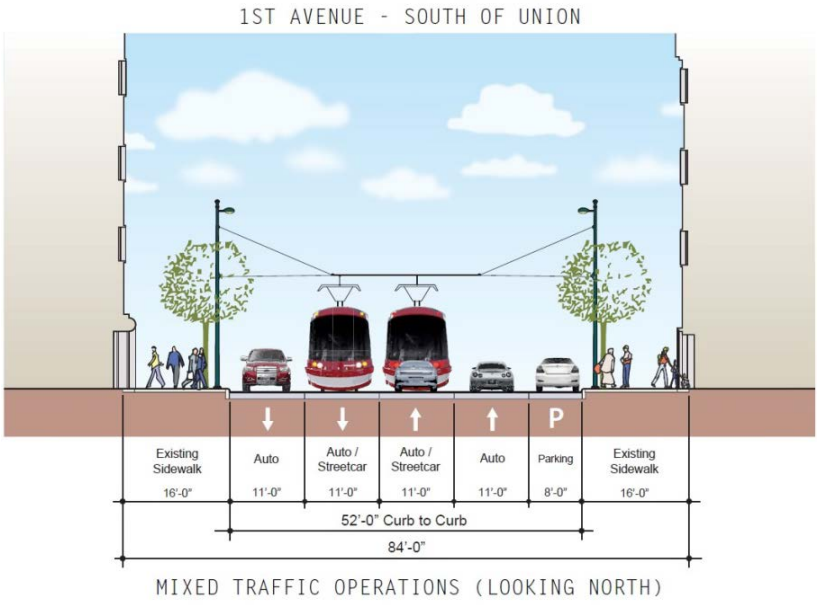
EXCLUSIVE STREETCAR LANES (LOOKING NORTH)

Cross Section with On-Street Parking (South of Union)

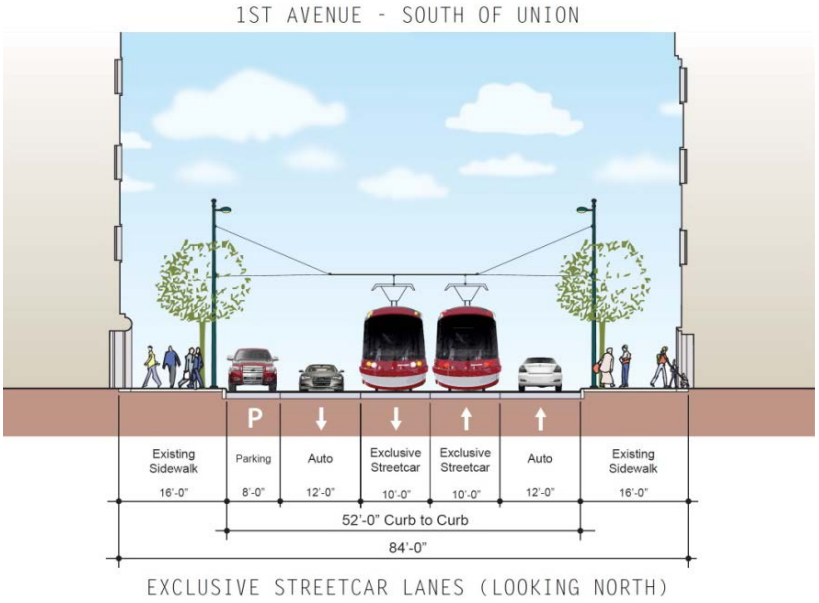
Figure 6-5 depicts a Mixed-Traffic Streetcar cross section south of Union where peak-restricted parking could be allowed in the curbside lanes on most blocks, terminating to accommodate turn lanes and streetcar stops. No peak-restricted parking would be available in the Exclusive Streetcar alternative, however the right-of-way design would enable a limited number of all-day parking spaces in some locations.

Figure 6-5 1st Avenue Cross Sections with On-Street Parking (South of Union)

Mixed-Traffic Streetcar



Exclusive Streetcar

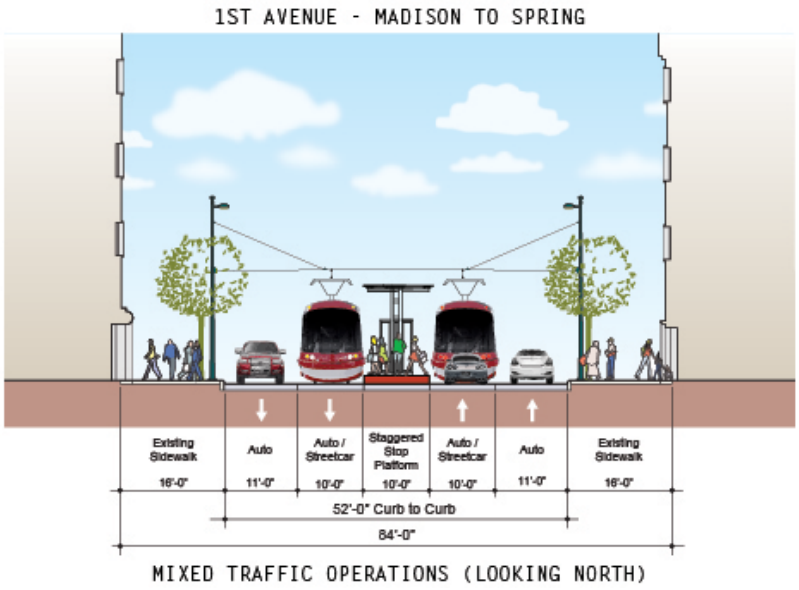


Typical Cross Sections at Stops

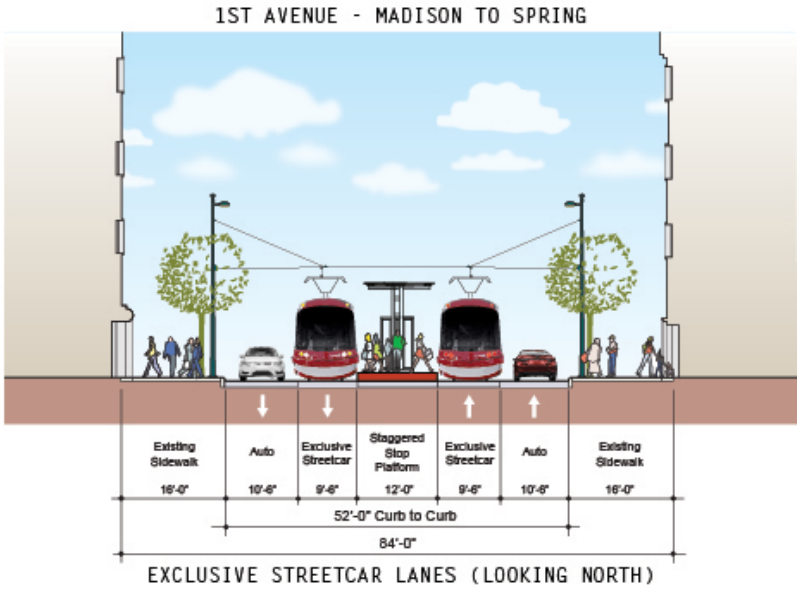
Figure 6-6 shows the typical cross sections at streetcar stops for the Mixed-Traffic and Exclusive Streetcar alternatives. Three new stops are proposed along 1st Avenue. The platforms at Pike and at Madison/Spring Streets would be located in the street median. Stop locations are identical in the Mixed-Traffic and Exclusive Streetcar alternatives. However, the Mixed-Traffic Streetcar would stop in a shared travel lane, potentially delaying the streetcar if vehicle traffic is blocking the lane adjacent to the stop platform. The Exclusive Streetcar would have dedicated use of the adjacent travel lane.

Figure 6-6 Typical 1st Avenue Cross Sections at Stops

Mixed-Traffic Streetcar



Exclusive Streetcar

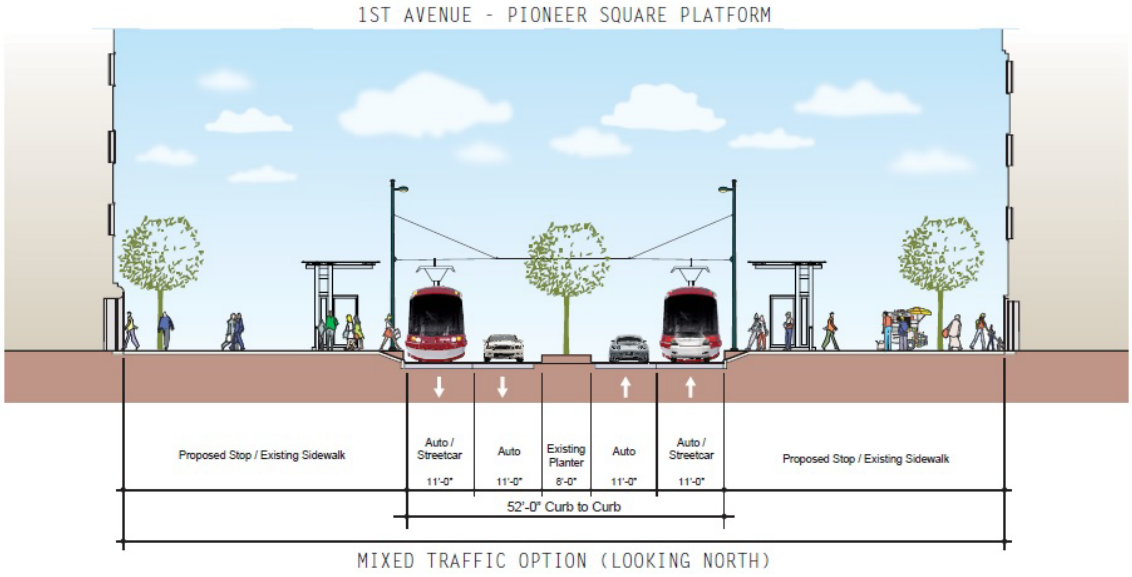


Pioneer Square Stop Cross-Section Options

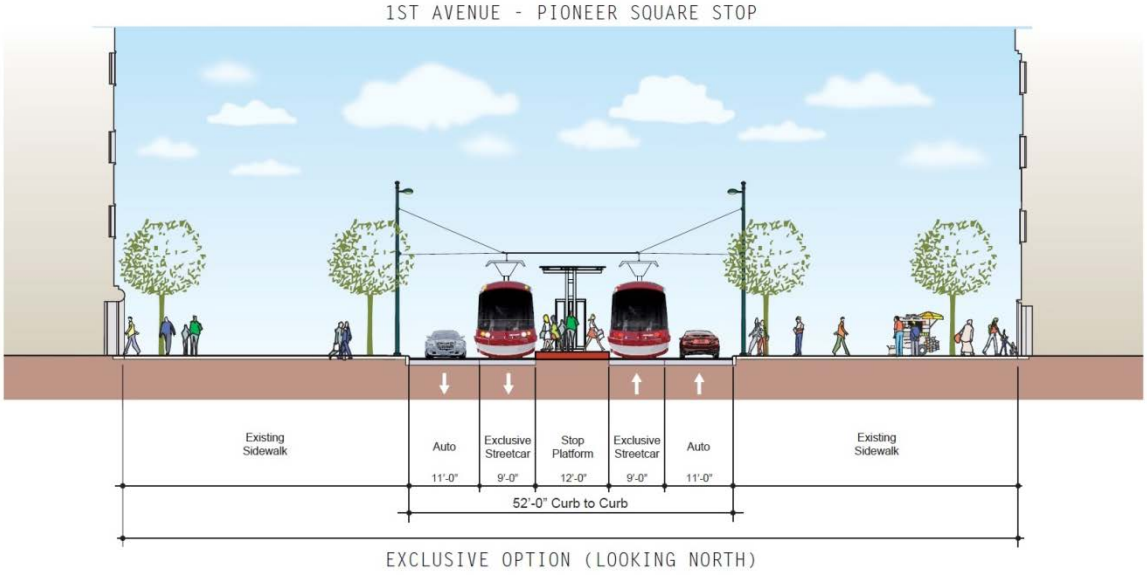
The proposed Center City Connector stop in Pioneer Square would be located between Cherry Avenue and Yesler Way. The alternatives represent two design options to illustrate tradeoffs related to the median street tree impacts that would occur with a center platform stop. The Mixed-Traffic Streetcar cross-section in Figure 6-7 shows platforms located on the curb, which would preserve all median street trees but require additional travel time for the streetcar to shift between the center lanes and curbside stops. The Exclusive Streetcar cross section shows a stop platform in the street median which would require removing approximately 2-3 trees.

