CENTRAL AUSTIN TRANSIT STUDY

DRAFT

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Rifeline

ASMP
AUSTIN STRATEGIC MOBILITY PLAN

July 15, 2010

Austin Strategic Mobility Plan

Vision

An Austin with an **integrated mobility network** for the entire community that provides safe and efficient alternatives to driving alone, supports connected development around activity centers and corridors, and respects the limitations of our natural resources as we respond to the region's rapid growth.

Mission

The Austin Strategic Mobility Plan (ASMP) will identify the best solutions to close gaps and remove barriers in Austin's road, rail and trail systems and to connect Austin's people, mobility systems and investments to the larger Central Texas region. The ASMP aims to extend the community's limited fiscal resources with partnerships and new funding opportunities.

The ASMP reflects the interdependence of transportation and land use. The ASMP will work in tandem with the Imagine Austin Comprehensive Plan (IACP) and emphasizes investments which directly implement other City and regional planning efforts, including neighborhood plans and corridor plans, the Bicycle and Sidewalk Master Plans, and the CAMPO 2035 Long Range Transportation Plan.

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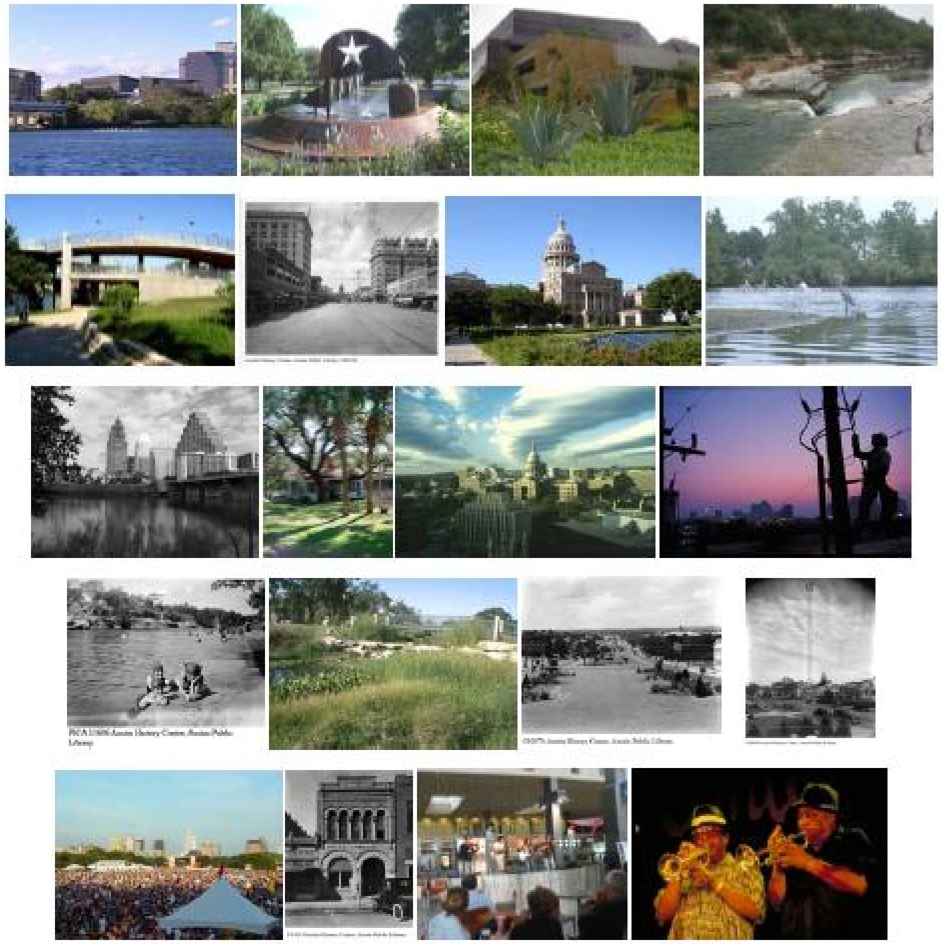

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Executive Summary

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Executive Summary

Overview

The *Central Austin Transit Study* is a key component of the City's *Austin Strategic Mobility Plan* (ASMP), which established a critical need for major transit investment in Central Austin. The main focus of this study is to validate previous recommendations for a new rail transit option serving Central Austin. The study area was drawn from a compilation of these studies, with the boundaries being approximately from the Mueller Redevelopment, through the central core of Austin (University of Texas, Capitol Complex, and the Central Business District) to the Austin-Bergstrom International Airport (ABIA). The *Transit Study* re-evaluates the various alternative routes, vehicles, and investment strategies (especially streetcar/urban rail) previously contemplated by this community.

The *Austin Strategic Mobility Plan* (ASMP) is a comprehensive effort to catalog, map, and prioritize the City's, and the Region's, transportation needs AND to identify, prioritize, and implement solutions. This innovative program is the centerpiece of the City of Austin's (COA) Transportation Planning efforts – both short- and long-term – and is a transparent, accountable, and coordinated approach to meeting the city's transportation needs for roads, bicycles, pedestrians, urban trails, and transit.

This *Transit Study* is a public forum for a community to identify mobility problems and other needs in Central Austin and to evaluate the benefits, costs, and impacts for a range of potential transportation solutions. This evaluation is the first step in the project development process and is used to determine a recommended transit investment strategy that may be advanced for even more focused study and development during the National Environmental Policy Act (NEPA) process.

Most importantly, the *Central Austin Transit Study* is an update and validation of the CMTA *Circulator Alternatives Evaluation*, and therefore owes much of the source material to that study. It should also be noted that while much of the contextual discussions in this chapter, along with Chapters 2 and 7, focuses on Urban Rail, the actual alternatives evaluations documented in Chapters 3, 4, and 5 were conducted without prejudice and according to standard industry practices.

Need and Purpose

The Need for a Transit Investment in Central Austin

Austin is at the heart of the rapidly growing Central Texas Region. The City of Austin and State of Texas Demographers project the region's population will grow by more than 1 million people in the next 25 years, while Austin's population will swell by 750,000. The tremendous growth presents both challenges and opportunities that can affect the livability, sustainability, and mobility of Austin and the region.

Central Austin's existing transportation network is at capacity during peak hours and there are few opportunities to expand roadways, yet Austin's continued vitality – social, environmental, and economic – depend on mobility. Central Austin needs improved mobility – person-moving capacity – in the form of new and expanded modal options to meet the demands of continued economic and population growth. Investing in transit is one of the most effective ways for Austin to meet its mobility needs given the significant obstacles to expanding its roadway network serving Central Austin.

Summary of Needs

1. ***Increasing Population Growth:*** Austin and Central Texas will experience significant growth over the next 25 years. Expanding population and employment require mobility improvements to connect people and places.
2. ***Changing Land Use:*** Growth will have a significant impact on land use and the City has a critical opportunity to focus and direct development for the benefit of the community.
3. ***Insufficient Connectivity:*** Major activity centers within Central Austin – CBD, Capitol, and UT – and throughout the region need better connectivity and people need more options for getting around. New commuter and regional transit modes are also in need of critical linkages.
4. ***Increasing Travel Demand:*** Increases in population and employment throughout the region will generate increases in trips to/from and within Central Austin. Mobility in and around Central Austin is essential to its livability.
5. ***Insufficient Network Capacity:*** Much of the existing roadway network in Central Austin is already at capacity during the expanding peak hours. A *Ring of Constraint,* defined by severe congestion points surrounding Central Austin, restricts access to the core of the region. Yet, there's no room to expand roads, let alone construct new ones.
6. ***Sustained Economic Development:*** Economic growth is critical to ensuring that the City can continue to meet the needs of its – and therefore the region's – rapidly growing population. Sustained economic development depends on a functioning transportation network and constraints on mobility have a dampening effect on economic activity. Alternatives for travel that can bypass the existing mobility constraint points or expand the capacity of existing bottlenecks are needed.
7. ***Protection of Air Quality:*** Today, Central Texas is confronting issues of poor air quality from automobile emissions and other sources. This pollution not only affects the health of our citizens, but also puts the region at risk of losing federal transportation dollars for non-compliance with air quality standards. Increasing population and employment growth means these problems will be compounded – unless we take intervening actions.

8. ***Protection of Quality of Life:*** For many residents of the region, travel times have increased due to traffic congestion and lower-density land uses. Growing travel times and travel delays adversely impact our pocketbooks, air quality, productivity, and quality of life. Austin needs more travel choices – ones that can reduce costs and stress factors – and, enable people to live closer to Central Austin.

Purpose of a Transit Investment in Central Austin

The purpose of a new transit investment is to improve mobility, connectivity, and the sustainability of Central Austin. New higher-capacity transit service can offer a safe, reliable, and efficient alternative to existing traffic congestion; relieving roadways with little room for expansion. By connecting Downtown, the Capitol Complex, and the University of Texas to each other and to the emerging regional rail network, new added transit can improve mobility and help manage Austin's inevitable growth.

Goals of a Transit Investment in Central Austin

A significant transportation improvement in the study area should meet the following goals:

1. ***Improve Place Connectivity:*** Improve connections to and between key existing and emerging destinations within the study area. Specifically, improve connections between Downtown, the Capitol Complex, UT, Mueller, and ABIA.

2. ***Improve Transit Connectivity:*** Improve the regional transportation network by providing connections among transit modes, including bus, commuter rail, and regional rail systems. Specifically, improve linkages to CMTA's new Red Line and planned Green Line commuter services and Lone Star Rail's planned regional service.

3. ***Improve Mobility:*** Increase the person-moving capacity of the transportation network by providing high-capacity options.

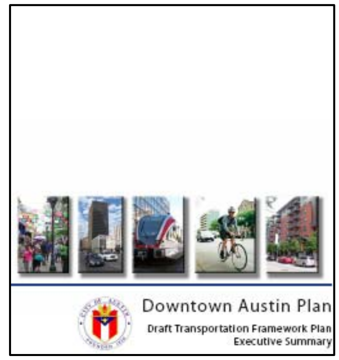
4. ***Maximize Community Benefits:*** Develop transit services that enhance and reinforce the characteristics of the existing and planned land uses and community environment.

5. ***Maximize Environmental Benefits:*** Develop transit services that maximize the positive benefits to the natural environment, including energy and emissions reductions.

6. ***Maximize Economic Benefits:*** Develop transit services that help increase economic opportunities and build wealth for local communities, while minimizing demands for increased local expenditures.

How Does This Study Relate to Previous Studies?

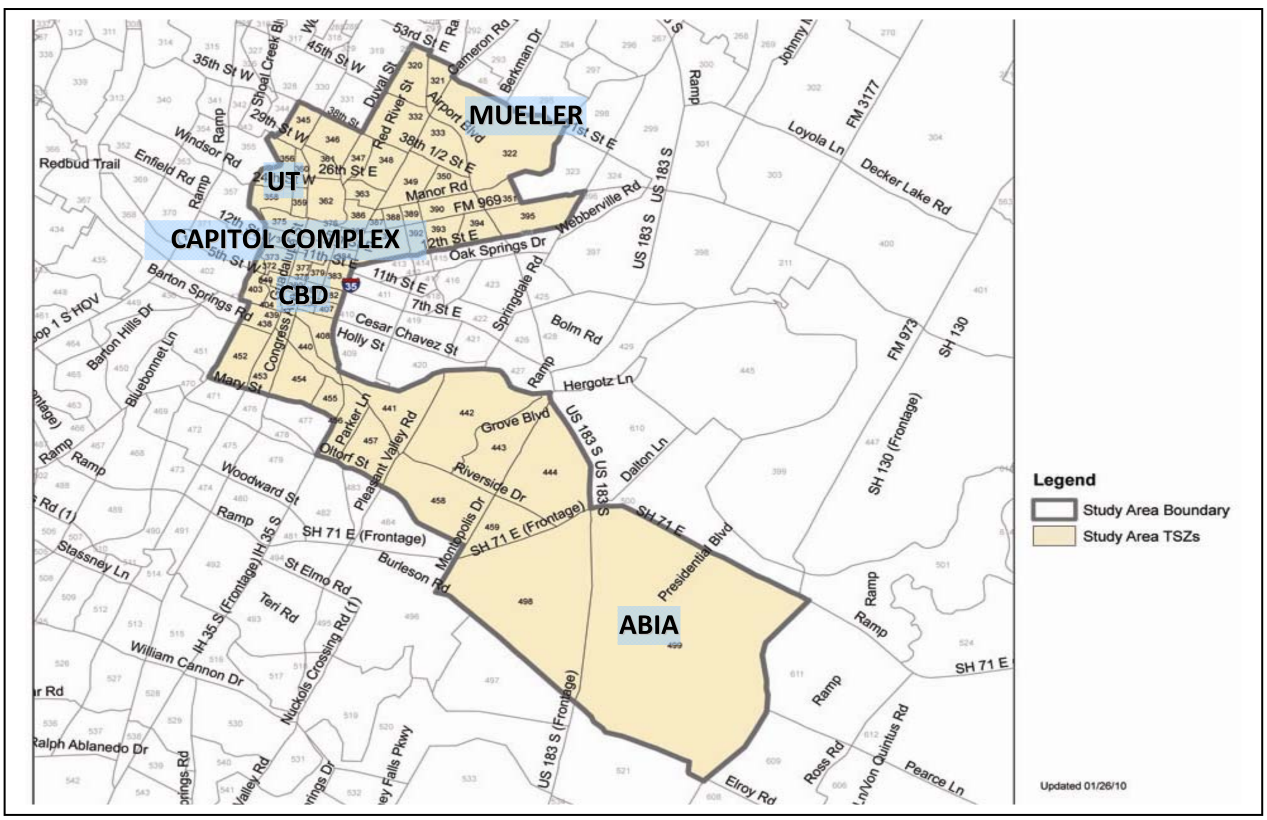
This *Central Austin Transit Study* builds primarily upon the community's more recent transportation and land use planning efforts, including the *Capital Metropolitan Transportation Authority (CMTA) Future Connections Study – Central Austin Circulator – Alternatives Evaluation,* 2006; *City of Austin/CMTA Modern Streetcar/LRT Proposal,* 2008; *City of Austin Downtown Austin Plan,* (Phase One, 2008, and Phase Two, 2009); and the *East Riverside Corridor Master Plan,* 2010; along with the current *City of Austin's Imagine Austin Comprehensive Plan* and *Austin Strategic Mobility Plan*.



What is this Project's Study Area?

This study area links Austin's "core" (downtown/central business district (CBD), Capitol Complex, and the University of Texas (UT)) – to the mixed use, master planned Mueller redevelopment in the Northeast to Austin-Bergstrom International Airport (ABIA) in the southeast. It links more than 16 miles of Central Austin to the commuter and regional rail facilities within the Central Business District (CBD.) As shown in Figure ES-1, the study area *links employment and population* in the core to population and employment centers at Mueller and the East Riverside Corridor.

Figure ES-1. Study Area

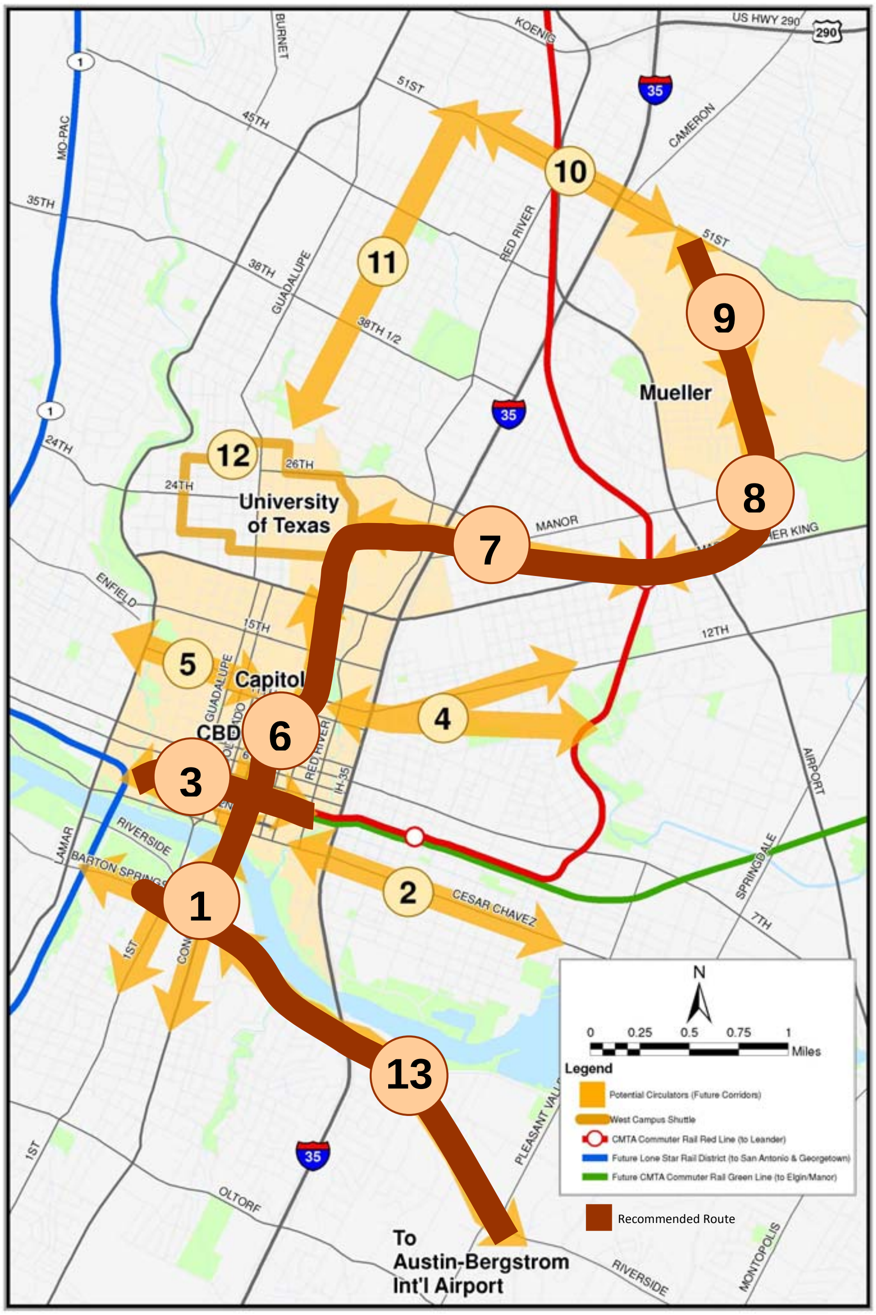


Source: URS Corporation, 2010.

What Route Alternatives were Evaluated?

The Central Austin population, employment, educational, and commercial activity centers – CBD, Capitol Complex, University of Texas, Mueller Redevelopment, and ABIA – were used to establish the set of *Connection Need Corridors.* These route alternatives are consistent with previous studies, historical travel patterns, neighborhood and City plans. Figure ES-2 shows the 13 Connection Need Corridors evaluated for this study, along with the seven routes advanced as alignments for additional study.

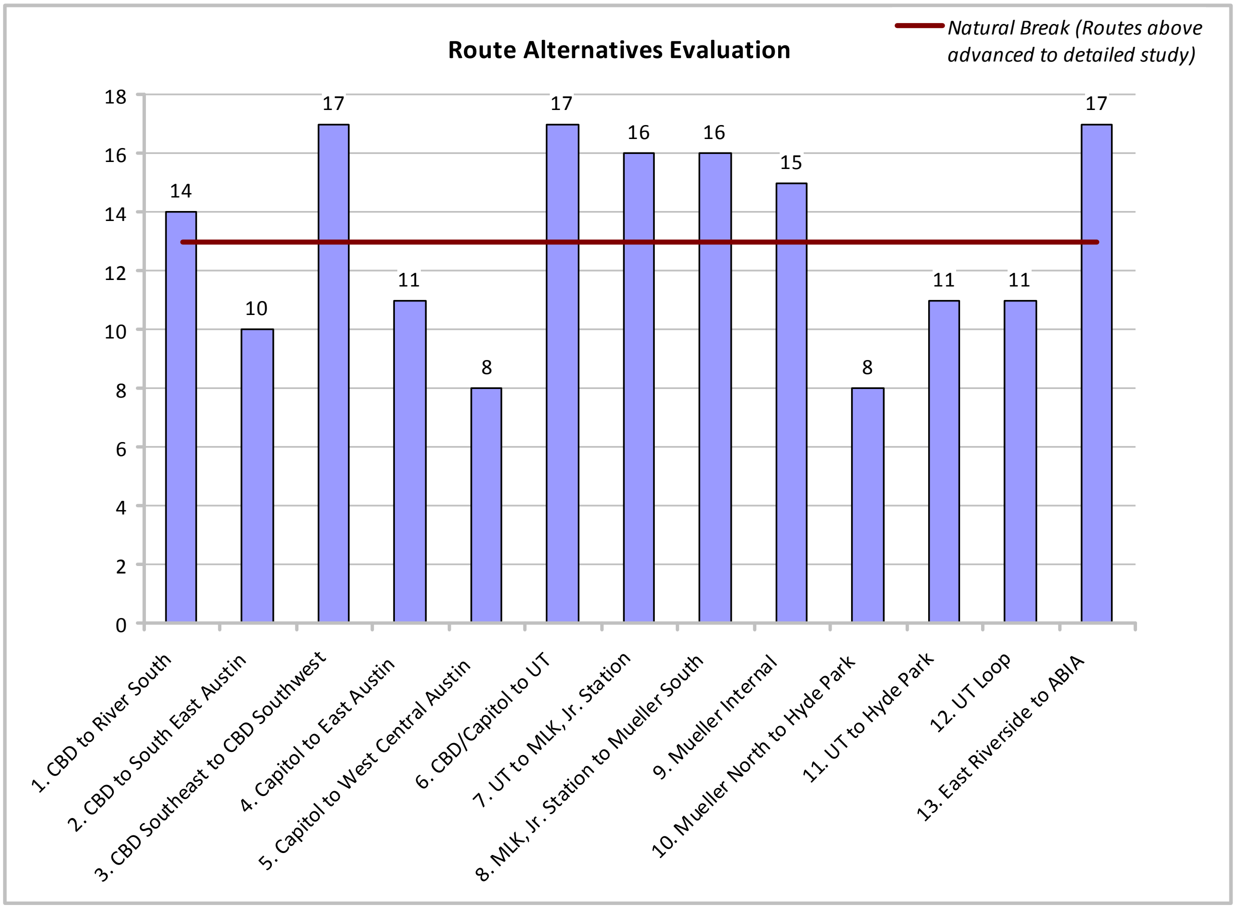
Figure ES-2. Recommended Route



Source: URS, 2010.

The recommended alignment was selected from the complete set of 13 route alternatives, or Connection Need Corridors, by identifying a natural break in the results tabulation. As shown below in Figure ES-3, six routes, **1, 3, 6, 7, 8, 9, 13**, scored noticeably higher than the other seven.

Figure ES-3. Routes Selected for Recommended Alignment by Evaluation Results

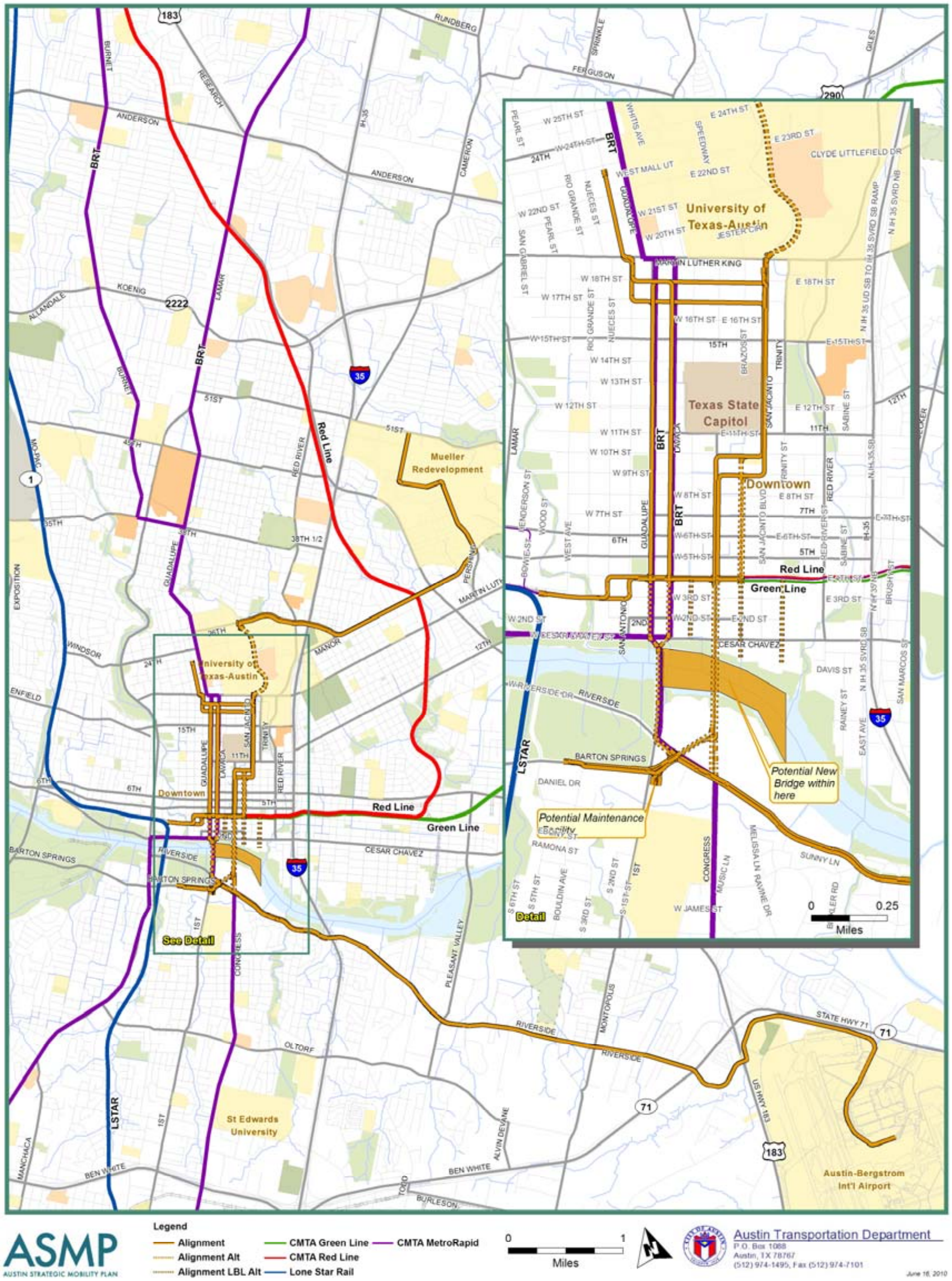


Recommended Alignments

The recommended alignment for the Build, TSM, and No-Build alternatives is summarized below and shown in Figure ES-4. The alignment consists of the following segments:

- ***Downtown Commuter Rail Station to Seaholm Redevelopment***
- ***Downtown/Capitol Complex to University of Texas (East & West CBD)***
- ***University of Texas to MLK, Jr. Commuter Rail Station/Mueller South***
- ***Mueller Redevelopment Internal***
- ***Lady Bird Lake Crossing***
- ***East Riverside to Austin-Bergstrom International Airport (ABIA)***
- ***Palmer/Long Center Spur***

Figure ES-4. Recommended Alignments



Source: City of Austin, 2010.

What Types of Transit Modes Were Evaluated?

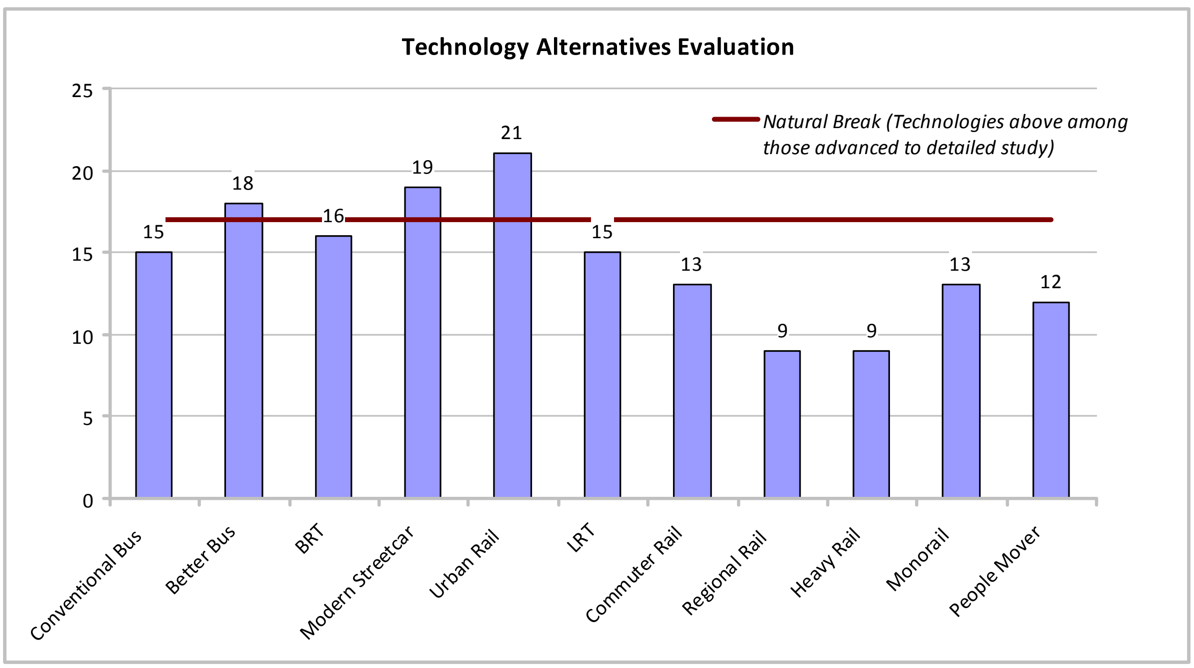
There is a broad range of vehicle, or modal, technology alternatives suitable for a major transit investment in Central Austin. The technology alternatives studied include the following:

- ***Conventional Bus***
- ***Better Bus***
- ***Bus Rapid Transit (BRT)***
- ***Streetcar/Urban Rail***
- ***Commuter Rail***
- ***Light Rail***
- ***Heavy Rail***
- ***Regional Rail***
- ***Monorail***
- ***People Mover/PRT***

***Urban Rail* is the City of Austin's term for a blend between a modern streetcar and light rail transit (LRT) vehicle, using an overhead-electric powered fixed-guideway service. An Urban Rail vehicle is smaller, lighter and more maneuverable than a typical light rail vehicle (LRV). Similar to a modern streetcar, Urban Rail vehicles can operate both in mixed traffic and in dedicated rights-of-way.**

Each vehicle technology alternative was scored based on knowledge of the corridors and input from the public gathered during the *Central Austin Circulator – Alternatives Evaluation,* 2006. The outcome of this technology evaluation is shown below in Figure ES-5.

Figure ES-5. Recommended Technologies by Evaluation Results



Recommended Technologies

The recommended **technologies** for advancement for the build alternatives are **urban rail** and **better bus**. Of the 11 modal technologies evaluated, urban rail ranked the highest and was selected as the fixed-guideway build alternative, while better bus was identified as the TSM build alternative, for on-going consideration.

What Transit Investment Alternatives were Evaluated?

Based on the conceptual evaluations of **routes** and vehicle **technologies**, the following **transit investment alternatives** were identified for detailed evaluation using the recommended **alignment**:

- **No-Build Alternative**, consisting of the existing transportation and transit facilities and services in the corridor, along with any planned improvements.
- **Better Bus Alternative (TSM)**, consisting of enhanced service over conventional bus, including intelligent transportation system (ITS) technologies and other priority measures to minimize travel delay. This is the TSM alternative.
- **Urban Rail Alternative (Build)**, consisting of a hybrid streetcar/LRT service running both in mixed traffic and semi-exclusive rights-of-way. Urban Rail also includes ITS and other priority measures. This is the Build alternative.

How Did the Alternatives Rank in Comparison to Each Other?

The three Investment Alternatives were subjected to a quantitative and qualitative assessment of each alternative's relative ability to meet the six overall goals established for the study. See Table ES-2 below:

Table ES-1. Summary of Detailed Evaluation

Goal	No-Build	Better Bus	Urban Rail
1. Improve Place Connectivity	○	◐	●
2. Improve Transit Connectivity	○	●	●
3. Improve Mobility	○	●	●
4. Maximize Community Benefits	○	◐	●
5. Maximize Environmental Benefits	○	◐	●
6. Maximize Economic Benefits	○	◐	●
OVERALL RATING	○	◐	●

What Are the Characteristics of the Recommended Locally Preferred Alternative?

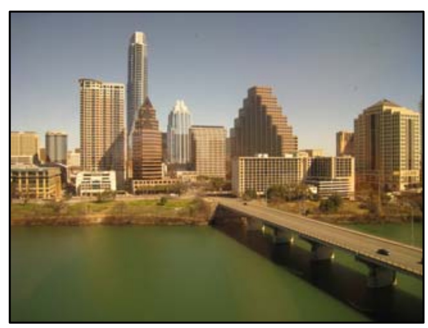
As a result of the conceptual and detailed evaluations, the recommended Locally Preferred Alternative (LPA) is Urban Rail, serving the Austin core (CBD, Capitol Complex, University of Texas,) Mueller Neighborhood, East Riverside Corridor, and Austin Bergstrom International Airport (ABIA). See Figure ES-4.

Length:	33.8 track miles, 16.5 route miles
Capital Cost:	$955 million in first quarter 2010 dollars or $1.3 billion in year-of-expenditure (YoE) dollars* at $37.2 million YoE per track mile.
Operations Cost:	Approximately $25 million YoE per year.
Ridership:	Average weekday ridership projected to be approximately 27,600 by 2030.
Operations Plan:	Two crossing routes (6.5 and 10 route miles each), with 10-minute peak/off-peak headways, using 27 vehicles (plus 2 spares), with service 16 hours a day/5 days a week and reduced service on weekends and holidays.
Travel Time:	Approximately 32 – 33 minutes from end-to-end for both routes.

(* Regional transportation plans require year of expenditure (YoE) estimates that account for inflation.)

What Issues Require Further Consideration?

The recommendation of a Locally Preferred Alternative identifies several unanswered planning questions to be addressed in further detailed efforts.



Alignment Options

East CBD – Congress Avenue vs. Brazos Street

One issue involves the designation of a core alignment through the east side of downtown. This study recommends that Congress Avenue, rather than Brazos Street, be used for the primary Urban Rail alignment on the east side of downtown.

Lady Bird Lake Crossing – Existing Bridge vs. New Bridge

A key issue is where should the crossing of Lady Bird Lake (LBL) take place – should Urban Rail cross on one of the existing bridges, Congress Avenue or South 1st Street, or on a new bridge within this vicinity. This study has looked at one option for a new structure and recommends additional study of both the ability of the existing bridges to accommodate Urban Rail and additional new alignments across LBL. This issue will be evaluated in detail through a NEPA environmental process planned for 2010-2011.

Maintenance Facility Options

Given the likelihood that an initial investment segment for Urban Rail will center around the downtown area, property is being sought to accommodate a maintenance facility in the immediate vicinity. Acquiring or developing any property in the CBD can be costly; therefore the City of Austin is reviewing existing city-owned properties to redevelop with a maintenance facility. A possible option for a near-downtown city –owned property is One Texas Center, on Barton Springs Rd. It is advised that additional study be conducted to provide a final recommendation.

Environmental and Community Impacts

Environmental and community impacts will be evaluated through a National Environmental Policy Act (NEPA) process that will allow for the initiation of a more detailed environmental study, such as an Environmental Assessment or Environmental Impact Statement. The NEPA environmental process is planned to commence in the Fall of 2010.

Funding Urban Rail Construction and Operations

The City is beginning work with a municipal financial consultant to develop a financial plan and analysis of financing options for an Urban Rail System. The plan will look at system costs, and potential sources of revenue to build, operate, and maintain an Urban Rail System. Funding options to be addressed in the review will include general obligation debt, TIF revenue, fare revenue, and federal funding, among others. The plan will assist the City in developing and evaluating funding alternatives. It is expected this study would be complete in the Fall of 2010.

What Are the Next Steps Toward Urban Rail System Implementation?

The next step in the program development process is for the City Council to adopt a Locally Preferred Alternative (LPA) recommendation.

This step will also designate the LPA as a project for additional study, under the auspices of the National Environmental Policy Act (NEPA) that will allow for the initiation of more detailed environmental study, such as an Environmental Assessment or Environmental Impact Statement. As part of the NEPA process, the City will identify a lead federal agency, publish a notice of intent (NOI), and begin additional public outreach and project development, including capital and operations funding plans, operations and governance strategies, and system phasing; as well as resolution of the design issues noted above for further consideration.

Ultimately, it is anticipated that voters will decide in a bond election whether to fund an initial phase of the Urban Rail system.

How can the Public Participate in this Process?

Citizens can stay in touch with the progress of the Urban Rail studies by visiting the project website at www.AustinStrategicMobility.com, and clicking on "Urban Rail" on the home page. All documents and presentations will be posted on line as soon as it is available. In addition, citizens can sign up for email notifications of meetings or new developments and send in comments at any time. For those without web access, comments and questions can be mailed to the Austin Transportation Department, P.O. Box 1088, Austin, TX 78767 or call ATD at 512-974-1150.

1. Introduction

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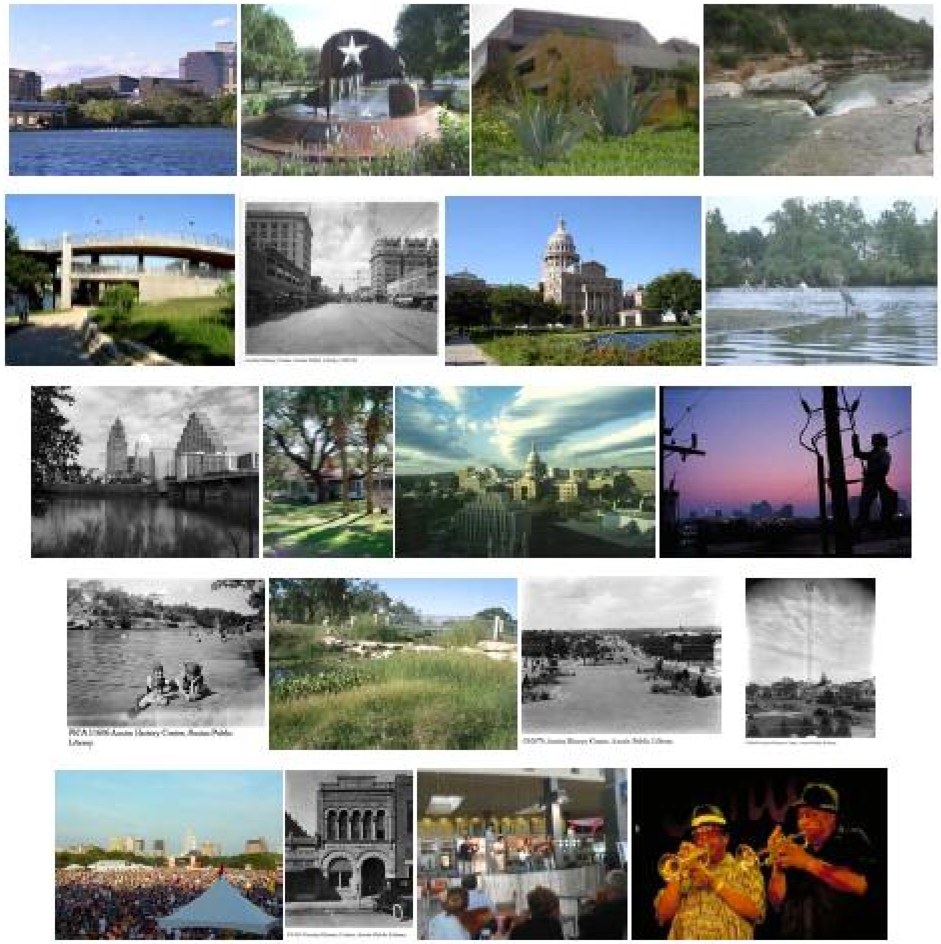

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1. Introduction

The *Central Austin Transit Study* is a key component of the City's *Austin Strategic Mobility Plan* (ASMP), which validates a critical need for major transit investment in Central Austin, from the Mueller Redevelopment to Austin-Bergstrom International Airport (ABIA).

The *Austin Strategic Mobility Plan* (ASMP) is a comprehensive program to catalog, map, and prioritize the City's, and the Region's, transportation needs and to identify, prioritize, and implement solutions. This innovative approach is the centerpiece of the City of Austin's (COA) Transportation Planning efforts – both short- and long-term – and is a comprehensive and coordinated approach to meeting all transportation needs for roads, bicycles and sidewalk facilities, urban trails, and transit. The City of Austin is conducting various studies, steering multiple inter-departmental working groups, and aggressively coordinating with local, regional, state, and national agencies as part of this program. ASMP has a significant public involvement component with public forums, stakeholder meetings, and citizen outreach so all of the City, and Region, have a say in the process.

While the *ASMP* focuses on the identification, prioritization, and implementation of solutions to the universe of regional transportation gaps, including highway/roads, bicycle and pedestrian facilities, and transit, the *Central Austin Transit Study* addresses a specific set of gaps related to mobility in and around Central Austin.

This Study

The *Central Austin Transit Study* builds upon the following succession of recent local transportation and land use planning efforts:

- *Capital Metropolitan Transportation Authority (CMTA) Future Connections Study – Central Austin Circulator – Alternatives Evaluation,* 2006
- *City of Austin/CMTA Modern Streetcar/LRT Proposal,* 2008
- *City of Austin Downtown Austin Plan,* (Phase One, 2008, and Phase Two, 2009)
- *East Riverside Corridor Master Plan,* 2010
- *City of Austin's Imagine Austin Comprehensive Plan, 2009*-ongoing
- *Austin Strategic Mobility Plan, 2009*-ongoing

Specifically, the *Central Austin Transit Study* is an update and validation of the *CMTA Circulator Alternatives Evaluation*, and therefore owes much of the source material to that study.

This *Transit Study* is a public forum for the community to identify mobility problems and other needs in Central Austin and to evaluate the benefits, costs, and impacts for a range of potential transportation solutions. This evaluation is the first step in the project development process and is being used to determine a preferred transit investment strategy that should be applied to a more focused study and implementation.

Contents of this Report

- An ongoing public, agency, and stakeholder involvement process;
- A review of previous studies and an assessment of related studies with influence on the development of an Urban Rail system in Austin;
- Conceptual route and technologies evaluations
- Detailed transit investment alternatives evaluation;
- Recommendation of Locally Preferred Alternative: Urban Rail system plan, operations plan, capital and O&M costs, maintenance facility, and ridership forecast; and
- A summary of various design and implementation issues related to Urban Rail.

Conceptual and Detailed Evaluations

The actual *Central Austin Transit Study* is a two-step process, with a conceptual evaluation followed by a more detailed evaluation. The conceptual evaluation identifies **route alternatives** and recommends a specific **alignment**. The conceptual evaluation in Chapter 4 identifies vehicle (or modal) **technology alternatives** and recommends two alternatives for detailed study in Chapter 5.

The detailed evaluation in Chapter 5 combines the alignment and technology recommendations into a Build alternative and a TSM alternative. These two **transit investment alternatives** are compared to each other and to a baseline, or No-Build alternative, also using the same alignment recommended in Chapter 3.

The outcome of the detailed evaluation is a recommended **Locally Preferred Alternative (LPA)** for a transit investment serving the Mueller Redevelopment, Central Austin, the East Riverside Corridor, and Austin-Bergstrom International Airport (ABIA).

Background and History

This *Transit Study* is a significant update of the *CMTA Alternatives Evaluation*, which ultimately proposed a Locally Preferred Alternative (LPA), consisting of streetcar technology along a similar route through Central Austin; however, the CMTA Board did not adopt the LPA and proposal stalled. Recognizing the continued need for improved mobility for Central Austin, along with other needs relating to Central Texas' rapidly growing population, the City of Austin assumed responsibility for the effort, with the support of CMTA.

This *Transit Study* builds upon previous and ongoing studies (summarized below), and includes these major activities:

- Continued public, agency, and stakeholder involvement process;
- A review of previous studies and an assessment of related studies with emphasis on the development of a new transit system in Austin;
- Development of a basic conceptual system and operations plan;

- A review and recommendation of potential sites for an Urban Rail maintenance facility; and
- Development of order-of-magnitude capital and operating cost estimates for all alignments and facilities.

How is this project coordinated with other ongoing transportation studies?

Three ongoing City of Austin efforts, all part of the *Austin Strategic Mobility Plan,* have goals to develop both short-term and long-term transportation projects for the City:

- The *Central Austin Circulation Study* includes recommendations for near-term fixes for traffic signal timing, intersection improvements, transportation demand management (TDM), and other operational traffic flow improvements.
- The *Strategic Mobility Plan* focuses on the identification of regional transportation gaps (including roads, transit, highways, and bicycle and pedestrian facilities) and integrates the City's transportation systems into a regional network. The plan also proposes interchange improvements and improvements to the management of key travel corridors, along with the preparation of long-term regional mobility plans to respond to the area's population growth, and the identification of potential rail line extensions.

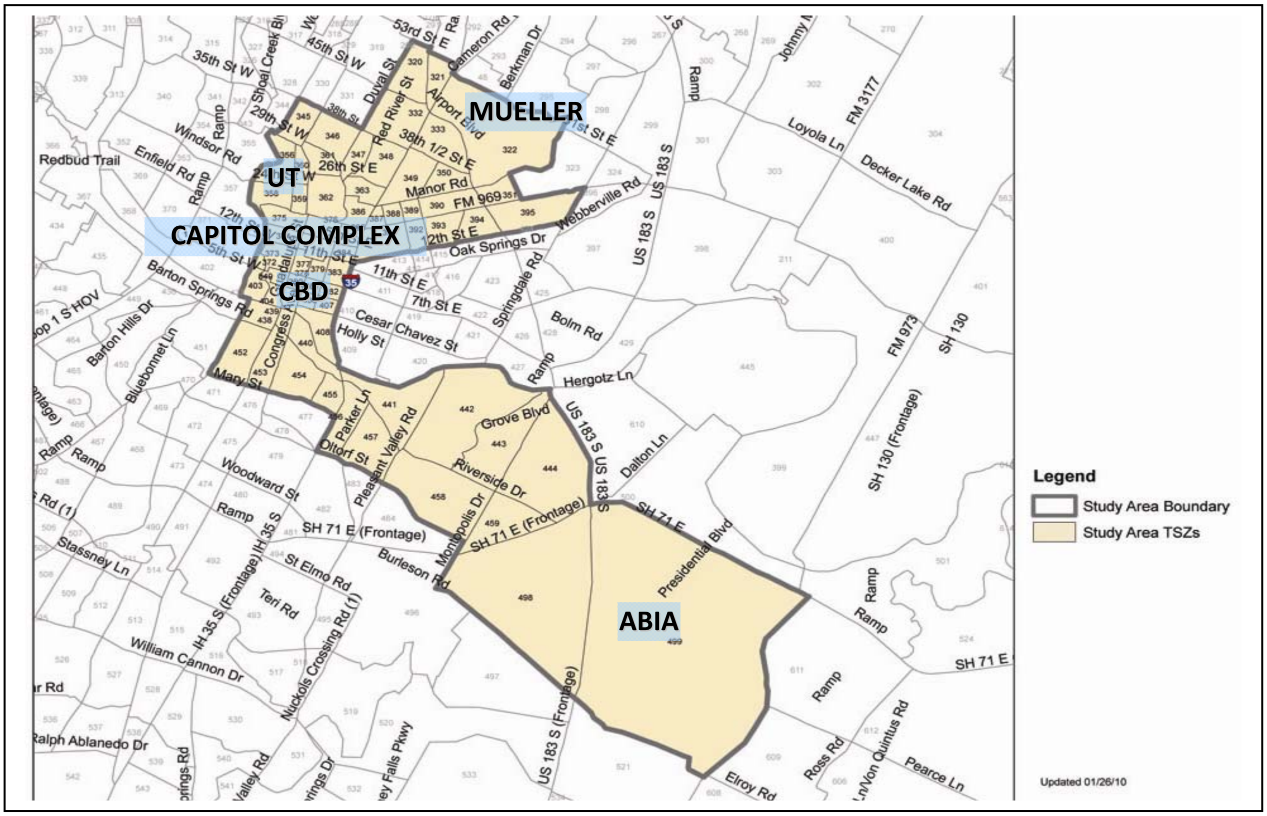
- The *Urban Rail Program* will advance the recommendations of this *Transit Study*. The components of the Urban Rail Program include Pre-NEPA and NEPA environmental studies, existing bridge evaluations, funding plan development, and advanced conceptual engineering. The Urban Rail Program will further refine the Locally Preferred Alternative, proposed in Chapter 5, such that City leaders and voters have sufficient information to proceed with implementation.

The *Central Austin Circulation Study* was a focused short-term effort that evaluated the current transportation network and made recommendations for near-term improvement. The *Austin Strategic Mobility Plan*, however, will be used to help determine both short-term and long-term transportation investments and improvements that potentially may be funded through multiple future bond cycles.

Study Area

The study area links Austin's "core" – downtown/central business district (CBD), Capitol Complex, and the University of Texas (UT) – to a major activity center to the northeast, the airport to the southeast, and commuter and regional rail transit facilities to the southeast and southwest within the CBD. To the northeast of the core is the mixed-use, master-planned Mueller redevelopment. Southeast of the core is Austin-Bergstrom International Airport (ABIA), which is linked via the East Riverside Corridor, a moderately high density, re-developing corridor. As shown in Figure 1-1, the study area *links employment and population* in the core to population and employment centers at Mueller and the East Riverside Corridor.

Figure 1-1. Study Area Based on Traffic Analysis Zones

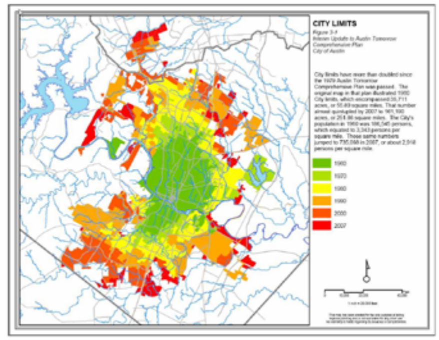


Source: URS Corporation, 2010.

The regional traffic analysis zones (TAZ) illustrated in Figure 1-1 broadly characterize the study area. Traffic analysis zones provide data concerning primary commuter roadways, traffic distribution patterns, traffic volumes, accident data, and populations living in or traveling to these zone(s). This information is useful for understanding the existing conditions under analysis.

Recent Urban Rail and Related Planning Activities

With its emergence as a major metropolitan area, Austin has been planning for rail transit since the 1970s. Most of the area's previous rail transit planning has been conducted by Capital Metro. In recent years, additional planning has been conducted by other entities including the City of Austin. The following pages describe these planning activities.



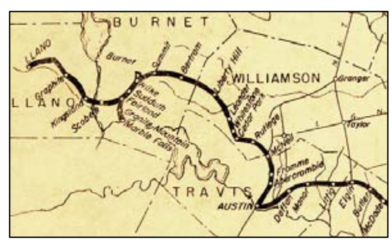
1979: Austin Tomorrow Comprehensive Plan ("Austin Tomorrow")

- Sponsors: City of Austin (prepared by the Planning Commission beginning in 1973)
- Listed rail as an alternative form of transportation. Policy 711.7 called for development of core area transit facilities that join rail, bus and bicycle facilities.
- Source: http://www.ci.austin.tx.us/compplan/comp_plan_austin_tomorrow.htm

1985: Capital Metropolitan Transportation Authority Referendum

- Created Capital Metro and approved a service plan that expanded the existing Austin city bus service and called for the development of a light rail transportation system to serve the area.
- Established a one cent sales tax to finance bus and rail improvements for the region.
- Source: http://www.capmetro.org/news/history.asp

1986: City of Austin Railroad Acquisition

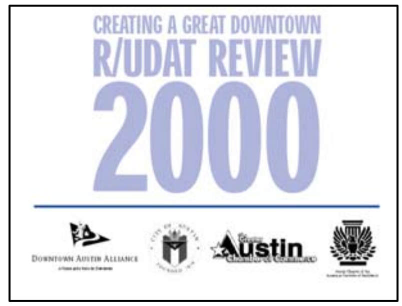


- Capital Metro joined with the City of Austin to purchase a 162-mile Southern Pacific railroad line from Llano to Giddings that passes through Austin, with the idea of eventually developing parts of the line for commuter rail. The final purchase price was over $9.4 million. Six million dollars of the investment came from a grant to the City from the Federal Transit Administration (FTA). Austin provided $600,000 of its own funds as well, while Capital Metro contributed about $2.7 million. With this purchase, Capital Metro and the City of Austin became responsible for the maintenance, rehabilitation, and improvement of railroad facilities on the line.
- In May 1998, Capital Metro purchased Austin's share of the line for $1 million and thus assumed sole responsibility for the line.
- Source: http://www.window.state.tx.us/tpr/capmet/chpt7.htm

1989: Transitway Corridor Analysis Project (TCAP)

- Sponsor: Capital Metro
- Alternatives Analysis/Draft Environmental Impact Statement
- Evaluated light rail and other transit alternatives within the Northwest/North Central Corridor of Capital Metro's service area. While light rail was rated favorably, the Capital Metro Board chose not to move forward with near-term implementation due to the local economic downturn.
- Source: Information from *Preliminary Draft Statement of Purpose and Need, Central Austin Circulator System Future Connections Study, Capital Metro October 2005*

1992: Regional/Urban Design Assistance Team (R/UDAT)



- Sponsors: City of Austin, the Greater Austin Chamber of Commerce, and the Austin Chapter of the American Institute of Architects (began in 1989)
- Team assessed the current state of Austin and developed detailed recommendations on how to improve downtown. A component of the review discussed light rail as an alternative form of transportation for Austin.
- Source: http://www.ci.austin.tx.us/downtown/rudataustin.htm

1996: Transit System Plan

- Sponsor: Capital Metro
- Included a proposal for fixed guideway transit service after evaluation of a light rail alternative that would serve downtown Austin, the UT main campus, and north central, northwest, and east Austin.
- Source: http://www.allsystemsgoconnections.org/study_overview/history.aspx

1997: Fixed Guideway Transit Investment Strategy: Major Investment Study (MIS)

- Sponsor: Capital Metro
- Recommended a Locally Preferred Strategy that included passenger rail segments from the UT main campus to Austin-Bergstrom International Airport and from Leander to downtown utilizing existing rail rights-of-way.
- Source: http://www.allsystemsgoconnections.org/study_overview/history.aspx; additional Information from *Preliminary Draft Statement of Purpose and Need, Central Austin Circulator System Future Connections Study, Capital Metro October 2005*

1997: Regional Rail District

- Sponsor: Cities of Austin and San Antonio, counties of Travis and Bexar
- Authorized by the Texas Legislature in 1997.
- The first meeting of the Rail District Board of Directors took place in February 2003 and the name, "Austin-San Antonio Intermunicipal Commuter Rail District" was adopted. The name was later changed to Lone Star Rail District in 2009.
- Source: http://lonestarrail.com/index.php/lstar/faq/

2000: Light Rail Referendum

- Sponsor: Capital Metro
- Referendum on proposed 52-mile regional light rail system as developed by Capital Metro's Future Transportation Alternatives Study.
- Though majority (50.6%) of City of Austin voters approved the measure and in precincts within a half-mile of the starter system voted 57.3% in favor of the system, the proposal was defeated,
- Recommendation included a phase one light rail system from 4th and Colorado to Lamar Blvd./Airport Blvd. and on to Howard Lane, with a second phase to include light rail from downtown to the airport and an extension north from Howard Lane to Leander.
- Source: http://www.capmetro.org/news/history.asp, additional Information from *Preliminary Draft Statement of Purpose and Need, Central Austin Circulator System Future Connections Study, Capital Metro October 2005;* and from *Light Rail Now Project: http://www.lightrailnow.org/features/f_aus006.htm*

2001 (Revised 2002): Downtown Great Streets Master Plan

- Sponsor: City of Austin
- Attempted to establish standard typical sections for downtown streets. Designated six key street types based on hierarchy of mode priority (pedestrian, transit, bicyclist, and auto users).
- Proposed changing the standard 80-foot street width found in most downtown streets into a 44-foot width with 18-foot sidewalks on each side to facilitate pedestrian movement.
- Proposed converting most downtown one-way streets to two-way.
- Since 2001, the City has implemented several Great Streets projects through grants and cooperation of the private sector.
- Source: http://www.ci.austin.tx.us/greatstreets/

Figure 1-2 shows a typical section of a 'rapid transit street' as envisioned in the Great Streets Master Plan; this graphic shows how 4th Street could look with integration of rail transit and enhanced pedestrian facilities (the plan for 4th Street states that it "has been officially designated by City ordinance as the east/west corridor for passenger rail").

Figure 1-2. Illustration of Future Rapid Transit Street from Great Streets Master Plan

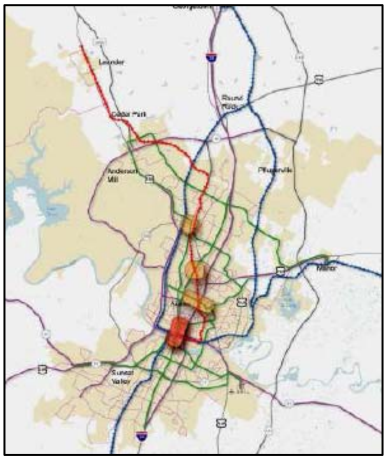
Source: Downtown Great Streets Master Plan, 2002.

2004: The Vision

- Sponsor: Envision Central Texas
- Regional leaders aimed at a new approach to address the tremendous growth pressures on the five-county region. More than 12,000 total participants.
- Outcome: Envision Central Texas Vision painted a compelling portrait of what citizens in the area would like life to be like in 20 to 40 years. Part of the transportation vision included a multi-modal option with light rail [Urban Rail] as a main component.
- Source: http://envisioncentraltexas.org/history.php

2004: All Systems Go Long-Range Transit Plan and Red Line Referendum

- Sponsor: Capital Metro
- The plan incorporated the participation of more than 8,000 Central Texans over the course of 21 meetings into the transit plan. Three central ideas evolved: Rapid and expanded bus service, passenger rail, and expanded hike and bike trails. Part of the rail mission was to build a 32-mile commuter rail service along Capital Metro's existing freight tracks. The Capital Metro Board's resolution approving the overall plan included a proposal to implement detailed studies of transit circulation areas in Central Austin, with connections to Mueller Redevelopment, University of Texas Pickle Research Center, and the emerging large-scale development at the Domain.



- Capital Metro Board adopted the Long-Range Transit Pan and CAMPO added it to the Regional Transit Plan.
- Voters approved the MetroRail Red Line commuter rail service for the 32-mile Austin-to-Leander right-of-way.
- Source: http://www.allsystemsgoconnections.org/study_overview/history.aspx

2004: Connect Austin

- Sponsors: Livable City Austin, Downtown Austin Alliance, Texas Community Project, and Austin Hotel and Lodging Association
- Recommended a north-south and east-west streetcar routes. The north-south route would run from Palmer Auditorium and Auditorium Shores North on Colorado or Congress through the Warehouse district, the Capitol complex, to UT Austin and the History Museum. The east-west route would link riders with the commuter rail at the convention center and run across town to the Warehouse district, Seaholm, and Lamar. [These routes are now part of the proposed Urban Rail system.]
- Source: City of Austin, *Austin On Track with Transit,* Newsletter Issue #2, July 27, 2004 http://www.ci.austin.tx.us/planning/downloads/OnTrack2.pdf

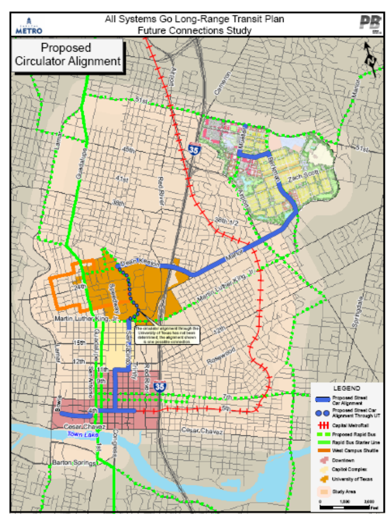
2005: CAMPO Mobility 2030 Plan

- Sponsor: Capital Area Metropolitan Planning Organization
- This long-range transportation plan for the Austin metro area specified "a set of investments and strategies to maintain, manage, and improve the surface transportation system" in Williamson, Travis, and Hays counties. It included rail transit projects such as the Lone Star regional rail system (formerly Austin-San Antonio Intermunicipal Commuter Rail District) between Georgetown and San Antonio, the CMTA Red Line commuter rail system between Leander and downtown Austin, and the CMTA Central Austin Circulator streetcar [now Urban Rail]. Note: the previous CAMPO 2025 mobility plan was the first regional plan to include rail transit in its programming.
- Source: *CAMPO Mobility 2030 Plan*, as Adopted June 6, 2005


CAMPO Mobility 2030 Plan
As Adopted June 6, 2005
Capital Area Metropolitan Planning Organization
Serving the Three County Region of Williamson, Travis, and Hays Counties in Central Texas

2006: Future Connections Study-Central Austin Circulator Study Alternatives Evaluation

- Sponsor: Capital Metro
- Intended to be FTA-sanctioned Alternatives Analysis as the first phase of project development for a transit circulator system serving Central Austin. This study was an addition to the All Systems Go Long Range Transit Plan approved by voters in 2004.
- Evaluated two transit technologies: modern streetcar running primarily in mixed traffic; and bus technology suitable for circulation service. Modern streetcar was recommended because of its potential for induced development, its operation in mixed traffic, its good acceleration and braking capacity for frequent stops, its high ridership compared with bus circulators, and its support of and ability to operate in high-volume pedestrian environments.
- It examined a number of potential rail alignments, but ultimately recommended rail connectivity between Seaholm, downtown along 4th Street, up Congress, over to Trinity, to the Capitol, UT, and across Manor to the Mueller redevelopment. The analysis noted that, using a sketch-planning modeling process, potential daily streetcar circulator ridership in 2017 was 11,500, increasing to 13,100 by 2030, with the elimination of 5,000 daily automobile trips as a result.

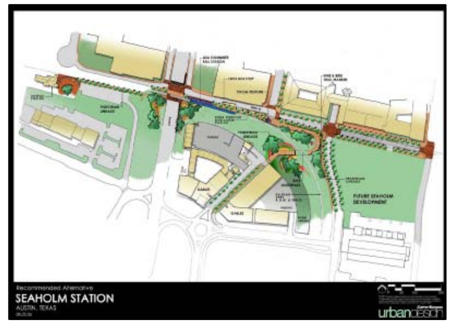


- A conceptual cost estimate was developed for the 13.3-track-mile system of $210 million, resulting in a per-track-mile cost of $15.8 million, with an annual operations and maintenance cost estimate of $5.8 million.
- This study was initially developed similar to an FTA alternatives analysis with the intent to start the NEPA process following adoption of the recommended Locally Preferred Alternative (LPA).

However, due to budget constraints the Capital Metro board did not adopt an LPA and the project was terminated.

- This is the source study for this COA Urban Rail Alternatives Evaluation.
- Source: *Future Connections Study-Central Austin Circulator Alternatives Evaluation Final Report,* November 2006

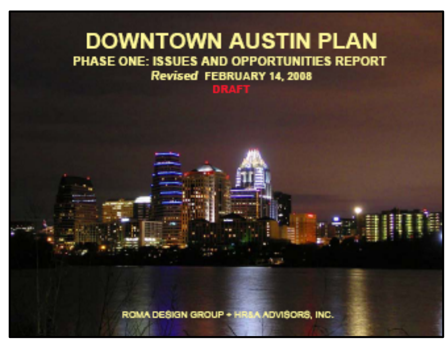
2006: Seaholm Station Study



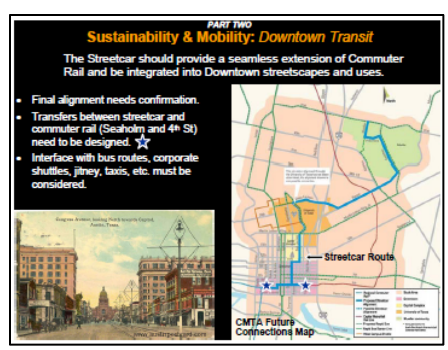
- Sponsor: Lone Star Rail District (formerly Austin-San Antonio Intermunicipal Commuter Rail District), Capital Metro, and City of Austin
- Identified and analyzed alternatives for a station to provide intermodal connections for intercity rail, downtown transit modes, the Amtrak station, and nearby residential and employment facitilites.
- Recommended an intermodal transit plaza and an intercity transit station along with station urban design recommendations.
- Source: *Seaholm Station Study Final Report,* December 2006

2008: Downtown Austin Plan Phase One: Urban Rail Connections Study

- Sponsor: City of Austin
- Determined the lack of a comprehensive transportation system was inhibiting Central Austin's ability to achieve its full potential as the commercial and cultural center of the region, and the auto-dominated nature of the existing transportation network limited mobility and access, resulting in an inhospitable environment for pedestrians and bicyclists. Updated the Great Streets Master Plan concept by incorporating ideas and programs from other groups and projects.



- This study built on the findings of the CMTA Central Austin Circulation Study and proposed two routes totaling 15.3 route miles (roughly 30 track miles):
    - o Seaholm to Mueller (via 4th Street, Congress, 9th and/or 10th, San Jacinto, Dean Keeton, Manor Road, and Berkman)
    - o University of Texas to ABIA (via Dean Keeton, San Jacinto, 9th and/or 10th, Congress, South Congress, and Riverside Drive)

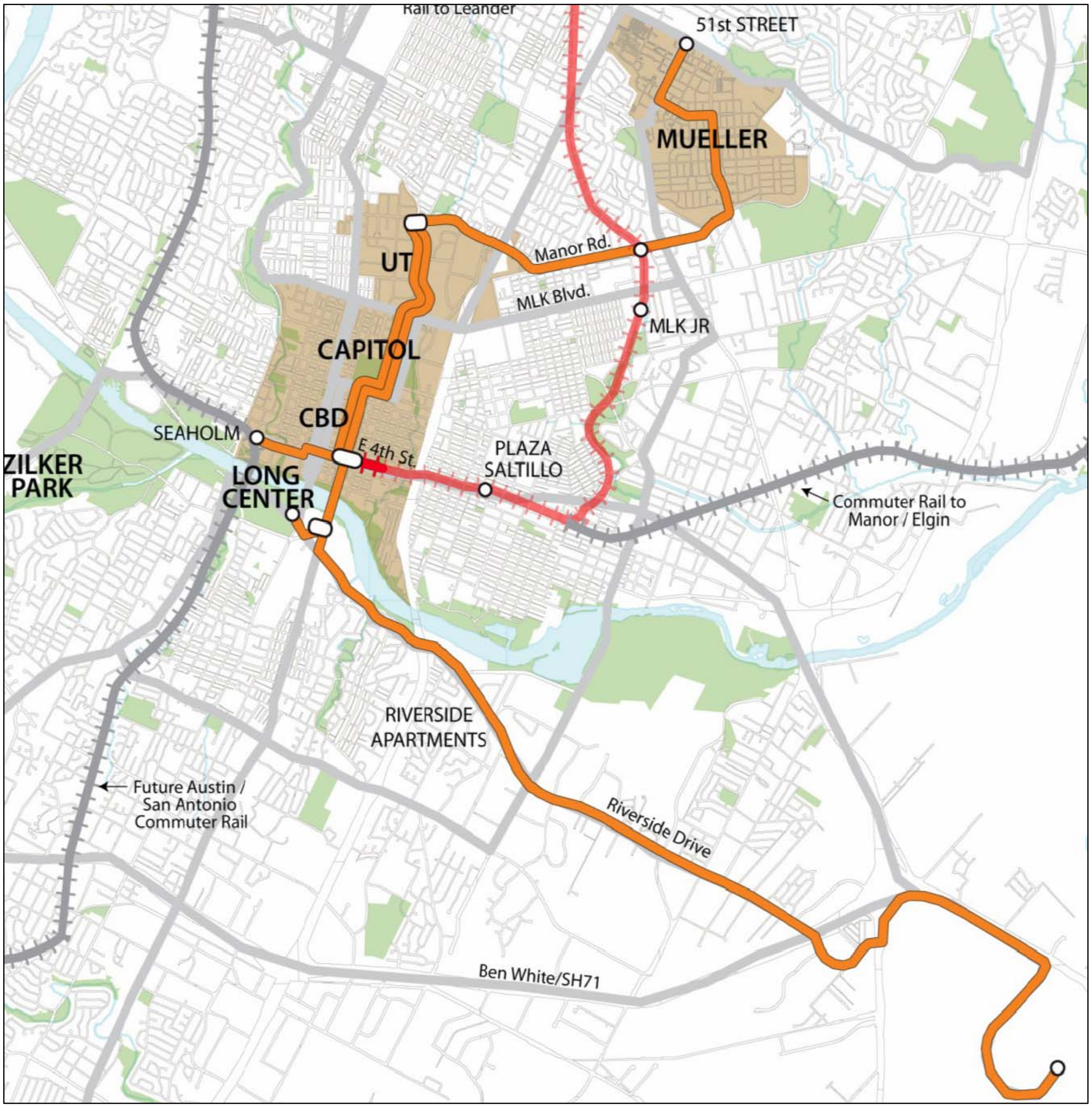


- Source: *Downtown Austin Plan Phase One,* 2008

2008: Modern Streetcar/LRT Proposal

- Sponsor: City of Austin with Capital Metro
- An analysis of three alternatives based on the Downtown Austin Plan Phase One report: a No-Action plan, high capacity bus system, and a streetcar/light rail alternative. Connections were recommended to be between and among ABIA, Downtown, The Capitol, UT, Manor Road, Mueller, the Long Center and Auditorium Shores (see Figure 1-3). Preliminary capital cost estimates for the roughly 30.6 miles of trackwork ranged from $537 million to $622 million (in 2008 dollars) depending on the extent of mixed-flow or exclusive guideway used (roughly $17.5 million to $20.3 million per track mile), with annual operating and maintenance costs for the entire system estimated between $21 million and $23 million. The system would generate more than 32,000 daily riders by 2030 (with roughly 28% being new riders), and reduce annual vehicle miles traveled by 91.3 million. The report recommended that the Urban Rail project be led by the City of Austin in close partnership with Capital Metro, with the aim of the City constructing new rail infrastructure, acquiring vehicles, and constructing the initial maintenance facility. Operations could be provided by Capital Metro, the City, or an independent contractor. The report envisioned a phased construction approach:
    - The initial focus (Phase 1) would be to connect Central Austin activity centers with the MetroRail Red Line downtown terminal station, with a likely crossing of Lady Bird Lake (roughly 4.4 route miles or 8.8 track miles). The report also envisioned a maintenance facility of 2 to 4 acres near Manor Road and I-35, with a six-vehicle initial fleet operating at 10-minute headways.
    - Phase 2 would add service along Riverside Drive from downtown to Pleasant Valley Road, an extension of 3.5 route miles (7 track miles), with service at 10-minute headways interlining with core downtown service, resulting in 5-minute effective headways downtown and requiring an additional five vehicles. This stretch of guideway could potentially be constructed in an exclusive right-of-way along Riverside.
    - Phase 3 would extend the service from the north end of the UT campus to the Mueller Redevelopment, adding 2.2 route miles (4.4 track miles) to the system and requiring three additional vehicles to maintain 10-minute headways.
    - The final phase would extend service along Riverside from Pleasant Valley to Austin-Bergstrom International Airport, an additional 5.4 route miles (10.8 track miles) with the intent of providing service in an exclusive guideway for more rapid service and requiring two additional vehicles.
    - The report also envisioned overlapping service in the downtown core with linked alignments from Mueller to Seaholm and from UT to ABIA. The specifics of that operational scheme were not outlined in detail, and actual sequencing of the proposed investment would be determined by more in-depth systems planning.
- Source: *Modern Streetcar/LRT Proposal,* 2008

Figure 1-3. Proposed Modern Streetcar/LRT Alignment from 2008 Study

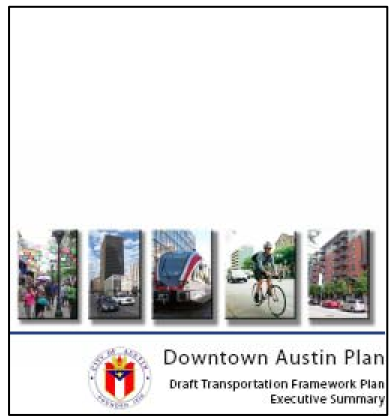


Source: Downtown Austin Plan City Council Briefing. July 24, 2008.

2008: Downtown Austin Plan 3rd Street Rail Study

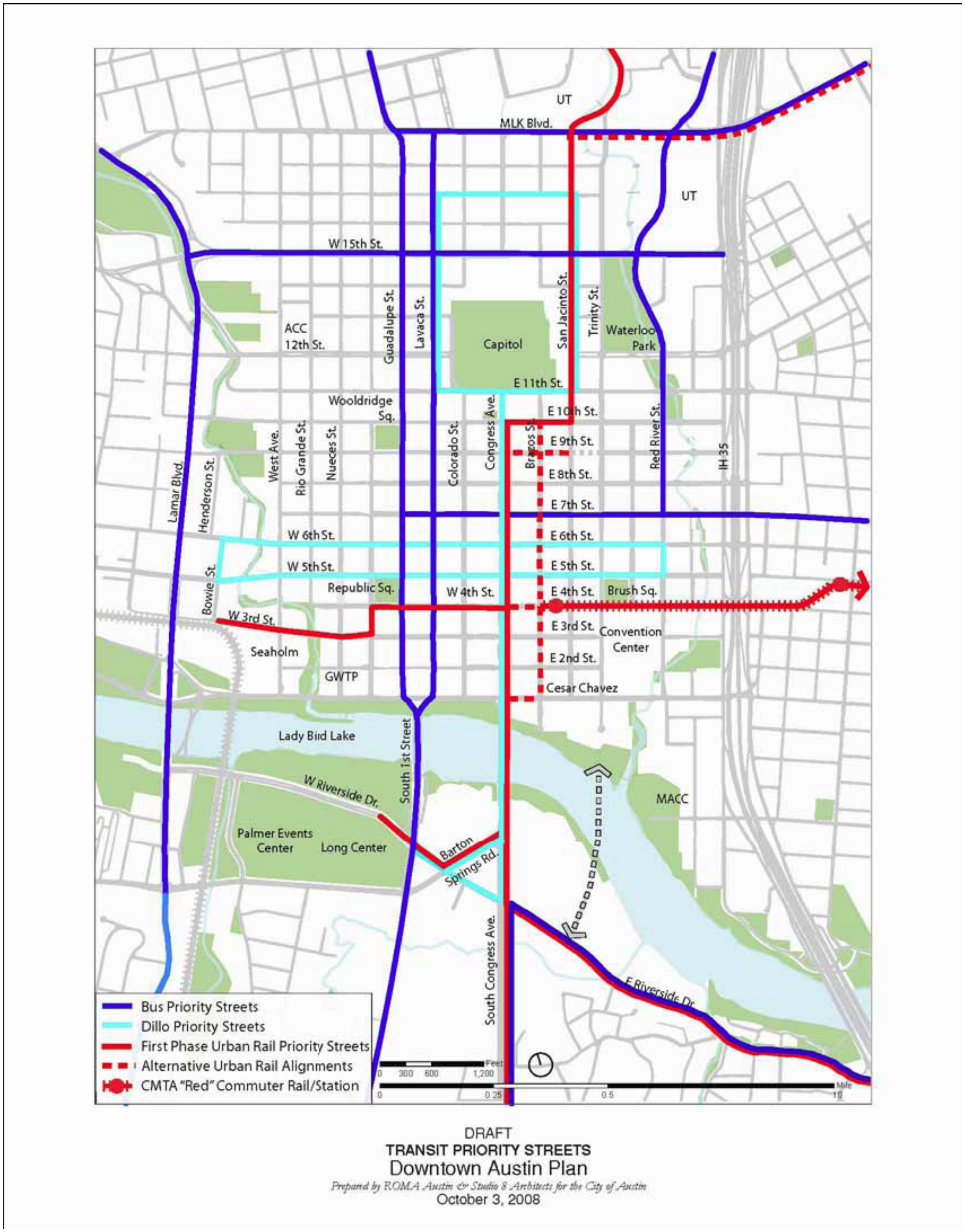
- Sponsor: City of Austin as part of Downtown Austin Plan
- This study examined urban design issues related to implementation of potential Urban Rail along 3rd Street between Lamar and San Antonio to understand issues related to utilities and street infrastructure. The study examined two alternatives: one that was primarily exclusive guideway in the center of the street; and one in the outside travel lanes that is shared with traffic. The study concluded that potential conflicts between City utilities and the proposed alignments would require further study.
- Source: City of Austin Memorandum December 17, 2008

2009: Downtown Austin Plan Phase Two: Transportation Framework Plan



- Sponsor: City of Austin
- Stated that "Congress Avenue is the preferred north-south alignment for Downtown urban rail service.
- Also designated transit priority streets (see Figure 1-4) and noted that 3rd and 4th, Congress, and San Jacinto "are envisioned as rail streets," though other corridors were not precluded.
- It further stated: "Two options for streetcar service in Downtown should be carried forward for further evaluation and refinement" during future phases of the streetcar system: a shared-running system and an exclusive guideway system; all were noted as aiming "to maintain and even maximize curbside parking along Congress Avenue and to improve the pedestrian experience."
- Guadalupe and Lavaca were also identified as transit priority streets with Capital Metro's proposal for the MetroRapid Bus Rapid Transit (BRT), and proposed that the City and Capital Metro should work together to develop a downtown transit transfer center or intermodal hub, preferably one or more "on-street" facilities that minimize off-street transit circulation and travel time and maximize user visibility and accessibility.