Figure 6-7 Pioneer Square Stop Cross-Sections

Mixed-Traffic Streetcar



Exclusive Streetcar



Stewart Street Cross Section

Figure 6-8 illustrates proposed cross-sections along Stewart Street/Olive Way between 1st Avenue and Westlake.

Northbound/Eastbound

In the Mixed-Traffic Streetcar alternative, the northbound/eastbound streetcar would run contra-flow along Stewart Street with a curbside stop west of 3rd Avenue. The streetcar would switch to the north-side along Olive Way at the 4th Avenue intersection. The Exclusive Streetcar alternative would be similar, but the contra-flow lane would be transit-only between 1st and 2nd Avenues.

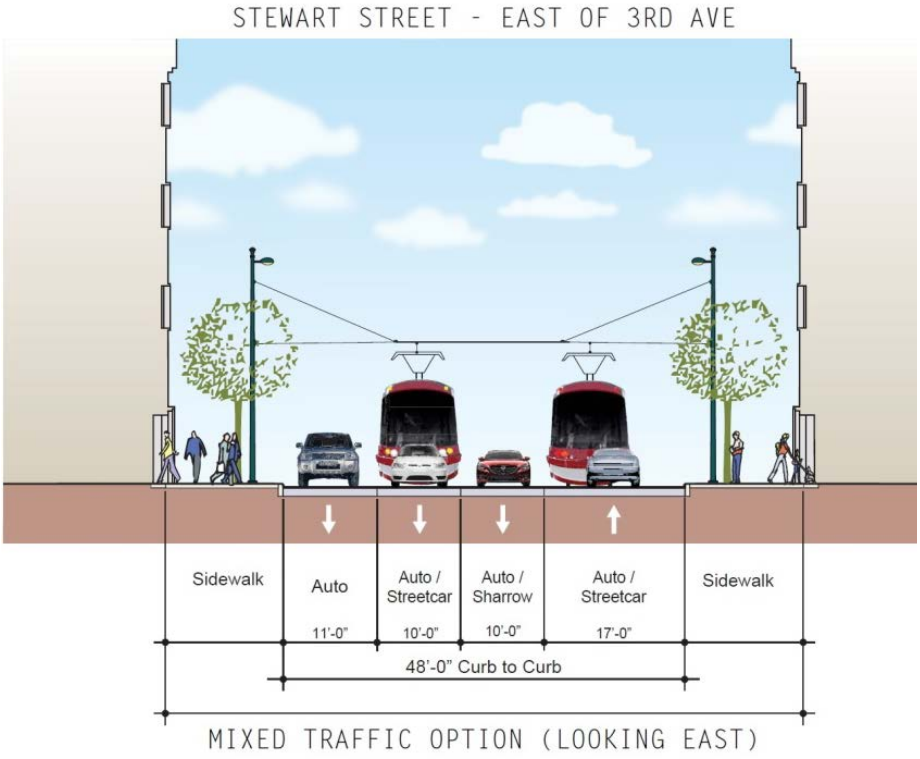
Southbound/Westbound

In the southbound/westbound direction from Westlake to 1st Avenue, the Mixed-Traffic streetcar would run in the center lane of Stewart Street, shifting to the curb lane at a curbside stop west of 3rd. In the Exclusive Streetcar alternative, the streetcar would run in the curbside lane of Stewart Street, which would be transit-only (shared with buses) to a curbside stop west of 3rd.

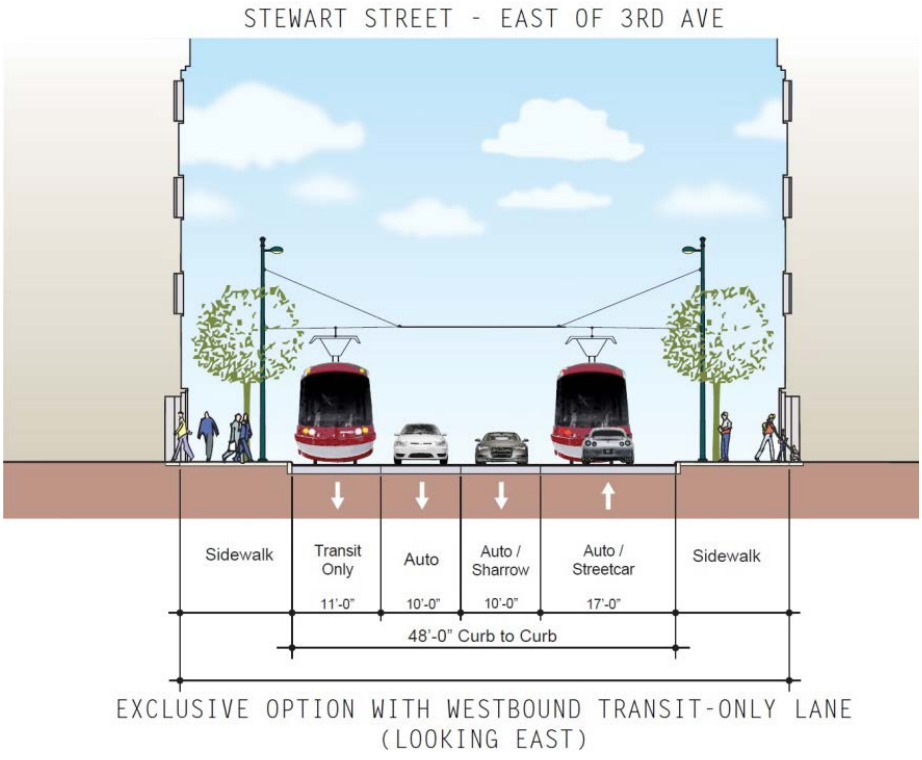
The design in both alternatives is intended to minimize conflicts with a westbound bus stop on Stewart Street east of 4th Avenue and buses that are making left-turns from westbound Stewart onto 3rd and 2nd Avenues.

Figure 6-8 Stewart Street Cross-Sections

Mixed-Traffic Streetcar



Exclusive Streetcar



Operating Scenarios

Two operating scenarios were evaluated in terms of operating costs, capital costs, and ridership forecasts. The preliminary operating plan for the Center City Connector under both scenarios assumes 10-minute headways from 6 a.m. to 7 p.m. on weekdays and from 8 a.m. to 7 p.m. on weekends. At all other operating times, the scenarios assume 15-minute headways. The preliminary operating plan provides 137 total weekly hours of service.

Hub-to-Hub Operating Scenario (Preferred)

A Hub-to-Hub operating scenario for the Center City Connector would connect the South Lake Union and First Hill Streetcars with a pair of lines that overlap between the Westlake and King Street Intermodal Hubs. This "Hub-to-Hub" segment with overlapping service is highlighted in orange in Figure 6-9 and would have a streetcar arrival up to every five minutes between 6 a.m. to 7 p.m. on weekdays and from 8 a.m. to 7 p.m. on weekends. At other times, the headway would be up to 7.5 minutes between the hubs. Streetcars would arrive up to every 10 minutes north of Westlake and east of King Street station.

End-to-End Operating Scenario

An End-to-End operating scenario for the Center City Connector (Figure 6-10) would connect the South Lake Union and First Hill Streetcars as a continuous integrated line with no transfers. This scenario would have a streetcar arrival up to every 10 minutes.

Recommended Operating Scenario: Hub-to-Hub

The Hub-to-Hub operating scenario was recommended as the preferred Tier 2 operating scenario for the Center City Connector. The Hub-to-Hub scenario would offer more frequent service between Westlake and King Street Intermodal Hubs than an End-to-End operating scenario. This resulted in higher projected ridership. The Hub-to-Hub scenario requires more streetcar vehicles and operators and therefore has higher operating costs and vehicle capital costs than the End-to-End scenario.

Appendix C (Operating and Maintenance Cost Estimates) provides additional detail on Tier 2 operating assumptions and the analysis methodology.

Figure 6-9 Hub-to-Hub Operating Scenario (Preferred)