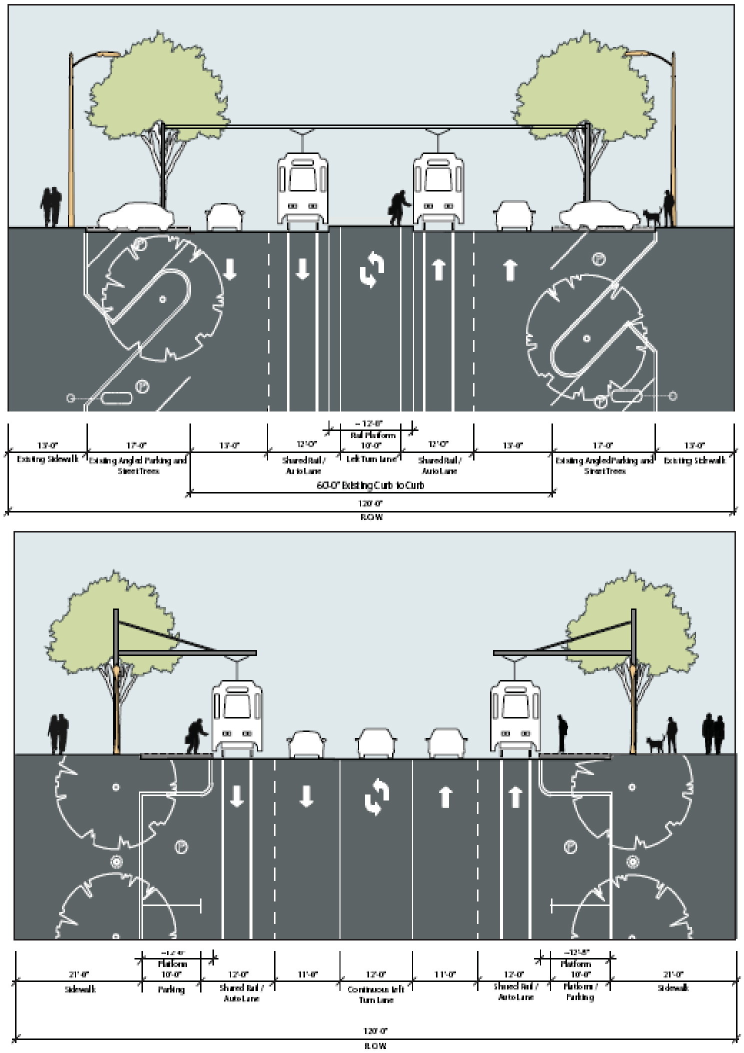
Figure 1-4. Downtown Austin Plan Transit Priority Streets



Source: Downtown Austin Plan Phase Two, 2009.

- Source: *Downtown Austin Plan Phase Two*, 2009

Figure 1-5. Downtown Austin Plan Conceptual Sections for Rail in Congress Avenue



Source: Downtown Austin Plan Phase Two, 2009.

Other Recent and Current Rail Planning Projects

2010: CMTA MetroRail System

Capital Metro's Red Line is a 32-mile commuter rail line running from Leander to downtown Austin, which began operations in March 2010. Figure 1-6 shows the Red Line route and stations.

Figure 1-6. Capital Metro MetroRail Red Line

Source: Capital Metro.

The downtown terminus of the Red Line is located at 4th and Trinity as shown in Figure 1-7 below. The City of Austin is working with Capital Metro to potentially extend the alignment two additional blocks westward and relocate the temporary Downtown terminal station to 4th and Brazos to provide closer connections to the core of downtown.

The MetroRail Green Line is proposed as the first expansion of the system. This 28-mile system will ultimately operate from downtown Austin to Manor and Elgin.

- Source: CMTA web site

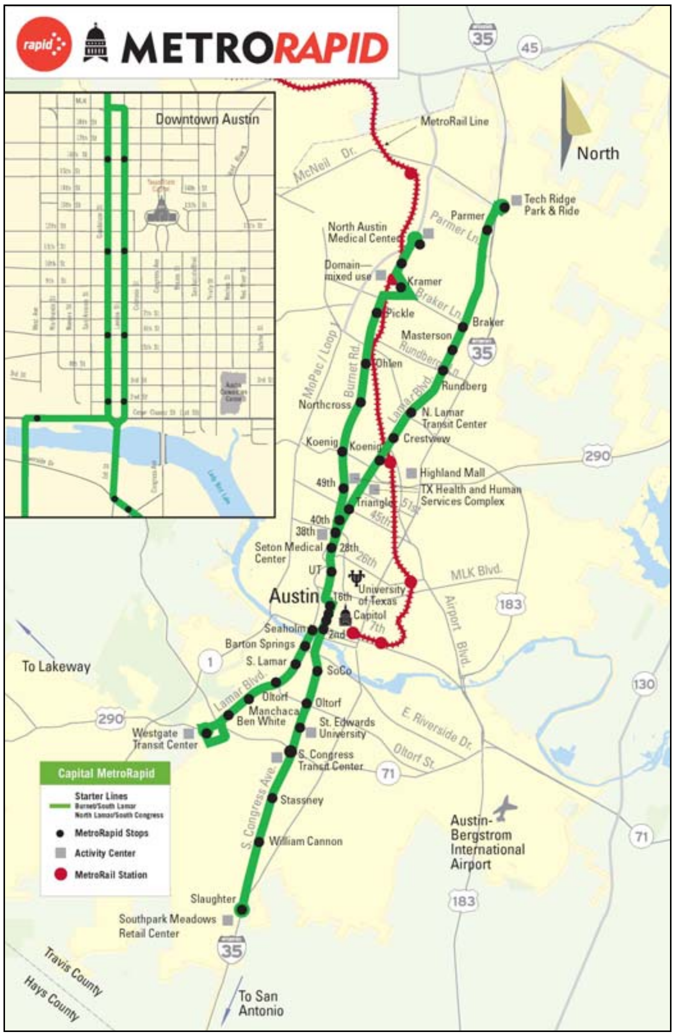
Figure 1-7. Capital Metro Red Line Downtown Terminal Station

Source: URS Corporation, 2009.

2009-ongoing: Capital Metro MetroRapid Bus Service

Capital Metro is proposing to establish a 37.5-mile street-running Rapid Bus (also referred to as Bus Rapid Transit or BRT) system along two interconnected corridors: the 21-mile North Lamar/South Congress corridor, from the Tech Ridge Park and Ride at I-35 and Howard Lane to the Southpark Meadows Shopping Center, and the 16.5-mile Burnet/South Lamar Corridor, from the North Austin Medical Center near Mopac/Loop 1 and Parmer Lane to the Westgate Transit Center at US 290 and South Lamar Boulevard. The two lines would share a 3-mile segment in central Austin between 38th Street (north of UT-Austin) and Cesar Chavez. Capital Metro plans to initiate service in 2012. Figure 1-8 illustrates the proposed project.

Figure 1-8. Planned Capital Metro MetroRapid Alignments



Source: Capital Metro, 2010.

Capital Metro requested FTA Small Starts funding totaling $37.6 million for 80% of the project's total capital costs (estimated at $47.0 million). Congress allocated $13 million in the FY2010 budget for MetroRapid. President Obama's FY 2011 budget proposal to Congress includes a recommendation for an additional $24 million in funding for the MetroRapid project through the FTA's Small Starts Program.

MetroRapid offers synergistic opportunities for Urban Rail given the commuter nature of rapid bus service and its planned presence with a corridor proposed for Urban Rail.

- Source: CMTA MetroRapid site http://allsystemsgo.capmetro.org/capital-metrorapid.shtml

2009-ongoing: Lone Star Rail District Regional Rail Service

In 1997, the State Legislature authorized creation of an Austin-San Antonio rail district by the two cities and their counties to develop intercity rail service between the two metropolitan areas. In 1997, TxDOT completed a study that indicates passenger rail service in the Austin-San Antonio corridor was technically and financially feasible, and in 2003, the district held its first Board meeting, with representatives from the cities, counties, transit authorities and metropolitan planning organizations from both metro areas, as well as two public members appointed by the Texas Transportation Commission. Staffing is provided by the Austin-San Antonio Corridor Council.

The District's ultimate plan envisions up to 12 trains a day between the two cities, including midday and evening service, 7 days a week in each direction for commuters, students and other regional travelers, with 90-minute express service from downtown Austin to downtown San Antonio, with stops in San Marcos and New Braunfels and local service from Georgetown to the South Side of San Antonio and stops at all stations in between. The District is planning up to sixteen new stations with parking and connections to local transit. In 2006, the District entered into interlocal agreements with the City of Austin and Capital Metro to study station locations in downtown Austin's Seaholm district (the proposed western terminus of the Urban Rail system). In 2009, the District began work on the engineering and environmental studies required for federal approval and on identifying specific station locations and areas, and it initiated development of final financing plans. The District hopes to complete those studies and receive a notice-to-proceed for final design and construction in 2011.

- Source: LSRD Web site http://www.lonestarrail.com/

2. Need and Purpose

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2. Need and Purpose

This chapter documents the need for, purpose of, and goals and objects of the transit investment proposed for the Central Austin study area. It includes a description of the demographics in Central Austin, its transportation network, and a summary of several previous transportation studies and analyses. These elements provide the basis for defining the *Central Austin Transit Study's* need and purpose.

Need and Purpose

The Need for a Transit Investment in Central Austin

Austin is at the heart of the rapidly growing Central Texas Region. The City of Austin and State of Texas Demographers project the region's population will grow by more than 1 million people in the next 25 years, while Austin's population will swell by 750,000. The tremendous growth presents both challenges and opportunities that can affect the livability, sustainability, and mobility of Austin and the region.

Central Austin's existing transportation network is at capacity during peak hours and there are few opportunities to expand roadways, yet Austin's continued vitality – social, environmental, and economic – depend on mobility. Central Austin needs improved mobility – person-moving capacity – in the form of new and expanded modal options to meet the demands of continued economic and population growth. Investing in transit is one of the most effective ways for Austin to meet its mobility needs given the significant obstacles to expanding its roadway network serving Central Austin.

1. ***Increasing Population Growth:*** Austin and Central Texas will experience significant growth over the next 25 years. Expanding population and employment require mobility improvements to connect people and places. The Texas Transportation Institute's (TTI) *2009 Annual Urban Mobility Report* concludes that Austin is already one of the most congested communities in the U.S. for its size and population, all based upon prior growth. City of Austin and CAMPO population projections forecast substantial, continued growth for the study area and, in particular, downtown Austin, which may see a 150% increase in population between now and 2030. Given its vital role as the region's center of business, government, culture, and employment, there is an urgent need to plan for this growth and mitigate its further impacts on mobility and land use.

2. ***Changing Land Uses:*** Increasing population growth is having a direct impact on existing land use patterns within Central Austin and the City has a critical opportunity to focus and direct development for the benefit of the community. Increasing density is already occurring within Austin's core. Higher densities both need and support higher-capacity transportation options to ensure mobility. The City has taken a number of steps to encourage density within the study area through master planning and zoning efforts. However, there is a significant need to support these land planning approaches to growth with improved and additional transportation infrastructure.

3. ***Insufficient Connectivity:*** More transportation connections are needed among and between Central Austin activity centers and the emerging regional transit network. Mobility options have changed little over the past 25 years, even as the dominant mode – single-occupancy vehicle – has become more costly and time-consuming.[1] Recently, the City has made bicycling a more viable mode with significant system improvements. Likewise, Capital Metro has initiated its Red Line commuter rail service, along with plans for the Green Line and Bus Rapid Transit routes, which all converge on Central Austin. There remains a need to expand support for, and better integrate, these new investments. A new transit investment is needed to extend the reach of short-distance modes, like walking and bicycling, to access longer-distance modes, like commuter and regional rail.

4. ***Increasing Travel Demand:*** As noted in the *Downtown Austin Circulation Study*, increasing traffic congestion in the study area is impacting mobility. Since 1992, traffic volumes have increased by only about 1% while employment has increased by 13% and population in the Central Austin study area has increased by 118%. The low travel growth is largely due to the extremely constrained mobility corridors serving Central Austin. Population and employment growth has occurred by squeezing out ancillary trips. Continued growth of Central Austin residential and employment densities requires new mobility connections. Essentially, increasing demand for travel in and out, and within Central Austin far outstrips the capacity of the network and more person-moving capacity is needed.

5. ***Insufficient Network Capacity:*** Much of the existing roadway network in Central Austin is already at capacity during the expanding peak hours. A *Ring of Constraint,* defined by severe congestion points surrounding Central Austin, restricts access to the core of this region. Yet, no room exists to expand roads, let alone construct new ones. Moreover, the downtown street grid is at capacity. The volume/capacity ratio (vc) of the roadway network is at 0.99 at peak periods for routes leading into and out of central Austin, with an increase to 1.26 when major arterials south of Lady Bird Lake are included. Bus activity is near capacity along Congress Avenue and other major arterials where transit vehicles are constrained by vehicular congestion. Operating at or above capacity also means that the network cannot adequately respond to 'shocks', such as traffic accidents or construction, which magnifies network problems. However, expanding Central Austin roadways or building new ones is not

[1] TTI, 2009, "2009 Urban Mobility Report, " Texas Transportation Institute, July 2009. http://mobility.tamu.edu/ums/report/

realistic given the community costs for displacements and disruptions, and the capital costs to acquire right-of-way. Fundamentally, the system needs to move more people rather than move more cars. An investment is needed that expands the reliable person-moving ability of the routes leading in and out of Central Austin.

6. ***Sustained Economic Development:*** Economic growth is critical to ensuring that the City can continue to meet the needs of its, and therefore the region's, rapidly growing population. Simply stated, more people require more services. Central Austin's economic activity has been increasingly pushed out from downtown in response to traffic pressures. A new transit investment is needed that can meet growing demands and promote – as well as sustain – continued economic growth in the core of Austin.

7. ***Protection of Air Quality:*** Today, Central Texas is confronting issues of poor air quality from automobile emissions and other sources. This pollution not only affects the health of our citizens, but also puts the region at risk of losing federal transportation dollars for non-compliance with air quality standards. Increasing population and employment growth means these problems will be compounded unless we take intervening actions.

8. ***Protection of Quality of Life:*** For many residents of the region, travel times have increased due to traffic congestion and lower-density land uses. Growing travel times and travel delays adversely impact our pocketbooks, air quality, productivity, and quality of life. Austin needs more travel choices – ones that can reduce costs and stress factors – that enable people to live closer to Central Austin.

Purpose of a Transit Investment in Central Austin

The purpose of a new transit investment is to improve mobility, connectivity, and the sustainability of Central Austin. New higher-capacity transit service can offer a safe, reliable, and efficient alternative to existing traffic congestion; to relieve roadways with little room for expansion. By connecting Downtown, the Capitol Complex, and the University of Texas to each other via the emerging regional rail network, new added transit can improve mobility and help manage Austin's inevitable growth.

Goals and Objectives of the Transit Investment

A major transit investment in Central Austin should meet the following goals established for the *Central Austin Transit Study*, which are further defined by their corresponding objectives:

Goal 1. Improve Place Connectivity: Improve connections among key existing and emerging destinations within the study area. Specifically, improve connections among Downtown, the Capitol Complex, UT, Mueller, East Riverside, and ABIA.

Objectives:

- Provide convenient and reliable service to destinations.
- Improve access to destinations.
- Provide high-capacity connections for special events and key venues, such as UT sporting events, civic events, and cultural/performing arts centers.
- Provide direct connections to existing and future population centers.

- Serve and support existing neighborhoods, as well as emerging centers.

Goal 2. Improve Transit Connectivity: Improve the regional transportation network by providing connections among transit modes, including bus, commuter rail, and regional rail systems. Specifically, improve linkages to CMTA's new Red Line and planned Green Line commuter services and Lone Star Rail's planned regional service.

Objectives:

- Link destinations to commuter and regional transit systems
- Leverage other transit investments by connecting transit systems to each other and to destinations
- Provide multiple, efficient transfers between transit systems
- Minimize the number of transfer.
- Improve access to transit
- Provide a flexible, scalable transit system that can accommodate future service expansions and extensions
- Support other modes, such as autos, bicycles, walking, etc.
- Maximize regional network efficiency

Goal 3. Improve Mobility: Increase the person-moving capacity of the transportation network by providing a new higher-capacity option.

Objectives:

- Provide reliable and convenient collection, distribution, and circulation service in, out, and within the study area
- Provide multiple, efficient transfers between transit systems
- Improve access to destinations within and beyond study area
- Increase the market share for all non-auto modes
- Extend the range of pedestrians and cyclists

Goal 4. Maximize Community Benefits: Provide benefits to the community by supporting sustainable land use planning, adding public amenities, and improving access to destinations.

Objectives:

- Support existing land uses by integrating service into the built environment
- Encourage density consistent with City neighborhood and master plans
- Provide access to and from existing and future housing opportunities, for a variety of economic levels
- Maximize the potential for compact, mixed-use development
- Support and provide opportunities to build community through placemaking
- Encourage community health with bicycle- and pedestrian-friendly facilities

Goal 5. Maximize Environmental Benefits: Invest in transit improvements with the greatest benefits to the built and natural environments

Objectives:

- Minimize impacts to the environment from a transit investment
- Maximize air quality benefits to the community
- Reduce dependency on single-occupancy vehicles (SOVs)
- Maximize the use of clean, renewable energy sources
- Minimize noise pollution of the transportation investment
- Provide access to, and support for, open/green spaces and water resources

Goal 6. Maximize Economic Benefits: Invest in transit improvements that support existing economies, catalyze economic growth, and provide economic benefits for users

Objectives:

- Attract, focus, and accelerate redevelopment along desired corridors
- Support and stimulate demand for compact, mixed-use development
- Provide cost-effective transportation by providing options and reducing dependency on single-occupancy vehicles (SOVs)
- Provide high value service
- Provide connections to and from housing and employment for all income levels
- Support and accelerate redevelopment and infill opportunities

Demographics

The key demographic characteristics of Central Austin are summarized below.

Table 2-1 summarizes the current and forecast population totals for the 5-county region (Bastrop, Caldwell, Hays, Travis, and Williamson Counties), Travis County, the City of Austin, the overall Study Area, and downtown Austin.

Table 2-1. Current and Future Population

Area	2007 Population	2030 Population	% Change
5-County Region	1,462,600	2,750,200	88%
Travis County	971,500	1,514,000	56%
City of Austin	735,100	1,136,300	55%
Study Area	97,600	123,500	27%
Downtown Austin	12,357	30,923	150%

Source: CAMPO; City Demographer's Office, City of Austin; note: Downtown Austin using 2010 figures for zip code 78701.

The table shows that while the City of Austin and the overall study area are forecast to grow at a slower rate than the region and Travis County, downtown Austin is expected to see significant population growth, increasing by 150% over the next decade. As the City of Austin's demographer noted in a February 2008 report:[2]

> *The ongoing scope and scale of housing stock expansion in and around downtown is nothing short of phenomenal. Almost 1,700 units have been completed since 2000, another 2,500 units are under construction, more than 2,700 units are already in the development pipeline, and an additional 2,000 units are in the preliminary planning stages. Downtown is experiencing what is just the beginning of what will ultimately become several decades worth of residential construction and household formation.*

Additional data can be derived from population density (per square mile), number of households, and household density. Table 2-2 shows population density, Table 2-3 household density, and Table 2-4 persons per household.

Table 2-2. Current and Future Population Density

Area	2007 Population Density	2030 Population Density	% Change
5-County Region	515	968	88%
Travis County	949	1,480	56%
Study Area	3,726	4,715	27%

Source: CAMPO; Density units: persons per square mile.

Table 2-2 obviously shows the same ratios as Table 2-1 but also illustrates the significantly higher population density of the study area compared with the region and the County.

[2] City of Austin Population and Households Forecast by ZIP Code, Ryan Robinson, City Demographer, February 2008

Table 2-3. Current and Future Number of Households and Density

Area	2007 Households/ Density	2030 Households/ Density	% Change
5-County Region	587,400/207	1,095,200/385	86%
Travis County	415,100/406	630,400/616	52%
Study Area	47,700/1,821	53,500/2,042	12%

Source: CAMPO; Density units: persons per square mile.

Table 2-3 shows that even though the percentage change of household density in the study area is smaller than that of the county or region, the overall household density in the study area is significantly higher than the county or region.

Table 2-4. Current and Future Persons per Household

Area	2007 Persons per Household	2030 Persons per Household	% Change
5-County Region	2.5	2.5	0%
Travis County	2.3	2.4	3%
Study Area	2.0	2.3	13%

Source: CAMPO.

Table 2-4 shows that the anticipated rate of growth of persons per household in the study area is significantly larger than that of the county or region. Table 2-5 summarizes the current and forecast employment totals for the same jurisdictions, and Table 2-6 shows employment density (per square mile). Together these tables show that, while the growth of employment in the study area is smaller than that of the region or the county, the overall employment density is significantly higher than in the other two areas.

Table 2-5. Current and Future Employment

Area	2007 Employment	2030 Employment	% Change
5-County Region	793,500	1,466,900	85%
Travis County	622,000	999,000	61%
Study Area	69,200	105,300	52%

Source: CAMPO.

Table 2-6. Current and Future Employment Density

Area	2007 Employment Density	2030 Employment Density	% Change
5-County Region	279	516	85%
Travis County	608	976	61%
Study Area	2,642	4,020	52%

Source: CAMPO; Density units: jobs per square mile.

Transportation Network of the Study Area

Natural and built barriers limit access to downtown Austin and surrounding areas. Only five vehicular bridges cross the Colorado River generally within downtown (from west to east): MoPac Expressway (Loop 1), Lamar Boulevard, South First Street (Drake Bridge), Congress Avenue (Ann W. Richards Bridge), and I-35 (and frontage roads). The two freeways on each side of downtown have few on/off ramps serving the CBD. Most of the streets from the north do not feed directly into the downtown grid because of the interruptions at the Capitol Complex and the University of Texas. The UT campus north of downtown has a street system that is largely non-public, and the West Campus neighborhood street grid, to the northwest of downtown, has an offset from the downtown grid at north of MLK, Jr. Boulevard. These two factors limit connectivity across MLK, Jr. Boulevard between these two districts. Only Lamar Boulevard, Guadalupe Street, and Red River Street provide direct, non-freeway access to downtown from the north. In addition to these built barriers, the north-south running creeks, Waller Creek to the east and Shoal Creek to the west, also interrupt the continuity of certain east-west streets, notably West 7th Street and 11th Street in the Central Austin area. These constraints are best characterized by the lack of trip growth over the past 20 years (+1%) in downtown, compared to the growth to the north (+20%) and south (+5%).

Additional barriers include many of downtown Austin's one-way streets. Studies over the past 15 years have suggested that the one-way street system should be reconsidered. Following some of these recommendations, 2nd Street and Cesar Chavez Boulevard have already been converted back to two-way travel. The Austin Transportation Department is also considering converting additional downtown streets, including Brazos Street, Colorado Street, 7th Street, and 8th Street, to two-way travel. Nevertheless, some of the one-way pairs, notably Guadalupe-Lavaca Streets and 5th to 6th streets, are widely viewed as necessary to facilitate the flow of traffic through downtown. Finally, connections to areas outside of downtown – specifically to Mueller Redevelopment and Austin-Bergstrom International Airport (ABIA) – are cumbersome in that they are blocked in many areas by I-35 and do not have continuous arterial connections.

Figure 2-1 illustrates a proposed downtown street grid with streets prioritized by mode of travel. This 2008 figure is from the *Downtown Austin Plan: Draft Transportation Framework Plan*, which has not been adopted by the City Council.

Figure 2-1. Proposed Downtown Street Priorities by Mode

Source: Downtown Austin Plan: Draft Transportation Framework Plan, November 25, 2008.

Traffic and Roadway Capacity

Roadway congestion levels can have a prominent effect on travel times and the propensity of travelers to utilize alternate modes, including car pools, bicycles, and transit. The tradeoffs between automobile and transit travel are important to examine as part of any multi-modal transportation system. Existing and projected travel conditions along key roadways and corridors, and travel times to key destinations allow for the examination of effects and benefits of a transit system. This section summarizes the existing conditions of the roadway system in the project study area. Traffic and roadway capacity information from several previous studies is summarized below.

The CMTA *Future Connections Study-Central Austin Circulator Alternatives Evaluation* completed in 2006 analyzed traffic conditions on several major downtown roadways. The report noted the following:

- On Congress Avenue, if "a streetcar alternative is implemented, then much of the existing bus traffic would likely be relocated to parallel facilities (likely Brazos Street)." The report stated that even with a streetcar, the "resulting travel characteristics of Congress Avenue would remain similar to those experienced today." In addition, the report suggested a more detailed traffic engineering study to confirm those preliminary observations.
- On San Jacinto Boulevard between 9th Street and MLK Jr. Boulevard, streetcar implementation would require a change in that street's operations because it is now a one-way thoroughfare. The report noted that sufficient capacity exists to convert the street to two-way operations or to operate a streetcar in a contra-flow configuration "with minimal impact to vehicular traffic operations." Again, a more detailed traffic engineering study of this scenario was recommended.
- The level of traffic on each road segment is such that vehicular traffic would mix comfortably with transit vehicles.

According to the 2008 *Downtown Austin Plan Phase One: Issues and Opportunities Report*:

- The existing road network leading into downtown is already very constrained, creating significant commuter delays in both AM and PM peak hours. This has diminished downtown's attractiveness and competitiveness as compared to the suburbs, as a location for office uses.
- The Downtown street grid is fully built-out, as is the street network surrounding Downtown. It is simply not possible to increase roadway capacity by widening or creating new roads without disfiguring neighborhoods and open space and creating a central core environment even more dominated by the car than it already is.

In 2009, the City of Austin completed the *Downtown Austin Circulation Study* to identify short-term and long-term transportation improvements needed to address reducing increased congestion in downtown. Its major findings included the following:

- Daily traffic volumes entering and exiting downtown Austin are "virtually unchanged" between 2009 (a 1% increase) and 1992, when the last complete traffic count and monitoring program was undertaken in central Austin.
- Some streets have seen an increase in volumes despite no major changes to their capacity or cross sections. There was an average 8% increase in traffic since 1992 on South Lamar Boulevard, South 1st Street, and South Congress Avenue south of the Colorado River.

- An average 20% increase in traffic volumes were noted on major arterials north of the University of Texas campus.
- Virtually the entire downtown network operates at v/c ratios of 0.99, which indicates that the network has a limited ability to move additional vehicles into and out of the central Austin area.
- The morning and evening peak periods are longer than an hour and continue to expand in duration.
- More than 29,000 vehicles enter the central Austin area during the morning peak hour, and more than 30,000 vehicles leave the area during the evening peak hour.
- More than 500,000 vehicles enter and exit the central Austin area during a 24-hour period.

Overall conclusions of the study included the following:

- Increasing traffic congestion is impacting mobility. Since 1992, when traffic volumes have increased by approximately 1%, employment has increased by 13%, and residences have increased by 118%.
- Central Austin's economic activity has increased on the outskirts of downtown. Trips increased in the UT campus area by 20%, and trips grew south of the river by 8%, indicating increased activity – including employment growth - in those outer areas.
- The access points serving downtown are at capacity. The v/c ratio is at 0.99 for routes leading into and out of central Austin, with an increase to 1.26 when major arterials south of the river are included. Any incident that affects mobility – such as a traffic accident or construction – can greatly exacerbate the capacity issue.

Recommendations included the following:

- Improvements to signal timing and minor intersection modifications. Many of these activities are already under way, including linking the Guadalupe-Lavaca signal grid to the UT-Guadalupe grid.
- Traffic demand management programs that can help mitigate demand by working with employers and other businesses to encourage alternative transportation modes and work schedules.
- Modernization of the City's on-street parking system, including converting single space meters to multi-space pay stations.
- Driver information systems, including signage (in coordination with TxDOT) to provide drivers with advanced information on incidents and traffic flow into and out of downtown.

Finally, the 2008 *Modern Streetcar/LRT Proposal* noted that Urban Rail can significantly increase person-trip capacity without increasing single-occupant auto travel. It noted that an Urban Rail system of this type, depending on the operating plan and headways, could provide during the peak hour, the capacity to serve more than 1,680 new inbound trips and 1,680 new outbound trips in each direction, which is almost equal to one new lane of freeway capacity in each direction.

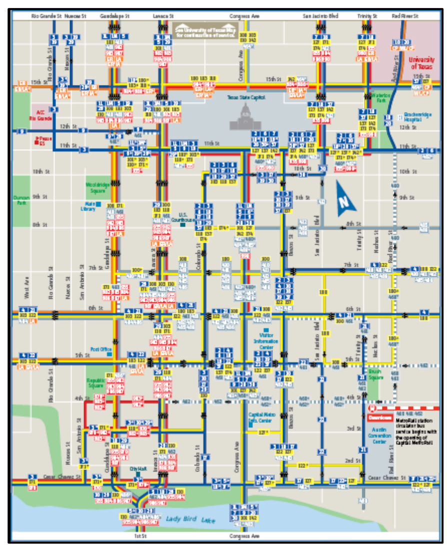
Parking

Two studies provide information on parking garages and other parking issues in downtown Austin.

- The *Great Streets Garage Impact Analysis* was conducted in 2002 for the Downtown Austin Alliance. It included an analysis of access and egress issues of some downtown parking garages and made recommendations on improvements to layouts and traffic flow to improve access and egress if the adjacent streets were converted to two-way flow.

- The *Downtown Parking Study* was conducted in 2009 for TC Austin Development, Inc., and the City of Austin. Its overall conclusion was that “the supply of parking in the Austin CBD is adequate to meet parking demand during most occasions” and that the existing parking supply is sufficient to meet the needs of new downtown developments for at least five years. However, it noted that certain areas of downtown (primarily the southwestern and southeastern sides of downtown, related to the convention center and the special events venues on both sides of the river in those two areas) are projected to “reach a parking occupancy at or above 85 percent” within the next five years. Overall parking supply in downtown Austin was documented at just over 44,000, with average occupancy at 30,000 (a rate of 67.5% occupancy).

Existing Transit Service



Central Austin is the core of the existing Capital Metro bus system, with a significant number of routes traversing the downtown area in all directions. However, the primary concentration of routes is along Guadalupe Street, Lavaca Street, Colorado Street, Congress Avenue, and Brazos Street. These are shown in Figure 2-2.

According to data from Capital Metro, the highest concentration of current bus boardings occurs at the intersection of Congress Avenue and 6th Street, with more than 4,500 daily bus boardings in all directions. Bus stops at Congress Avenue and 10th Street have the next-highest bus boarding totals, with more than 3,500 daily boardings. Other high-volume boarding locations include:

- Brazos Street and 6th Street
- Congress Avenue and 4th Street
- Congress Avenue and 3rd Street
- Brazos Street and 7th Street

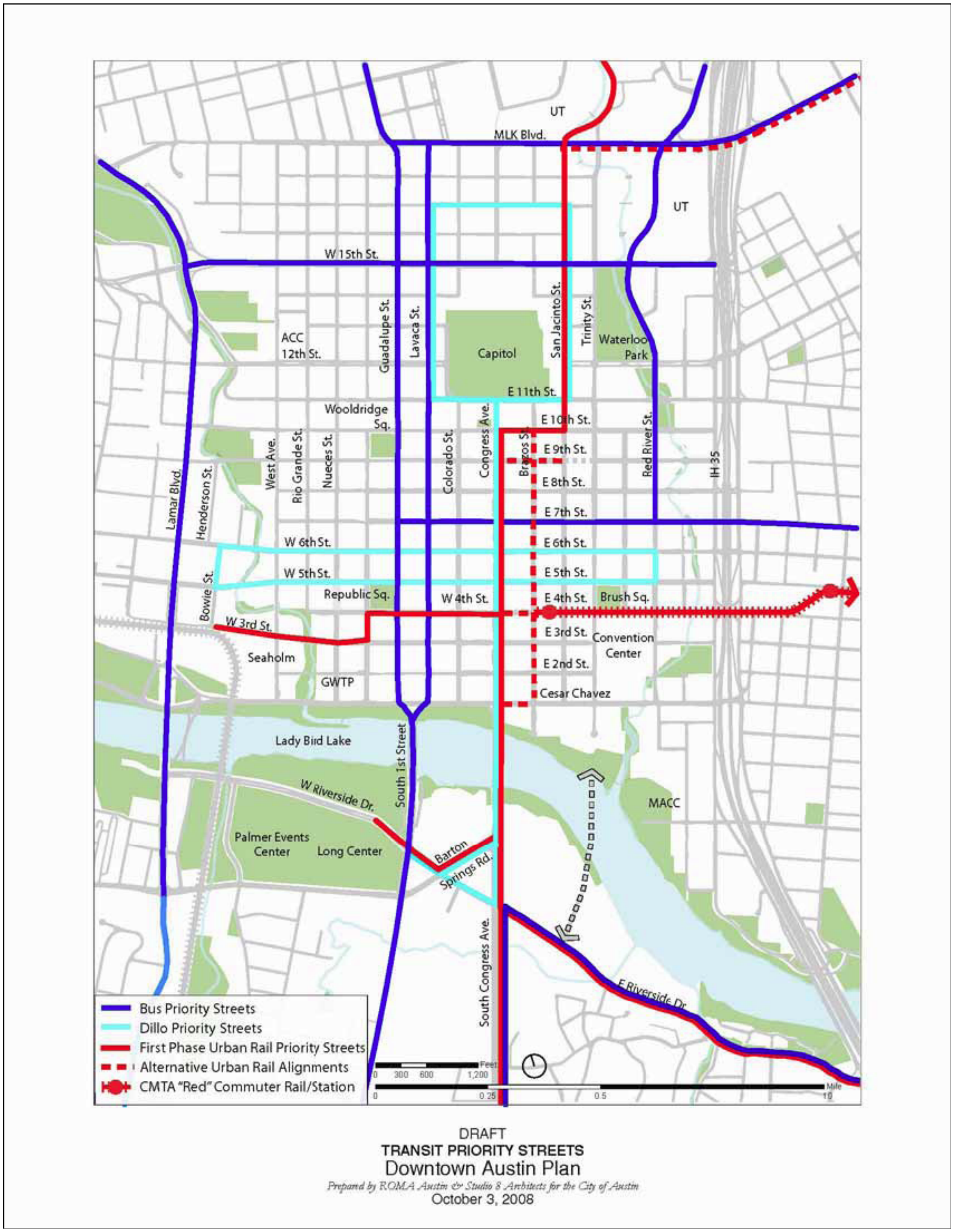
The number of bus boardings on key downtown corridors indicates a strong current demand for transit that an Urban Rail system could supplement or enhance.

Figure 2-2. Daily Bus Boardings on Downtown Streets

Source: Capital Metro.

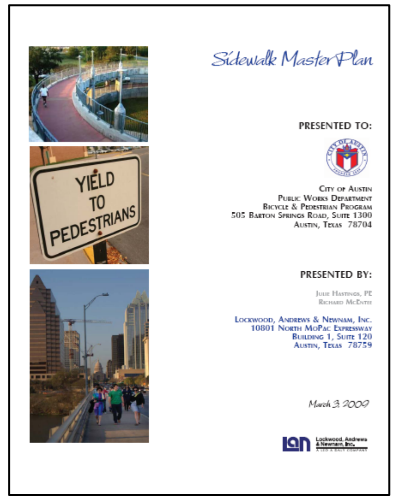
Figure 2-3 shows the proposed transit priority streets identified in the *Draft Downtown Austin Plan Phase Two.* Note that since this study, Dillo service has been discontinued in favor of fixed-route service designed to provide a more distinct shuttle-type service to/from the MetroRail Downtown Station at the Convention Center.

Figure 2-3. Proposed Downtown Transit Priority Streets



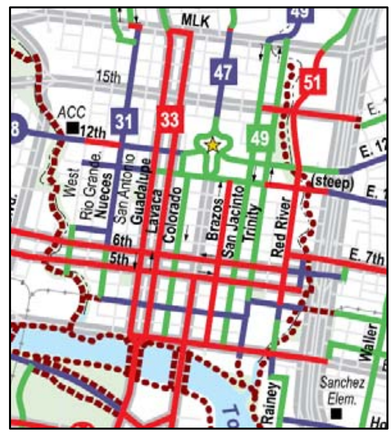
Source: Downtown Austin Plan: Draft Transportation Framework Plan, November 25, 2008.

Pedestrian Facilities



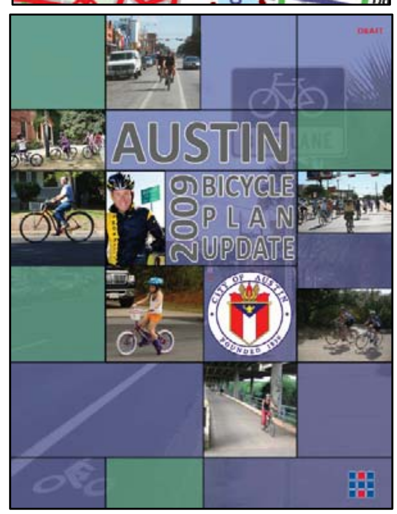
The City of Austin's *Pedestrian Master Plan* is identifying and prioritizing the City's sidewalk needs with the aim of filling major gaps in the system. *The Sidewalk Master Plan* was approved by the City Council in May 2009 and developed an evaluation matrix and recommended implementation plan for filling the City's sidewalk needs and pedestrian connections, especially related to ADA accessibility. Many downtown streets were rated "medium" in their ability to meet pedestrian needs, and a significant number of streets on the western edge of downtown were rated "low" or "very low." An accessible and convenient pedestrian network will be important in the success of an Urban Rail project to allow maximum pedestrian access to the system.

Bicycle Facilities



Austin's *Bicycle Master Plan Update* was completed in 2009 with the aim of setting goals, objectives, and actions over the next 10 years to "transform Austin into a world-class bicycling city." Its major goal was to significantly increase bicycle usage in Austin by:

- Increasing the City-wide workforce commuter bicycle mode share to 2% by 2015 and to 5% by 2020;
- Increasing the central Austin workforce commuter bicycle mode share to 8% by 2015 and 10% by 2020;
- Completing 50% of the City's bicycle network by 2015, 70% by 2020, and 100% by 2030; and
- Equipping all buses, rail cars, and vanpools to accommodate at least three bicycles on every vehicle by 2020 and have bicycle parking at 100% of all transit stops by 2020.



Land Use

Land use in the study area reflects the unique characteristics of the state's capital and the home of the main campus of the University of Texas. In addition, large major redevelopment projects in the study area indicate areas of extensive land use change. Study area land uses are the most diverse of any in Austin and include commercial, office, single-family and multi-family residential, light industrial, institutional, transportation, utilities, and parks and open space.

Central Austin: Relatively dense office, institutional, and commercial land uses are found in the study area from Lady Bird Lake north through Downtown to the State Capitol Complex and east to IH-35. Office uses are prevalent within the State Capitol Complex, along with major institutional (State Capitol and Bob Bullock Museum of Texas History), transportation (large numbers of stand-alone parking garages), and numerous commercial uses. The UT campus accounts for a large proportion of the central study area's land. Together with the State Capitol Complex and other institutional land uses, public land occupies more than 20% of this portion of the study area. The area west of the UT campus (West Campus) focuses on high- and medium-density multifamily residences, most housing UT students. Guadalupe Street commercial corridor extends northward as far as 45th Street.