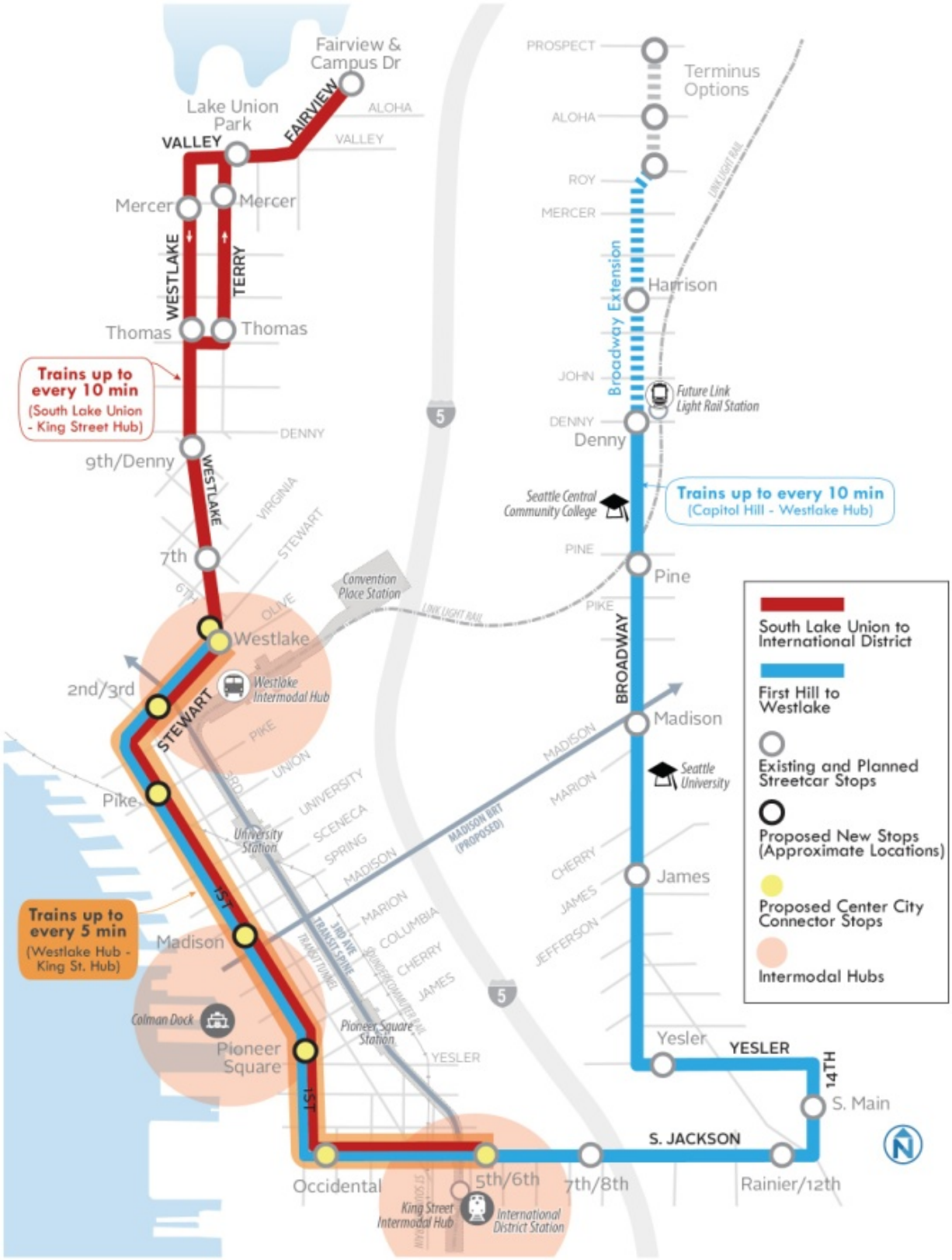
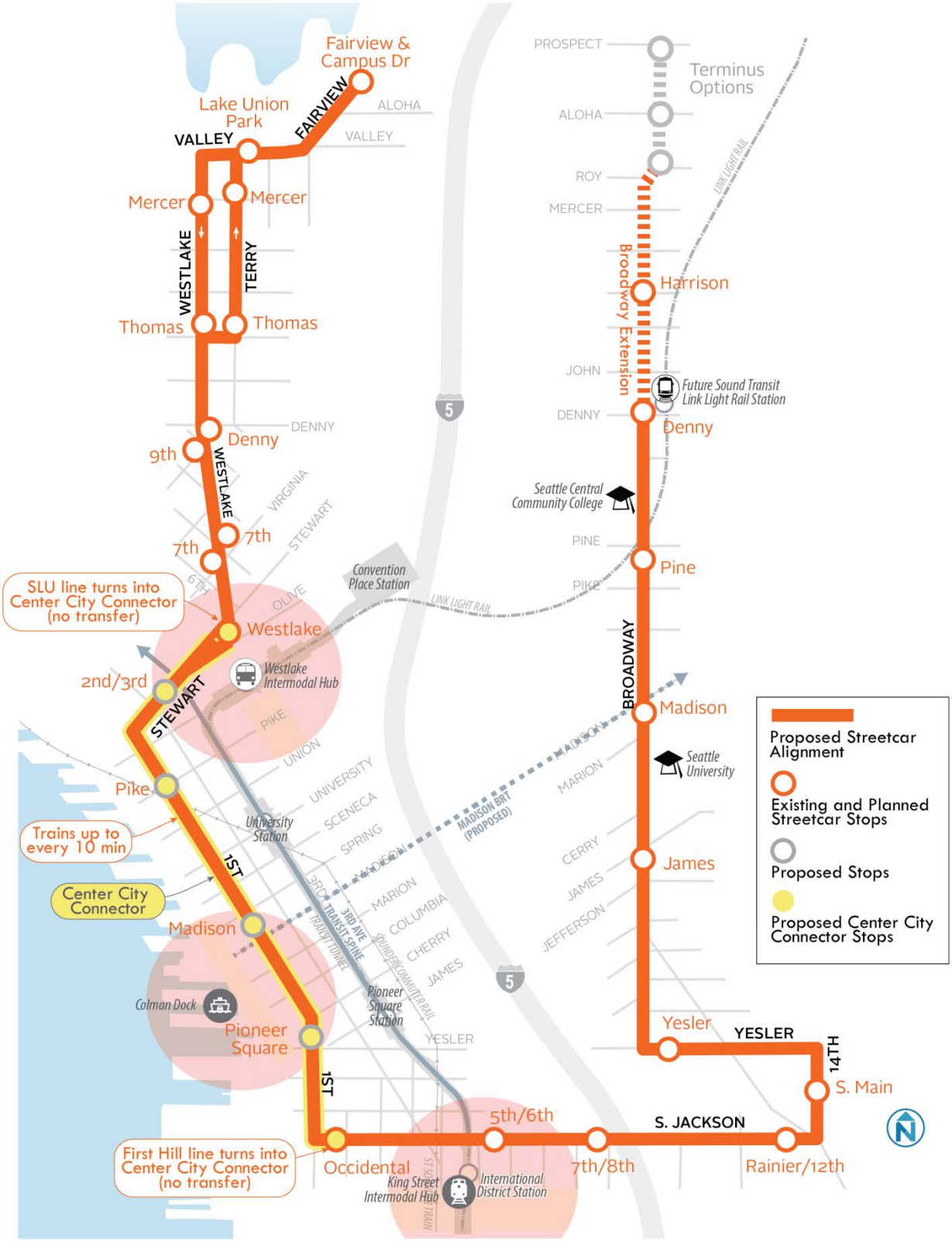


Figure 6-10 End-to-End Operating Scenario



7 TIER 2 EVALUATION RESULTS

The Tier 2 evaluation compared the Mixed-Traffic and Exclusive Streetcar alternatives using many of the same evaluation measures (see Chapter 2: Evaluation Framework) as were used in the Tier 1 evaluation, but using more detailed data and modeling to compare the alternatives. For several measures, there was no difference in the analysis inputs for the Tier 1 and Tier 2 alternatives for 1st Avenue, so the Tier 1 rating was carried into the Tier 2 evaluation.

This chapter first provides a summary of the Tier 2 evaluation results, followed by a discussion of the results supporting each evaluation measure. The discussion references technical appendices that provide the detailed analysis results for some measures.

Summary of Tier 2 Evaluation Results

Each Tier 2 alternative was evaluated based on a set of measures corresponding to the Project goals and objectives, and rated on a relative scale for each measure. Figure 7-1 and Figure 7-2 summarize the evaluation measures and qualitative ratings for the Tier 2 alternatives.

Figure 7-1 Tier 2 Evaluation Results

MIXED-TRAFFIC STREETCAR	EVALUATION MEASURES	EXCLUSIVE STREETCAR
11.5 minutes	**Streetcar Travel Time, PM Peak** (Jackson/Occidental - Stewart/Westlake, average north/southbound, including stops, 2018)	**7.5 minutes**
26%	**Streetcar Travel Time Reliability, PM Peak** (Variance between streetcar travel times, 2018)	**12%**
20,000 - 27,000 daily riders	**Forecasted Weekday Daily Riders** (Integrated CCC, First Hill, and SLU lines, 2018)	**23,000 - 30,000 daily riders**
$16.5 million/year	**Annual Operating & Maintenance Costs** (Integrated CCC, First Hill, and SLU lines, 2018 $)	**$15.0 million/year**
$110-$119 million	**Total Capital Costs** (Center City Connector, including vehicles, 2013 $)	**$104-$111 million**
6.5 minutes	**Auto Travel Time, PM Peak** (Jackson/Occidental - Stewart/Westlake, avg. north/southbound, 2018; "No-Build" travel time: 5.7 min)	8.0 minutes
Diversion: < 10% **Avg. Delay Increase: 2 sec**	**Traffic Delay from Diversion, PM Peak** (% diversion of vehicles from 1st Avenue and increase in average intersection delay on parallel streets, 2035)	Diversion: up to 50% Avg. Delay Increase: 3.5 sec
Peak-restricted: 80 **All-day: 15** **Loading: 45**	**On-Street Parking and Loading Impacts** (Approx. number parking stalls and loading zone spaces retained. No-Build: about 145 peak-restricted, 25 all-day parking stalls; 80 general/passenger loading spaces)	Peak-restricted: 5 All-day: 20 Loading: 15

Figure 7-2 Tier 2 Evaluation Summary Matrix

	Evaluation Measures	1st Avenue	
		Mixed-Traffic Streetcar	Exclusive Streetcar
ENHANCE	Streetcar Travel Time	Fair	Best
	Streetcar Travel Time Reliability	Fair	Good
	Bus Travel Time and Reliability Impacts: Aggregate Bus Delay	Fair	Best
CONNECT	Auto Travel Time	Good	Fair
	Traffic Diversion Impacts	Good	Fair
	Projected Ridership	Good	Best
	Annual Operating & Maintenance Costs	Good	Best
	Capital Costs	Good	Best
DEVELOP	On-Street Parking and Loading Impacts	Fair	Poor
	Economic Development Opportunities (from Tier 1 Evaluation)	Best	Best
THRIVE	Public Support (Open House and Online Survey Feedback) and Stakeholder Support	Fair	Best
	Access to Jobs (from Tier 1 Evaluation)	Good	Good
	Access to Social Services and Affordable Housing (from Tier 1 Evaluation)	Good	Good
	Access to Tourist Destinations, Civic and Cultural Assets, and Open Spaces (from Tier 1 Evaluation)	Best	Best

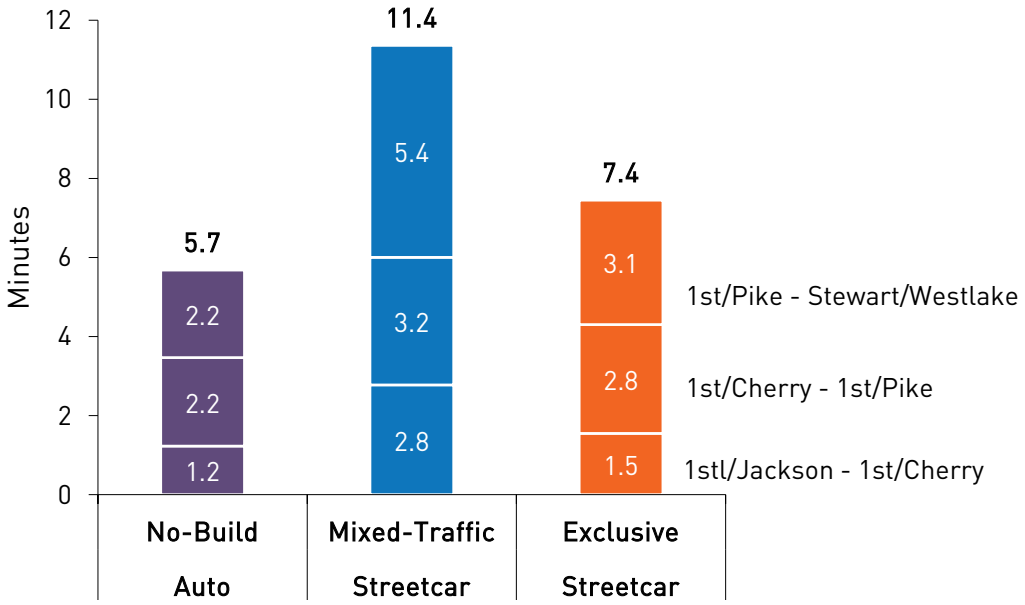
Streetcar Travel Times

Figure 7-3 compares PM peak period travel times for both streetcar alternatives and the No-Build[3] auto travel time in an assumed 2018 opening year. These travel times were produced from the VISSIM traffic simulation model. The VISSIM modeling incorporated the impact of exclusive streetcar lanes and a range of transit signal priority (TSP) treatments, with the Mixed-Traffic Streetcar alternative assuming a low level of TSP and the Exclusive Streetcar alternative assuming a higher level of priority.[4]

The Tier 2 analysis found that streetcar travel times would be nearly 30% faster in the Exclusive Streetcar alternative compared to the Mixed-Traffic Streetcar alternative. About half of the travel time difference occurs between the 1st/Pike and Stewart/Westlake intersections, and is primarily related to the different levels of TSP assumed in each alternative.

Further detail on the streetcar travel time analysis can be found in Appendix G: Traffic Analysis. Appendix H: Evaluation of Westlake and Jackson Priority Improvements provides an assessment of potential streetcar priority improvements along the South Lake Union Streetcar line and the Jackson Street segment of the First Hill Streetcar line.

Figure 7-3 Average Streetcar Travel Times vs. Auto (No-Build), 2018, PM Peak, 1st/Jackson to Stewart/Westlake (by segment)



Note: Streetcar travel times include an assumed 20-second dwell time at stations. Travel times are the average of one-way northbound and southbound travel times.

[3] A "No-Build" condition analyzes the projected transportation conditions for a target year, in this case 2018, assuming the Project or "Build" alternatives (Mixed-Traffic or Exclusive Streetcar) are not implemented.

[4] In either of these TSP conditions, side-street green times were not reduced below minimum pedestrian street crossing thresholds and did not skip pedestrian phases. Additional details are provided in Appendix G.

Streetcar Travel Time Reliability

Figure 7-4 and Figure 7-5 compare travel time reliability between the Exclusive and Mixed-Traffic Streetcar alternatives. Reliability is measured as the variability of travel times from each streetcar trip along the route during the peak hour. The reliability of the Mixed-Traffic Streetcar alternative reflects the impact of operating in mixed-traffic conditions during periods of traffic congestion. Congestion in the study area is projected to increase in the future.

The Exclusive Streetcar alternative is more reliable, with northbound and southbound travel time varying by approximately 12% during the PM peak period. The Mixed-Traffic Streetcar alternative is less reliable due to the operating conditions in a mixed-traffic environment, with travel times varying by 26%. The Mixed-Traffic alternative could take up to 10.3 minutes northbound and 13.2 minutes southbound during the PM peak, while both directions of the Exclusive Streetcar would be less than 9 minutes. Streetcar travel time reliability was cited frequently in public comments as a high priority, and reliability on the Mixed-Traffic alternative could deteriorate beyond expected levels if congestion downtown increases more than is expected. Increased streetcar reliability in the Exclusive Streetcar alternative reduces operating costs and vehicle fleet requirements compared to the Mixed-Traffic alternative.

Further detail on streetcar travel time reliability can be found in Appendix G: Traffic Analysis.

Figure 7-4 Streetcar Travel Time Reliability, 2018, PM Peak, Northbound

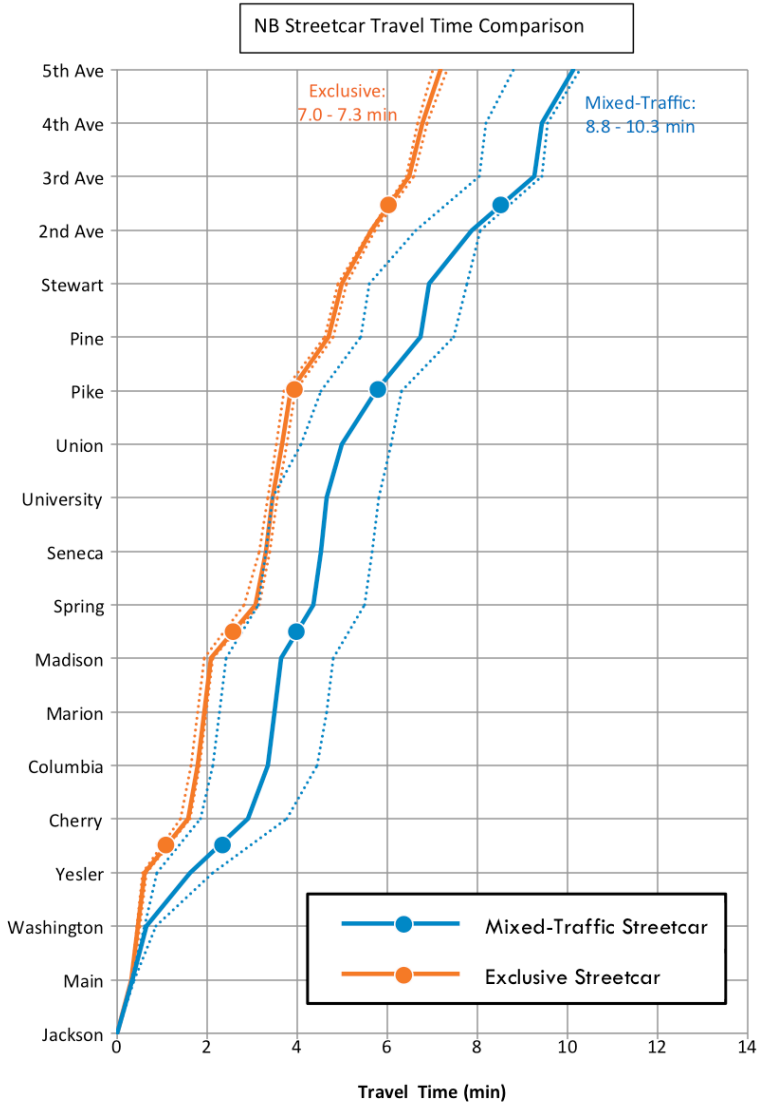
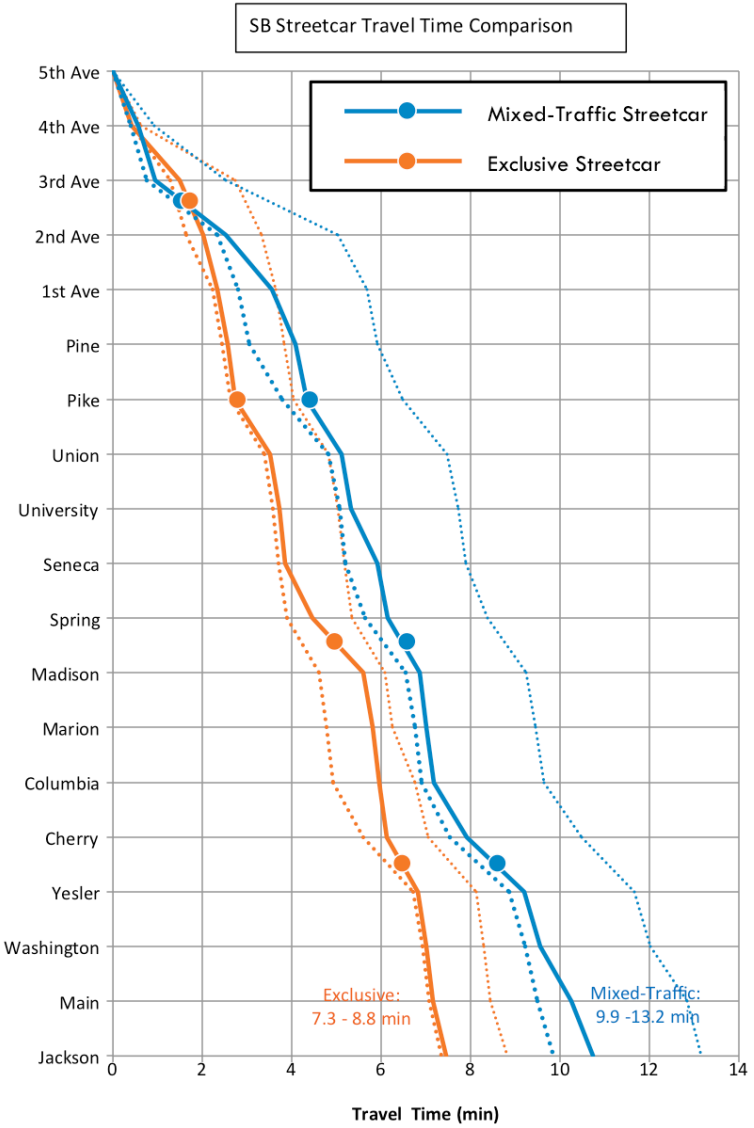


Figure 7-5 Streetcar Travel Time Reliability, 2018, PM Peak, Southbound



Bus Travel Time and Reliability Impacts

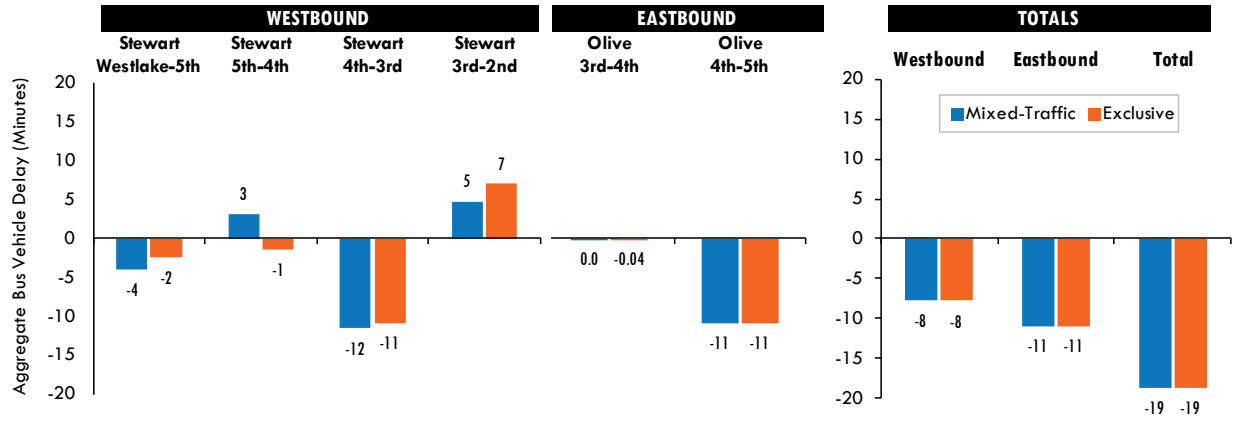
The Tier 2 analysis evaluated bus travel time and delay on the Stewart Street/Olive Way east-west connection for the Mixed-Traffic and Exclusive Streetcar and No-Build alternatives for the PM peak hour in 2018.[5] The purpose of this evaluation criterion was to assess potential adverse impacts on Stewart Street/Olive Way bus operations resulting from the streetcar alternatives. Bus delay impacts on the 1st Avenue alignment are assumed to be minimal; King County Metro Route 99 is currently the only bus route operating along 1st Avenue (peak periods only).

There are 189 bus trips on Stewart Street/Olive Way in the PM peak hour (5-6 p.m.).[6] Figure 7-6 shows the change in aggregate bus delay by block, direction, and overall. Both streetcar alternatives would slightly reduce aggregate bus delay[7] compared to the No-Build alternative. The reduction can be attributed to improved signal timing and transit signal priority.

As described in Chapter 6, the alternatives were designed to minimize conflicts between the streetcar and buses by running the westbound Mixed-Traffic Streetcar in the middle lane of Stewart Street and providing a westbound transit-only lane on Stewart in the Exclusive Streetcar alternative. In both alternatives, the eastbound streetcar runs along the north side of Olive Way to avoid conflicts with curbside bus stops.