Northern and Northeastern Study Area: From the UT campus north to 51st Street, the dominant land use is residential with mostly single-family residences, though there is a significant cluster of multi-family residences near Guadalupe Street and 38th Street. The area around the Lamar Boulevard/38th Street intersection focuses on institutional and office uses, primarily health care. Between Lamar Boulevard and Guadalupe Street from 38th Street to 51st Street the most common land uses are institutional and offices, with a major commercial center (the Hancock Center) at 41st Street and IH-35. East of IH-35, single-family residential is the most common land use, with major commercial uses clustered just south of the Mueller redevelopment site. The Mueller site itself is 711 acres and will ultimately accommodate 10,000 residents, 10,000 employees, and 140 acres of open space.

Southern and Southeastern Study Area: The area immediately south of Lady Bird Lake is a mixture of institutional uses (including City and State offices, parks, and auditoriums) and commercial, with a scattering of multi-family and hotel uses. Several mixed-use developments are planned along Lady Bird Lake just southeast of downtown along Riverside Drive. The area on Riverside Drive adjacent to and east of I-35 features market-rate affordable housing and an aging multi-family and single-family housing stock with a scattering of commercial establishments focused mainly at key intersections.

Development Activities and Trends

In addition to the proposed rail-related development studies and plans (such as Seaholm) listed in Chapter 1, four other development areas deserve attention in this study: the University of Texas campus Master Plan, the Mueller Redevelopment, the East Riverside Corridor Master Plan, and Downtown Austin Emerging Projects.

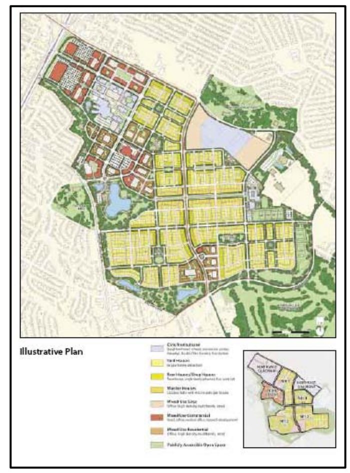
University of Texas Master Plan

The campus Master Plan was produced in 1999 and is the subject of continuous review and revision. The plan focused on a few key principles, including the following:

- Returning the core campus to pedestrians and keeping vehicular traffic at the edges of the campus;
- Adding substantially to existing on-campus housing and establishing new centers of on-campus student housing; and
- Concentrating future construction in the core campus instead of on the edges.

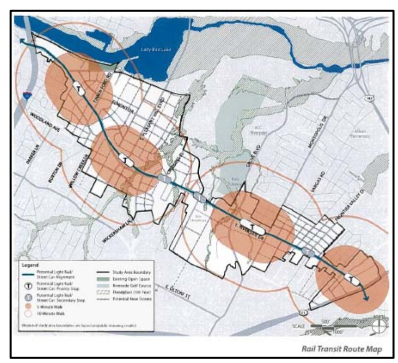
The implementation and further evolution of the Master Plan will influence the potential role of a new transit investment through, and/or adjacent to, campus. This is especially true given the inter-relationships between bicycle and pedestrian activities, campus vehicle circulation, and connections to outlying activity centers.

Mueller Redevelopment

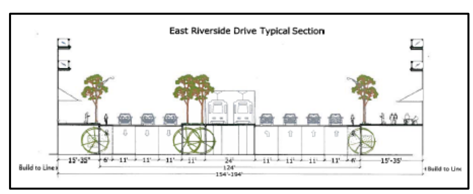


The redevelopment of the former Mueller Municipal Airport began in 1999 with the transfer of airport operations to the new ABIA. The Mueller site is 711 acres and will ultimately accommodate 10,000 residents, 10,000 employees, and 140 acres of open space. The Mueller Design Book was completed in 2004, and construction began on the first retail area in 2006. Construction began on the first single-family homes and apartments in 2007, and in late 2007 the area's first residents moved into the area. The Mueller redevelopment area represents a significant population and employment base now and in the future that could benefit from a new transit investment connection to other activity centers in the community.

East Riverside Corridor Master Plan



The East Riverside study is near completion as the project's draft report was released in January 2010. The purpose of the Master Plan effort was to guide the redevelopment of the corridor from downtown to ABIA to correspond with the community vision for the area. That vision focuses on a framework for public investment and private development "to reinvigorate the area, making it attractive for further investment as a local employment center and transit-supportive neighborhood, while managing to address the needs of all citizens living in the area, now and in the future." The plan states that "East Riverside Drive should be re-designed to be a multi-modal corridor that allows for safe and efficient movement of all transportation modes, including transit vehicles, pedestrians, and bicyclists."

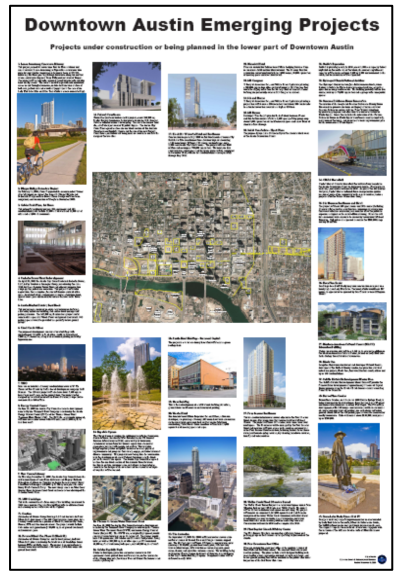


Specifically, the plan's key concepts and recommendations related to transit in the corridor include an assumption of streetcar or light rail on Riverside Drive with four primary stops or hubs that can be focal points for development. In addition, secondary stops are identified to provide good access to the neighborhoods along the corridor. The plan states that existing and future bus service should be coordinated with any rail improvement.

Downtown Austin Emerging Projects

The City of Austin's Department of Economic Growth and Redevelopment Services has identified major projects under construction or being planned in the lower part of downtown Austin. The quarterly Downtown Austin Emerging Projects map and database show both public and private-sector projects in and near downtown Austin that are currently under construction or in the planning phase. The report issued on October 28, 2009, identified twelve projects currently under construction, including the following:

- Two commercial projects (The W Austin Hotel and 1300 Guadalupe);
- Five residential projects (Gables Park Plaza, The Fondren Building, The Austonian, Four Seasons Residences, and BartonPlace Condos); and
- Two City of Austin, one U.S. Government, one non-profit, and one transportation/infrastructure project (the Lance Armstrong Crosstown Bikeway), along with the Capital Metro Red Line project.



In addition, 44 projects are currently being planned, including 17 commercial projects, 14 residential projects, six government projects, four non-profit projects, and three transportation/ infrastructure projects (the LSTAR Regional Rail Service, the Pfluger Bridge Extension project, and the Waller Creek Flood Diversion Tunnel).

Utilities

As part of this project, a high-level review of utilities in the downtown area was undertaken to identify potential conflicts and other issues. This utility investigation includes the general area from the Colorado River to the northern edge of the University of Texas campus and from the MoPac Expressway (Loop 1) to IH-35. The source of the utility data is public data from the City of Austin and private data from the individual utility owners. A GIS model has been built to contain the proposed rail alignments and the investigated utilities. Some data was in a GIS format and some data had to be input into the GIS model. All data obtained was approximate but adequate for planning purposes. Field surveys and Subsurface Utility Engineering (SUE) services will be necessary once the Urban Rail routes are finalized and preliminary design has begun. (Note: A complete summary of this utility investigation is included in the *Conceptual Engineering Documents*, published separately and available from www.austinstrategicmobility.com).

The City hosted an Austin Utility Location and Coordination Committee (AULCC) meeting on November 5, 2009, and requested utility data along the proposed rail routes from all possible City utility departments and private companies. The utilities documented along the potential urban rail routes include public water, wastewater, electric (overhead and underground), storm drain, chilled water, traffic signal lines, private communication (overhead and underground), and gas lines. A utility matrix has been prepared to list all the utilities located on each street and give specific information such as owner, approximate location, orientation (crossing or parallel/overhead or underground), carrier facility, encasement, property interest, and comments. A summary of this information is listed in Table 2-7 by utility owner.

Table 2-7. Summary of Existing Utility Issues in Central Austin

Utility Provider	Key Issue
Austin Energy-Electric	Generally has overhead or underground lines along every street.
Austin Energy-Chilled Water	Has chilled water and fiber communication lines along 2nd, 3rd 5th, 6th, Bowie, Nueces, San Antonio, and Guadalupe Streets. The chilled water lines have a fiber communication line running on top of the chilled water line. The communication fiber is used to transmit chilled water system information from the users to the plant.
Austin Water Utility-Water	Generally has lines in every street.
Austin Water Utility-Wastewater	Generally has lines in every street.
City of Austin-Watershed	Generally has lines in every street.
City of Austin-Traffic Signals	Generally has signals at every major intersection
AboveNet Communications	Has lines in 10th, Guadalupe, South 1st, Lavaca, and Brazos.
Alpheus Communications	Has lines in 4th, 9th, 15th, San Antonio, Guadalupe, South 1st, Lavaca, Brazos, and San Jacinto.
AT&T	Has lines in Barton Springs, 9th, 15th, 17th, 18th, Dean Keeton, San Antonio, Lavaca, Congress, Brazos, and San Jacinto.
Apogee	Has lines along 18th, 24th, and San Antonio Streets.
GAATN	because "disclosure of information poses serious security and business risk to Verizon and/or its customers". Detailed information is not provided in this report.
Grande Communications	Has lines in 10th, Guadalupe, South 1st, Lavaca, Congress, Brazos, and San Jacinto.
Level 3 Communications	Has lines in 9th, 10th, 18th, San Antonio, Guadalupe, South 1st, Lavaca, Congress, Brazos, and San Jacinto.
McLeod	Has a ductbank with fiber and two manholes, on San Jacinto between 11th and 12th Streets only.
Tel West Network Services	Has lines along 1st, 3rd, 7th, 9th, San Antonio, South 1st, Lavaca, and Brazos Streets.
Texas Gas Service	Generally has lines in every street.
Time Warner Cable	Has lines in Barton Springs, 4th, 9th, 10th, 15th, 17th, 18th, Dean Keeton, San Antonio, Guadalupe, South 1st, Lavaca, Brazos, and San Jacinto.
TxDOT Maintenance	Has illumination, traffic signal, and ITS lines along IH-35.
University of Texas	Has lines along Dean Keeton and San Jacinto.
Verizon Business	Likely has lines along Urban Rail routes but will not release information because "disclosure of information poses serious security and business risk to Verizon and/or its customers."
ZNET	Has lines along 1st, 3rd, 7th, 8th, 9th, 10th, 12th, Guadalupe, Lavaca, Colorado, and Brazos Streets.

Source: CAS Engineers, 2009.

Some utility companies in the Austin area do not have facilities in the downtown or University of Texas areas and therefore do not need to be investigated for this phase of the Urban Rail Alternatives Evaluation. Phone calls and emails were sent to each utility to determine if the utility had facilities within the limits of this phase of the Alternatives Evaluation. The following utility companies stated they did not have facilities within the limits of this study:

- Atmos Gas
- Bluebonnet Electric
- Chevron Pipeline
- CITGO Utilities
- Enterprise Texas Pipeline
- Kinder Morgan
- Kock Petroleum
- Longhorn Pipeline
- Pedernales Electric
- Phillips Pipeline
- Sprint Communications
- TxDOT Campus Communications
- TXU Electric

Typical utility vertical locations will be important to determine the potential for conflicts. Table 2-8 summarizes typical utility vertical locations in downtown Austin. The *Conceptual Engineering Documents* (Attachment F) contains the source information concerning utilities.

Table 2-8. Typical Utility Vertical Locations

Utility	Typical Utility Vertical Locations (Above or Below Top of Pavement)	
	Overhead* (Minimum Height)	Underground** (Minimum Depth)
Communications (fiber & conduit)	18’	36”
Communications (conductor)	18’	24”
Electric (primary)	18’	30”
Electric (secondary)	18’	24”
Traffic Signals (signal head for OH)	17’	30”
Water	NA	42”
Chilled Water	NA	42”
Wastewater	NA	42”
Storm Drain	NA	20”
Gas	NA	18”

Source: CAS Consulting, 2009. *Typical Urban Rail Overhead Contact System (OCS) elements are 18' above grade. **Typical Urban Rail track construction is within 18"-24" below grade.

Although Table 2-8 lists the typical utility vertical locations, it is common for field conditions or older design practices to dictate locations closer to the pavement. Consideration should be made in the planning process to account for some number of each utility’s lines that will be closer to the pavement than the typical distances listed above. Also, ancillary facilities may have additional impacts from the Urban Rail line. These ancillary facilities may include but are not limited to fire hydrants, building valve and meter vaults, inlets, drainage junction boxes, manholes, pull boxes, tracer wires, conduit banks, encasements, meter boxes, street light standards, traffic light masts, electric/communication poles, electric/communication vaults, and valve boxes.

The information contained in this report can be used to identify utility impacts and preliminary costs of relocations in the urban rail route selection. Many factors will need to be considered in the selection of the preferred urban rail route and utility impacts will be one of the important considerations. Once the preferred Urban Rail route is selected, additional investigations will be needed to determine the exact utility location (horizontally and vertically) by survey and pothole measurements of the utility facilities. Coordination will also be needed with each impacted utility company to determine if relocations are needed and to ensure any necessary relocations are scheduled properly with the overall project schedule.

The downtown Austin and UT areas have an extensive number of utilities, and some of these utilities are in need of repair or upgrade. Route selection for the proposed Urban Rail lines should consider all the issues related to utilities. The overhead utilities are easily observed by software such as Google Maps and generally should not be a conflict for clearance. Overhead power supply to the urban rail car will need to consider the locations and configurations of the overhead utilities. The underground utilities will need to be investigated for conflict with the urban rail structural slab and for consideration of utility condition (age, capacity, structural condition).

Consideration should be given to coordinating this project with the City's Capital Improvements Program (CIP) and the short/long-term roadway and utility reconstruction and maintenance plans. Relocation of aerial power lines may be facilitated through Austin Energy's Downtown Network Upgrade Program that plans to take all aerial lines underground within the area bounded by IH-35 on the east, MoPac Expressway (Loop 1) on the west, Lady Bird Lake on the south and 35th Street to the north. In addition, the Planning Department should be consulted to gather information of planned buildings that may be considering encroachment into the street right-of-way with underground basements, office floors or parking garages. Finally, consideration should be given to protect chosen rail corridors via Council designation, which would prohibit new utility construction and impose more restrictive guidelines for the reconstruction or maintenance of existing utilities within those designated streets.

Environmental Issues

As part of the Urban Rail Program the City commissioned a Pre-NEPA (*National Environmental Policy Act*) Environmental Study to establish baseline environmental conditions, identify issues, and prepare for more detailed study. The environmental study was organized in compliance with NEPA. The *Urban Rail Pre-NEPA Environmental Study* is a separate report (available from www.austinstrategicmobility.com) and only a summary is included below.

General Environmental Considerations

The proposed Urban Rail system is located in developed urban districts. It is proposed to be installed along the existing public road system, or within existing rights-of-way, minimizing infrastructure effects. The general land use along the right-of-way is a mixture of commercial, residential and park systems. The city streets provide no significant habitats but the surrounding community is home to five (5) unique environments.

Features located west of the proposed Urban Rail system include Zilker Park, Barton Springs and Edwards Aquifer. The Edwards Aquifer lies to the west, outside the reaches of the proposed Urban Rail system. The Edwards Aquifer environment should not be affected by any Urban Rail activities. Zilker Park and Barton Springs are upstream from the proposed Urban Rail corridor and, therefore, should not be considered inside the area of potential effect (APE).

One unique manmade environment in Austin that attracts millions of 'visitors' through the spring and summer months is the Ann W. Richards (Congress Avenue) Bridge. Congress Avenue Bridge is home to an estimated 1.5 million Mexican freetailed bats (*Tadarida brasiliensis*), the largest urban colony in North America. The Mexican free-tailed bat population under the Congress Avenue Bridge is a unique biological resource that will require special attention. As noted in the *Urban Rail Pre-NEPA Environmental Study,* preliminary discussions with US Fish and Wildlife (USFWS) and Bat Conservation International (BCI), have established that this species is not a "species of concern" and that the bats have become habituated to the sounds and vibrations due to normal traffic. However, it will be construction activities that will impose the greatest constraint. Mitigation of construction noise and vibration and preservation of the bats' roosts under the bridge will be critical. Upon selection of the crossing alternative, a more detailed review should be conducted.

Opportunities and Constraints

To help understand the environment in which the proposed Urban Rail system would operate, the project team conducted a review of aerial photos of the study area, a walking tour of major corridors, and discussions with various stakeholders in Central Austin. The opportunities and constraints noted are briefly described here.

Opportunities-Land Use

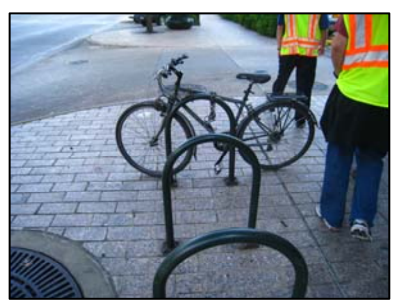
- Significant population and employment growth is forecast for Central Austin and the region over the next 20 years. This presents a generational opportunity to influence land use patterns and development so that key cultural aspects of Austin can be preserved.
- The pending redevelopment of the Seaholm District on the southwest side of downtown presents the opportunity to enhance density and the population base of downtown and provides an impetus for a vital east-west transit connection.
- The large number of parking garages on the east side of downtown, both near the State Capitol complex and the UT-Austin campus, in addition to other properties owned by the State and University, provide the potential for extensive redevelopment or development of joint use facilities. In fact, the State has proposed moving as many as 5,000 additional workers into the area north of the Capitol and south of UT. These facilities would be enhanced by a new transit investment and its connections to other activity centers in Central Austin.
- The potential for extensive new hotel development on the southeast side of Central Austin (near the Convention Center and the MetroRail Red Line) provides the potential for new transit ridership and connections.
- The focused development along potential new transit alignments provides the opportunity to ensure a balance of housing opportunities for all income levels and to enhance employment possibilities for all job categories in Central Austin.

- The ongoing redevelopment at Mueller provides a prominent anchor and northern terminus for the system. Opportunities for new employment and residential development will benefit from improved mobility from a new transit investment.
- The potential alignment along Riverside presents the opportunity for promoting redevelopment in that corridor, providing additional residential and employment opportunities for local residents and the entire region.

Opportunities-Mobility

- Roadways in Central Austin are currently at capacity during the expanding peak period, but there is no limited right-of-way to add vehicle capacity. This presents an opportunity for greater person-moving capacity via new transit on existing rights-of-way.
- The potential use of a new transit alignment along Guadalupe-Lavaca Streets or other streets paralleling Congress Avenue could present the opportunity to shift transit traffic off an already-congested Congress Avenue; alternatively, a fixed-guideway alignment on Congress Avenue could allow other transit (such as bus service) to be located on parallel streets or eliminated, spreading the transit coverage throughout downtown.
- The abundance of cultural facilities on both sides of Lady Bird Lake (including UT and City facilities and those on the south side of the lake such as the Long Center, Auditorium Shores, and others) provides the opportunity for a new transit investment to link established public facilities and to facilitate mobility between and among those facilities.

- The ongoing efforts of the City to update and implement its bicycle and pedestrian plans provide significant opportunities for non-auto access to a new transit investment.
- The potential of extended transit services to the airport presents the opportunity to intercept significant auto traffic coming towards downtown from the southeast during the morning peak periods; a park-and-ride facility or near the airport would allow a new transit investment to provide significant alternative passenger capacity.
- The student, employment, and visitor base provided by the UT-Austin campus, and all its activities and related facilities, provides a tremendous opportunity for a new transit investment to enhance campus access and mobility.



Opportunities-Connectivity

- The opening of the MetroRail Red Line at the southeast corner of downtown provides the first fixed-guideway transit link for the area and presents the opportunity to establish extensive multi-modal connections to enhance mobility throughout the community. The potential exists for a new transit investment connecting with the Red Line along with other transportation options (including buses, bicycles, and pedestrian facilities) into both an integrated transportation network for Central Austin and one or more potential multi-modal hubs or passenger transfer facilities.

- The Amtrak station and the adjacent Lone Star regional rail corridor at the southwest corner of downtown present an opportunity to provide improved access to regional connections with a new transit investment.

- The proposed MetroRapid Rapid Bus corridor on Guadalupe-Lavaca Streets on the west side of downtown provides the opportunity to integrate a new transit investment into a designated high-capacity transit corridor and to implement the City's Great Streets design approach to that corridor that incorporates multiple transit modes.

- Potential alignments through the UT-Austin campus provide significant connectivity opportunities especially with the West Campus Shuttle, a high-frequency bus system now serving UT students, employees, and visitors.
- The potential alignment along Riverside towards the airport would provide significant reverse-commute opportunities for downtown area residents (or commuters coming from farther north on the MetroRail Red Line) to jobs in the southeast and near the airport. It would also provide relatively seamless transit service for transit patrons on the Red Line wanting to go to the airport for airline service.

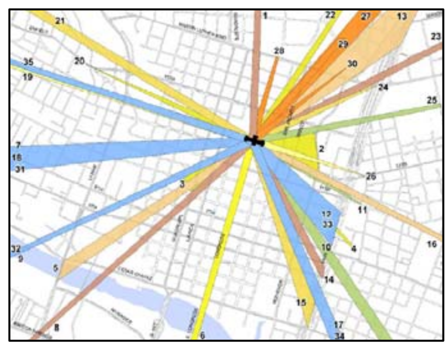
Constraints

- The *Urban Rail Pre-NEPA Environmental Study* includes a detailed discussion of environmental issues and constraints, which **not** duplicated here in the *Central Austin Transit Study*.

- The open flangeways in the track slab present hazards for bicyclists. Mitigation, whether some kind of 'filler' material or simply separating rails and bikes within the same street, or onto different alignments, should be carefully considered.
- The presence of head-in angled parking on Congress Avenue presents traffic engineering challenges when considering implementation of a new fixed-guideway transit investment alignment. These parked vehicles cause conflicts with existing bus service on Congress Avenue today.
- Congress Avenue presents design challenges due to crown and drainage issues in many locations.
- Brazos Street is challenged by the abundance of parking garage entrances, potentially conflicting with a new fixed-guideway alignment on that street.

- The one-way southbound travel flow on San Jacinto Boulevard could present challenges to implementing two-way fixed-guideway operations. Conversion to two-way flow is recommended.
- Permission to locate new transit stops around the Capitol on San Jacinto Boulevard and Governor's Mansion on Lavaca Street may be difficult to obtain due to security concerns expressed by the Texas Department of Public Service (DPS).
- Very high traffic volumes on both existing bridges, South 1st Street and Congress Avenue, could be problematic for transit operations on those bridges. Additionally, and perhaps more importantly, traffic disruptions during transit guideway construction on either bridge would be a significant traffic operations issue. These potential impacts should be considered when comparing Lady Bird Lake crossing alternatives (existing structures versus new structure).

- The Mexican free-tailed bat population under the Congress Avenue Bridge is a unique biological resource that will require special attention. As noted in the *Urban Rail Pre-NEPA Environmental Study,* preliminary discussions with US Fish and Wildlife (USFWS) and Bat Conservation International (BCI), have established that this species is not a "species of concern" and that the bats have become habituated to the sounds and vibrations due to normal traffic. However, it will be construction activities that will impose the greatest constraint. Mitigation of construction noise and vibration and preservation of the bats' roosts under the bridge will be critical.



- The limitations of the Capitol View Corridors will constrain the ability to locate and size related facilities such as a maintenance facility or station stop canopies within the CBD. Unique solutions at each stop may be necessary.
- While the presence of Capital Metro's fixed-route and MetroRapid services on Guadalupe-Lavaca Streets presents significant mobility and connectivity opportunities, significant coordination will be required to manage

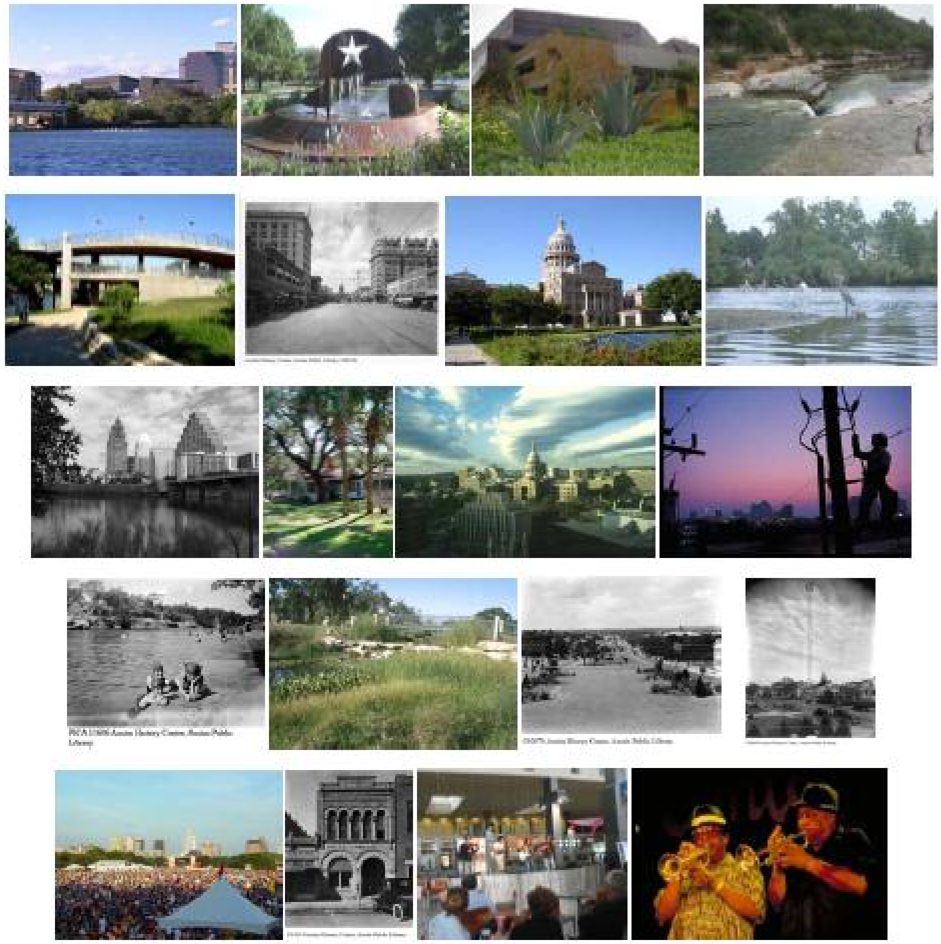


PHOTO CREDITS (L to R): City of Austin photo; Photo by Karen Grotefend, City of Austin; City of Austin photo; Photo by Mike Lyday, Watershed Protection and Development Review Department; Photo by Karen Grotefend, City of Austin; Austin History Center, Austin Public Library C00138 Photo; Photo by Bob Parker; Photo by Mike Lyday, City of Austin Watershed Protection and Development Review Department; Photo by Bob Parker, Austin Fire Department; Photo by Victor Ovalle, City of Austin Parks and Recreation Department; Photo by Mike Lyday, Watershed Protection and Development Review Department; Photo courtesy of Austin Energy; Austin History Center photo; Photo by Mike Lyday, Watershed Protection and Development Review Department; Austin History Center photo; Austin History Center photo; Photo by Victor Ovalle, City of Austin Parks and Recreation Department; Austin History Center photo; Photo by Jim Halbrook, Department of Aviation; City of Austin Parks and Recreation Department

3. Route Definition and Evaluation

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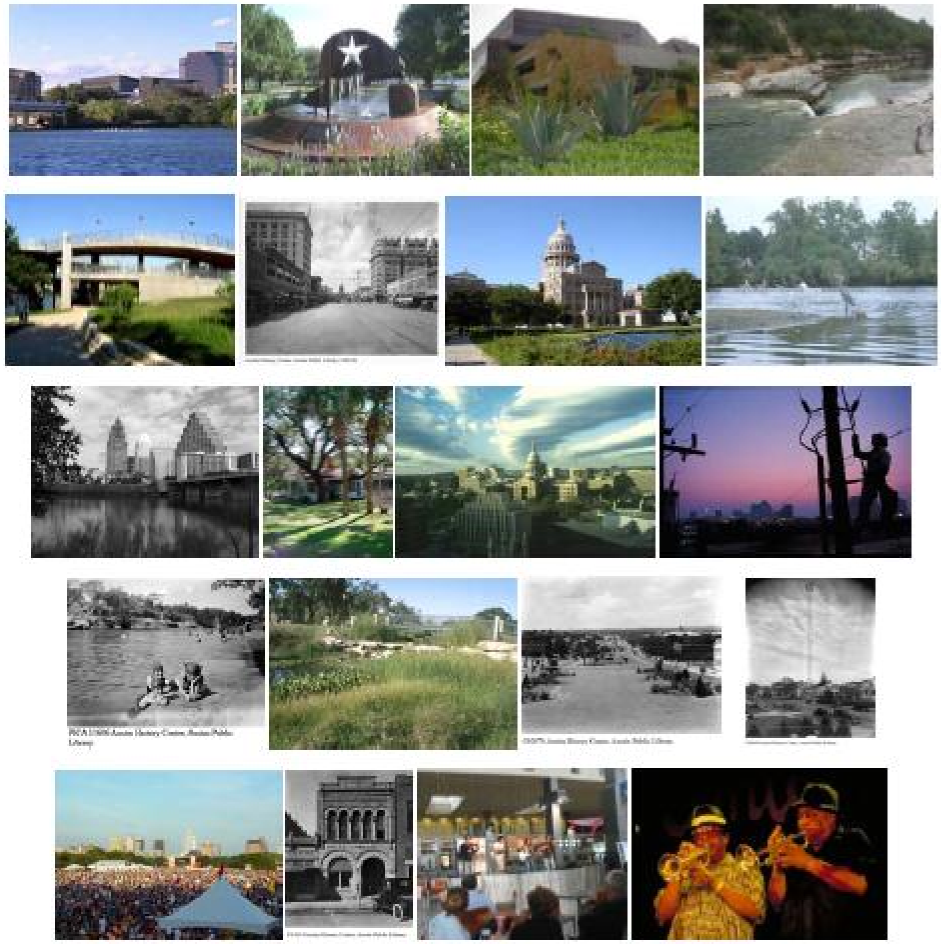

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3. Route Definition and Evaluation

Route Alternatives Evaluation Process

The first step in the *Central Austin Transit Study* is the conceptual evaluation of alternative routes and alternative vehicle (or modal) technologies. This chapter addresses the **routes** and Chapter 4 considers the **technologies**. The conceptual alternatives recommended by Chapters 3 and 4 are advanced to the detailed evaluation of **investment alternatives** in Chapter 5.

The process for evaluating route alternatives consists of: establishing the evaluation criteria, defining the alternatives, and systematically evaluating the alternatives according to the criteria. At the conclusion of this chapter is the recommended **alignment**, drawn from the highest ranked routes.

Route Alternatives Evaluation Criteria

At the conceptual level, route options were evaluated according to each of the six overall goals, previously described in greater detail in Chapter 2:

1. ***Improve Place Connectivity***
2. ***Improve Transit Connectivity***
3. ***Improve Mobility***
4. ***Maximize Community Benefits***
5. ***Maximize Environmental Benefits***
6. ***Maximize Economic Benefits***

The scoring criteria established for each goal ranges from 1 to 3 based upon how well a route alternative can meet each stated goal, with a score of 1 indicating a neutral or minimal response to the goal and a score of 3 indicating that a corridor is able to respond well to the goal. Table 3-1 details the scoring and criteria for each goal.

Table 3-1. Goals and Scoring Methodology for Conceptual Route Evaluation

Goal	Scoring & Criteria	
1. Improve Place Connectivity	3 =	Connects primary destination to another primary destination.
	2 =	Connects primary destination to existing or future population concentration.
	1 =	Neutral/minimally meets goal.
2. Improve Transit Connectivity	3 =	Connects to major/regional transit facility.
	2 =	Improves access to transit.
	1 =	Neutral/minimally meets goal.
3. Improve Mobility	3 =	Improves access in/out of Central Austin.
	2 =	Improves access along/parallel to a well-travelled corridor.
	1 =	Neutral/minimally meets goal.
4. Maximize Community Benefits	3 =	Support and provide opportunities to build community through placemaking.
	2 =	Provides access for socio-economically disadvantaged population.
	1 =	Neutral/minimally meets goal.
5. Maximize Environmental Benefits	3 =	Maximizes potential for compact, mixed-use development.
	2 =	Along/parallel to a well-travelled corridor.
	1 =	Neutral/minimally meets goal.
6. Maximize Economic Benefits	3 =	Maximizes development potential (community benefit).
	2 =	Along/parallel to a well-travelled corridor (user benefit).
	1 =	Neutral/minimally meets goal.

Route Alternatives Definition

The Central Austin population, employment, educational, and commercial activity centers – Mueller Redevelopment, University of Texas, CBD, Capitol Complex, East Riverside Corridor, and ABIA – used to establish the study area represent the key destinations in need of connection and corridor development. As initiated in the 2006 CMTA *Future Connections Study – Central Austin Circulator – Alternatives Evaluation,* connection needs within the study area were identified according both to historical travel patterns and to the study's six overall transportation investment goals.

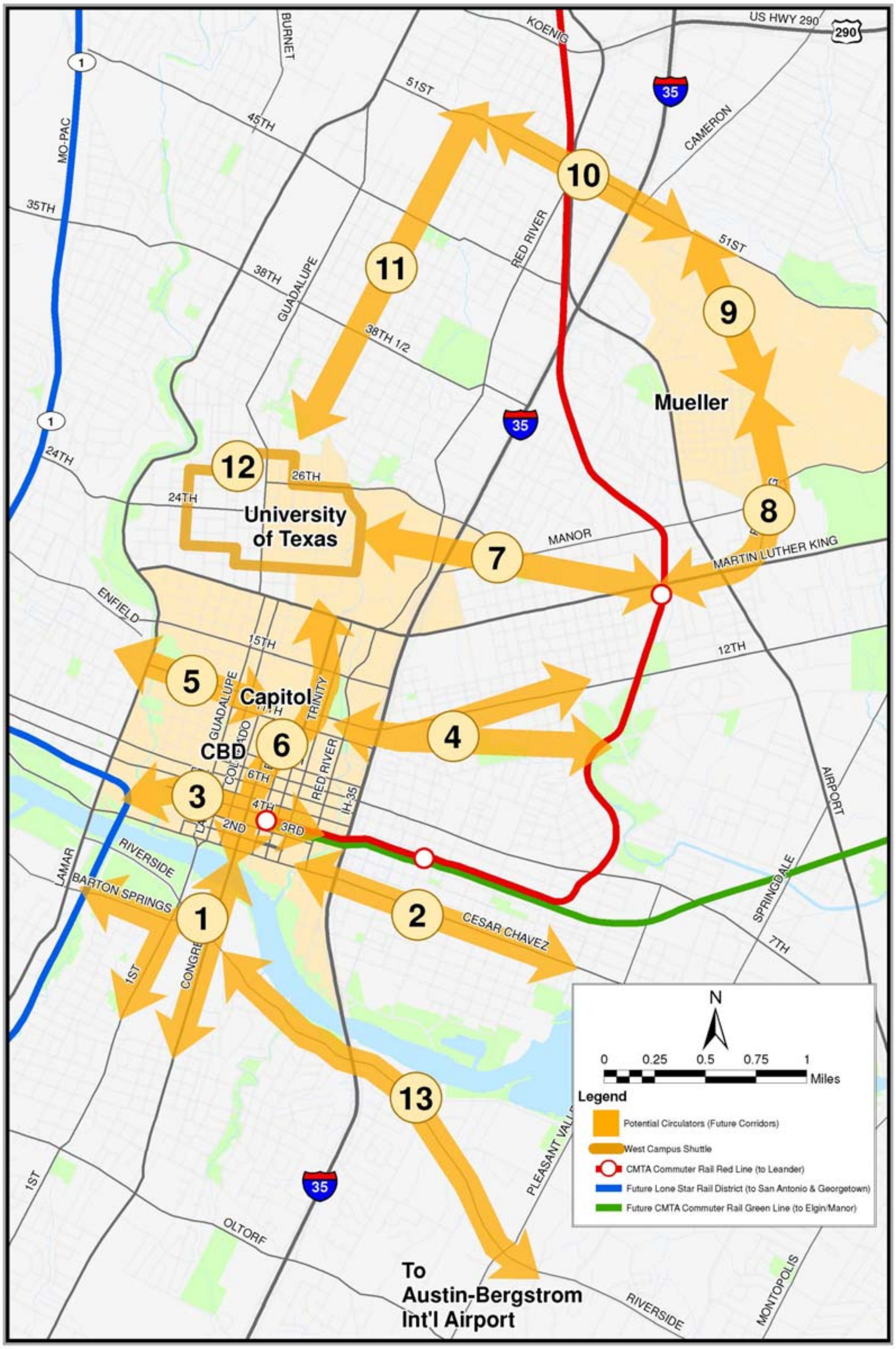
Connection Need Corridors

A list of alternative *Connection Need Corridors* was developed based upon previous studies, historical travel patterns, neighborhood and City plans, and the six overall transportation investment goals noted above and discussed in greater detail below. It is important to note that the Connection Need Corridors are general routes and not necessarily specific alignments along particular streets. For some corridors, potential street alignments are identified due to limited options or defined features. For other corridors (through downtown, for example) several alignment options may be available. Figure 3-1 shows the set of Connection Need Corridors defined and evaluated for this study.

Ultimately, 13 Connection Need Corridors were identified that, when taken together, meet the collection, distribution, and circulation needs expressed by the community. These Connection Need Corridors are:

1. **Downtown (CBD) to South Central Austin (River South)**
2. **Downtown (CBD) to South East Austin**
3. **Downtown Commuter Rail Station (CBD Southeast) to Seaholm Redevelopment/planned Lone Star Regional Rail Station (CBD Southwest)**
4. **Capitol Complex to East Austin**
5. **Capitol Complex to West Central Austin**
6. **Downtown (CBD)/Capitol Complex to University of Texas (UT)**
7. **University of Texas (UT) to MLK, Jr. Commuter Rail Station**
8. **MLK, Jr. Commuter Rail Station to Mueller Redevelopment (South)**
9. **Mueller Redevelopment (Internal) to 51st Street**
10. **Mueller Redevelopment (North) to North Central Austin (Hyde Park)**
11. **University of Texas (UT) to North Central Austin (Hyde Park)**
12. **University of Texas (UT)/West Campus Loop**
13. **East Riverside Drive to Austin-Bergstrom International Airport (ABIA)**

Figure 3-1. Connection Need Corridors



Source: URS, 2010.