Further detail on bus delay can be found in Appendix J: Bus Operations Analysis.

Figure 7-6 Aggregate Change in Bus Vehicle Delay Compared to No-Build on Stewart/Olive, by Block and Total, 2018, PM Peak Hour (in Minutes)



Westbound bus delay increases slightly in some blocks (e.g., Stewart between 2nd - 3rd and 4th - 5th Avenues in the Mixed-Traffic condition and between 2nd - 3rd Avenues in the Exclusive condition). These increases are balanced out by travel time improvements in other blocks. Eastbound, both alternatives would reduce bus delay compared to the No-Build alternative. Note: Bus vehicle delay estimates were produced using VISSIM and include dwell time at the Stewart & 4th Avenue and Olive & 4th Avenue stops.

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[5] The Stewart Street/Olive Way east-west connection was assumed in the Tier 2 evaluation; additional east-west alternatives using Pike and Pine Streets will be evaluated in the next study phase.

[6] The Tier 2 analysis included only the PM peak period; the AM peak period was not analyzed in this study.

[7] Aggregate bus delay is calculated as average delay per block per bus multiplied by the number of PM peak hour bus trips utilizing that block.

Auto Travel Time Impacts

In the Tier 2 evaluation, auto travel times were produced for a 2018 year of opening condition and compared between the No-Build, Mixed-Traffic Streetcar, and Exclusive Streetcar alternatives. These travel times were produced from the VISSIM simulation model. Auto travel times for 2018 are shown in Figure 7-7. The Exclusive Streetcar alternative has the biggest impact on auto travel time, with a total increase in travel time of 2.2 minutes compared to the No-Build alternative (approximately 35%). Most of the increase in auto travel time occurs on 1st Avenue between Cherry and Pike, where the streetcar has an exclusive lane. Auto travel time in the Mixed-Traffic alternative is just under one minute longer than in the No-Build condition (8% increase).

Figure 7-7 Average Auto Travel Times in No-Build and Streetcar Scenarios, 2018, PM Peak Jackson/Occidental to Stewart/Westlake (by Segment)

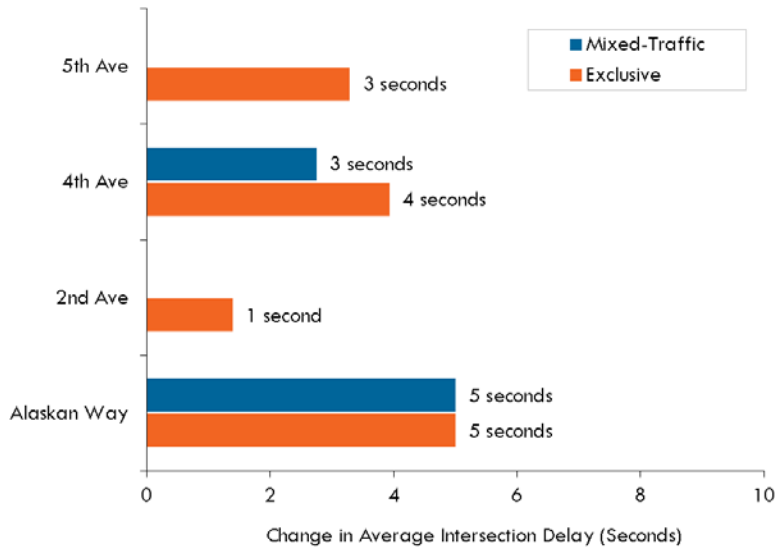
Note: Travel times are the average of one-way northbound and southbound travel times.

Auto throughput and intersection delay is expected to be similar between the No-Build and Mixed-Traffic Streetcar alternatives. The Exclusive Streetcar is expected to reduce auto throughput along 1st Avenue by between half to two-thirds of the throughput in the No-Build condition, while average intersection delay would be about 10 seconds worse than in the No-Build condition along with more intersections expected to have vehicles queued back into them. Additional detail on these results is provided in Appendix G: Traffic Analysis.

Traffic Diversion to Parallel Streets

Figure 7-8 shows PM peak impacts to parallel corridors in terms of the average delay at intersections in 2035. In the Mixed-Traffic Streetcar alternative, there is minor traffic diversion (less than 10%) from 1st Avenue. Intersection delay on parallel streets increases by an average of about 2 seconds. In the Exclusive Streetcar alternative, up to 50% of traffic is diverted from 1st Avenue. Intersection delay on parallel streets increases by an average of about 3.5 seconds. A more detailed analysis, which includes expected levels of service for each intersection on the parallel corridors evaluated, is included in Appendix G: Traffic Analysis.

Figure 7-8 Change in Traffic (Average Intersection) Delay on Parallel Corridors, 2035, PM Peak Impacts due to Traffic Diversion from 1st Avenue

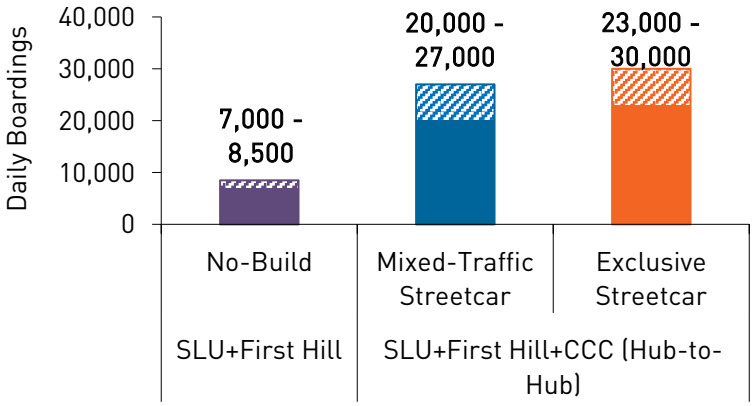


Note: Based on analysis of 20 intersections on Alaskan Way and 2nd, 4th, and 5th Avenues. In the Mixed-Traffic Streetcar alternative, diversion primarily affects northbound travel on parallel streets. Therefore, the analysis did not show noticeable impacts on 2nd and 5th Avenues. The Mixed-Traffic Streetcar alternative impacts represent increases of 6% on 4th Avenue and 13% on Alaskan Way. Exclusive Streetcar alternative impacts represent 9 to 13% increases on parallel corridors relative to the No-Build alternative.

Ridership Projections

Weekday daily ridership was projected for No-Build (South Lake Union and First Hill Streetcars), Mixed-Traffic, and Exclusive Streetcar alternatives using the Federal Transit Administration (FTA) Simplified Trips-on-Project Software (STOPS) ridership model. Figure 7-9 shows that approximately 23,000 to 30,000 weekday daily boardings are projected for the integrated streetcar system with the Center City Connector Exclusive Streetcar alternative, an increase of about 14,500 to 23,000 boardings above the No-Build condition. In part due to higher average speed and better reliability, the Exclusive Streetcar is projected to attract approximately 3,000 more daily boardings than the Mixed-Traffic Streetcar.

Figure 7-9 Projected Weekday Daily Streetcar Boardings, 2018

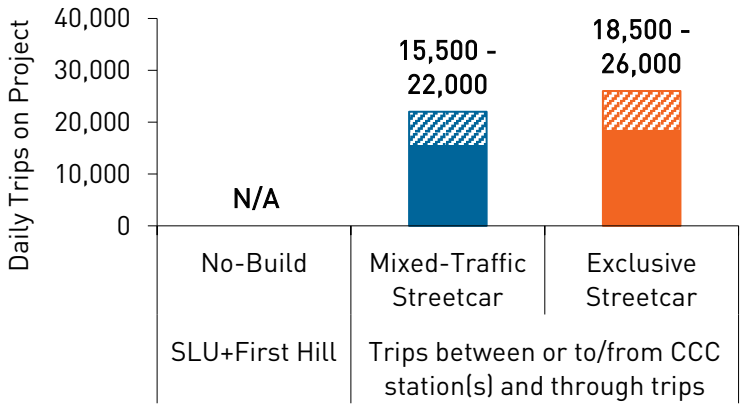


Note: The low-end of each range is based on a STOPS model run calibrated to current characteristics of the South Lake Union Streetcar, which do not fully reflect anticipated use of the Center City Connector by visitors and for non-work purposes. Although STOPS is not designed to fully capture such trips, the high-end STOPS model projection is intended to more fully account for these new ridership markets.

Figure 7-10 shows projected streetcar passenger trips utilizing the Center City Connector stations and/or segment, from the STOPS model, including through trips traveling between stations along the South Lake Union and First Hill Streetcar lines. It does not include trips on the South Lake Union and First Hill Streetcar lines that do not utilize or pass through the Center City Connector segment. The FTA uses such "Project trips" to evaluate federal New and Small Starts funding applications.

Figure 7-11 illustrates total daily boardings and Project trips utilizing the Center City Connector stations and/or segment in the projected 2018 opening year.

Figure 7-10 Projected Weekday Daily Trips on Project, 2018



Note: The low-end of each range is based on a STOPS model run calibrated to current characteristics of the South Lake Union Streetcar. The high-end STOPS model projection is intended to more fully account for these visitor and non-work ridership markets. Project trips by transit dependent individuals are weighted as two trips in the FTA's evaluation; the data in Figure 7-10 is not weighted.

Appendix A of the Detailed Evaluation Report provides additional detail on the ridership analysis.

Additional Ridership Markets: Visitors and Special Events

In addition to the ridership forecasted using the STOPS model, two additional ridership markets exist for the Seattle City Center Connector Project—visitors and special events. These markets are both expected to generate ridership on the Seattle City Center Connector Project, but the STOPS model does not fully or directly account for this type of ridership. The high-end STOPS model ridership projection in Figure 7-9 and Figure 7-10 is intended to more fully capture these types of non-work and visitor trips.

Appendix B describes a separate analysis of these ridership markets. This analysis indicated that about 3,500 daily visitors (mid-range estimate) would utilize the streetcar system with the Center City Connector in place, and estimated streetcar ridership from Seahawks, Sounders, and Mariners games. The analysis also found limitations in the local data available for these travel markets, particularly for special events. Developing additional data sources and conducting further investigation of these new markets is needed to more fully estimate their ridership potential.

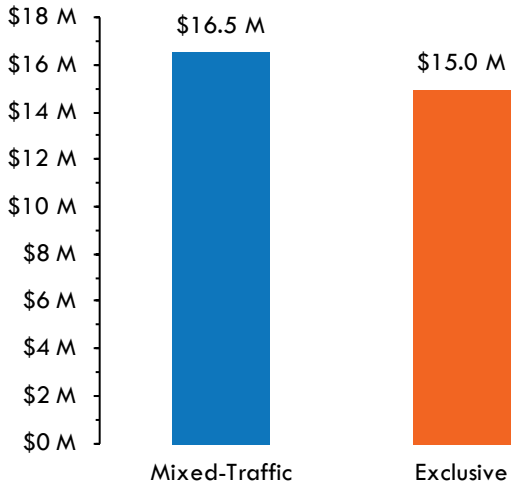
Figure 7-11 Projected Daily Total Boardings and Project Trips by Stop, 2018

Operating and Maintenance Costs

Operating and maintenance costs are lower for the Exclusive Streetcar alternative due to efficiency enabled by faster and more reliable travel times; the same frequency is provided with fewer vehicles and shorter operating trip times.