Route Alternatives Evaluation

The scoring criteria established for each goal ranges from 1 to 3 based upon how well a route alternative can meet each stated goal, with a score of 1 indicating a neutral or minimal response to the goal and a score of 3 indicating that a corridor is able to respond well to the goal. Table 3-1 details the scoring and criteria for each goal and Table 3-2 includes the actual route alternative evaluation. A discussion of the results follows the table.

Table 3-2. Results of Route Alternatives Evaluation

CNC/Route	Goals						
	Goal 1. Improve place connectivity	Goal 2. Improve transit connectivity	Goal 3. Improve mobility	Goal 4. Maximize community benefits	Goal 5. Maximize environment-tal benefits	Goal 6. Maximize economic benefits	TOTALS
1. CBD to River South	3	2	3	1	2	3	**14**
2. CBD to South East Austin	1	1	1	3	2	2	**10**
3. CBD Southeast to CBD Southwest	2	3	3	3	3	3	**17**
4. Capitol to East Austin	2	1	1	3	2	2	**11**
5. Capitol to West Central Austin	1	1	1	1	2	2	**8**
6. CBD/Capitol to UT	3	2	3	3	3	3	**17**
7. UT to MLK, Jr. Station	3	3	3	2	2	3	**16**
8. MLK, Jr. Station to Mueller South	3	2	3	3	2	3	**16**
9. Mueller Internal	3	1	2	3	3	3	**15**
10. Mueller North to Hyde Park	1	1	2	2	1	1	**8**
11. UT to Hyde Park	2	1	2	1	3	2	**11**
12. UT Loop	1	1	3	2	2	2	**11**
13. East Riverside to ABIA	3	3	2	3	3	3	**17**

Discussion of Evaluation Results

The results show that the route alternatives **1, 3, 6, 7, 8, 9, and 13**, as highlighted in Table 3-2, ranked highest according to the project's goals. Discussions for each route alternative's evaluation are included below. The highest ranking routes are noted with an underline and their scores are in parentheses ().

1. **CBD to River South (14)** – This route scores high in improving place connectivity as it connects the south end of the CBD to South Austin commercial corridors along South Congress, South 1st Street, and South Lamar (and potentially on to Zilker Park), and to the Palmer/Long Centers. This route also scores high in improving mobility and economic benefits because it provides access to the East Riverside Corridor (route 13), as well as a potential TOD on the south shore of Lady Bird Lake. This route can also serve a potential maintenance facility site at One Texas Center.

However, this general corridor already has a substantial mix of modes and is well-served by conventional bus.

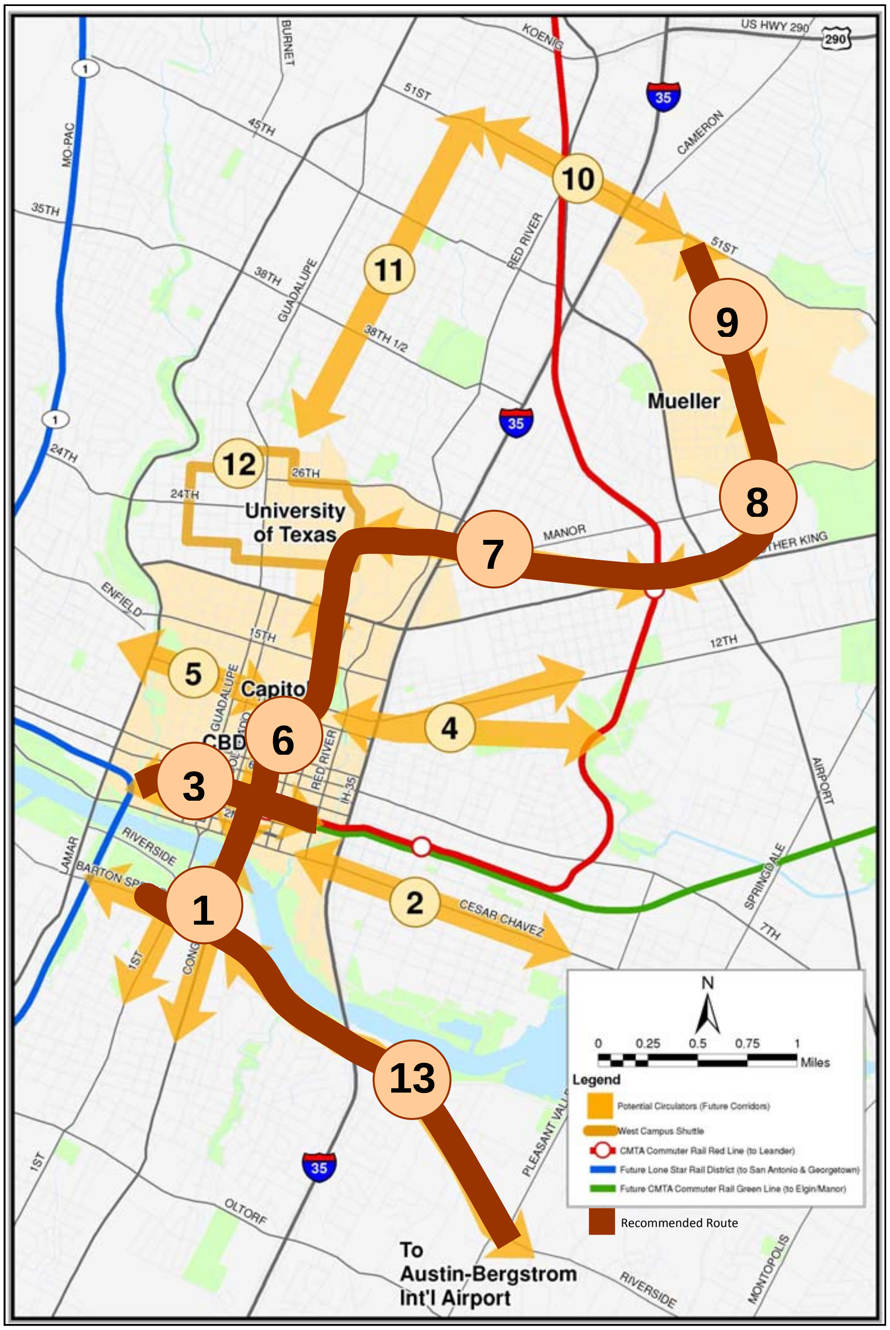
2. **CBD to South East Austin (10)** – Due primarily to lower density population and employment along this Connection Need Corridor, the route does not score well when compared to the other alternatives. A notable and developing place along this corridor is the Waller Creek District, which may make this a more viable route for future consideration.
3. **<u>Downtown Commuter Rail Station to Seaholm Redevelopment (17)</u>** – This corridor scores very well due to the transit connectivity provided between the Capital Metro Commuter Rail Station and the proposed Lone Star Regional Rail Station, just west of the existing UPRR wye. This route also connects the Convention Center to the east with the nascent cultural and residential Seaholm Redevelopment/District to the west, which includes the proposed New Central Library, the Shoal Creek Hike & Bike Trail, Lance Armstrong Bikeway (LAB), redeveloping former Green Water Treatment Plant, the Austin Music Hall, and three new high-rise condominium towers, among other amenities.
4. **Capitol Complex to East Austin (11)** – This route does not score well compared to others because it does not connect with the Red Line, nor does it connect medium to high density population or employment to the east with the employment center at the Capitol Complex. Ultimately, this corridor presents future opportunities with the 11th and 12th Street corridors, which have been a long-running redevelopment target for the community.
5. **Capitol Complex to West Central Austin (8)** – This route does not connect to a proposed Lone Star station (nearest are Seaholm and 35th Street), nor does it connect medium to high density population or employment to the west with the employment center at the Capitol Complex. However, like the Capitol to East Austin route, this corridor has tremendous potential should the University of Texas proceed with a large-scale redevelopment of the 345 acre Brackenridge Tract to the far west of the corridor.
6. **<u>Downtown/Capitol Complex to University of Texas (17)</u>** – This corridor scores among the highest and is the logical backbone of any Central Austin transit system. Connecting the Red Line and Rapid Bus commuter services at the south end to major employment centers (CBD, Capitol, and UT), this route links places and transit services; provides access in/out of Central Austin (by way of the commuter connections); improves circulation within Central Austin; and, can catalyze redevelopment along the east and north sides of the Capitol Complex.
7. **<u>University of Texas to MLK, Jr. Commuter Rail Station (16)</u>** – This route alternative scores very well because it links the main UT campus to Commuter Rail (at the MLK Jr. Station), which links to UT's Pickle Research Campus in north Austin (at the Braker Station). This improves both place and transit connectivity, along with mobility, which has significant environmental benefits due to the many frequent trips between UT campuses.
8. **<u>MLK, Jr. Commuter Rail Station to Mueller Redevelopment (South) (16)</u>** – This route connects two transit-oriented developments (TODs): one smaller-scale, partially constructed TOD adjacent to the Red Line station and the other a large-scale mixed-use "urban village" at Mueller. In fact, Mueller was developed for rail transit and has even incorporated general design geometric criteria into its street network. This route provides transit connectivity, place connectivity, and support for economic development at Mueller, given its two dedicated employment centers (one defined by the Dell Children's Medical Center), substantial retail component, and planned 42-acre mixed-use town center.

9. **Mueller Redevelopment (Internal) to 51st Street (15)** – Unlike the other routes, this alternative is focused on circulation within a single neighborhood/development. Despite its limited reach, the Mueller Internal route provides direct connections to multiple activity centers within Mueller, including the first residential phase, the Medical Center, the 20-acre Austin Film Studio complex, and the first two retail phases.
10. **Mueller Redevelopment (North) to North Central Austin (Hyde Park) (8)** – This corridor is more compelling for the potential for a route loop than for direct connectivity along its route. This corridor does begin with major employment at the north end of Mueller but links to only low to medium density residential the general Hyde Park area. A notable destination at the west end of the route is UT's Whitaker (Intramural) Fields at 51st Street and Guadalupe Street, which hosts intercollegiate events, along with intramurals. This route does intersect Airport Boulevard, for which the City intends to initiate a corridor master planning effort. Redevelopment of this corridor would benefit from and provide support to a higher-capacity transit corridor along 51st Street. Also worth noting is that a Red Line Commuter Rail station at 51st Street would be a viable alternative to the lightly used Highland Station to the north, which has been problematic due to its proximity to the nearby Crestview Station. A 51st Street station offers better spacing between MLK, Jr. to the south (~2.5 miles) and Crestview to the north (~1.9 miles) and better connectivity with a higher-capacity transit service in this corridor.
11. **University of Texas (UT) to North Central Austin (Hyde Park) (11)** – The strength of this corridor lies with its proximity to three well-travelled north-south corridors in Lamar Boulevard, Guadalupe Street, and Red River Street, which are all commercial/retail routes connecting to UT. However, this route lacks significant place or transit connectivity and passes through only low to medium density residential neighborhoods.
12. **University of Texas (UT)/West Campus Loop (11)** – This circulation route would provide improvements in mobility through this portion of Central Austin, which is currently served by a shuttle bus route. Currently, there is limited parking in West Campus and new developments incur substantial costs in order to provide structured parking, which could be potentially mitigated with the introduction of higher-capacity transit. Much of the mobility along this route is achieved via bicycle and pedestrian, so environmental benefits are somewhat limited though travel time reductions would be achieved for this segment of the population.
13. **East Riverside Drive to Austin-Bergstrom International Airport (ABIA) (17)** – This corridor scored among the highest as it meets all – and exceeds many – of the goals for this investment study. The East Riverside Corridor links high density populations east of I-35 with medium to high density downtown employment centers south of Lady Bird Lake, including City of Austin and Austin Energy (a City-owned electric utility) offices, Austin American-Statesman office and production facilities, and TxDOT Division headquarters. Also located near the western end of this route are major cultural facilities, such as the Long Center for the Performing Arts and the Palmer Events Center, along with recreational destinations like Auditorium Shores and the Lady Bird Lake Hike & Bike Trail, and even two civic event locations (South First Street, or Drake, Bridge and the Ann W. Richards Congress Avenue Bridge). East of I-35 the corridor is already redeveloping, even as the City just completed the East Riverside Corridor Master Plan, which envisions a vibrant, mixed-use, transit-oriented destination, complete with multiple rail transit stations. Other destinations along this corridor include an Austin Community College (ACC) campus, large metropolitan parks, and an international airport. This corridor is currently served by more than a half-dozen conventional bus routes, including an airport route and multiple UT

shuttle routes. Benefits of higher-capacity transit in this corridor include the ability to reduce the intensity of bus service and reduce travel times. Additionally, given the low-rise, lower density auto-centric development and vast tracts of undeveloped property along the corridor, there is substantial redevelopment potential with corresponding economic benefits to the City.

Figure 3-2 below shows the recommended route comprised of the seven highest scoring alternatives.

Figure 3-2. Recommended Route



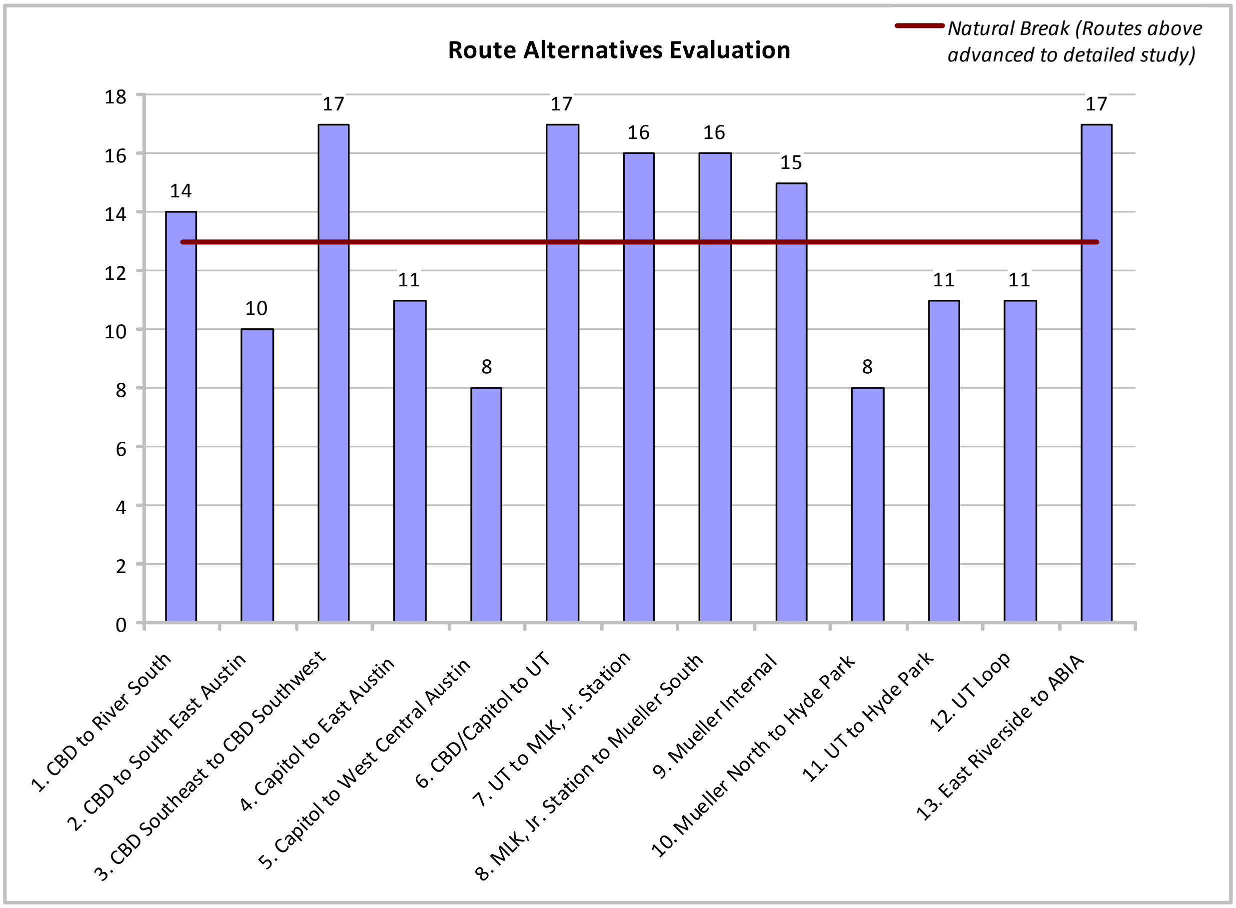
Source: URS, 2010.

Recommended Alignment for Investment Evaluation

Following selection of the recommended route alternatives, a specific alignment within the routes, or Connection Need Corridors, was identified for use with the recommended **technologies** from Chapter 4 to define the **transit investment alternatives** for evaluation in Chapter 5.

The recommended alignment was selected from the complete set of 13 route alternatives, or Connection Need Corridors, by identifying a natural break in the results tabulation. As shown below in Figure 3-3, six routes, **1, 3, 6, 7, 8, 9, 13**, scored noticeably higher than the other seven.

Figure 3-3. Routes Selected for Recommended Alignment by Evaluation Results



The sections below describe the various alignment **segments** comprising the recommended alignment.

1. Downtown to South Central Austin

This alignment segment provides a critical linkage across Lady Bird Lake, which is vital for access to the potential maintenance facility site and to ABIA, via the East Riverside Corridor. This segment has two elements:

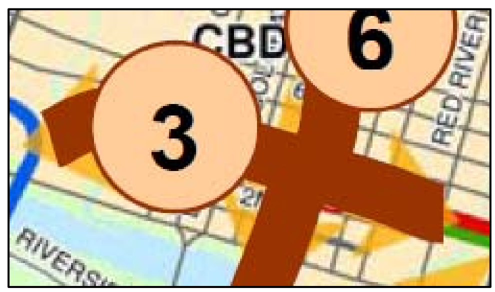
Lady Bird Lake Crossing

This short segment is currently a 'gap' in the alignment, as there is no recommendation for a specific Lady Bird Lake crossing. This issue is discussed in detail in Chapter 6. In summary, there are two basic options: retrofit one of the two existing bridges or construct a new, possibly multi-modal or transit-/pedestrian-/bike-only, crossing between South 1st Street and Trinity Street, off of Colorado, Brazos, or Trinity Street. Issues for consideration in making a recommendation include transit and traffic operations, construction cost, construction impacts, development times, structural capacity, and others.

Palmer/Long Center Spur

This short segment of the alignment is drawn from part of route alternative 1 and would also start from the south touchdown of the LBL crossing, but turn westbound on Riverside Drive, depending upon the crossing location. The alignment would head west on Riverside Drive to Barton Springs Road where it would turn west onto Barton Springs Road. From Barton Springs Road the alignment provides direct access to a potential maintenance facility at the City of Austin offices at 505 Barton Springs Road (refer to Chapter 6 for detailed discussion), where it could be truncated if necessary. Beyond this potential maintenance facility site the alignment crosses South 1st Street and reaches an off-street terminal station in front of the Palmer Events Center, also providing access to the Long Center for the Performing Arts.

3. Downtown Commuter Rail Station to Seaholm Redevelopment

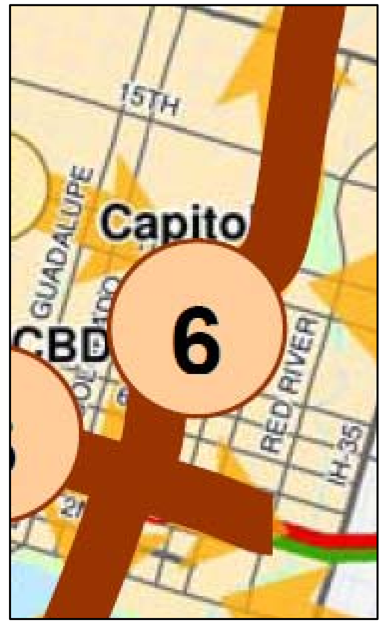


In Downtown Austin, the proposed alignment starts on 4th Street at the MetroRail Downtown station. Currently served by an interim station at Trinity Street, adjacent to the Convention Center, Capital Metro plans to relocate to a permanent location possibly at Brazos Street. The future terminus/transfer station will likely depend upon where this proposed alignment ultimately turns south from 4th Street to cross Lady Bird Lake, as discussed below. The alignment then continues west on 4th Street, a City-designated transit corridor, and across Congress Avenue to the Nueces-San Antonio Street couplet. The proposed alignment turns south onto the Nueces-San Antonio Street couplet in order to shift to 3rd Street, where it can cross Lower Shoal Creek through City right-of-way. Now in the Seaholm District, the alignment heads west to its west terminus adjacent to the Union Pacific Railroad (UPRR) wye, between West Avenue and Bowie Street. Just east of Bowie Street, an intermodal transit station redeveloped out of the former Seaholm power plant would provide a direct connection to the future Lone Star regional rail system planned for operation in the current UPRR corridor.

6. Downtown/Capitol Complex to University of Texas

The conceptual evaluation above scored the route from Downtown through the Capitol Complex to UT among the highest. Given this critical function as the hub of any recommended alignment, it is also recommended that the following two alignments through Downtown/Capitol/UT be pursued: Congress-San Jacinto (East CBD) and Lavaca-Guadalupe Couplet (West CBD). Two routes through Downtown can provide vital operational flexibility, greater economic potential, and geographic equity:

- Operational Flexibility – Congress Avenue is considered the "Main Street of Texas" and was the backbone of Austin's original streetcar system of the first half of the 20th century. This special status enjoyed by Congress Avenue makes it ideal for a higher-capacity transit investment. However, as Congress Avenue continues to serve as the focal point for Downtown, it is also the site of many special events throughout the year that require street closures. Therefore, the City proposes a second alignment through Downtown that will allow for uninterrupted higher-capacity transit service. Two routes also provide for multiple service options and can accommodate Downtown circulation in addition to collection-distribution service.



- Economic Potential – Whereas Congress Avenue is a more developed corridor with limited redevelopment potential, Lavaca-Guadalupe offers significant redevelopment opportunities due to its lower-rise buildings, lower-density, and scarce retail, despite being anchored on the south by City Hall and the redeveloped Second Street District.

- Geographic Equity – As Downtown redevelops to the east, along the Waller Creek District, and to the west, with the Seaholm District and potential Travis County consolidation, it is anticipated that demand for higher-capacity transit will grow along both corridors.

Experience of other systems, notably DART in Dallas, shows that system expansion plans can be hampered by constrictions within the core of the system. Therefore, it is vital to plan for two north-south corridors through Downtown in order to ensure long-term system sustainability. The two sub-segments of the recommended alignment are East CBD and West CBD:

East CBD

The East CBD segment runs north on Congress Avenue from 4th Street to the 9th - 10th Street couplet, where it shifts east to San Jacinto Boulevard along the east side of the State Capitol Complex. San Jacinto Boulevard is a one-way southbound street and it is proposed that the right lane be dedicated as a contra-flow lane in which the higher-capacity transit system would run northbound. The alignment then crosses East Martin Luther King, Jr. Boulevard, where it becomes two-way, as it continues north on San Jacinto Boulevard through the University of Texas campus, past the Recreational Sports Center, Darrell K. Royal Texas Memorial Stadium, and Performing Arts Center to East Dean Keeton Street.

An alternate alignment to the Congress Avenue segment was considered along Brazos Street. Refer to Chapter 7 for a detailed discussion of this evaluation.

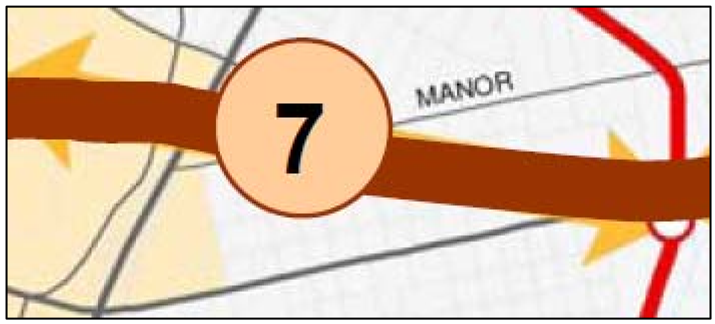
West CBD

The West CBD segment runs on the Lavaca-Guadalupe couplet from 4th Street at the south end to the 17th – 18th Street couplet at the north end, along the west side of the Capitol Complex. At the 17th – 18th Street couplet the alignment shifts west to double-track on San Antonio Street. From there, the alignment crosses West Martin Luther King, Jr. Boulevard and enters UT's West Campus area as a single-track alignment, terminating at 23rd Street.

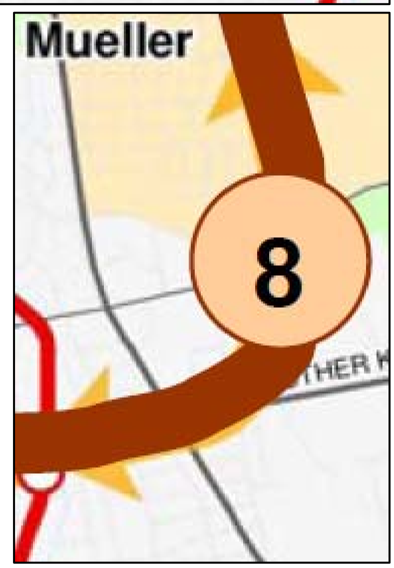
The Lavaca-Guadalupe couplet is designated by the City as a transit corridor and will see the introduction of Capital Metro's MetroRapid service beginning mid-2012. It is currently proposed that this higher-capacity transit system, MetroRapid bus, and conventional (or local) bus service will all share the right-most travel lane (converted to transit-only). The details of this joint-use operation have not been finalized and will require further study. Another issue for continued study of this segment is the presence of the sharrow bike facilities (currently in both left and right outside lanes), given the concerns about the interaction between bikes and rails, as noted in Chapters 2 and 7.

It should also be noted that West Campus/University is an important route because it has a large ridership base that already uses alternate modes at high proportions and it is close to a major trip generator (i.e., ACC-Rio Grande and University of Texas). The selection of San Antonio Street as the alignment along this route represents: 1) a balance between proximity to campus and to the high-density (for Austin) residential neighborhood and 2) a tradeoff between access to campus and The Drag's vibrant retail with impacts to traffic on Guadalupe Street. Guadalupe Street is a high volume four-lane undivided arterial with high frequency local bus service and, as acknowledged above, will also have to accommodate MetroRapid service.

7. & 8. University of Texas to MLK, Jr. Commuter Rail Station/Mueller South



At the intersection of San Jacinto Boulevard and Dean Keeton Street at the northeast corner of the UT campus, the proposed alignment turns east on Dean Keeton, crosses under I-35, and continues into the Manor Road corridor, also known as "Restaurant Row". The alignment then continues east on Manor Road to its intersection with Capital Metro's Red Line. At the intersection of the Red Line and Manor Road, a potential new transfer facility is recommended at this crossing. Alternately, a routing from the west approach to the Manor Road crossing south on Alexander could also provide direct transfers at the MLK Jr. Station. The proposed alignment then continues east from the Red Line crossing along Manor Road and across Airport Boulevard to Berkman Drive, where it enters the Mueller Redevelopment.



This routing along Manor has been recommended previously over the use of East Martin Luther King, Jr. Boulevard because of its lower traffic volumes and more favorable roadway grades.

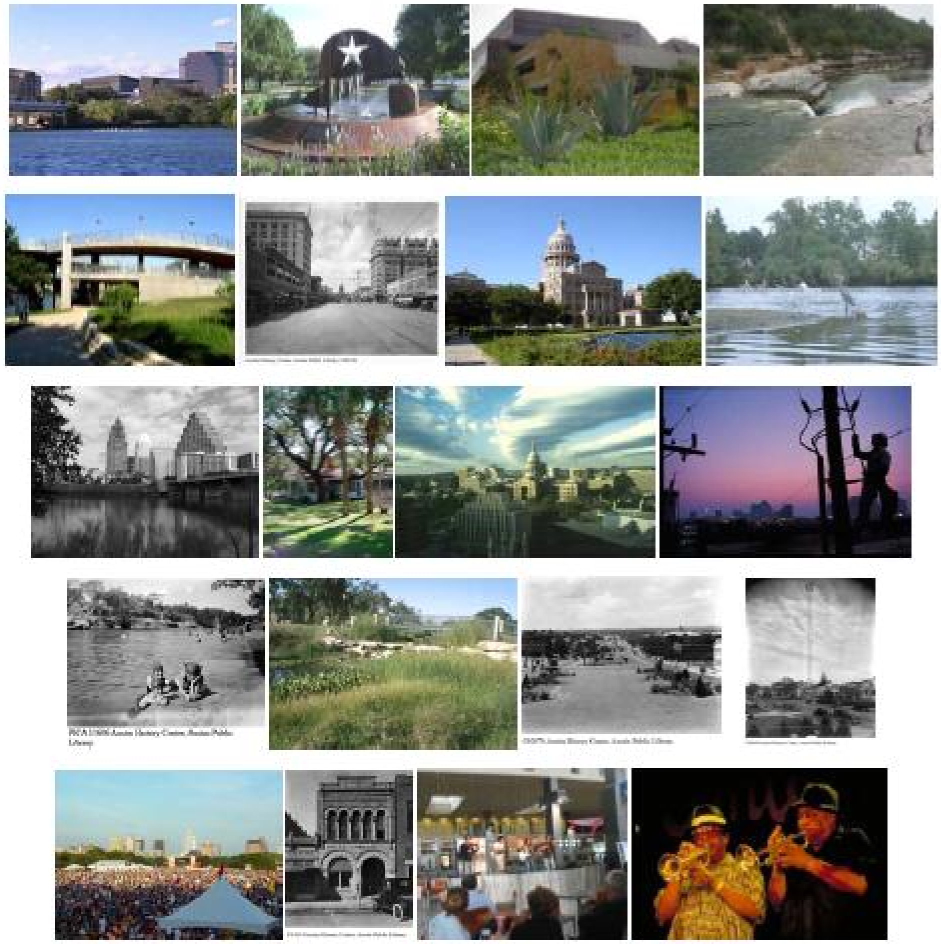
9. Mueller Internal

Within the Mueller Redevelopment the proposed alignment runs north along Berkman Drive, turns west on Robert Browning Street, and north on Mueller Boulevard. The alignment would end at 51st Street with the terminal station located on Mueller Boulevard. This alignment is preferred through Mueller as it connects the residential neighborhoods in the south to the (planned) Town Center, Dell Children's Medical Center, and UT's Health Research Campus.

13. East Riverside to Austin-Bergstrom International Airport (ABIA)

This segment of the alignment would start from the south touchdown of the Lady Bird Lake (LBL) crossing and, depending upon the location, likely continue east on West/East Riverside Drive, crossing over I-35 on the existing structure into the East Riverside Corridor (ERC). Between any of the possible LBL crossings and I-35, East Riverside Drive is a four-lane divided arterial. East of I-35 East Riverside Drive is a six-lane divided arterial with wide rights-of-way which can likely accommodate a dedicated, or semi-exclusive, transit guideway (in which other vehicles may not travel in, but can cross at-grade for left/right turns, intersections, etc). The alignment continues along East Riverside Drive over SH 71, on a new structure currently being designed by TxDOT to accommodate a fixed guideway system, and over US 183, on a new structure, and onto ABIA property. Within ABIA the alignment proceeds around the perimeter to Spirit of Texas Drive and into the terminal area, before looping back to Spirit of Texas Drive.

This alignment is recommended for use with the recommended **technologies** from Chapter 4 to define the **transit investment alternatives** proposed for evaluation in Chapter 5.



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4. Technology Definition and Evaluation

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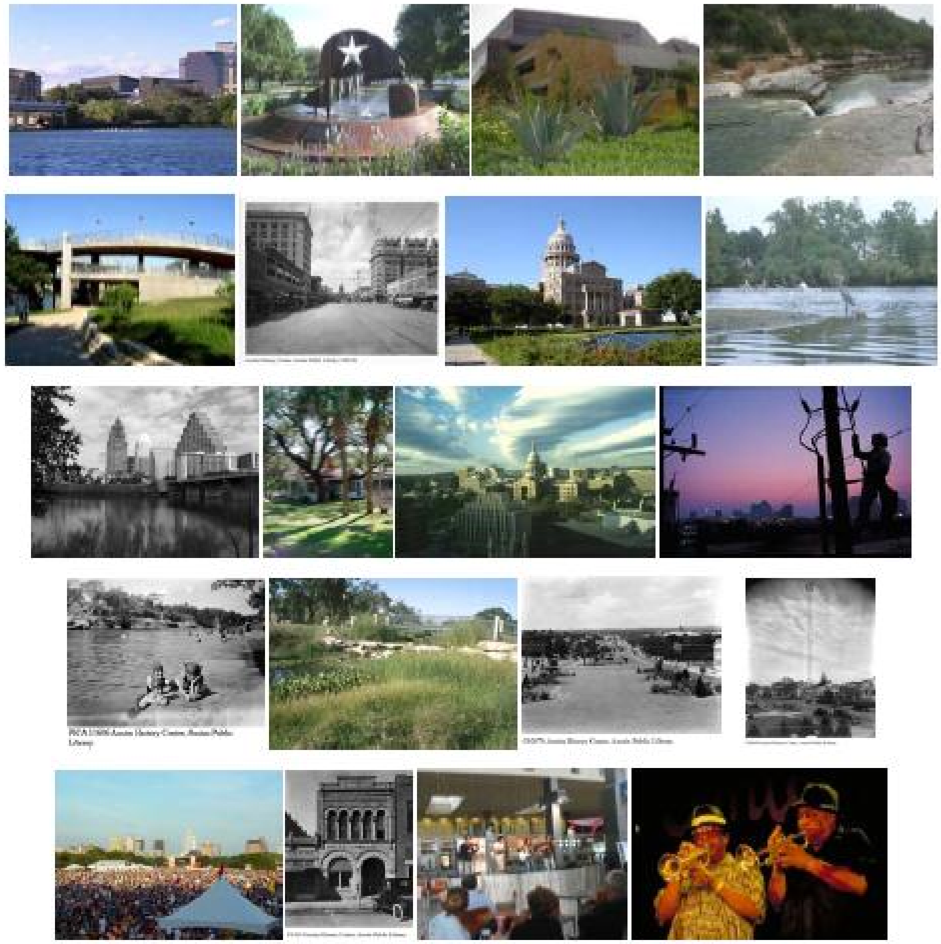

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4. Technology Definition and Evaluation

Technology Alternatives Evaluation Process

The conceptual evaluation in Chapter 3 identifies **route alternatives** and recommends a specific **alignment**. Similarly, the conceptual evaluation in Chapter 4 identifies vehicle (or modal) **technology alternatives** and recommends two for detailed study in Chapter 5.

The detailed evaluation in Chapter 5 combines the alignment and technology recommendations into a Build alternative and a TSM alternative. These two **transit investment alternatives** are compared to each other and to a baseline, or No-Build alternative, also using the same alignment recommended in Chapter 3.

The outcome of the detailed evaluation is a recommended **Locally Preferred Alternative (LPA)** for a transit investment serving Central Austin, the Mueller Redevelopment, East Riverside Corridor, and Austin-Bergstrom International Airport (ABIA).

The process for evaluating vehicle technology alternatives is to establish the evaluation criteria, define the alternatives, and rate the alternatives according to the criteria. At the conclusion of this chapter are the recommended **technologies** for advancement into the detailed evaluation.

Source: CMTA CAC AE, 2006

Guideway Types[1]

Transit technologies are defined by vehicle, as well as by guideway, type. Some vehicles can operate on a variety of guideway types, while others are uniquely associated with a particular guideway. There is a broad range of vehicle alternatives suitable for a major transportation investment in the Central Austin study area; however, the range of suitable guideway alternatives is more limited.

[1] CMTA, 2006, *Central Austin Circulator Alternatives Evaluation*, Capital Metro, November, 2006. http://allsystemsgo.capmetro.org/circulator-system.shtml

There are four basic transit guideway types, as shown in the above graphic:

- ***Elevated Reserved***
- ***In-Street Non-Reserved***
- ***In-Street Reserved***
- ***Tunnel Reserved***

From a strictly mobility perspective, the ideal guideway is entirely separated from other traffic, physical obstructions, and the weather, providing the most reliable, safe, fast, and efficient transit service. Tunnel reserved right-of-way meets these criteria and can offer significant mobility benefits beyond those of other guideway types. However, the extremely high cost for such exclusivity makes this option nearly prohibitive to deploy in most cases. To a lesser degree, elevated reserved guideway provides many of the same mobility benefits, but is subject to physical obstructions, like buildings and trees, and the weather, and is still very expensive. The costs for grade-separated, reserved guideway are about two- to three-times more expensive for elevated than surface transit. Tunnels are typically two- to three-times more expensive than are elevated. Both grade-separated options would encounter major design hurdles along the recommended alignment at the two crossings of I-35, where the multi-level highway presents physical obstructions that would likely require costly work-arounds. Tunnel guideway would have to contend with crossing under both the depressed Dean Keeton Street at I-35 and the depressed I-35 main lanes at East Riverside Street, along with Lady Bird Lake. On the other hand, elevated guideway would have to go over the current aerial section of I-35 at Dean Keeton Street. Elevated guideway would also present a considerable visual obstruction and may not even be attainable within Capitol View Corridors.

At-grade guideways, both reserved and non-reserved, offer much lower costs and improved access (no stairs, escalators, or elevators) over grade-separated types. While reserved right-of-way can offer better reliability, options for obtaining it within the identified corridor exist only excess right-of-way exists or where parking can reasonably be removed. Acquiring entirely new right-of-way corridors, or expanding existing ones within Central Austin, would be prohibitively expensive in terms of property costs, legal proceedings, and social costs associated with the necessary displacements. However, where reserved right-of-way is available within the study area (along East Riverside Street and around ABIA property), it is recommended that the proposed vehicle be able to take advantage of it. Another hybrid guideway type is semi-exclusive, or semi-reserved, in which the guideway takes the form of a designated travel lane without a physical barrier or separation. Semi-exclusive guideway offers reliability benefits because the transit service is in its 'own' lane and is less disruptive to the right-of-way since it fits within it. But, semi-exclusive reduces the auto capacity of the roadway, which may not be desirable along some segments.

Therefore, in-street non-reserved guideway is the most appropriate option for Central Austin because it is least expensive and least disruptive.

Technology Alternatives Evaluation Criteria

The technology alternatives were evaluated at a conceptual level using a set of performance-related criteria. As with route alternatives, each technology option is given a score ranging from 1 to 3 within each of the measures, with 1 being neutral to 3 indicating that a modal alternative is best able to respond to a stated performance measures. The vehicle evaluation criteria are described below and the evaluation results are summarized in Table 4-2.

- ***Moderate speed:*** Vehicle performance should match the predominant operating condition(s). There are trade-offs in vehicle performance, due to gearing, such that a vehicle geared for higher speed operations will not perform as well in a moderate or low speed environment, etc. The proposed route has a mix of low speed (~20 mph) in-street operations and moderate speed (35 to 45 mph) semi-exclusive operations. This range of speeds can be best served by a vehicle geared for moderate speeds.

- ***Moderate capacity:*** Passenger peak loads are not likely to be extremely high and should be well distributed along the route. Projected overall system ridership in 2030 is 27,600 passengers per day, which translates to an approximate peak hour load of 4,140 passengers. Refer to Chapter 6 for the ridership discussion.

- ***Ease of boarding:*** Vehicles should allow convenient, quick boarding and alighting. This should include an efficient means of fare payment to increase operating efficiency and minimize travel times.

- ***Fits within urban environs:*** Vehicles operating within the urban environment should "fit" within it by being sized appropriately, having minimal noise impacts, and being sufficiently maneuverable to navigate 90 degree corners within the existing street limits.

- ***Distinctive vehicles:*** Distinctive, branded vehicles can attract ridership, provide better revenue-generating opportunities (i.e., sponsorships), and become an urban amenity. The vehicles should also be easy to recognize, especially by visitors to the city.

- ***Good performance:*** Vehicles should have good acceleration, deceleration, and braking rates. These features are required to minimize travel times and operate safely within an urban environment where they must interact with vehicular traffic, pedestrians, and bicycles. In the case of in-street operations, vehicles should incorporate ITS technologies to coordinate with existing traffic signal systems and appropriate safety equipment.

- ***Low infrastructure need:*** Vehicles should be able to operate at-grade when running in, or crossing, surface streets.

Technology Alternatives Definition

The technology alternatives studied for this *Central Austin Transit Study* include the following:

- ***Conventional Bus***
- ***Bus Rapid Transit (BRT)***
- ***Commuter Rail***
- ***Heavy Rail***
- ***Monorail***
- ***Better Bus***
- ***Streetcar/Urban Rail***
- ***Light Rail***
- ***Regional Rail***
- ***People Mover/PRT***

Conventional Bus: Conventional, or local, bus service is what most people are familiar with here in Austin. Capital Metro's MetroBus service provides expansive routing with frequent stops. Fare collection is done on-board. Typical capital costs for conventional bus range from $2 million to $4 million per lane mile.

Better Bus: Better bus, or circulator bus, is a hybrid mode combining elements of conventional and express service with that of bus rapid transit (BRT). Better bus vehicles are larger, technologically advanced buses offering enhanced convenience to passengers. These vehicles usually incorporate a variety of features distinguishing them from conventional buses, including intelligent transportation system (ITS) technologies, and other priority measures to minimize delay. Stops are typically less frequent and fare collection is likely accomplished off-board. Capital Metro's planned MetroRapid Bus is an example of better bus and Los Angeles County Metropolitan Transportation Authority (LACMTA) currently operates Metro Rapid better bus service. Better bus qualifies for the Federal Transit Administration's TSM option, which is the most that can be done without a major guideway investment (discussed in more detail in Chapter 5). Typical capital costs for better bus range from $4 million to $8 million per lane mile.

Bus Raid Transit (BRT): BRT is considered a fixed-guideway mode similar to streetcar/light rail transit (LRT) with off-board fare collection, stations with platforms, and level boarding. BRT vehicles are branded and technologically advanced, using real-time arrival information and traffic signal priority to move more quickly. BRT is often deployed in dedicated lanes or rights-of-way and has fewer stops than local or better bus service, often serving longer distance commuters. Typical capital costs for BRT range from $15 million to $25 million per lane mile.

Streetcar/Urban Rail: Often referred to as "modern streetcar" (or trams in Europe), this vehicle is often characterized as a sidewalk/pedestrian extender. Streetcar is an overhead-electric-powered, fixed-guideway technology that typically operates with traffic in city streets. Routes tend to be short with frequent stops, usually every 2-4 blocks. Vehicles are generally narrower than conventional buses. Streetcar typically operates at speeds comparable to surrounding traffic. It is also worth noting that some streetcar systems around the country use restored historic or vintage trolleys and even modern replicas of those vehicles. These trolleys can operate like modern streetcars but have limited passenger capacity and operational characteristics. An urban rail vehicle is essentially a streetcar with some operating characteristics at the higher end of the speed- and capacity-ranges of streetcar. Streetcar/urban rail vehicles fit into the urban environment because they are smaller, lighter, and more maneuverable (i.e., smaller turning radius and quicker acceleration and braking) than light rail vehicles (LRVs). Streetcar/urban rail vehicles are typically run in single car trains that can operate both in mixed traffic and in dedicated rights-of-way; and, can also be fitted with couplers to operate in multi-vehicle sets (consists), such as those on San Diego's Green Line (a longer version of the S70). These flexible vehicles can provide operational characteristics comparable to those of light rail, despite they're smaller size. Streetcar/urban rail vehicles range from the “modern streetcar” currently used in Seattle, Tacoma, WA, and Portland, OR (66 feet long with a total passenger capacity up to 120 and a top speed of approximately 45 miles per hour) to a new, short LRV such as the Siemens S70 Ultra Short being manufactured for use in Salt Lake City (79 feet long with a total passenger capacity up to 160 and a top speed approaching 60 miles per hour). Additionally, supplemental power sources such as capacitors and batteries are under development by some manufacturers and may provide a viable alternative to systems powered completely by overhead electric wires. Typical capital costs for recent streetcar/urban rail systems range from $10 million to $40 million per track mile.

Light Rail: Like urban rail, light rail transit (LRT) is a fixed-guideway technology but usually with larger, heavier weight and slightly less maneuverability than Urban Rail vehicles. It is used in cities such as Houston, Dallas, Seattle, Portland, Denver, and Los Angeles. Light rail usually operates in a dedicated or semi-exclusive right-of-way (though LRT does operate in mixed traffic in a few locations around the country) and typically operates over modest commute distances (8 to 25 miles) in urban settings, including in downtown areas or between downtowns and adjacent suburbs. Trains usually consist of two to four electric-powered, articulated vehicles that are capable of operating in city streets, usually in semi-exclusive guideways. Typical vehicles are approximately 95 feet long, with a seated/standing passenger capacity of up to 166, and a top speed of 55 to 65 miles per hour. Typical capital costs for recent LRT systems range from $30 to $60 million per track mile.

Commuter Rail: Commuter rail typically operates on existing track, often in current or former freight rail corridors, with diesel or electric-powered vehicles. Vehicles are usually push-pull diesel locomotive-hauled coaches, self-powered diesel multiple units (DMUs), or electric multiple units (EMUs). Most familiar to Austinites are the DMUs used on Capital Metro’s MetroRail Red Line. Traditional commuter rail is medium- to long-distance passenger commuter service (30 to 100 miles), usually between a central city and surrounding or adjacent suburbs. For locomotive-hauled coaches, the commute coach cars can be either single-level or bi-level, with passenger capacity between 80 and 150 depending on the type of car. Maximum speed is 79 to 100 miles per hour, with stations typically spaced between 3 and 10 miles apart. DMU technology, such as that operated by Capital Metro, provides a lower-profile vehicle that is

approximately 135 feet long and carries up to 200 seated and standing passengers per car. Commuter rail technology typically does not operate in mixed traffic in city streets. Capital costs for recent commuter rail systems range from $20 million to $40 million per route mile.

Regional Rail: Regional, or intercity, rail such as that proposed by the recently rebranded LSTAR service, from the Lone Star Rail District, for the Union Pacific Railroad corridor from San Antonio to Georgetown (along Mopac/Loop 1 thru Austin). Regional rail also includes the type of service operated by Amtrak within regional corridors and typically uses locomotives or DMUs for longer-distance travel between metropolitan areas. Other examples include ACE Rail in California between San Jose and Stockton, TRI-RAIL in South Florida, and SEPTA Regional Rail in Southeastern Pennsylvania, among many others. Capital costs are similar to those for commuter rail.

Heavy Rail: Heavy rail technology uses an electrified third rail, usually 750 to 1000 volts DC, for power and therefore requires a dedicated guideway. Heavy rail applications are typically designed for elevated structures or subways due in large part to the requirements of a dedicated totally grade-separated guideway. This technology is used in very densely populated corridors (such as San Francisco and Washington, DC) with headways as frequent as five minutes. Heavy rail may operate with between two and ten passenger cars, with 100-150 passengers per car, for extremely high passenger volumes. Capital costs for heavy rail systems range from $75 million to $100 million per route mile, for higher-speed service up to 50 to 80 miles per hour.

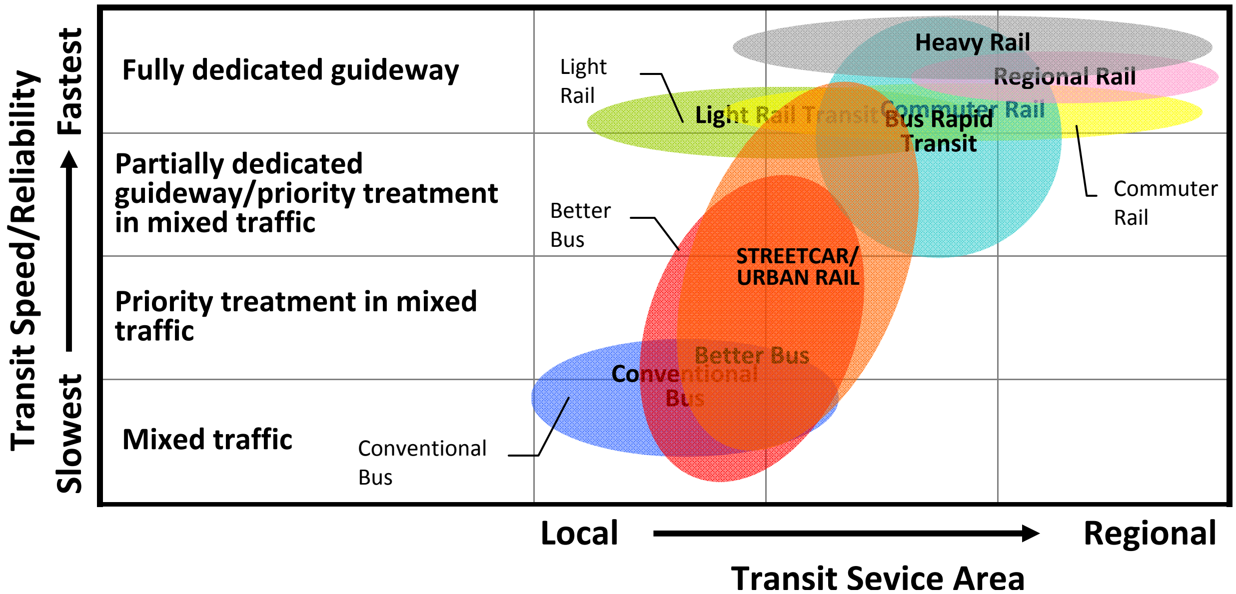
Alternative Technologies: Alternative or non-traditional technologies are those used or proposed for use in special circumstances around the world. Most require exclusive guideways, which increases costs, and are focused on either very short or very long distances. Typical vehicle technologies in this category include:

- ***Monorail***: a guideway-beam technology that is most often used in short-haul specialty applications such as amusement parks or highly concentrated activity centers. Capital costs for monorail typically range from $50 million to $100 million per route mile depending on structural requirements.

- ***People Mover/PRT:*** People mover and personal rapid transit (PRT) technologies are focused on providing limited stop service in highly concentrated activity centers such as airports or shopping areas. Typically automated and in exclusive, structured guideways, people mover/PRT costs range from $50 million to $100 million per route mile.

Another way to consider how the various technologies relate to each other is shown in Figure 4-1. Though not all of the technologies under evaluation are included in this figure, much of the spectrum of typical operations is captured. Each mode is plotted according to a range of critical operational characteristics: speed reliability, service extent, and guideway type.

Figure 4-1. Relationship Between Speed/Reliability and Service Area for Technologies



Key to Figure 4-1:

- Conventional Bus
- Bus Rapid Transit (BRT)
- Commuter Rail
- Heavy Rail
- Better Bus
- Streetcar/Urban Rail
- Light Rail
- Regional Rail

Table 4-1 below summarizes the characteristics for some of the technologies considered most suitable for this study area and are closely related.

Table 4-1. Comparison of Most Closely-Related Vehicle Technologies

Typical Characteristics	Better Bus	Streetcar/Urban Rail	Light Rail Vehicle (LRV)
Size	60’ long x 8’ 6” wide	66’-79' long x 8’1” wide	95’ long x 8’ 6” wide
Power	Diesel, Diesel/Electric, CNG	Overhead electric 600-750 Vdc	Overhead electric 600-750 Vdc
Passenger Capacity	65 (40 seats)	140-165 (30-60 seats)	166 (64 seats)
Typical peak riders/hour	390 (10 min. headways)	600-990 (10 min. headways); some models can run in 2-car consists	2,400 (7.5 min. headways, 3-car trains)
Lifespan	15 years	30 years	30-35 years
Cost per vehicle	$1,000,000	~$3.75-4.5 million	$3.8 million
Right-of-way	Mixed-flow	Mixed-flow and semi-exclusive; standard gauge track	Semi-exclusive and exclusive; standard gauge track
Geometry/curves	City streets	~60’	>85’
Operating rationale	Local/limited stop	Local/limited stop	Limited stop/regional
Station/stop spacing	2-3 blocks	2-4 blocks to ½ mile	½ mile to 1 mile+
Speed	City street speeds in an urban environment	City street speeds and up to 45-60 mph	55 mph
Fare collection	On-board or Off-board	On-board or Off-board*	Off-board*

*Off-board fare collection is also known as “honor system.”

Technology Alternatives Evaluation

Using the criteria listed previously, the results of the vehicle technology evaluation are shown in Table 4-2. Each technology option was given a score ranging from 1 to 3 for each criterion, with 1 being neutral to 3 indicating that a modal alternative is best able to respond to a stated performance measures.

Table 4-2. Results of Modal/Vehicle Technology Alternatives Evaluation

Mode	Criteria							
	Moderate speed	Moderate capacity	Ease of boarding	Fits within urban environs	Distinctive vehicles	Good perform-ance	Low infrastruc-ture need	TOTAL
Conventional Bus	3	3	1	3	1	1	3	**15**
Better Bus	3	3	2	3	3	2	3	**19**
BRT	2	3	3	2	3	2	1	**16**
Streetcar/Urban Rail	3	3	3	3	3	3	3	**21**
LRT	2	1	3	2	2	3	1	**14**
Commuter Rail	2	1	3	1	2	2	2	**13**
Regional Rail	1	1	3	1	1	1	1	**9**
Heavy Rail	1	1	3	1	1	1	1	**9**
Monorail	1	1	3	2	3	2	1	**13**
People Mover	1	1	3	1	2	3	1	**12**

Discussion of Evaluation Results

- ***Moderate speed:*** Conventional bus, better bus, and streetcar/urban rail scored highest in this category for their ability to serve both high-density, lower speed operations, as well as lower-density, longer distance, and moderate speed operations. Whereas monorail, and people mover are geared too low for moderate maximum speeds, BRT, LRT, commuter / regional / heavy rail are all built for higher speeds and with significant performance trade-offs at lower speeds.

- ***Moderate capacity:*** Conventional bus, better bus, and streetcar/urban rail scored highest in this category for their ability to serve both high-density and lower-density areas in different operating environments. Due to a combination of higher capacities and higher infrastructure costs, LRT, commuter / regional / heavy rail, monorail, and people mover, and to a lesser degree BRT, these modes generally cannot serve low to moderate capacities cost-effectively.

- ***Ease of boarding:*** Systems typically with level boarding and off-board fare collection all scored highly in this category. Better bus does not have both level boarding *and* off-board fare collection, whereas conventional bus usually has neither.

- ***Fits within urban environs:*** Technologies scoring the highest are sized to the scale of the urban environment, can fit reasonably well within typical roadway travel lanes, and mix with pedestrians. Though longer, streetcar/urban rail are narrower than better bus and BRT vehicles and fit better in 10' to 11' travel lanes. Better bus scored better than BRT due to BRT's typical requirement for dedicated lanes or rights-of-way.

- ***Distinctive vehicles:*** BRT, streetcar/urban rail, commuter rail, and monorail are the highest scoring technologies and all typically employ a "modern" or European-looking vehicle. While all vehicles present opportunities for branding, the lower scoring alternatives are typically limited to color schemes, while the modern vehicles also have a form-factor that sets them apart. It is also worth noting that since the commuter rail alternative includes both traditional locomotives and sleek DMUs, and therefore did not score the full three points.

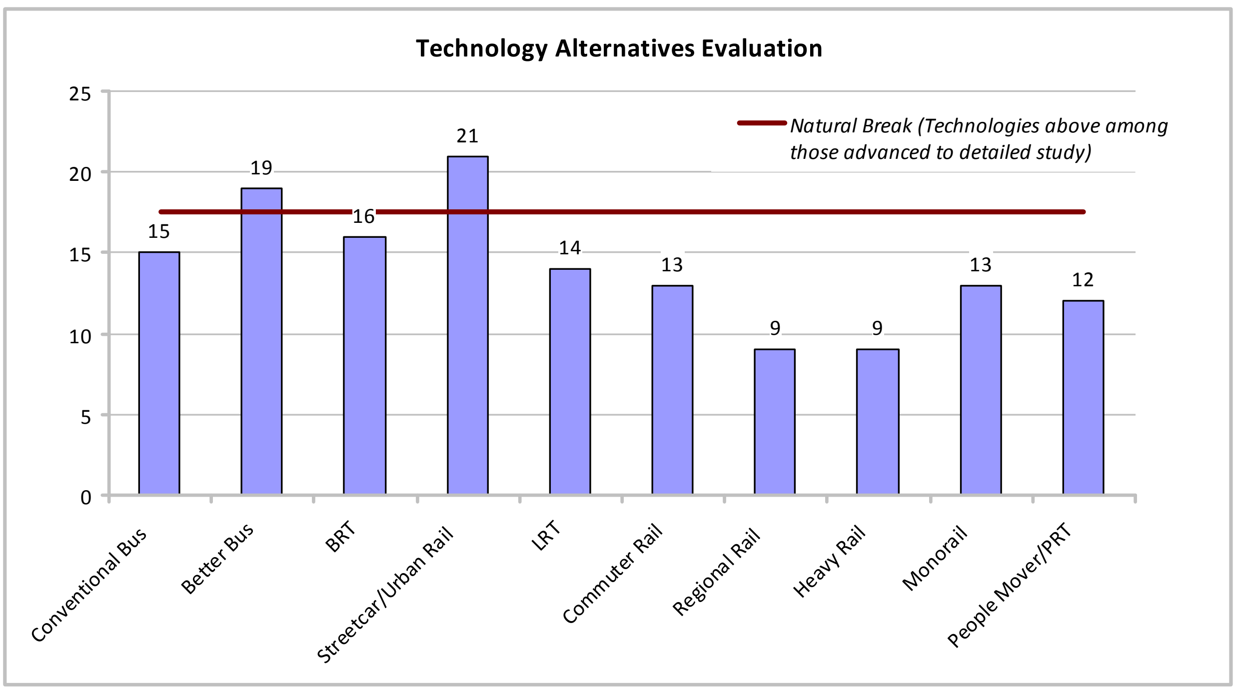
- ***Good performance:*** Vehicles scoring the highest exhibit clear performance advantages within their typical operating environment(s), when compared to other alternatives, due to lighter weights, ITS, and electric propulsion. Conventional bus scored poorly as it shares lanes with vehicles that generally have far better performance, but doesn't benefit from ITS. Other technologies that scored the lowest, regional and heavy rail, suffer from their long train lengths.

- ***Low infrastructure need:*** Conventional bus, better bus, and streetcar/urban rail scored highest mostly due to their ability to operate in mixed-traffic, since exclusive guideways often require ROW acquisition or sacrificed auto/truck capacity. Technologies scoring the lowest require dedicated, or reserved, guideways and grade-separations (regional and heavy rail and monorail and people mover). Scoring moderately well, LRT and commuter rail are often deployed in existing dedicated corridors and generally cross other facilities at-grade (with crossing gates).

Recommended Technologies for Investment Evaluation

As shown in Figure 4-2, the top two ranked vehicle alternatives, streetcar/urban rail and better bus, are somewhat separated from the rest and, therefore, are advanced to the detailed transit investment alternatives evaluation in Chapter 5.

Figure 4-2. Recommended Technologies by Evaluation Results



These recommended **technologies**, together with the recommended **alignment** from Chapter 3, are used to define the **transportation investment alternatives** for evaluation in Chapter 5.

5. Transit Investment Definition and Evaluation

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5. Transit Investment Definition and Evaluation

Transit Investment Alternatives Evaluation Process and Criteria

At the detailed level, the **Build** alternative is evaluated against two baseline scenarios, the **Transportation System Management (TSM)** and **No-Build** alternatives. All three investment alternatives use the recommended alignment from Chapter 3 and as described below. The Build alternative also includes the recommended fixed-guideway technology alternative, **urban rail**, while the TSM alternative includes the **better bus** technology. These investment strategies are subjected to a quantitative and qualitative assessment of each alternative's ability to meet the six overall goals established for the study. The three transit investment alternatives are described in greater detail below.

Recommended Alignment

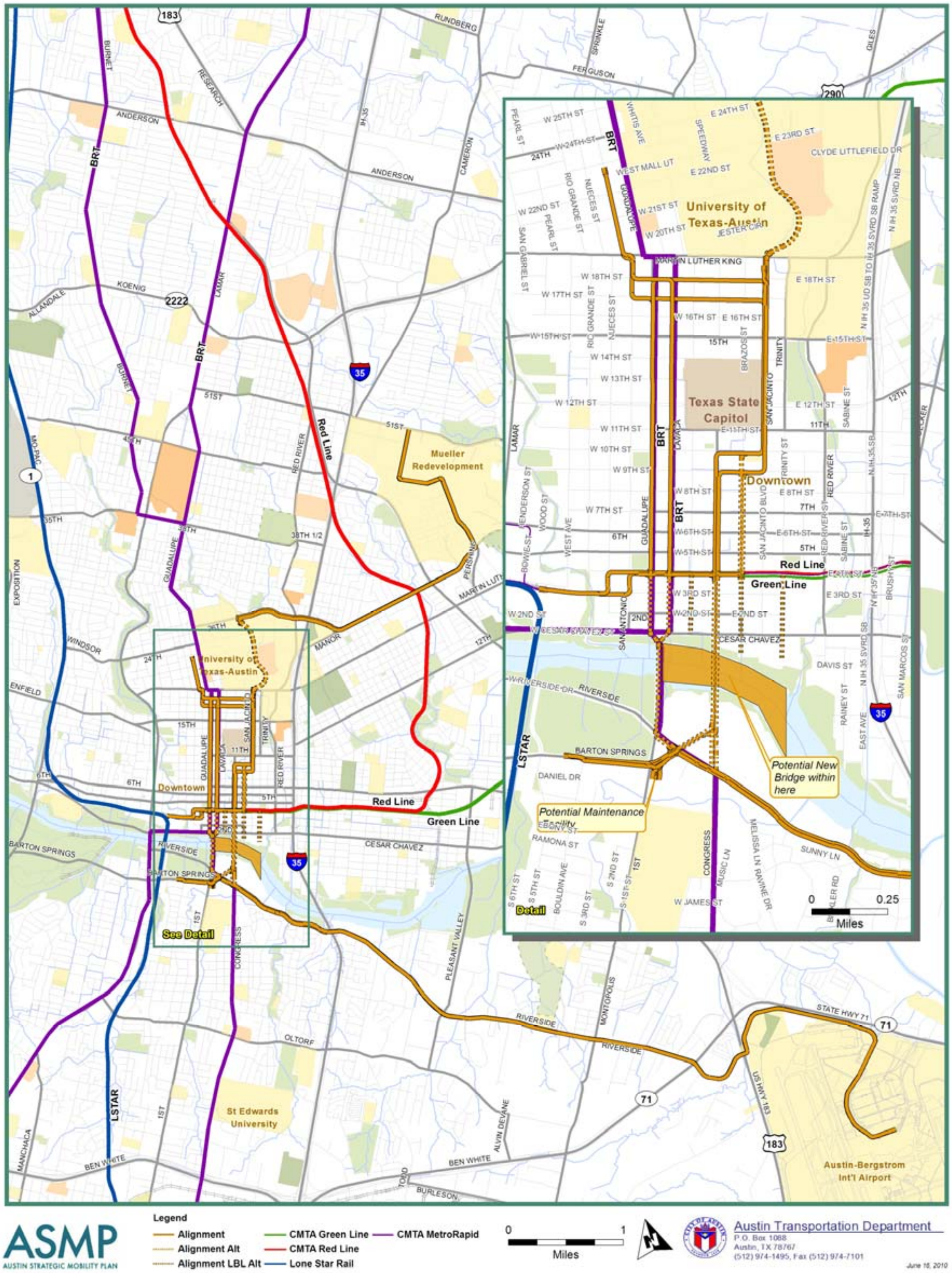
The recommended alignment for the Build, TSM, and No-Build alternatives, previously described in Chapter 3, is summarized below and shown in Figure 5-1. The alignment consists of the following segments:

- ***Mueller Redevelopment Internal***
- ***University of Texas to MLK, Jr. Commuter Rail Station/Mueller South***
- ***Downtown/Capitol Complex to University of Texas (East & West CBD)***
- ***Downtown Commuter Rail Station to Seaholm Redevelopment***
- ***Lady Bird Lake Crossing***
- ***East Riverside to Austin-Bergstrom International Airport (ABIA)***
- ***Palmer/Long Center Spur***

Recommended Technologies

The recommended technologies are **urban rail** for the Build alternative and **better bus** for the TSM alternative. Of the 11 modal technologies evaluated in Chapter 4, urban rail ranked the highest and was selected as the fixed-guideway build alternative. Better bus, similar to the MetroRapid system being implemented by Capital Metro, was the highest scoring non-fixed-guideway technology alternative and, therefore, advanced to the investment alternative evaluation.

Figure 5-1. Recommended Alignment



Source: City of Austin, 2010.

Investment Alternatives Definition (Build/TSM/No-Build)

Based on the conceptual evaluations of **routes** and vehicle **technologies** described in Chapters 3 and 4, the following **transit investment alternatives** are identified for detailed evaluation using the recommended **alignment** shown in Figure 5-1:

- **No-Build Alternative**, consisting of the existing transportation and transit facilities and services in the corridor, along with any planned improvements.
- **Better Bus Alternative (TSM)**, consisting of enhanced service over conventional bus, including intelligent transportation system (ITS) technologies and other priority measures to minimize travel delay. This is the TSM alternative.
- **Urban Rail Alternative (Build)**, consisting of a hybrid streetcar/LRT service running both in mixed traffic and semi-exclusive rights-of-way. Urban Rail also includes ITS and other priority measures. This is the Build alternative.

No-Build Alternative

All elements of the No-Build alternative are part of each of the other alternatives, except where an alternative replaces existing services or facilities in the study area. Under the No-Build alternative, existing transit services in the Manor Road, University Area, Capitol Complex, Downtown, and East Riverside corridors are assumed to remain much as they are today. For instance, UT shuttles now serving the student housing along East Riverside would continue to operate and expand in order to keep pace with growth in student populations. No-Build assumes Capital Metro's current investments in Rapid Bus and other emerging express transit routes would be implemented, with MetroRapid in the North Lamar/South Congress corridor coming online in mid-2012. Under the Capital Metro *ServicePlan2020*, existing bus services will continue and will be adjusted to match rider demand and changing travel patterns, in addition to integration with other new transit modes to be introduced as part of the plan. Another planned transit service within the study area is the Lone Star Rail District's LSTAR regional rail service along the Union Pacific Railroad/MoPac corridor. Inclusion of this transit investment is consistent with the CAMPO 2035 Plan.

Existing Services

Nearly every type of transit service currently offered by Capital Metro operates within the study area boundaries.

- **Local Service Routes:** These buses provide multiple stop service to and from downtown, serving specific neighborhoods and areas of the community with frequent stops.
- **Limited and Flyer Routes:** These routes provide limited-stop service to and from neighborhoods and downtown. Limited Routes, as the name suggests, stop less frequently than local routes to move people with less delays between key origins and destinations. Flyer Routes offer direct service between residential neighborhoods and the UT Main Campus or Downtown Austin and ABIA (through the Airport Flyer).
- **UT Shuttle Routes:** The shuttles provide limited-stop service from student living centers and the UT Main Campus, with a comprehensive schedule of service between several Austin neighborhoods and the campus. The UT Shuttle System is the largest university shuttle system in the United States, with 16 routes and over 7.5 million passengers annually and has been in service for more than 40 years. This service provided by Capital Metro is subsidized by UT.

- **Express Routes:** Express buses provide limited-stop service to and from UT, Downtown, and nine park-and-ride facilities located in outlying portions of the CMTA Service Area (none are located in the study area).
- **Cross-Town Routes:** Cross-town bus routes provide direct, multiple-stop services in all directions that do not directly access downtown.
- **AISD Magnet Route:** Capital Metro provides service to Austin Independent School District (AISD) students enrolled in the Magnet Arts and Sciences Program at Kealing Middle School (located in the study area) and LBJ High School.
- **MetroRail Red Line Service:** MetroRail Red Line service opened in March 2010. Operating on Capital Metro's existing freight tracks, this line from Leander to downtown provides commuter rail service to both suburban and downtown passengers. The system includes nine stations, eight within the City of Austin. The passenger rail vehicles are diesel multiple units (DMU).

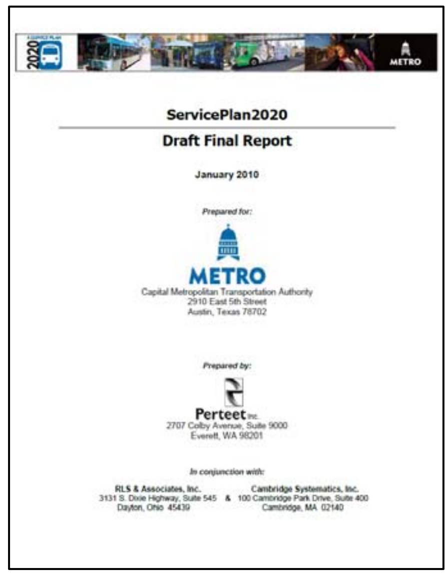
Planned Services

The planned improvements in Capital Metro service are assumed for all three investment alternatives and include elements of the 2004 *All Systems Go Long-Range Transit Plan*, the recently adopted *ServicePlan2020*, and LSTAR regional rail service, as noted above. Planned Capital Metro transit improvements in the study area include.

- **MetroRapid Bus Service:** New, technologically advanced buses will use a traffic signal priority system to move buses with less delay throughout Austin. This service will significantly improve bus commutes between major residential and employment origins and destinations. These vehicles will also provide real-time arrival information. The system will include a starter line from North Lamar Boulevard to South Congress Avenue, scheduled for initial operations in 2012. A second line is planned for Burnet Road to South Lamar Boulevard. Extensions may include but are not limited to: Riverside Drive, East 7th Street/Austin-Bergstrom International Airport, Oltorf Street, Pleasant Valley Road, 51st Street, Northeast Austin, Mueller redevelopment site, Rundberg Lane, Research Boulevard, Parmer Lane, Ben White Boulevard, and Oak Hill. Inclusion of these service lines is consistent with the CAMPO 2035 Plan.
- **Commuter/Express and Local Service[1]:**
  - **Frequent Service Corridors:** Implement a network of frequent bus routes throughout the urbanized area. Frequent Service Corridors can either be MetroRapid routes, or regular fixed routes.
  - **Downtown Austin:** Improve speed and reliability and customer amenities; consolidate routes on main corridors and reduce the number of bus stops.
  - **East Austin:** Improve frequency on several routes; improve route directness; use flexible service in low-density areas; provide direct service from East Austin to the South Congress Transit Center; improve connectivity to Cross Park and Rutherford areas.

[1] Capital Metropolitan Transportation Authority, 2010, *ServicePlan2020 Draft Final Report, January 2010*, by Perteet, Inc., http://www.capmetro.org/serviceplan2020/docs/ServicePlan2020%20-%20Final%20Report.pdf, accessed July 9, 2010.

- **West Austin:** Consolidate UT and regular fixed routes into two full-time routes; the Lake Austin route should operate as a "Frequent Service Route" year-round; replace fixed-route bus service with flexible service in several lower density neighborhoods.
- **North Central Austin:** Improve directness and frequency of trips to the Cameron and St. John's areas and Rutherford shopping; improve directness to East Austin.
- **North Austin:** Consolidate several feeder routes into a cross-town route; delete service to low ridership areas; adjust commuter services commensurate with demand once the Red Line begins.
- **South Central Austin:** Delete service from underperforming neighborhood routes; improve connectivity and frequency from South Congress Transit Center to East Austin and Barton Creek Square Mall.
- **South Austin:** Shift the focal point of service in South Austin from Bluff Springs to Southpark Meadows and extend South Austin routes to more destinations.
- **Southeast:** Improve frequency and directness between downtown, Riverside and ABIA. Provide a direct connection to Ben White Boulevard and the South Congress Transit Center.
- **Southwest Austin:** Increase park-and-ride service in the SH 71 West and South Loop 1 (Mopac) corridors; reduce the level of local bus service in some neighborhoods; extend service further south to serve new development.
- **University of Texas:** Utilize existing regular service routes to supplement or replace UT Shuttles; adjust frequencies by day based on demand.


ServicePlan2020
Draft Final Report
January 2010
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- **Mueller Redevelopment Area:** In the short-term, connect the high density residential areas along Mueller and Aldrich directly to downtown and UT; in the next ten years, connect Mueller with downtown and UT via a MetroRapid corridor.
- **New Commuter Service:** Add commuter service from the east, south, and southwest; add regional park-and-rides in Manor, the I-35 South corridor, south Mopac, and in the SH 71 West corridors.
- **New Flexible Service:** A Tarrytown Flexible Service route should replace three existing fixed-routes; a Decker – Springdale route should serve areas of East Austin; and a Riata – Millwood – Domain route should connect residential and commercial areas of Northwest Austin with the Domain and Kramer Station.

- **Rails with Trails:** Capital Metro is working with local biking organizations to provide access to right-of-way along existing Capital Metro tracks to build safe and accessible hike-and-bike trails. Funding sources to construct the trails have not been determined but could be provided by federal grants and other existing local agency programs.

- **MetroRail Green Line Service:** The Green Line is proposed as the first expansion of Capital Metro's MetroRail system. This 28-mile system would operate from downtown Austin east to Manor and Elgin. Any future extensions would require detailed analysis and a referendum, under current state law. Inclusion of the MetroRail Green Line Service is consistent with the CAMPO 2035 Plan.
- **LSTAR Regional Rail Service:** The Lone Star Rail District (LSRD) is planning regional rail service between Georgetown, TX (to the north of Austin) and San Antonio, TX (to the south of Austin). The proposed 120-mile route will utilize existing Union Pacific right-of-way and run up to 12 trains a day through up to 16 stations, with five slated for Austin, including one at Seaholm on the proposed transit investment alignment. Inclusion of this rail service is consistent with the CAMPO 2035 Plan.

Better Bus Alternative (TSM)

Better Bus technology offers enhanced convenience to passengers by incorporating a variety of features distinguishing it from conventional bus, including, for example, employment of intelligent transportation system (ITS) technologies and other priority measures to minimize travel delay, use of special stops or stations to distinguish the service and add visibility (prominence) to the route, and the use of special, distinctive vehicles, possibly with added passenger amenities.

Better Bus vehicles may be technologically advanced buses using a traffic signal priority (TSP) system to move with less delay through traffic. This modal alternative would also employ other ITS technologies, such as off-board fare collection, also known as 'honor system', and would stop curbside approximately every three blocks. The Better Bus alternative *may* use rapid loading features incorporated into the vehicle design. Unlike Urban Rail, Better Bus does not include a dedicated right-of-way, though like Urban Rail it could include a transit-only lane for portions of the alignment.

Because this alternative still uses the bus as the basic mode of transportation, improving the level of service by the introduction of new operating scenarios and/or enhancement technologies, this alternative is considered the FTA Transportation Systems Management (TSM) alternative. Under FTA's New Starts program, a TSM alternative is used for a baseline for comparison against the proposed guideway alternative at the preliminary engineering phase. The TSM alternative is characterized as the "best that can be done" to improve transit service in the corridor via operational modifications and lower-cost capital improvements, without constructing a new transit guideway. From FTA's draft *Definition of Alternatives*:

Generally, the TSM alternative emphasizes upgrades in transit service through operational and small physical improvements, plus selected highway upgrades through intersection improvements, minor widenings, and other focused traffic engineering actions. A TSM alternative normally includes such features as bus route restructuring, shortened bus headways, expanded use of articulated buses, reserved bus lanes, contra-flow lanes for buses and HOVs on freeways, special bus ramps on freeways, expanded park/ride facilities, express and limited-stop service, signalization improvements, and timed-transfer operations.[2]

The Better Bus vehicle can also run in a more express mode; for example, this type of service could operate within the East Riverside Corridor portion of the study area, providing express service through the Corridor and access to ABIA. Dedicated bus lanes would be required for the express mode, similar to the dedicated, or semi-exclusive, trackway envisioned for the Urban Rail alternative. Stops would be similar to those envisioned under the Urban Rail alternative as well.

The alignment for both the Better Bus and Urban Rail alternatives is the same as shown above in Figure 5-1. All the elements of the No-Build alternative are incorporated into the Bus alternative. It is likely that if a higher-capacity transit mode is introduced into the corridors under study, individual bus transit routes would be modified to provide direct and efficient access to the higher capacity systems. Therefore, some bus or shuttle routes might be truncated at a new transit station within the corridor to provide the maximum access to a higher-capacity bus or rail system and minimize the redundancy of services.

Although the Lady Bird Lake Crossing segment of the proposed alignment includes further consideration for a new bridge, it is unlikely that an independent crossing for Better Bus would be contemplated.

Urban Rail Alternative

Urban Rail is the City of Austin's term for an overhead-electric-powered fixed-guideway service that blends the technological and operational characteristics of modern streetcar and light rail transit (LRT). Urban Rail can operate in both mixed-traffic and within a dedicated right-of-way. When operating in a mixed-flow environment, Urban Rail vehicles typically operate at speeds comparable to surrounding traffic. However, within a dense urban environment and when provided with dedicated right-of-way, Urban Rail vehicles can provide operational characteristics comparable to that of light rail. Urban Rail vehicles range from the "modern streetcar" currently used in Seattle, Portland, and Tacoma (approximately 66 feet long with a total passenger capacity up to 120, with a top speed of approximately 45 miles per hour) to new cross-over vehicles such as the S70 Ultra Short proposed for use in Salt Lake City

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[2] Federal Transit Administration, 2010, "Definition of Alternatives," *Procedures and Technical Methods for Transit Project Planning*, http://www.fta.dot.gov/planning/newstarts/planning_environment_9717.html#252_The_TSM_Alternatives, accessed June 14, 2010.

that is approximately 79 feet long with a total passenger capacity of 160 and a top speed approaching 60 miles per hour. Urban Rail vehicles can be designed to operate in multi-vehicle trains, if needed. In addition, alternative power modes such as batteries are under development by some manufacturers and warrant further investigation as an alternative to a system powered completely by overhead electric wires.

The Urban Rail alternative is proposed to include both exclusive right-of-way and mixed flow operations. Urban Rail vehicles would operate in mixed traffic (with automobiles) in more congested urban areas such as downtown where extra ROW for independent guide way is scarce. In the Riverside Corridor, where street rights-of-way are typically wider, there is generally sufficient room to create a semi-exclusive or dedicated right-of-way by widening the overall street to the outside to provide replacement auto capacity for those lanes converted for transit use.