Figure 7-12 shows the estimated operating and maintenance costs for the hub-to-hub operating scenario. This estimate represents the total operating and maintenance costs for the integrated streetcar system, including the South Lake Union and First Hill Streetcar lines. The Mixed-Traffic Streetcar alternative is expected to cost about $1.5 million more per year to operate and maintain than the Exclusive Streetcar (2018 dollars).

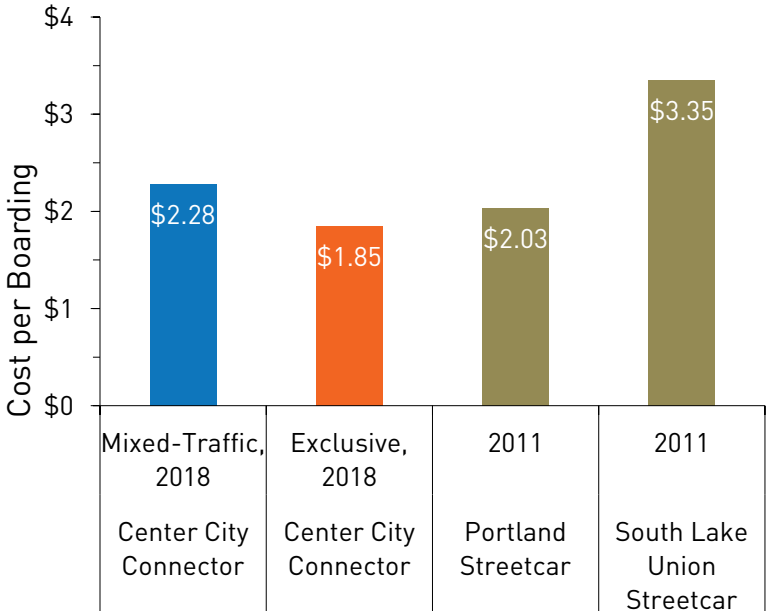
Figure 7-12 Estimated Operating and Maintenance Costs, Hub-to-Hub Operating Scenario, 2018 Dollars



Note: Costs are revised from initial Tier 2 costs reported at Open House #3 in 2013 dollars. The operating cost is in 2018 dollars and is based on updated cost projections for the South Lake Union and First Hill Streetcar lines.

Figure 7-13 illustrates the estimated operating and maintenance cost per passenger boarding for the integrated streetcar system compared to the existing South Lake Union Streetcar and the Portland Streetcar. The Project operating cost per boarding for the combined streetcar system would be $1.85 for the Exclusive Streetcar, lower than the per-trip cost for the existing South Lake Union Streetcar or the Portland Streetcar. The Mixed-Traffic Streetcar cost per boarding of $2.28 is higher than the cost per boarding of the Portland Streetcar but still significantly lower than current cost per boarding for the South Lake Union Streetcar. The faster travel speeds on the Exclusive Streetcar are expected to attract more riders, resulting in a lower operating cost per boarding.

Figure 7-13 Estimated Operating and Maintenance Costs per Boarding



Note: Based on average of low and high ridership projections for each alternative. Center City Connector ridership and operating and maintenance (O&M) costs are for the Hub-to-Hub operating scenario and are in 2018 dollars. Portland Streetcar and South Lake Union Streetcar ridership and O&M costs are in 2011 dollars.

Additional detail on operating and maintenance costs is provided Appendix C: Operating and Maintenance Cost Estimates.

Capital Costs

Capital costs are also lower for the Exclusive Streetcar alternative primarily because fewer vehicles are required to operate the integrated streetcar system.

The non-vehicle capital costs are slightly higher for the Exclusive Streetcar alternative largely due to allowances for exclusive lane treatments and upgraded stop platforms.

Figure 7-14 shows total non-vehicle capital costs, which are about $1.5 million higher for the Exclusive Streetcar than for the Mixed-Traffic Streetcar. Figure 7-15 shows costs on a per-mile basis; there is no difference in the alignment length (1.23 miles) between the alternatives.

Figure 7-14 Estimated Total Non-Vehicle Capital Costs, 2017 Dollars

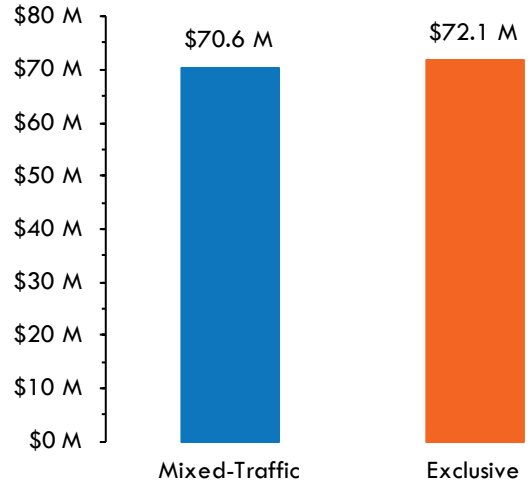


Figure 7-15 Estimated Non-Vehicle Capital Costs per Mile, 2017 Dollars

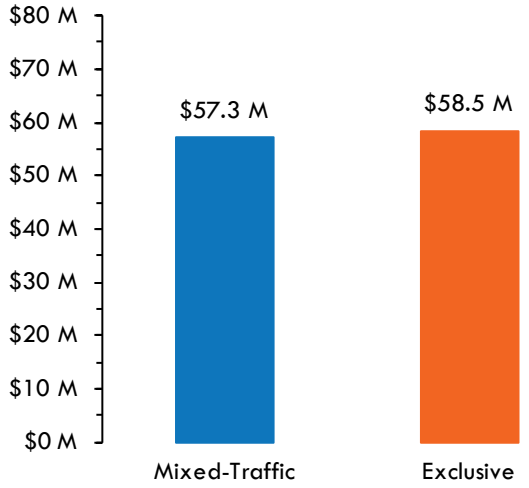
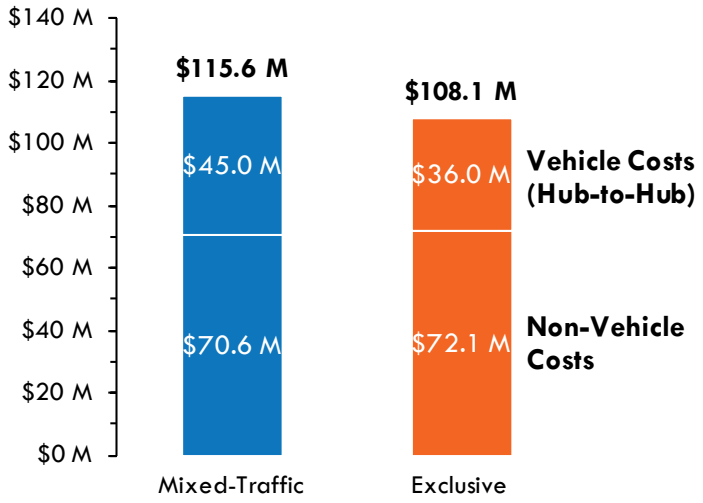


Figure 7-16 shows total capital costs for each alternative, and the non-vehicle and vehicle cost component. Vehicle costs are for the Hub-to-Hub operating scenario, which provides overlapping service between Westlake and King Street Intermodal Hubs. Vehicle costs are estimated to be about $9 million lower for the Exclusive Streetcar alternative than for the Mixed-Traffic Streetcar alternative operate—the most significant capital cost difference between the alternatives. The Mixed-Traffic Streetcar would require two more vehicles to operate. The lower vehicle costs offset the Exclusive Streetcar's slightly higher capital costs, resulting in total capital costs of about $7.5 million less for the Exclusive Streetcar alternative than for the Mixed-Traffic Streetcar alternative

Figure 7-16 Estimated Total Capital Costs, 2017 Dollars



Appendix E: Capital Cost Methodology and Estimates provides additional detail on the capital costs described in this section. The capital cost estimates include an allowance for utility coordination but do not include utility construction costs; the cost of relocating utilities for transportation projects is the responsibility of the utility provider. These costs would be included in the capital improvement programs of public utilities (Seattle Public Utilities and Seattle City Light). Appendix F: Utility Impact Assessment provides additional detail on utility impacts and order-of-magnitude cost estimates for comparative purposes; utility costs are estimated to be on the order of $8 million (Exclusive Streetcar) to $9 million (Mixed-Traffic Streetcar)—approximately $1 million lower for the Exclusive Streetcar alternative.

On-Street Parking and Parking Impacts

On-street parking stalls and loading zones support small/local businesses along and around the 1st Avenue streetcar alignment. This section provides an overview of impacts to parking and loading zones for each alternative. The assessment of impacts is based on order-of-magnitude estimates for comparative purposes. Actual parking and loading zones would be refined in later stages of design.

Figure 7-17 shows the impact to on-street parking in each alternative. In the Mixed-Traffic Streetcar alternative, peak-restricted parking is maintained outside of turn lanes and streetcar stops. All parking in the Exclusive alternative is on the west side of 1st Avenue and is not peak-restricted.

There are also 1,265 total off-street parking stalls within a one-block distance of 1st Avenue (Jackson-Stewart). On average, only 46% are occupied between 8:30-11:30 am and 60% between 1:30–3:30 pm.[8]

Figure 7-18 shows the impacts to loading zones by segment for each alternative. A total of 65 loading zones currently exist along the alignment. In the Mixed-Traffic Streetcar alternative this number would be reduced to 55, and in the Exclusive alternative the total number of loading zones would be 25. General or passenger loading zones that are available for parking off-peak are also included as peak-restricted on-street parking.

More information on impacts to parking and loading spaces can be found in Appendix I: Parking Impacts Assessment.

[8] Puget Sound Regional Council (PSRC), Parking Inventory, 2010

Figure 7-17 On-Street Parking Impacts (Comparative Analysis)