The Urban Rail alternative generally consists of two sets of tracks – one set in each direction. In many areas, where streetcar-like mixed-flow operations are proposed, curbside tracks would be employed and stops would use existing or expanded sidewalks. In areas where LRT-like dedicated or semi-exclusive rights-of-way are proposed, a center-running system could be used. Placement of tracks in the center of streets would entail use of narrow side-platform or center-platform stops, which could reduce the street width available for traffic in some locations. Under streetcar-like operations, Urban Rail stops would be spaced approximately every two to four blocks; whereas under LRT-like service, stops would be placed generally every ¼ to ½ mile. These rapid service stops would be strategically located and consistent with neighborhood plans to maximize ridership generation, connection to cross transit routes, and efficiency of the system. Urban Rail would incorporate similar features and amenities to the Better Bus alternative, like off-board fare collection and ITS technologies, such as signal priority (TSP) and queue jump[3], as well as additional enhancements, like level boarding.

[3] Queue jump refers to a combination of intersection lane geometry and signalization used to expedite transit service. Refer to the Federal Transit Administration (FTA): http://www.fta.dot.gov/research_4359.html.

Investment Alternatives Evaluation Criteria

Table 5-1 lists the criteria and describes the individual measures of effectiveness (MOEs) used to determine how well an alternative meets the criteria. Table 5-2 lists the six goals and shows which criteria are applied to each goal. Note that many of the criteria apply to more than one goal and are, therefore, evaluated in the context of each of its corresponding goals.

Table 5-1. Investment Alternatives Evaluation Criteria and Measures of Effectiveness (MOEs)

Criteria	Measures of Effectiveness (MOEs)
Ridership	Achieve maximum Build alternative and transit system ridership.
Transit-to-Transit Transfers	Provide opportunity for riders to minimize travel time through efficient transfers.
Transit Travel Time	Provide opportunity for riders to minimize end-to-end travel time between and among all stations.
Permanence	Make a visible and significant fixed capital investment.
Access	Provide increased access to places and transit.
Capacity	Increase the person-moving capacity of the transportation network.
Land Use Compatibility	Minimize conflicts with existing and planned land uses and maximize support for formal land use plans.
Development Potential	Provide focal points that support and attract development, redevelopment, and infill.
Environmental Benefits	Minimize adverse environmental impacts and provide long-term environmental benefits.
Construction Impacts	Minimize noise, air pollution, and disruption of access and activities during construction.
Neighborhood Compatibility	Supportive of neighborhoods.
Implementation Costs	Minimize capital costs.
Compact, Mixed-Use Development	Provide conditions that attract developer, resident, and business interest.
Operating Costs	Minimize operations and maintenance costs.
Private Investment	Has the potential to attract private investment.
Cost-Effectiveness	Provide measurable benefits to users and desired economic development in favorable proportion to costs.

Table 5-2. Investment Alternatives Evaluation Criteria per Goal

Criteria	Goals					
	Goal 1. Improve place connectivity	Goal 2. Improve transit connectivity	Goal 3. Improve mobility	Goal 4. Maximize community benefits	Goal 5. Maximize environmen-tal benefits	Goal 6. Maximize economic benefits
Ridership	X	X	X	X	X	
Transit-to-Transit Transfers		X				
Transit Travel Time		X	X			
Permanence	X			X		
Access	X		X	X		
Capacity			X			
Land Use Compatibility	X			X		
Development Potential				X		X
Environmental Benefits					X	
Construction Impacts					X	
Neighborhood Compatibility	X			X		
Implementation Costs						X
Compact, Mixed-Use Development	X			X	X	X
Operating Costs						X
Private Investment						X
Cost-Effectiveness						X

Detailed Evaluation of Investment Alternatives

This section summarizes the results of the detailed evaluation process. In evaluating the ability of each alternative to meet the goals and criteria, the following ranking system is used:

○ = Neutral rating/baseline

◐ = Alternative provides somewhat better performance

● = Alternative provides significantly better performance

As noted in the Need and Purpose statement (Chapter 2), the following six goals have been established for this study:

1. **Improve Place Connectivity**
2. **Improve Transit Connectivity**
3. **Improve Mobility**
4. **Maximize Community Benefits**
5. **Maximize Environmental Benefits**
6. **Maximize Economic Benefits**

Goal 1. Improve Place Connectivity

The purpose of this goal is to improve connections to and between key existing and emerging destinations ("place connectivity") within the study area. By improving connectivity to places within Central Austin, and beyond, the transit investment can improve the *practical* value of these places to the community. Put another way, a place with high *intrinsic* value may have little *practical* value if it is difficult to get to. Most of the objectives in support of this goal were also considered during the preliminary screening of connection needs and vehicle technologies that ultimately resulted in the proposed investment alternatives.

The proposed alignment provides direct service connections among the Seaholm District, Downtown, Capitol Complex, UT campus, Mueller Redevelopment, and ABIA, as well as links those destinations with the CMTA MetroRail and planned MetroRapid systems and the proposed Lone Star regional rail system. Development of the proposed alignment also addresses objectives to provide connections east to west (Mueller to UT; Convention Center to Seaholm; and Downtown to ABIA), between and among existing and emerging activity centers, that serve existing and future student housing (UT area, East Riverside, and Mueller), and that accommodate special event venues (UT's Darrell K. Royal-Texas Memorial Stadium, Convention Center, Long Center for the Performing Arts, and Palmer Events Center).

Criteria used to evaluate the performance of the alternatives against the objectives of Goal 1 and the results of that evaluation are provided below. Table 5-3 summarizes the relative rankings of the alternatives under Goal 1 and its criteria. Urban Rail is ranked highest in this category.

Goal 1 Evaluation Results

Table 5-3. Detailed Evaluation for Goal 1. Improve Place Connectivity

Criteria	No-Build	Better Bus	Urban Rail
1.1 Ridership	○	◐	●
1.2 Permanence	○	◐	●
1.3 Access	○	◐	●
1.4 Land use compatibility	◐	●	●
1.5 Neighborhood compatibility	◐	●	●
1.6 Supportive of compact, mixed-use development	○	◐	●
1.0 OVERALL RATING	○	◐	●

Goal 1 Evaluation Discussion

- **Ridership:** The average weekday ridership, based on the forecast discussed in Chapter 6, is much greater for the Urban Rail alternative as compared to the Better Bus alternative average. Daily ridership on Urban Rail is projected to be approximately 27,600 in 2030, compared with 9,000 riders per day for Better Bus. The much higher ridership forecast for Urban Rail suggests that this alternative provides better place connectivity because it connects more people to the same places than Better Bus.

A note on ridership: data from across the country have demonstrated a positive bias towards rail transit in the traveling public:

> *When these service conditions are equal, it is evident that rail transit is likely to attract from 34 percent to 43 percent more riders than will equivalent bus service. The data do not provide explanations for this phenomenon, but other studies and reports suggest that the clearly identifiable rail route; delineated stops that are often protected; more stable, safer, and more comfortable vehicles; freedom from fumes and excessive noise; and more generous vehicle dimensions may all be factors.*[4]

[4] Tennyson, Edson L., 1989, "Impact on Transit Patronage of Cessation or Inauguration of Rail Service", *Transportation Research Record 1221*, Transportation Research Board, http://www.publictransit.us/ptlibrary/TRB1221.pdf, accessed June 14, 2010.

- **Permanence:** Urban Rail is a permanent infrastructure service due to its fixed-guideway and related facilities. While Better Bus implementation involves bus stop construction, the absence of guideway construction means that it is neither 'fixed' nor permanent. There are numerous benefits to building a permanent system, including changes to land use patterns, reductions in vehicle miles traveled, reductions in CO_2 emissions, and accelerated and increased development. According to the American Public Transportation Association (APTA), a notable benefit of Urban Rail-type systems is:

  > *once fixed guideway transit investments are committed and station locations set, the private sector will build transit-oriented developments which produce dramatic reductions in vehicle travel and transportation-related emissions.*[5]

  The benefits of permanence extend from land use to economic to environmental.

- **Access:** Improving access to places improves the connectivity of those places, and vice versa. By providing direct connections between key destinations in and around Central Austin, both Urban Rail and Better Bus improve access. Urban Rail's superior ability to focus development along its alignment (as discussed above under "Permanence") implies that it is better at providing access than is Better Bus. Additionally, given that Urban Rail offers level boarding, off-board fare collection, vehicles with more doors, and clearly delineated alignments, access to transit is improved beyond what Better Bus can offer.

- **Land Use Compatibility:** Urban Rail and Better Bus are both compatible with existing land uses in Central Austin. Both fit within the existing rights-of-way and neither requires changes in land use, despite any beneficial influences. However, Urban Rail-type transit is cited specifically in a number of formal land use plans, including the Downtown Austin Plan, East Riverside Corridor Master Plan, Seaholm District Master Plan, and the emerging Imagine Austin Comprehensive Plan; whereas bus service beyond conventional or local is not though it is assumed to address the general intent for enhanced transit service of those plans.

[5] American Public Transportation Association, 2008, *Testimony of William W. Millar, President, APTA, Before the House Committee On Ways And Means on September 18, 2008*, http://www.apta.com/gap/testimony/2008/Pages/testimony080918.aspx, accessed June 14, 2010.

- **Neighborhood Compatibility:** Both Urban Rail and Better Bus are compatible and supportive of neighborhoods. Many neighborhood plans propose improvements in conventional bus transit amenities and establish access to transit as a high priority. Urban Rail may be viewed as somewhat more supportive of neighborhood planning efforts as evidenced by its specific inclusion in many neighborhood plans and City master plans. For instance, the North Loop Neighborhood Plan (at the north end of the study area), clearly establishes rail transit as vital to the neighborhood, "*This neighborhood sees light rail as part of the neighborhood vision, and recognizes the important link between mixed-use development, increased residential densities, access to services, greater use of non-automobile transport and access to public transit such as light rail, as well as to buses.*"[6] Simply put, Urban Rail/Streetcar systems "connect neighborhoods."[7]

- **Compact, Mixed-Use Development:** While both Urban Rail and Better Bus support compact, mixed-use development by reducing auto use, Urban Rail-type systems have been demonstrably better at catalyzing this kind of development. Cities across the country, including Austin, developed compactly around streetcar systems from the late 1800s to the 1920s.[8] Contemporary Urban Rail/Streetcar systems have "*demonstrated the…ability to attract and shape development that was compact, walkable, high-density, and mixed-use, with a very high-quality streetscape.*"[9]

Goal 2. Improve Transit Connectivity

The purpose of this goal is to improve the regional transportation network by providing connections among transit modes, including bus, commuter rail, and regional rail systems. As with place connectivity, the supporting objectives of this goal were considered during the conceptual screening of connection needs (or routes) and vehicle technologies.

The proposed alignment serves as the backbone of the developing regional transit network and provides a vital collection/distribution system for MetroRail's Red Line and planned Green Line commuter rail systems, the planned MetroRapid bus service, and the proposed Lone Star regional rail line. The proposed alignment encourages efficient and easy downtown rail-to`-rail, bus-to-rail, and bus-to-bus transfers. Implementation of a new high-capacity transit investment is anticipated to reduce the number of buses and curbside transfer points in downtown by focusing transit service along its alignment.

To consider further how the proposed alternatives would serve the objective of providing convenient and reliable connections between transit modes and routes, an alternative's ability to facilitate transfers

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[6] City of Austin, 2002, *The North Loop Neighborhood Plan*, May 23, 2002, http://www.ci.austin.tx.us/planning/neighborhood/downloads/northloop/intro_top10_toc.pdf , accessed June 14, 2010.

[7] Nasser, Haya El, 2007, "Cities rediscover allure of streetcars," USA TODAY, January 10, 2007, http://www.usatoday.com/news/nation/2007-01-08-streetcars_x.htm, accessed July 9, 2010.

[8] Melosi, Martin V., "The Automobile Shapes the City," Automobile in American Life and Society, http://www.autolife.umd.umich.edu/Environment/E_Casestudy/E_casestudy3.htm, accessed July 9, 2010.

[9] Reconnecting America, 2009, "Streetcars and Cities in the 21st Century", edited by Gloria Ohland and Shelley Poticha. http://www.reconnectingamerica.org/public/display_asset/090305streetcarbook, accessed May 18, 2010.

between transit modes is considered a measure of its ability to improve transit connectivity. It is also generally accepted that riders are more likely to transfer between similar transit modes or from a transit mode of lesser quality service to one that is perceived as providing greater quality service. For example, a rail-to-rail transfer would tend to be more preferable then a rail-to-bus transfer. Similarly, a bus-to-rail transfer would be preferable to a transfer from rail-to-bus.

Evaluation criteria used to evaluate the performance of the alternatives against Goal 2 and the results of that evaluation are provided below. Table 5-4 summarizes the relative rankings of the alternatives under Goal 2 and its criteria. Urban Rail and Better Bus received equal overall ratings for this goal.

Goal 2 Evaluation Results

Table 5-4. Detailed Evaluation for Goal 2. Improve Transit Connectivity

Criteria	No-Build	Better Bus	Urban Rail
2.1 Ridership	○	◐	●
2.2 Transit-to-Transit Transfers	○	●	●
2.2.1 LSTAR to alternative	○	◐	●
2.2.2 MetroRail to alternative	○	◐	●
2.2.3 MetroRapid to alternative	◐	●	●
2.2.4 Conventional bus to alternative	●	●	●
2.3 Transit Travel Time	○	●	●
2.0 OVERALL RATING	○	●	●

Goal 2 Evaluation Discussion

- **Ridership:** The much higher ridership forecast for Urban Rail suggests that this alternative provides better transit connectivity because it connects more people to other transit modes than does Better Bus.

- **Transit-to-Transit Transfers:** The higher ridership forecast for Urban Rail implies that more passengers will transfer to other modes, thus improving each mode's ridership. Additionally, given the tendency of riders to favor transfers to like or better quality service, Urban Rail was evaluated as having a modest advantage over Better Bus. Another factor influencing the slightly more favorable ratings earned by Urban Rail relate to the ability of Urban Rail to attract compact, mixed-use (i.e., transit-oriented or TOD) development, as noted elsewhere in this study. This type of supportive development is known to increase ridership and encourage transfers.[10]

- **Transit Travel Time:** Both the Build and TSM alternatives are expected to improve travel times for transit riders over the No-Build alternative, which includes conventional bus service with frequent stops and without ITS technologies, level boarding, and off-board fare collection. Under a No-Build scenario a transit patron would also need to make several transfers to reach the same destinations. Better Bus and Urban Rail are assumed to have similar travel times due to ITS technologies, including traffic signal priority (TSP), similar stop-spacing and off-board fare collection. The estimated travel time for both the Build and TSM alternatives is 33 minutes end-to-end, for either route, under the conceptual operating plan detailed in Chapter 6. Many trips anticipated on the transit alternative route would be much shorter than the end-to-end trip and have even shorter travel times, typically ten to twelve minutes. Other factors influencing travel time may likely offset each other, such as Urban Rail's use of level boarding, which reduces station dwell times, countered with Better Bus' ability to go around obstructions, etc.

A note on travel time: despite improvements in transit travel time offered by both Urban Rail and Better Bus over the No-Build alternative, travel time in the corridor is not likely to be significantly improved over auto travel time. However, travel time has a minimal impact on transit ridership for choice riders (i.e., not transit-dependent), as noted below:

> *among travelers who do have a choice, the data analyzed shows that differences in travel times between automobile and transit modes does little to influence the choice of whether or not to use transit.*[11]

Goal 3. Improve Mobility

The purpose of this goal is to increase the person-moving capacity of the transportation network by providing a new higher-capacity option. A secondary goal is to provide improved access to places, services, activities, and goods within Central Austin and throughout the study area. An alignment was developed that provides connections between places and existing and proposed major transit modes. This provides for multiple opportunities to promote added transportation options for the community.

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[10] Victoria Transport Policy Institute, 2010, *TDM Encyclopedia*, updated February 17, 2010, http://www.vtpi.org/tdm/tdm112.htm, accessed June 14, 2010.

[11] Beimborn, Edward A., Michael J. Greenwald, and Xia Jin, date unknown, "Transit Accessibility and Connectivity Impacts on Transit Choice and Captivity", Center for Urban Transportation Studies and Department of Urban Planning, University of Wisconsin-Milwaukee.

To evaluate how well the investment alternatives serve the objective of improving mobility in/out/around Central Austin, performance indicators were selected that suggest the ability of one alternative over the other to respond to travel demands within the study area. Under both the Build and TSM alternatives, mobility within Central Austin, the study area, and the region are expected to be improved, because both alternatives present an additional transportation option. Table 5-5 summarizes the relative rankings of the alternatives under Goal 3 and its criteria. Urban Rail and Better Bus are ranked equally in this category.

Goal 3 Evaluation Results

Table 5-5. Detailed Evaluation for Goal 3. Improve Mobility

Criteria	No-Build	Better Bus	Urban Rail
3.1 Ridership	○	◐	●
3.2 Transit Travel Time	○	◐	●
3.3 Access	○	◐	●
3.4 Capacity	○	●	●
3.0 OVERALL RATING	○	●	●

Goal 3 Evaluation Discussion

- **Ridership:** The much higher ridership forecast for Urban Rail suggests that this alternative provides better mobility because it moves more people than Better Bus.

- **Transit Travel Time:** Both Build alternatives are expected to improve travel times for transit riders by about the same amount over the No-Build alternative. This modest reduction in travel time improves mobility and access because patrons can get farther and/or more places within a given amount of time. Better bus includes technology to interact with the signal system, allowing for better travel times over the No-Build. Rail includes this signal controlling technology, but also uses a dedicated Right of Way in portions of the corridor, thus providing improved travel times, even over the better bus alternative.

- **Access:** Access is the ability to reach destinations and, perhaps, the overall goal of transportation. How well an alternative improves access to places, services, activities, and goods indicates how well it improves mobility, or the ease by which a destination is reached. Whereas "mobility" refers to the process of transportation, "access" refers to the result. Alternatives that improve the result – getting 'there' – make the process of getting there easier, whether it's by reducing travel time or distance or other barriers. Urban Rail's ability to stimulate and accelerate compact, mixed-use development (as discussed above under "Permanence") means that many more of those destinations are closer and therefore more accessible. By concentrating and aggregating those 'theres' – by affecting land use – Urban Rail can indirectly reduce travel time by reducing travel distance. Additionally, given that Urban Rail offers level boarding, off-board fare collection, vehicles with more doors, and clearly delineated alignments, access to transit is improved beyond what Better Bus can offer.

- **Capacity:** Both the Build and TSM alternatives are expected to increase the person-moving capacity of the transportation network, over the No-Build, by providing an additional higher-capacity mode within the study area. While some modes have reached saturation (i.e., autos) and others are inherently limited in scale (i.e., pedestrian and bicycle), Urban Rail and Better Bus both offer significant increases in capacity *within* the existing roadway network. Urban Rail does have a slight advantage over Better Bus in its vehicle size and ability to couple vehicles, though it is assumed that single trains would be the most likely configuration. Urban Rail (and higher-/high-capacity rail transit in general) is a scalable mode that can add capacity for much smaller incremental increases operating costs than Better Bus because a single vehicle operator can carry more people by attaching more units to the train. This is also accomplished without the environmental impacts attendant with Better Bus expansion.

Goal 4. Maximize Community Benefits

The purpose of this goal is to provide benefits to the community by supporting sustainable land use planning, adding public amenities, and improving access to destinations.

To evaluate how well the investment alternatives maximize benefits throughout the study area, performance indicators were selected that reflect an assortment of community benefits that higher-capacity transit can provide. Table 5-6 summarizes the relative rankings of the alternatives under Goal 4 criteria. The Urban Rail alternative ranked highest.

Goal 4 Evaluation Results

Table 5-6. Detailed Evaluation for Goal 4. Maximize Community Benefits

Criteria	No-Build	Better Bus	Urban Rail
4.1 Ridership	○	◐	●
4.2 Permanence	○	◐	●
4.3 Access	○	◐	●
4.4 Land Use Compatibility	◐	●	●
4.5 Development Potential	○	◐	●
4.6 Neighborhood Compatibility	◐	●	●
4.7 Compact, Mixed-Use Development	○	◐	●
4.0 OVERALL RATING	○	◐	●

Goal 4 Evaluation Discussion

- **Ridership:** The much higher ridership forecast for Urban Rail suggests that this alternative provides greater benefit to the community because it affects more people than Better Bus.

- **Permanence:** A permanent public investment in infrastructure is a direct benefit to the community. As discussed above, a fixed-guideway transit system is an inherently 'more permanent' investment than the more modest roadway and streetscape improvements typically associated with Better Bus systems. In contrast, Better Bus represents a 'less permanent' improvement given that the alignment can be changed and therefore reflects a lower commitment to the community.

- **Access:** As discussed previously, Urban Rail's ability to stimulate and accelerate compact, mixed-use development means that many more destinations are closer and therefore more accessible, whether to home or work for instance. Additionally, Urban Rail vehicles, stops, and guideways offer improved access to transit – and therefore destinations – beyond what Better Bus and No-Build can provide. The easier access to transportation facilities provides greater community benefits by encouraging transit use.

- **Land Use Compatibility:** Both the Build and TSM alternatives are compatible with various City of Austin plans (i.e., Downtown Austin Plan, Seaholm District Master Plan, East Riverside Corridor Master Plan, and the emerging Imagine Austin Comprehensive Plan), which all call for more transit-oriented, compact, mixed-use development. However as noted previously in this study, rail transit is cited specifically by these plans and Urban Rail is a better catalyst for realizing these types of sustainable developments. Higher densities maximize benefits to the community by preserving open space and the character of lower-density outlying areas (like West and Southwest Austin) because it draws population and employment to established/desired zones, thus relieving pressures on more sensitive areas. Development that relies on transit more and autos less is more sustainable and imposes a lesser burden on other City infrastructure, which is less expensive to upgrade than to extend.

- **Development Potential:** Urban Rail's permanence and ridership potential are characteristics that would much more likely catalyze and accelerate re-/development along the alignment than Better Bus. Two examples are the East Riverside and Far West Boulevard corridors, which have high (bus) transit ridership, yet low-density commercial and retail development. The UT shuttle bus service can be credited with supporting these higher-density residential developments; however it has not generated much in the way of development, which was established prior to the system's extension to these corridors. In the two years since the Downtown Austin Plan Phase One proposed rail transit (in the form of streetcar) for this corridor, two new higher-density, mixed-use developments at the west end near I-35 have begun. According to an article in the November 3, 2008 edition of the Austin American-Statesman, the design of the new mixed-use development by Grayco Partners at East Riverside Drive and South Lakeshore Boulevard is directly influenced by the expectation of rail transit on East Riverside Drive. As this example shows, along with others documented elsewhere in this report, development can happen just in response to an announcement that rail transit is being planned.

- **Neighborhood Compatibility:** As discussed above, both Urban Rail and Better Bus are compatible with, and supportive of, most neighborhood plans. However, while many plans cite relatively minor bus improvements, generally related to stop amenities, several within the study area call for a substantial Urban Rail-type investment.

- **Compact, Mixed-Use Development:** The Urban Rail alternative is far more likely to catalyze compact, mixed-use development than the Better Bus alternative, as notes previously, which will maximize community benefits by increasing the tax base, introducing new retail, residential, and commercial opportunities, and placemaking. Another significant community benefit due to compact, mixed-use development is improved public fitness and health: "*transit users are four times as likely to achieve the target of 20 minutes or more of walking per day as people who do not use transit on a particular day.*[12]

Goal 5. Maximize Environmental Benefits

The purpose of this goal is to invest in transit improvements with the greatest benefits to the natural environment.

To evaluate how well the investment alternatives maximize environmental benefits, performance indicators were selected that focus on minimizing impacts, in addition to adding benefits. Table 5-7 summarizes the relative rankings of the alternatives under Goal 5. Urban Rail ranked highest in this category.

Goal 5 Evaluation Results

Table 5-7. Detailed Evaluation for Goal 5. Maximize Environmental Benefits

Criteria	No-Build	Better Bus	Urban Rail
5.1 Ridership	○	◐	●
5.2 Environmental Benefits	○	◐	●
5.3 Construction Impacts	●	●	○
5.4 Compact, Mixed-Use Development	○	◐	●
5.0 OVERALL RATING	○	◐	●

Goal 5 Evaluation Discussion

- **Ridership:** Both the Build and TSM alternatives encourage greater transit use, which reduces impacts related to auto use, or the growth thereof, such as air and noise pollution, carbon emissions. But, the much higher ridership forecast for Urban Rail suggests that this alternative

[12] Litman, Todd, 2009, "Comprehensive Evaluation of Transit Oriented Development Benefits", *Planetizen*, June 7, 2009, http://www.planetizen.com/node/39133, accessed June 14, 2010.

provides greater environmental benefits to the community as it encourages greater transit use than Better Bus.

- **Environmental Benefits**: Urban Rail minimizes environmental impacts, thus maximizing benefits compared to other alternatives, due primarily to two factors: 1) use of electrical power and 2) support for more compact, transit-oriented land uses. Austin Energy will supply electrical power for the Urban Rail alternative and it has a substantial renewable portfolio; therefore, Urban Rail will have far fewer environmental impacts related to its power source than Better Bus. Although cleaner engine technologies are becoming more widely available for buses, including hybrid motors and clean diesel, the internal combustion engine remains the primary power source for the majority of buses, which makes the all-electric Urban Rail vehicle more beneficial to the community. While No-Build alternative is advantageous because there would be no additional operational impacts within the study area, those benefits are far outweighed by the unsustainable perpetuation of a reliance on single-occupant vehicles to handle existing and additional trip capacity. Maximized environmental benefits due to compact, transit-oriented land uses are discussed below.

- **Construction Impacts:** Better Bus would have minimal construction impact, as compared to Urban Rail since there is no guideway to construct. Construction impacts under the No-Build alternative provide, by definition, the least environmental impact of the investment alternatives.

- **Compact, Mixed-Use Development:** As noted previously, the Urban Rail alternative is the most supportive of compact, mixed-use development. This type of development provides significant environmental benefits because the concentration of multiple uses reduces the need to travel – by any motorized mode whether it's by auto, bus, or even rail. Research has shown that transit-oriented developments generate half as many auto trips as typical residential development.[13] Travel contributes to a whole host of harmful environmental impacts, from polluted runoff to consumption of open space to increased emissions. The direct environmental benefits of the type of compact, mixed-use development generated by the Portland Streetcar have been estimated as "[reducing] *the carbon footprint by 60 percent over conventional suburban development – providing a 76 percent reduction in transportation-related GHG emissions and reducing the development footprint by 46 percent.*"[14]

Goal 6. Maximize Economic Benefits

The purpose of this goal is to invest in transit improvements that support existing economies, catalyze economic growth, and provide economic benefits for users. Supporting objectives include maximizing the cost-effectiveness of both capital investments and operating costs, each of which is predicated on a full cost accounting.

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[13] Cervero, Robert and Arrington, G.B., 2008, "Vehicle Trip Reduction Impacts of Transit-Oriented Housing", *Journal of Public Transportation*, Vol. 11, No. 3, 2008, http://www.nctr.usf.edu/jpt/pdf/JPT11-3Cervero.pdf, accessed June 14, 2010.

[14] Reconnecting America, 2009, "Streetcars and Cities in the 21st Century", edited by Gloria Ohland and Shelley Poticha. http://www.reconnectingamerica.org/public/display_asset/090305streetcarbook, accessed May 18, 2010.

Table 5-8 summarizes the relative rankings of the alternatives under Goal 6 and its criteria. Urban Rail ranked highest in this category.

Goal 6 Evaluation Results

Table 5-8. Detailed Evaluation for Goal 6. Maximize Economic Benefits

Criteria	No-Build	Better Bus	Urban Rail
6.2 Development Potential	○	●	●
6.3 Implementation Costs	●	◐	○
6.4 Compact, Mixed-Use Development	○	◐	●
6.5 Operating Costs	◐	◐	◐
6.6 Private Investment	○	○	●
6.7 Cost-Effectiveness	○	◐	●
6.0 OVERALL RATING	○	◐	●

Goal 6 Evaluation Discussion

- **Development Potential:** As discussed above, Urban Rail's permanence and ridership potential are characteristics that have been shown to catalyze and accelerate re-/development along its alignment more so than Better Bus. When compared to the No-Build alternative, the argument that development has happened, is happening, and will continue – irrespective of a new transit investment – misses the point of this measure of effectiveness. Ultimately, a more robust public transit system will attract some additional development that wouldn't otherwise come to Austin; but, high quality transit's, especially rail's, true power is to attract and accelerate development that's already going to come. The benefits of this development engine are twofold: 1) development along the route is that which is drawn from environmentally sensitive areas, outlying areas, and/or even competing nearby communities, etc. and 2) the time value of money means that development now, rather than later, is more valuable due to the effects of compounding. And, this development has the power to catalyze and concentrate additional development. Austin has experienced this in several industries, most notably in high tech. The ability of Urban Rail to maximize economic benefits by attracting, catalyzing, and accelerating development makes it more than a mobility alternative.

- **Implementation Costs:** The estimated construction cost for Urban Rail is only part of the overall cost of implementation. For the Urban Rail alternative, the construction cost is approximately $955.1 million in 2010 dollars. Although some of this cost will be shared with the Federal government, other public agencies, and even private entities, this represents the full construction cost for the system. By comparison, the Better Bus alternative is estimated to cost $132 million in 2010 dollars, as extrapolated and escalated from Capital Metro's 2006 *Future*

Connections Study. It is important to note that the No-Build alternative should not be considered 'free', as there is a cost of doing nothing to improve mobility and encourage desirable development, etc. These costs are discussed below under recurring costs. Nevertheless, when considering the full cost of implementing a higher-capacity transit system, Urban Rail is actually much more competitive with Better Bus. Figure 5-2 below shows the full external costs for various transportation modes and includes the costs of:[15]

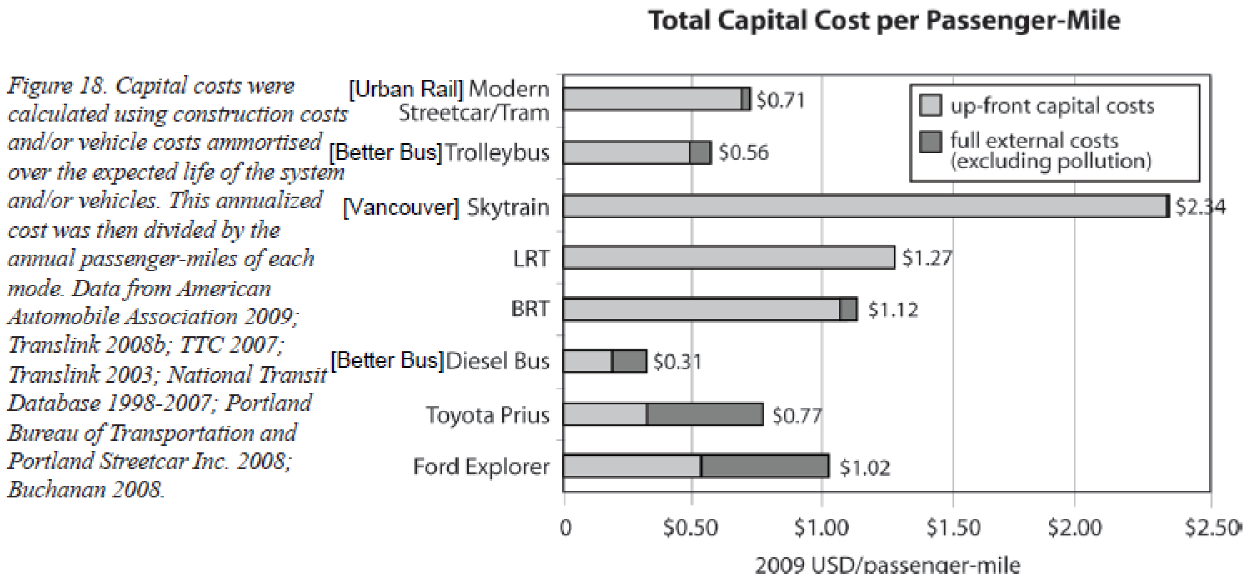
- Parking infrastructure
- Land value
- Resource externalities
- Traffic services
- Barrier effects[16]
- Road facilities
- Land use impacts
- Congestion
- Transport diversity

When reviewing the comparisons made in the figures below, Better Bus as defined in this *Transit Study* is a cross between "Trolleybus" and "Diesel Bus", while Urban Rail is akin to "Modern Streetcar/Tram". "Trolleybus" is actually based on Vancouver's New Flyer electric rubber wheeled, low floor trolley bus with regenerative braking technology. Note that the full cost of even an electric-hybrid auto is more expensive than both the Urban Rail and Better Bus corollaries.

[15] Condon, Patrick M. and Kari Dow, 2009, "A Cost Comparison of Transportation Modes", Foundational Research Bulletin No. 7, November. 2009, http://www.sxd.sala.ubc.ca/8_research/sxd_FRB07Transport.pdf , accessed June 15, 2010.

[16] Barrier effects "refers to delays, discomfort and lack of access that vehicle traffic imposes on non-motorized modes (pedestrians and cyclists)". Victoria Transport Policy Institute, *Transportation Cost and Benefit Analysis II – Barrier Effect*, http://www.vtpi.org/tca/tca0513.pdf, accessed June 24, 2010.

Figure 5-2. Full Implementation Costs of Various Modes[17,18]



- **Compact, Mixed-Use Development:** As noted previously, Urban Rail is the alternative that is most supportive of compact, mixed-use development. The transit-oriented development that can be generated by rail transit could provide substantial economic benefits to the community at-large and to users and nearby residents. The community can benefit from an increase in the tax base and in economic activity (i.e., sales tax) due to new development clustered around rail transit facilities and from an increase in property values of 5-15%.[19] Users and nearby residents alike can benefit from compact, mixed-use development in terms of improved connectivity, mobility, access, air quality, and exercise, as noted above. And, beyond those quality of life benefits citizens can benefit economically from lower personal transportation costs – whether they use transit or not. Residents and employees in and around compact, mixed-use development can save expenses by walking and bicycling more and using cars less (saving gas and wear and tear) or even by reducing the number of autos per household.

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[17] Text in [brackets] added by *Transit Study* team for clarification.

[18] Condon, Patrick M. and Kari Dow, 2009, "A Cost Comparison of Transportation Modes", Foundational Research Bulletin No. 7, November. 2009, http://www.sxd.sala.ubc.ca/8_research/sxd_FRB07Transport.pdf , accessed June 15, 2010.

[19] Victoria Transport Policy Institute (VTPI), 2010, "Transit Oriented Development: Using Public Transit to Create More Accessible and Livable Neighborhoods", *TDM Encyclopedia*, updated June 4, 2010, http://www.vtpi.org/tdm/tdm45.htm, accessed June 14, 2010.

- **Operating Costs:** The largest part of the operating costs for the Build and TSM alternatives is labor. For bus operations labor and fuel alone can represent from 50-80% of an agency's expenses.[20,21] Because rail transit, from streetcar to heavy rail, is a higher capacity mode than bus transit, from conventional bus to bus rapid transit, labor costs are inherently lower for the same level of service. Additionally, electrically-powered modes have lower, and less volatile, fuel costs than their internal combustion-powered counterparts. As shown in Figure 5-3 below, the proxy comparison between Better Bus and Urban Rail, as noted above, shows that Urban Rail can be less than half as expensive to operate as Better Bus.

Figure 5-3. Operating Costs of Various Modes[22,23]

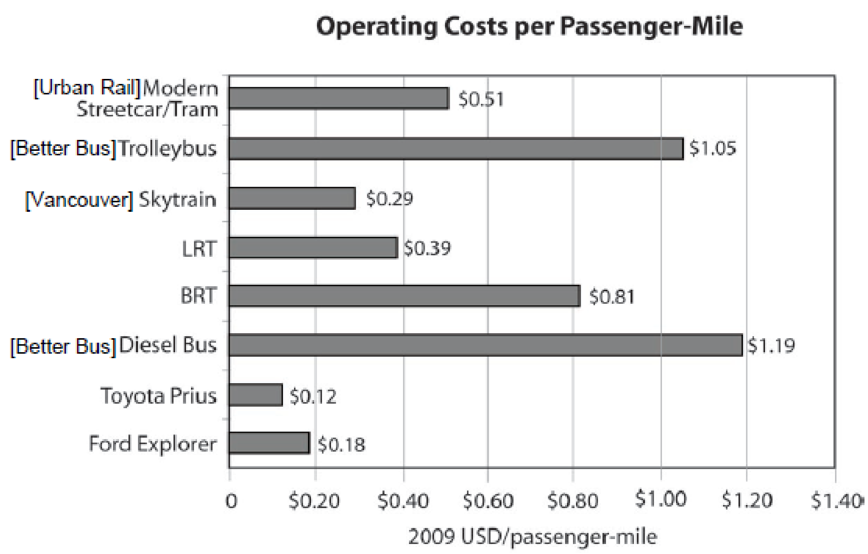

Figure 19. Operating costs for private automobile include parking, insurance, maintenance and fuel. Operating costs for transit modes also include employee salaries.

For local context, Capital Metro's reported operating costs for the fixed routes they operated in 2008 (latest full statistics available) were $0.79 per passenger-mile.[24] Another differentiator between the Build alternatives in terms of operating cost is the service life of the vehicles. FTA sets the "minimum normal service life" for large transit buses (including Better Bus-type) at 12 years, while rail vehicles (including Urban Rail-type) are 25 years.[25,26]

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[20] Capital Metropolitan Transportation Authority, 2008, *Comprehensive Annual Financial Report for the Year Ended September 30, 2008*, http://www.capmetro.org/docs/cafr_08.pdf, accessed June 15, 2010.

[21] Valley Metro, 2003, "Bus Program Operating Costs", Presentation to Transportation Policy Committee on July 2, 2003, http://www.mag.maricopa.gov/pdf/cms.resource/TPC7-2-transit-costs79421.ppt, accessed June 15, 2010.

[22] Text in [brackets] added by *Transit Study* team for clarification.

[23] Condon, 2009.

[24] CMTA, 2008.

[25] Federal Transit Administration, 1998, Capital Program: Grant Application Instructions, October 1, 1998, http://www.fta.dot.gov/funding/grants/grants_financing_4128.html#chapter3, accessed June 15, 2010.

[26] FTA, 1998, http://www.fta.dot.gov/funding/grants/grants_financing_4128.html#chapter4, accessed June 15, 2010.

Under the No-Build alternative it's important to note that there are significant recurring costs for 'doing nothing' to adequately address the mobility needs of Central Austin. Some are opportunity costs, though not quantified in this study, and include savings related to travel time reductions, mobility and access improvements, air quality and community health improvements, and increased and accelerated private investment.

- **Private Investment:** The ability of an alternative to attract private investment – whether around a proposed higher-capacity transit system or directly into the system – is good indicator as to how well that alternative can maximize economic benefits. But while considerable data is available for rail transit systems, little exists for bus systems. Prior discussion has established that Urban Rail is much more likely to attract and catalyze development than Better Bus and Table 5-9 quantifies the impact that rail transit systems similar to the Urban Rail alternative have had on ancillary private investment.