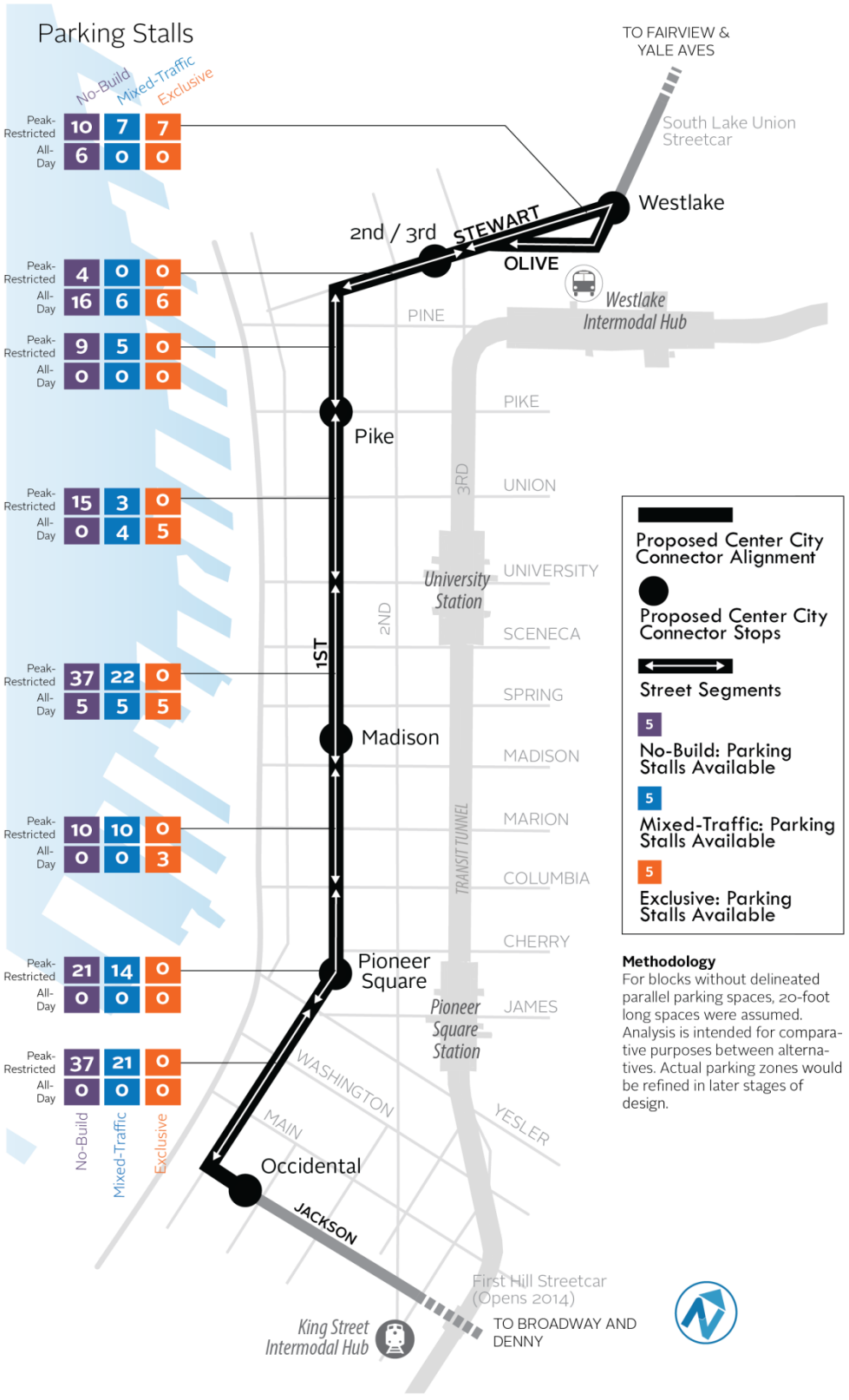
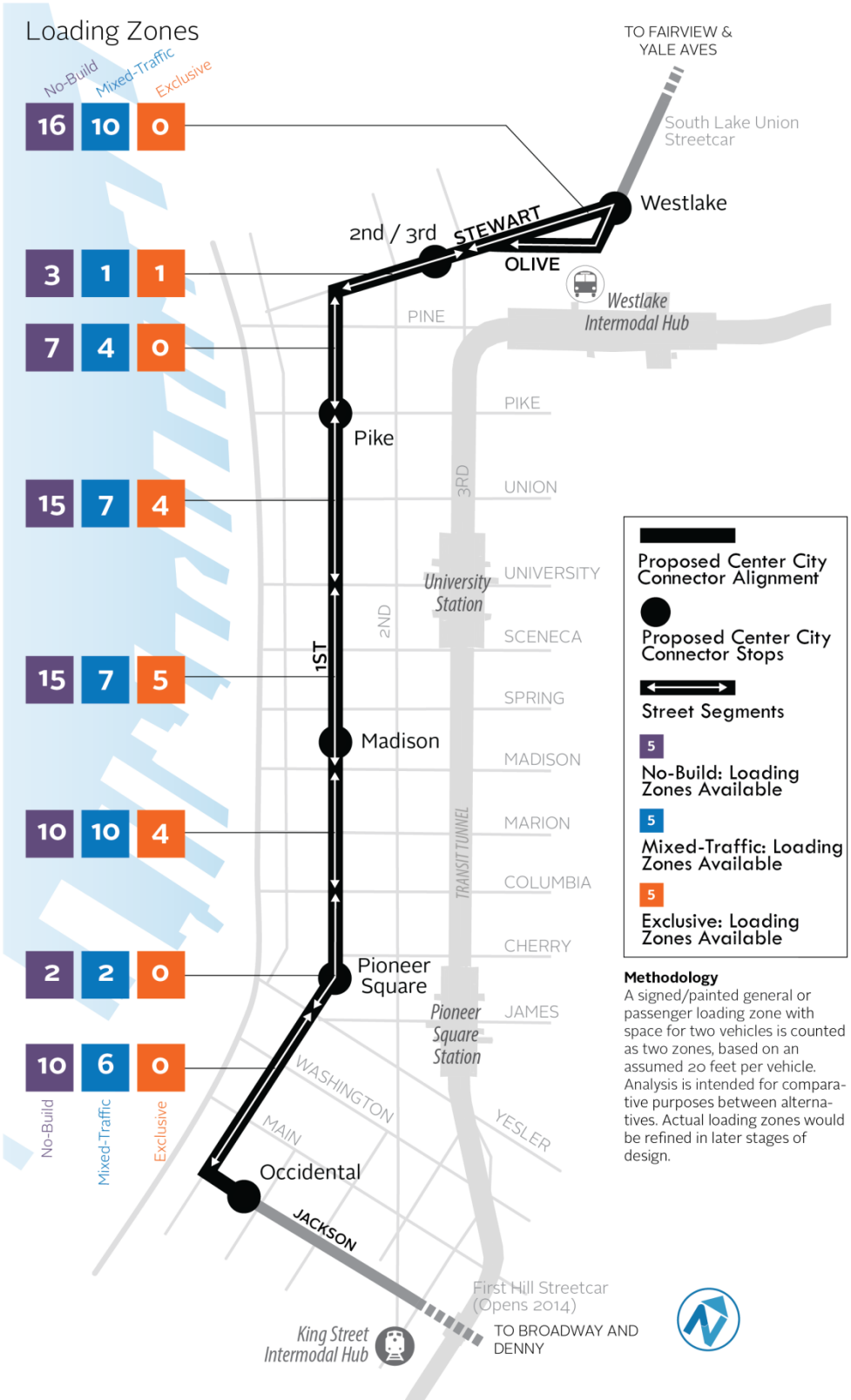


Figure 7-18 On-Street Loading Impacts (Comparative Analysis)



Additional Results/Details

In addition to the appendices referenced in each section of this chapter, several additional appendices provide supplemental information related to the Tier 2 evaluation:

- Appendix K: Economic Development Analysis.
- Appendix L: Affordable Housing Assessment.
- Appendix R: Additional Conceptual Drawings.

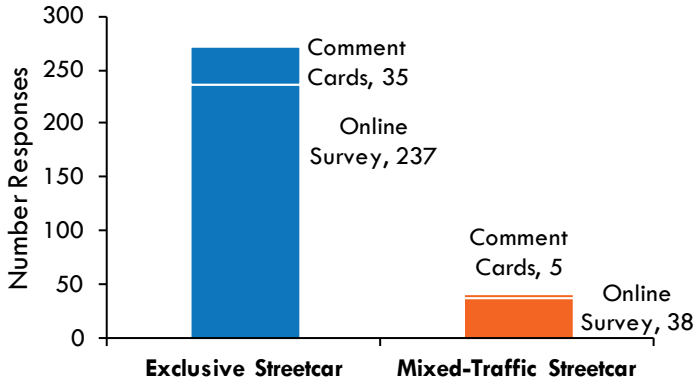
8 TIER 2 PUBLIC OUTREACH SUMMARY

This section summarizes public input related to the Tier 2 evaluation, which included Open House #3 held on October 29, 2013 and an online survey made available for several weeks following the open house. The comment card distributed at the open house and the online survey both asked a series of similar questions regarding respondent preference for the Tier 2 alternatives as well as demographic information. This section provides a high-level summary of responses from both public engagement tools. Additional detail on these results and the full text of all comments received can be found in Appendix P of this report.

Alignment Preference

Public input on the Tier 2 alternatives strongly favored the Exclusive Streetcar. Figure 8-1 shows a summary of feedback from Open House #3 and the online survey. A total of 315 responses were received, 86% of which favored the Exclusive Streetcar alternative compared to 14% that favored the Mixed-Traffic Streetcar alternative.

Figure 8-1 Public Input on Tier 2 Alternatives



n=349. Note: 34 of the online survey respondents did not indicate a preference between the Mixed-Traffic and Exclusive Streetcar Alternatives.

Both survey instruments (open house comment cards and online survey) asked respondents to rank the evaluation criteria that were most important in determining their overall alternative preference. Figure 8-2 shows the difference in ranking between those who preferred the Exclusive Streetcar alternative and those who preferred the Mixed-Traffic Streetcar alternative.

Respondents who preferred the Exclusive Streetcar alternative consistently ranked "streetcar travel time" and "streetcar travel time reliability" as the first or second-most important evaluation criteria. These respondents consistently ranked evaluation criteria that measured impacts to other modes as the least important, including "average auto travel time," "increase in delay on parallel corridors," and "parking and loading impacts."

For respondents who preferred the Mixed-Traffic Streetcar alternative, the average rankings for all criteria were closer to the middle, indicating greater differentiation in the reasons for their preference. On average, the "parking and loading impacts" criterion was ranked as the most important. The criteria related to auto travel times and delays were more important among respondents favoring the Mixed-Traffic Streetcar alternative.

The results were similar between the comment cards from the open house and online survey responses; Appendix P documents these results separately.

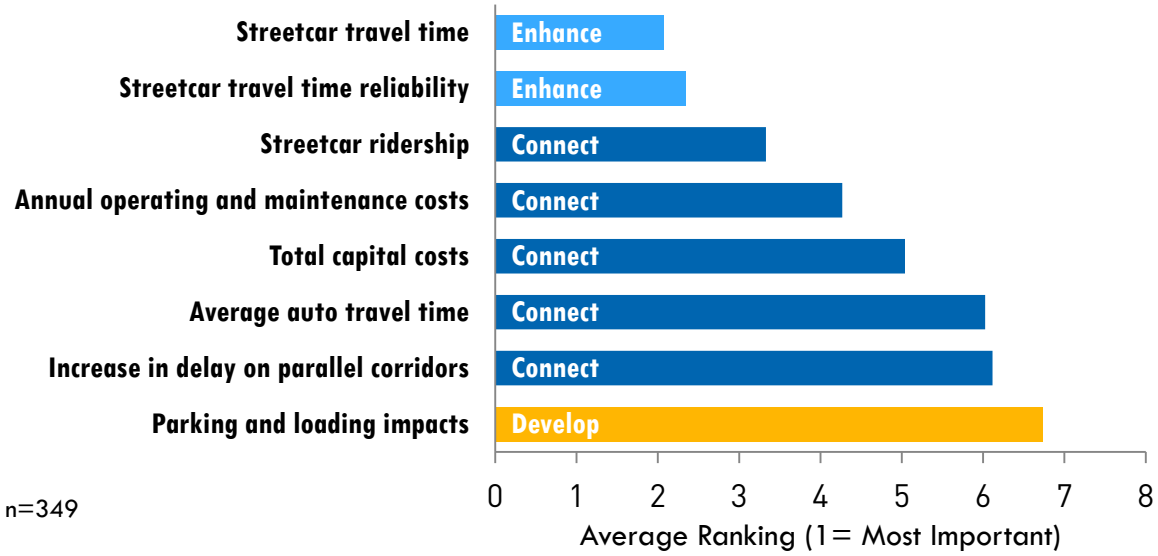
Figure 8-2 Criteria Ranking by Alignment Preference (Combined Open House #3 & Online Survey Results)

		Ranking of Importance (1 to 8)		
	Evaluation Measures	Overall	Prefer Mixed-Traffic Streetcar	Prefer Exclusive Streetcar
ENHANCE	Streetcar Travel Time	2.0	4.1	1.8
ENHANCE	Streetcar Travel Time Reliability	2.3	4.5	2.0
CONNECT	Streetcar Ridership	3.3	4.4	3.1
CONNECT	Annual Operating & Maintenance Costs	4.3	4.3	4.2
CONNECT	Total Capital Costs	5.1	4.8	5.1
CONNECT	Auto Travel Times	6.1	4.3	6.3
CONNECT	Increase in Delay on Parallel Corridors	6.2	5.3	6.3
THRIVE	Parking/Loading Impacts	6.7	3.6	7.2
	Number of Responses	355	48	307

Importance of Evaluation Measures

Figure 8-3 identifies the relative importance of the eight evaluation criteria presented in Figure 8-2 (page 8-2), as ranked by online survey respondents and open house participants. Evaluation measures were ranked from 1 (most important) to 8 (least important).

Figure 8-3 Ranking of Evaluation Measures by Importance, Open House #3 and Online Survey

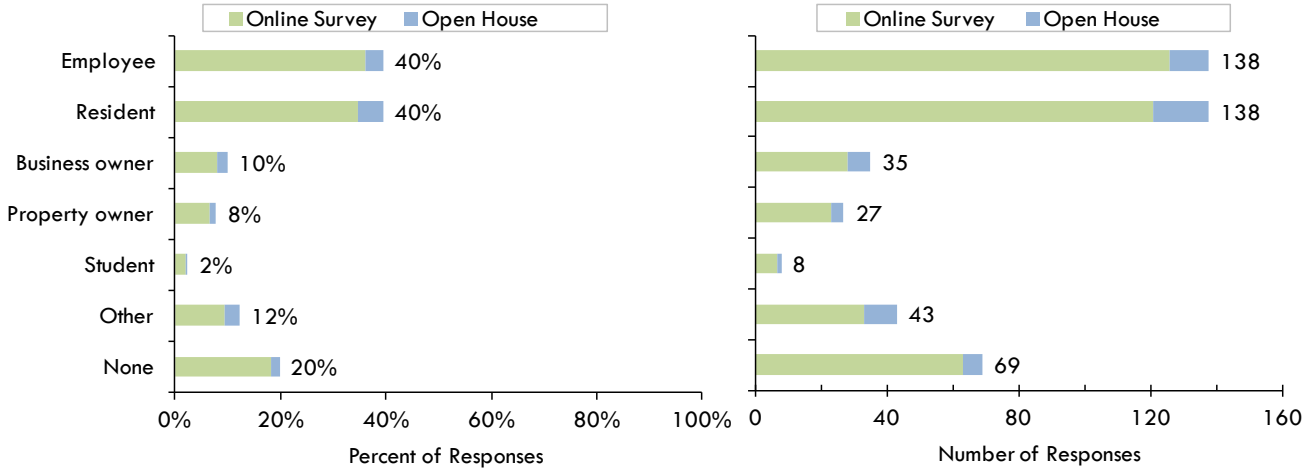


Relationship to project

Several questions on the open house comment card and online survey asked respondents about their relationship to downtown, frequency of transit use, attendance at previous Project open houses, and familiarity with the Project. This section summarizes responses to these questions.

Figure 8-4 shows the relationship of survey respondents to downtown Seattle. Respondents were able to identify with as many categories as applied, so the total number of responses is greater than the number of respondents. In both the comment card and online survey responses, residents and employees within the study area represented the largest number of respondents (combined 80%). Approximately 10% of respondents identified as downtown business owners and an additional 8% as property owners. Nearly a third of respondents identified as either "None" or "Other"; of these, many described themselves as residents of other Seattle neighborhoods who are frequent visitors to downtown for shopping, entertainment, or business purposes. Only 2% of respondents identified as downtown students, which is not surprising given that there are no large schools within the study area.

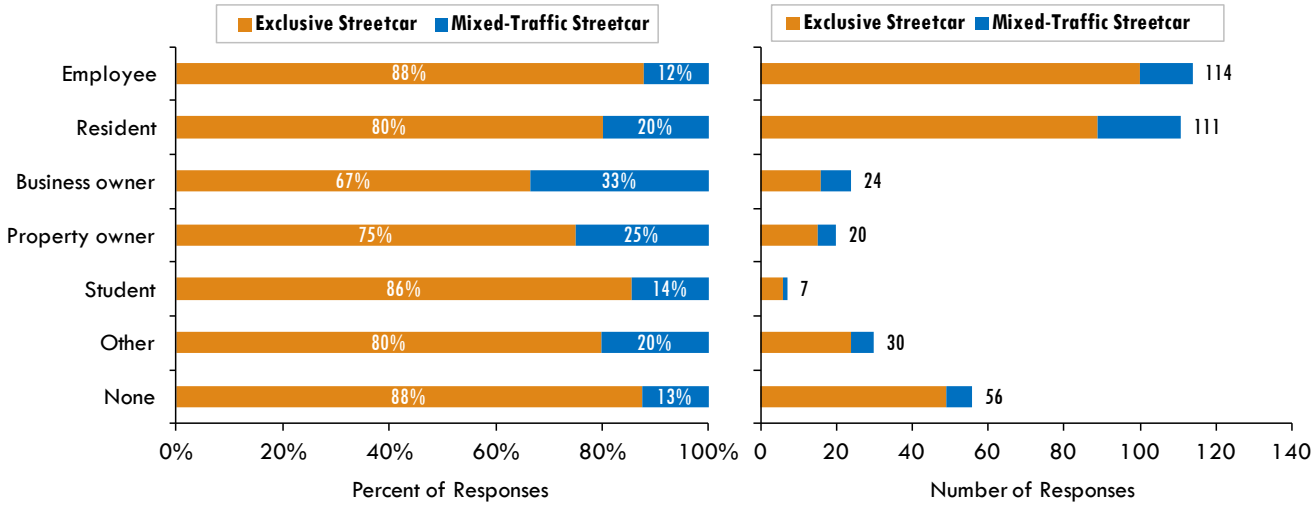
Figure 8-4 Respondent Relationship to Downtown



Note: Respondents could select multiple categories; total percentage is greater than 100%; n=349

The Exclusive Streetcar alternative was preferred by all groups (Figure 8-5). The strongest preference for the Exclusive Streetcar alternative was found among downtown employees, students, and respondents who identified as "None." The smallest margin of preference was found among downtown business owners; about two-thirds (67%) of these respondents favored the Exclusive Streetcar. Among downtown property owners, about three-quarters (75%) favored the Exclusive Streetcar alternative.

Figure 8-5 Alignment Preference by Relationship to Downtown



Note: Respondents could select multiple categories; n=349

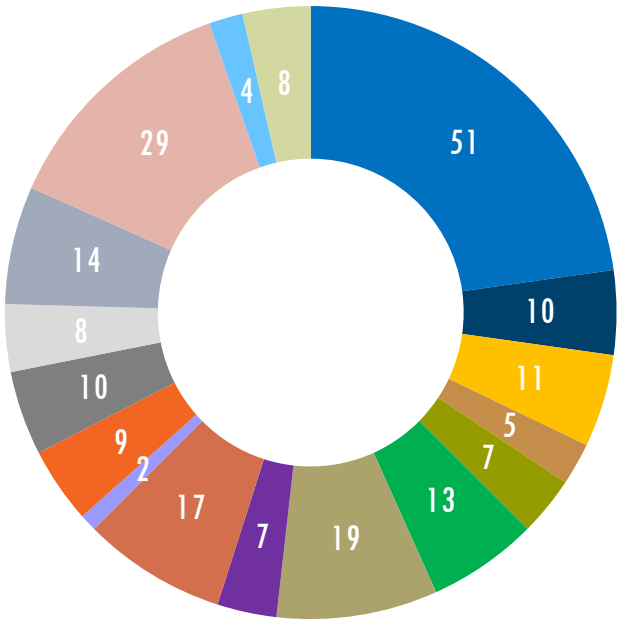
Survey Comments

Figure 8-6 shows the topics included in free-response comments on the online survey. Online survey comments that addressed multiple topics were coded once for each topic included. The most frequent topic of comments was support for the Exclusive Streetcar alternative, with numerous respondents indicating that they did not feel the Mixed-Traffic Streetcar alternative would be worth building; a limited number of comments preferred the Mixed-Traffic Streetcar alternative. There was also strong interest by some in using the historic Benson streetcars for some or all of the streetcar operations. However, several respondents stated that they would support using the Benson streetcars only if their use would not negatively impact transit frequency, speed, and comfort or opposed their use altogether. Other themes from both the online survey and open house included:

- Comments supporting the Stewart/Olive east-west connection were relatively balanced with comments that supported or wanted additional analysis of a connection using Pike and/or Pine Streets.
- Comments supporting a Waterfront alignment appeared to be relatively balanced between respondents who favored it instead of a 1st Avenue streetcar alignment and those who envisioned it as a complement to a 1st Avenue alignment.
- Comments supporting extensions to either Uptown/Seattle Center or South of Downtown (SODO)/Stadium District mostly favored these as complements to a 1st Avenue streetcar alignment.
- A number of comments addressed the need for bicycle facilities and/or bicycle safety considerations.
- Various comments offered design suggestions related to specific stop placement, compatibility with longer/Rapid Streetcar vehicles, track placement, intermodal connections, and the operating plan/scenarios.
- Specific concerns were raised related to a 1st Avenue streetcar alignment, including maintaining street trees and/or neighborhood character of Pioneer Square, parking/loading impacts, and traffic impacts.
- Some comments offered general support for the project while others expressed general criticism of the project or expressed a preference for different alignments.

A full listing of comments from the online survey and open house comment cards can be found in Appendix P: Tier 2 Public Outreach Summary.

Figure 8-6 Free-response Comments (Online Survey)



- Support for Exclusive Streetcar (51)
- Support for Waterfront alignment (including to complement 1st Avenue) (10)
- Support for extension(s) (Uptown/Seattle Center, Stadium District, or elsewhere) (11)
- Support for Stewart/Olive east-west connection (5)
- Support for (or desire to further investigate) east-west connection using Pike and/or Pine (7)
- Suggestion/concern about inclusion of bicyclists (13)
- Design suggestion (stop placement, support for longer vehicles, track placement, intermodal connections) (19)
- Comment/suggestion on operating plan/scenarios (7)
- General support for project (17)
- Prefer Mixed-Traffic Streetcar (2)
- Preference for another corridor (e.g., 1st/2nd, 3rd, 4th/5th) (9)
- Concern about historic street trees (or other concerns related to Pioneer Square neighborhood character) (10)
- Concern about loss of parking/loading zones and/or auto capacity/traffic congestion impacts (8)
- General criticism of project (14)
- Support use of Benson streetcars (29)
- Oppose use of Benson streetcars (4)
- Other concerns or comments (8)

9 TIER 2 RECOMMENDATION

Based on stronger performance against the project evaluation criteria and the level of public support, the project team recommended 1st Avenue Exclusive Streetcar as the Center City Connector Locally Preferred Alternative (LPA). Both Stewart/Olive and Pike/Pine/4th/5th east-west connections between 1st Avenue and the South Lake Union Streetcar were recommended for inclusion in the LPA.

Chapter 6 of the Center City Connector LPA Report (Volume I) describes the recommended LPA and Chapter 7 of the LPA Report (Volume I) outlines next steps for advancing the City Connector Project.

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