Table 5-9. Private Returns on Public Investment in Streetcar

System	Start of Service	Initial Track Miles	Initial System Cost Per Mile	Initial System Cost	Development Investment	Return on Investment
		mi	*$M/mi*	*$M*	*$M*	
Kenosha	2000	2.0	3.10	6.20	150	2319.35%
Little Rock	2004	2.5	7.84	19.60	200	920.41%
Tampa	2003	2.4	20.13	48.30	1000	1970.39%
Portland (1)	2001	4.8	11.50	55.20	1046	1794.93%
Portland (Ext)	2005	1.2	14.83	17.80	1353	7501.12%

Source: Reconnecting America and the Center for Transit-Oriented Development, "Why Transit-Oriented Development and Why Now?", *TOD101*, http://www.reconnectingamerica.org/public/show/tod101full , accessed June 15, 2010.

The other way that Urban Rail has the potential to maximize economic benefits is in its ability to attract private investment directly into they system, beyond advertising. Streetcar systems in Portland, Seattle, and Tampa have been successful at leveraging their services to generate operating income from various sponsorship opportunities. Revenues from sponsorship can be spread out over a series of payments and invested in an operations fund to support the system. Table 5-10 includes a summary of the sponsorship rates for various system elements for Portland, Seattle, and Tampa.

Table 5-10. Sponsorship Fees for Selected Streetcar Systems

	Portland[27]	Seattle[28]	Tampa[29]
System Naming Rights			$1,000,000/40 years
Car-Exterior	$25,000/car/year	$50,000/car/year	$250,000/car/year
Car-Interior			$3600-20,000/car/year
Stop/Station	$6,000/stop/year	$18,000-40,000/stop/year	$100,000/stop/year
Shelter Glass			
Ticket	$50/book of 50 tickets		
Restaurant	$600/year		
Brochure			

- **Cost-Effectiveness:** Cost-effectiveness is the traditional means for evaluating the financial advantage of one transit alternative over another and is ultimately required by the Federal Transit Administration when applying for federal funding. At this stage in the alternatives evaluation process, additional planning elements remain to be completed before a comprehensive cost effectiveness evaluation can be conducted. However, using national cost averages for various transit modes provides a useful comparison of the Build and TSM alternatives. 2008 data (latest year available) from the National Transit Database[30] shows that the average operating cost per rider trip for all bus systems in the US is $3.30 (Capital Metro is $3.18). For light rail, the national average cost per trip is $2.80, while the cost for the five most recent streetcar systems in the US is $2.33. Using the projected operating costs discussed in detail in Chapter 6, the operating cost per trip for the entire Urban Rail system is estimated at approximately $3.05 (assuming daily ridership in 2030 of 27,600 and an annual operating cost of $25.3 million, using 10-minute peak/off-peak headways), indicating that the system's operating characteristics would be similar to other Urban Rail-type systems around the country. Table 5-11 below includes the Better Bus operating plan assumptions and estimated costs, similar to the calculations for Urban Rail provided in Chapter 6. The Better Bus cost per trip is estimated at $3.88 (note that 2-minute peak headways would be required in order to match the estimated 2030 ridership).

[27] Portland Streetcar, "Sponsorship Page", http://www.portlandstreetcar.org/sponslist.php, accessed June 16, 2010.

[28] Melone, Ethan, Seattle Streetcar Program Manager, email correspondence June 16, 2010.

[29] Moudon, Anne Vernez, Mark Hallenbeck, and others, 2007, Financing Options for an Expanded Seattle Streetcar System and Network, April 2007, http://depts.washington.edu/trac/bulkdisk/pdf/Streetcar.pdf, accessed June 16, 2010.

[30] Federal Transit Administration, 2010, *National Transit Database*, http://www.ntdprogram.gov/ntdprogram/, accessed June 15, 2010.

Table 5-11. Better Bus Operating Plan and Costs: 2-Minute Peak/10-Minute Off-Peak Headways

BETTER BUS Operating Plan	Route A	Route B	Totals
Length (one-way route miles)	6.5	10	16.5
Round-trip travel time (minutes)*	65.0	66.2	
Vehicles needed (does not include 2 spares)	33	34	67
Peak-hour capacity (65/vehicle)	2,145	2,210	4,355
Peak-hour capacity needed			4,140
Difference			215
Passenger Trips/day	960	960	
Vehicle miles/day	6,240	9,600	15,840
Annual vehicle miles (Annualization = 300)			4,752,000
Vehicle hours/day			1072
Annual vehicle hours**			321,600
Annual O&M costs ($100/veh/hr YoE)			$32,160,000
Annual O&M cost/lane mile (34 lane miles)			$974,545

Source: URS Corporation/City of Austin, 2010.
*12 mph average speed on shared segments and 25mph average speed on semi-exclusive segments.

Table 5-12. Comparison of Cost-Effectiveness (Operating Cost per Trip) by Transit Mode

Mode	Operating Cost per Trip
Average for Bus	$3.30
Capital Metro MetroBus	$3.18
Average for Light Rail	$2.80
Average Streetcar	$2.33

Source: FTA National Transit Database, 2010.

Better Bus (estimated)	**$3.88**
Urban Rail (estimated)	**$3.05**

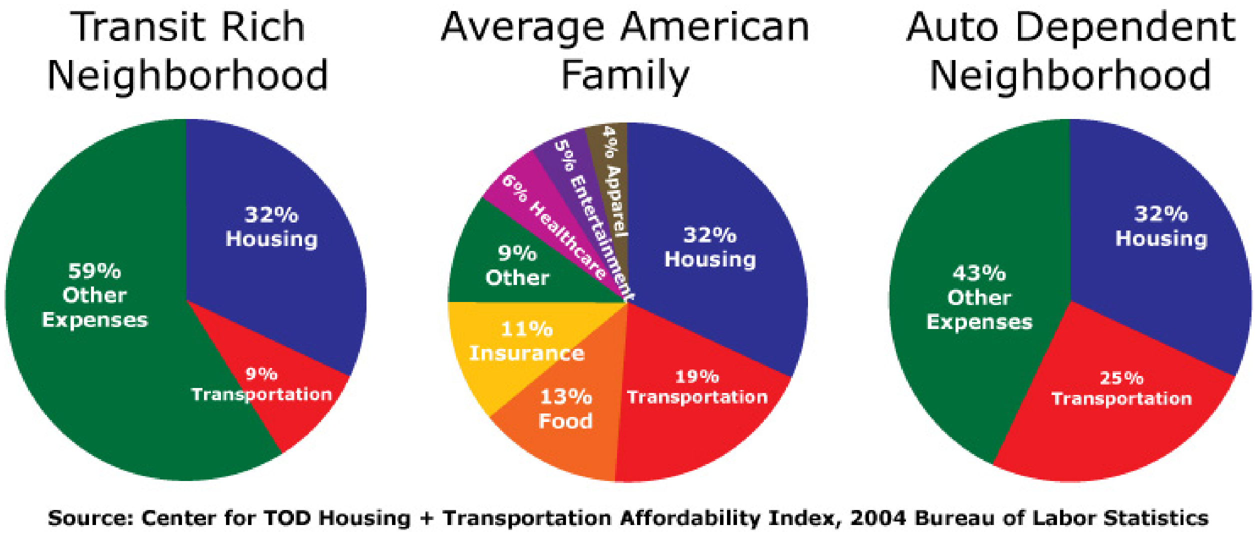
Source: URS Corporation/City of Austin, 2010.

Another aspect of cost-effectiveness is how well the transit investment alternative benefits the user. As noted above, residents and employees in and around compact, mixed-use development can save on expenses. Figure 5-4 on the following page shows the benefits to households in transit-rich neighborhoods. However, it is system users that can see the greatest benefits. The American Public Transit Association (APTA) reports that transit riders can save an average of $770 per month based on national averages for just gas and parking (note that there is no 'free parking', as urban surface spots can cost up to $10,000 each and structured parking can be two- to four-times that, and these costs are borne by developers, owners, employers, and eventually workers)[31,32]. It is assumed that a Better Bus system can be similarly cost-

[31] APTA, 2010, "Riding Public Transit Saves Individuals $9,242 Annually", Media Advisory January 12, 2010, http://www.apta.com/mediacenter/pressreleases/2010/Pages/100112_Transit_Savings.aspx, accessed June 15, 2010.

effective for users; however, given the higher ridership forecast, the ancillary benefits to the non-users (due to the better ability to attract compact, mixed-use development), and the lower operating cost per trip, the Urban Rail alternative is rated highest for this criterion.

Figure 5-4. Impact of Transit on Household Expenses[33]



Summary of Detailed Evaluation

The Urban Rail alternative clearly outperformed both the Better Bus and No-Build alternatives for each of the goals, due primarily to its ability to attract both riders and economic development. Table 5-9 summarizes the results of the detailed evaluation.

* Additional detailed cost information for the Recommended Preferred Alternative will be developed and published as part of the proposed financing plan.

[32] Victoria Transport Policy Institute (VTPI), 2009, *Transportation Cost and Benefit Analysis: Techniques, Estimates and Implications [Second Edition]*, Updated January 2009, http://www.vtpi.org/tca/tca0504.pdf, accessed June 15, 2010.

[33] Reconnecting America, 2007, "Where You Live Impacts Affordability," http://www.reconnectingamerica.org/public/factoids/171, accessed July 13, 2010.

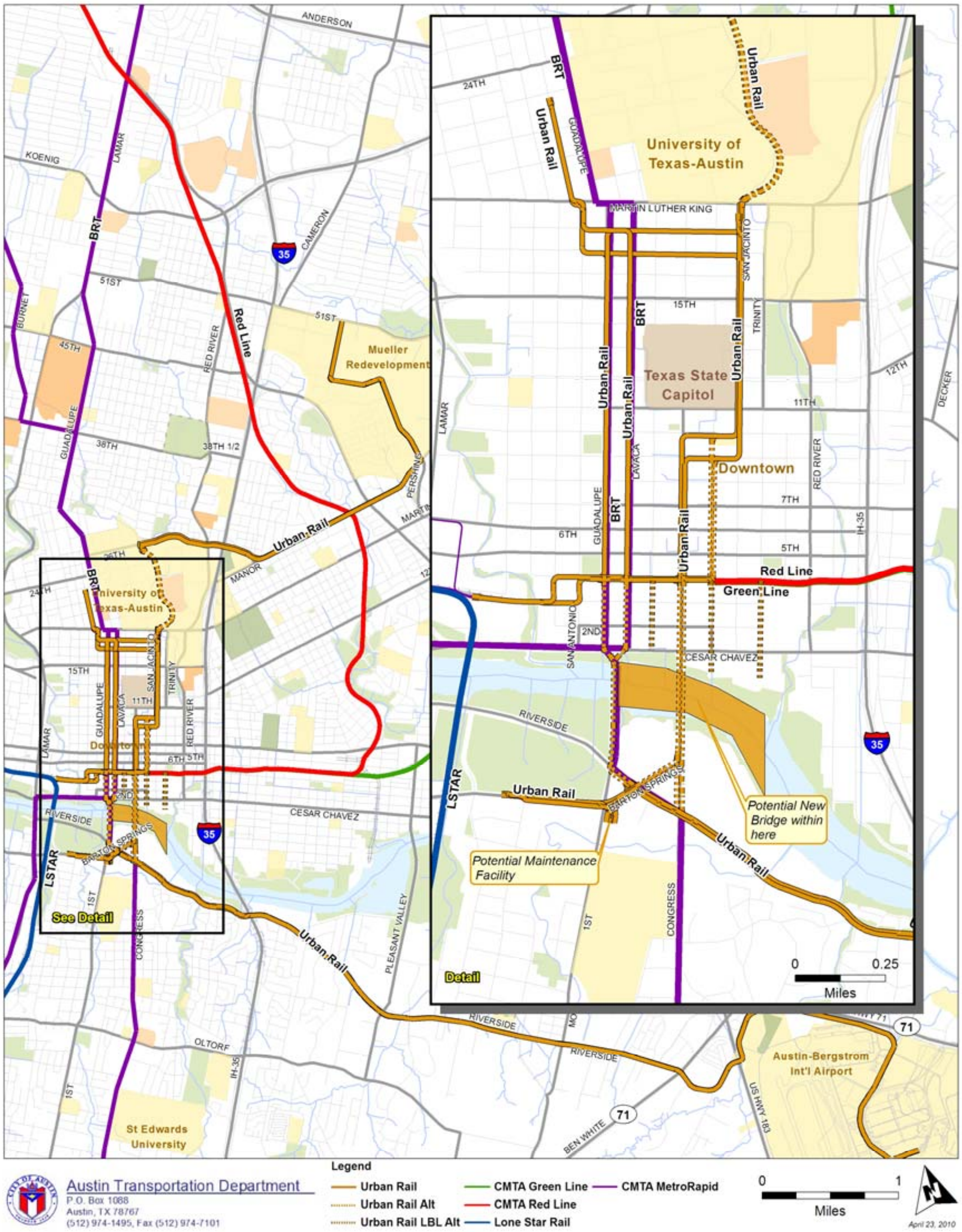
Table 5-13. Summary of Detailed Evaluation

Goal	No-Build	Better Bus	Urban Rail
1. Improve Place Connectivity	○	◐	●
2. Improve Transit Connectivity	○	●	●
3. Improve Mobility	○	●	●
4. Maximize Community Benefits	○	◐	●
5. Maximize Environmental Benefits	○	◐	●
6. Maximize Economic Benefits	○	◐	●
OVERALL RATING	○	◐	●

Recommended Locally Preferred Alternative

As a result of the detailed evaluation, the recommended **Locally Preferred Alternative** is **Urban Rail** on the conceptual alignment as illustrated in Figure 5-4. Urban Rail consistently out-performed the TSM and No-Build alternatives due to its ability to attract more riders and development, as well as its use of cleaner source power.

Figure 5-5. Recommended Urban Rail Locally Preferred Alternative



Source: City of Austin, 2010.

Next Steps

The next step in the program development process is for the City Council to adopt this Locally Preferred Alternative (LPA) recommendation. This step will also designate the LPA as a project for additional study, under the auspices of the National Environmental Policy Act (NEPA) and will allow for the initiation of more detailed environmental study, such as an Environmental Assessment or Environmental Impact Statement. As part of the NEPA process, the City will identify a lead federal agency, publish a notice of intent (NOI), and begin additional public outreach and project development, including capital and operations funding plans, operations and governance strategies, and system phasing; as well as resolution of the design issues noted above for further consideration.

*Additional detailed information, including refined ridership, financing, costs, and environmental benefits, will be published in subsequent reports once a first investment for the Preferred Alternative is identified. Additional public comment will be sought throughout the process.

6. Locally Preferred Alternative

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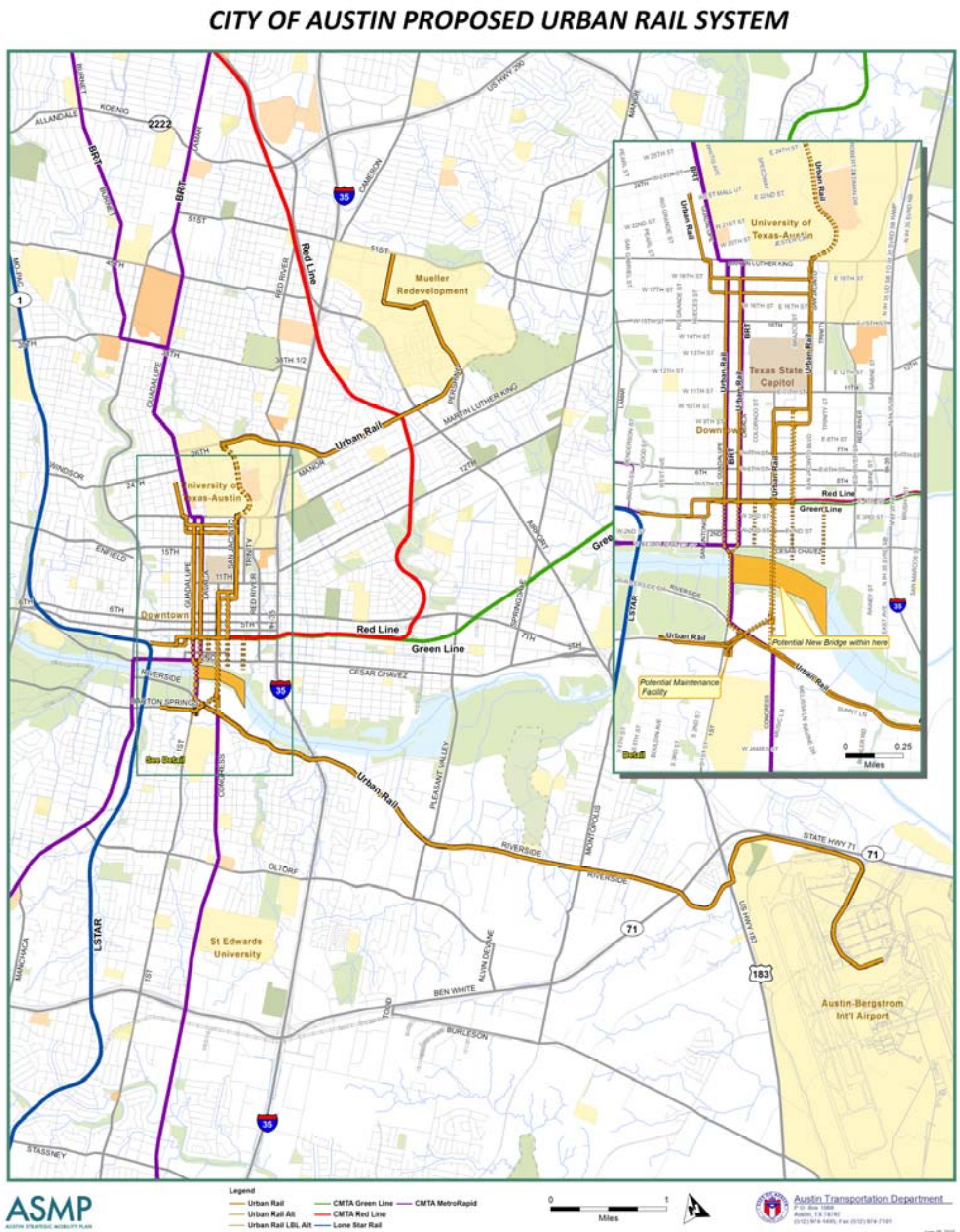
6. Locally Preferred Alternative

Recommended Locally Preferred Alternative

As a result of the detailed evaluation, the staff recommended **Locally Preferred Alternative** is **Urban Rail** on the conceptual alignment as illustrated in Figure 6-1.

Figure 6-1. Recommended Urban Rail Locally Preferred Alternative



Source: City of Austin, 2010.

Capital Cost Estimate

Capital cost estimates for the Urban Rail system plan were prepared consistent with the Standard Cost Categories used for Federal Transit Administration (FTA) New Starts projects. The project team developed the estimates using three general steps:

- The team prepared a number of conceptual engineering documents, including a Basis of Design, conceptual design (to approximately 10-15% complete), and utility conflict estimation for the proposed system plan, which is sufficient for budget-level cost estimates. **These conceptual engineering documents are published separately** and will be available from the City's Austin Strategic Mobility Plan website, http://www.austinstrategicmobility.com/resources/urban-rail-project.

- The project team identified system components, quantities, and localized unit cost data. System components and quantities were compiled from individual alignment segment estimates, which will facilitate future project phasing discussions.

- Finally, the project team applied additional factors such as contingencies, engineering and administration (E&A) costs, and year-of-expenditure escalation to the cost subtotals in order to generate the final estimates. For year-of-expenditure estimates, the team used a conceptual construction schedule predicated on a project start date in mid-2011, with actual construction running from late 2011 through mid-2014. **At the time of this publication (July 2010), City leaders have extended the project development timeline so that these calendar assumptions are no longer appropriate. Therefore, the timeline assumptions will be updated prior to seeking public funding. The current estimates do, however, provide a basic estimate of cost for on-going discussion.** The assumed construction schedule is based on a design-build, or similar, delivery method can help ensure a higher quality product due to the integration of design and construction efforts. This approach can be more expensive – and conservative – because it accounts for the assumption of risk by the contractor, which is otherwise held by the owner under a conventional design-bid-build delivery method. Year-of-expenditure costs were developed using a straight-line projection based on a calculated mid-point of construction, according to the schedule noted above and included in the conceptual engineering documents. An inflation rate of 5.25% per year was used for escalation and reflects uncertainty and unpredictability of inflation in the construction industry.

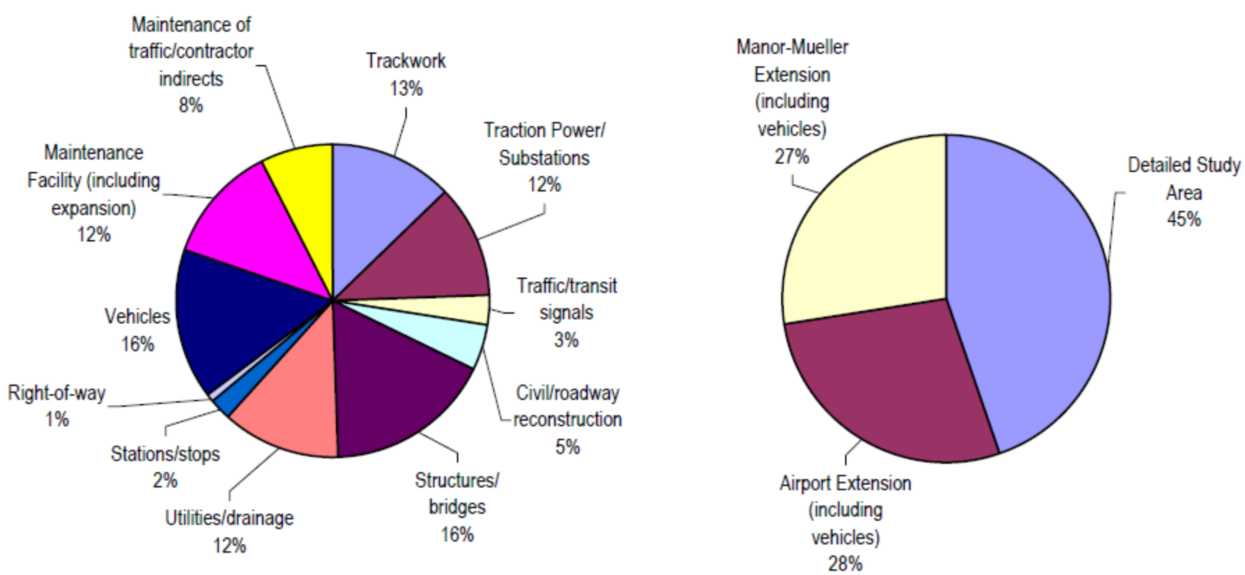
The capital cost estimate includes a cost for building a new multi-modal bridge over Lady Bird Lake, as a "worst case" scenario given that it is likely to be somewhat more expensive than rehabilitating either of the existing downtown bridges, for a total cost of $33.8 million after application of contingencies. At 33.8 track miles, the recommended Urban Rail Locally Preferred Alternative, as shown in Figure 5.2, is estimated to cost $955.1 million in first quarter 2010 dollars ($1.3 billion in year-of-expenditure dollars). This equates to $37.2 million per track mile. Table 6-1 and Figure 6-2 summarize the system plan cost by major cost category.

Table 6-1. Summary of Capital Cost Estimate by Major Category

Capital Cost Category	Estimated Capital Cost		
DETAILED STUDY AREA			
Trackwork	$56,840,000	12.8%	
Traction Power/Substations	$51,485,000	11.6%	
Traffic/transit signals	$13,165,000	3.0%	
Civil/roadway reconstruction	$21,625,000	4.9%	
Structures/bridges	$76,385,000	17.2%	
Utilities/drainage	$54,065,000	12.2%	
Stations/stops	$9,680,000	2.2%	
Right-of-way	$3,735,000	0.8%	
Vehicles	$68,835,000	15.5%	
Maintenance Facility (including expansion)	$54,590,000	12.3%	
Maintenance of traffic/contractor indirects	$33,445,000	7.5%	
SUBTOTAL	**$443,850,000**	100.0%	44.8%
EXTENSIONS			
Airport Extension (including vehicles)	$275,355,000		27.8%
Manor-Mueller Extension (including vehicles)	$271,625,000		27.4%
SUBTOTAL	**$990,830,000**		100.0%
Unallocated contingencies (15%)	$148,625,000		
Contractor/risk markup (12%)	$118,900,000		
TOTAL	**$1,258,355,000**		

Source: URS Corporation, 2010.

Figure 6-2. Summary of Capital Cost Estimate by Major Category



The previous system cost estimate developed for the 2008 *Modern Streetcar/LRT Proposal* was $537 to 622 million in mid-2008 dollars (depending upon alignment and design components). This updated cost estimate of $955 million in first quarter 2010 dollars ($1.3 billion YoE) is consistent with the previous estimate and differs for the following reasons:

System Plan Length

- A longer system plan at 33.8 track miles (vs. 30.6 track miles for the 2008 *Modern Streetcar/LRT Proposal*) due to the addition of the West CBD, or Lavaca-Guadalupe, alignment into West Campus, as well as the Maintenance Facility and Palmer/Long Center Spur.
- An increase in the number of vehicles anticipated, from 20 in the 2008 study to 33 in this study, based upon the proposed operating plan for this longer system.
- An assumption of $53 million for the Urban Rail maintenance facility in this most recent estimate vs. $15 million in the 2008 proposal to include contingencies and other add-ons and to reflect the larger fleet proposed herein.

Timing/Year-of-Expenditure (YoE)

- A change in the base year from 2008 to 2010, escalated at 5.25% per year.
- The use of year-of-expenditure (YoE) dollars instead of current year dollars, consistent with CAMPO requirements, which more accurately reflects the anticipated costs at the time of construction.

Risk/Delivery Method

- A contractor, or risk, markup of 12%, which is typical of FTA-funded projects and a realistic accounting for risk (i.e., cost overruns). This markup is an actual cost that is paid up front to the contractor under a design-build contract, which is generally lump sum, or it is held by the owner under a conventional design-bid-build delivery method.
- An increase in engineering and administration costs (E&A) from 20% of construction under the 2008 proposal to 31% under this Urban Rail estimate, to more accurately reflect typical FTA assumptions, and a more detailed (and conservative) estimation of contingencies, both allocated and unallocated, consistent with FTA requirements.

NOTE TO READER: It is important to recognize that these cost estimates are conceptual in nature and reflect the level of design appropriate for this *Transit Study*. These estimates are subject to change due to more detailed planning and design activities, changes to the program development schedule, and public and agency reviews.

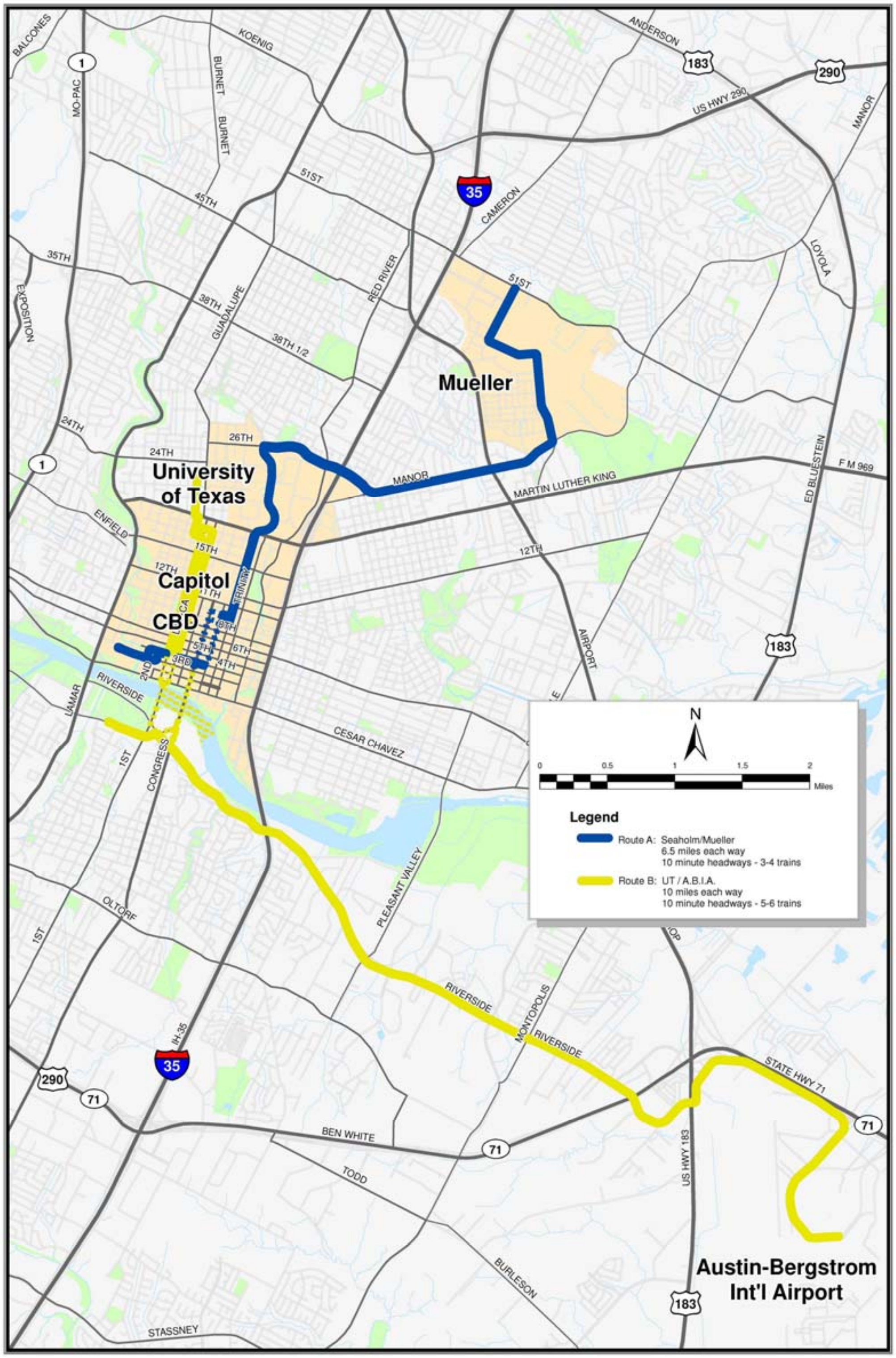
Operating Plan

For this concept plan, the Urban Rail system is assumed to operate with two 'legs' that cross downtown on Fourth Street, as shown in Figure 6-3. Additional operations assumptions include:

- Two crossing routes:
    - Route A links Seaholm Redevelopment to Mueller Redevelopment using the East CBD alignment (Congress-San Jacinto) through downtown and the UT campus. This route is 6.5 miles each way or 13 total track miles.
    - Route B links West Campus to ABIA using the West CBD alignment (Guadalupe-Lavaca) and crosses Lady Bird Lake, on either of the two existing bridges or a new bridge, and continues down East Riverside Drive to the airport. This route is 10 miles in each direction or 20 track miles.
- 10-minute peak and off-peak headways (time between train arrivals) for 16 hours per day.
- Annualization factor of 300 applied to daily vehicle miles and vehicle hours to account for reduced service on weekends and holidays.
- Average operating speeds of 12 miles per hour on shared right-of-way segments (typical of local streets due to effects of traffic lights, etc.) and 25 miles per hour on semi-exclusive segments (such as East Riverside Street to ABIA).
- Vehicle is comparable to the Siemens S70 Ultra Short model, which can accommodate up to 269 total passengers (seated and standing) at AW4 loading.[1] The peak hour passenger capacity used to develop the operating plan is 165 passengers at AW2 loading.

[1] AW0 refers to total car weight, in a ready for revenue service condition, without passengers; AW1 refers to car weight plus fully seated passenger load (at 155 pounds per passenger); AW2 (Design Load) is seated load plus standing passengers at 4 per square meter of suitable standing space; AW3 (Crush Load) is seated load plus standing passengers at 6 per square meter of suitable standing space; and AW4 (Structure Design) is seated load plus standing passengers at 8 per square meter of suitable standing space. Source: TCRP 57, 2000, "Track Design Handbook for Light Rail Transit," Transit Cooperative Research Program Report 57, National Academy Press, 2000.

Figure 6-3. Proposed System Operation Plan



Source: URS Corporation, 2010.

Operations and Maintenance Cost Estimate

As noted above, the proposed Urban Rail system is assumed to operate at 10-minute peak/off-peak headways for 16 hours a day, with a three-hour peak period in both the morning and evening. An annualization factor of 300 was applied to daily vehicle miles and vehicle hours to account for reduced service hours on weekends; this figure is a typical annualization factor used in FTA New Starts applications and calculations.

In order to validate the operating assumptions, three alternative scenarios were evaluated for passenger capacity and cost. A typical planning assumption is that a system's peak hour ridership is equal to approximately 15% of its average daily ridership. This system's estimated daily ridership in 2030 is 27,600 passengers (as detailed later in this chapter); therefore, the operating plan should be able to accommodate approximately 4,140 passengers during peak hour operations.

The three operating scenarios, for the full 33.8 track-mile system, that were evaluated used the following headways:

- 12.5-minute peak/12.5-minute off-peak.
- 10-minute peak/10-minute off-peak;
- 7.5-minute peak/10-minute off-peak; and

The methodology for estimating operations and maintenance costs is based on an assumed typical cost per vehicle revenue hour for modern streetcar systems, which are sufficiently similar to the proposed Urban Rail alternative. According to FTA's 2008 National Transit Database[2] , operating costs per vehicle revenue hour for streetcar systems in Portland, Seattle, Tacoma, Little Rock, and Tampa range from a high of $313/vehicle/hour in Tacoma to a low of $68/vehicle/hour in Little Rock, for a national average of $146 per vehicle revenue hour. According to the U.S. Department of Labor's *Davis-Bacon Wage Determinations*[3], labor costs in the Austin area are lower than the national average; consequently, this study uses a cost per vehicle revenue hour of $140/vehicle/hour for operations and maintenance costs estimation. By way of comparison, the 2008 National Transit Database shows that the national average for operating costs for light rail is $219/vehicle/hour. Figure 6-4 illustrates the comparative cost basis data used to develop the proposed Urban Rail system plan operating cost estimate.

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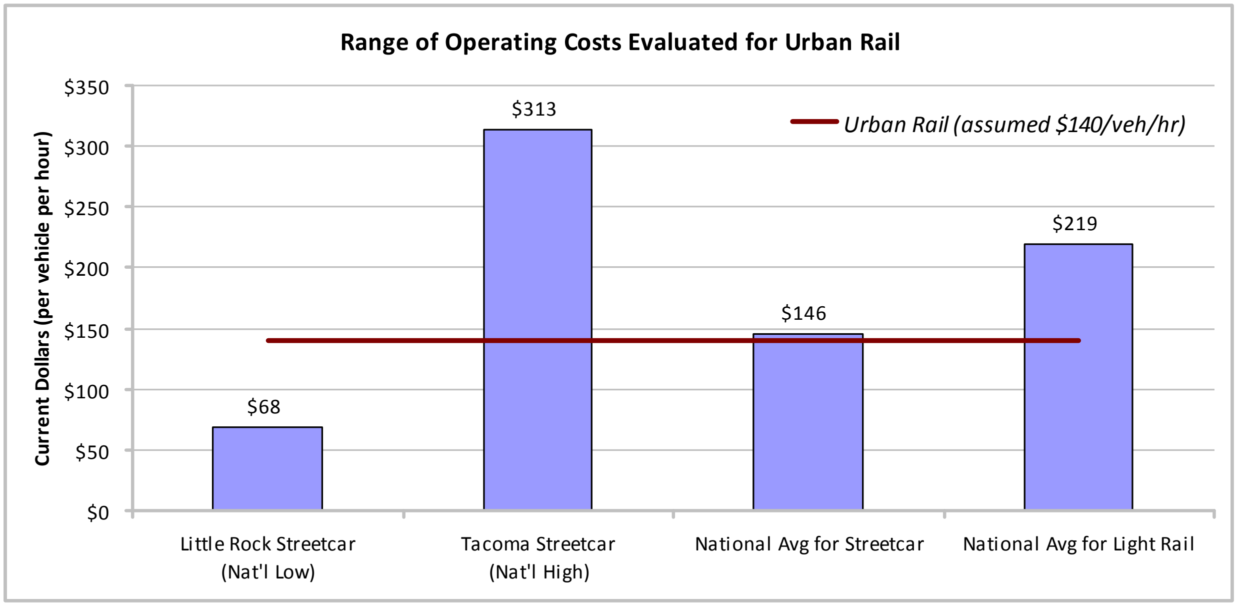
[2] Federal Transit Administration, 2010, *National Transit Database*, http://www.ntdprogram.gov/ntdprogram/, accessed June 15, 2010.

[3] U.S. Department of Labor, 2010, *Davis-Bacon Wage Determinations*, http://www.gpo.gov/davisbacon/, accessed June 17, 2010.

Figure 6-4. Range of Operating Costs Evaluated for Urban Rail



Source: FTA National Transit Database, 2010.

Similar to the capital cost estimate, current dollar operating costs need to be escalated to the anticipated year-of-expenditure (YoE). Consistent with the full system ridership projection year of 2030, the operating cost of $140/vehicle/hour was escalated at an assumed rate of 1.50% for 22 years (2008 – 2030) to arrive at an estimated operating cost of $195/vehicle/hour. This escalation rate is consistent with the historical trends in operating costs for the systems noted above in the National Transit Database.[4]

Tables 6-2 through 6-4 contain the operations and maintenance cost estimation parameters and calculations for the three operating scenarios considered.

Table 6-3 shows that the base operating scenario, 10-minute peak/off-peak headways, meets the projected system capacity demands in 2030 using two-car consists (i.e., two trains coupled together) for an estimated cost of $25.3 million. In comparison, Table 6-2 shows that for $20.6 million (about 19% less), a 12.5-minute peak/off-peak service could still meet nearly 88% of the projected demand. On the other hand, Table 6-4 shows that increasing the peak service from 10- to 7.5-minute headways is quite expensive and overshoots the demand considerably. This range of estimated annual operating costs for 10- and 12.5-minute service is consistent with the $21-$23 million estimate from in the 2008 *Modern Streetcar/LRT Proposal*, especially given the escalation for YoE costs and additional vehicles.

The vehicles in this exercise are assumed to be comparable to the Siemens S70 Ultra Short model, which can accommodate 165 passengers seated and standing under AW2 loading (4 passengers standing per square meter plus seated). This peak hour service capacity is typical for planning purposes.

[4] Federal Transit Administration, 2010, *National Transit Database*, http://www.ntdprogram.gov/ntdprogram/, accessed June 15, 2010.

Note also that these two viable scenarios equate to approximately $640,000 to $785,455 per track mile; this compares with the national average for the five most recent streetcar systems (Portland, Seattle, Tacoma, Little Rock, and Tampa) of $822,000 per track mile.[5]

Table 6-2. Operating Plan and Costs: 12.5-Minute Peak/12.5-Minute Off-Peak Headways

	Route A	Route B	Totals
Length (one-way route miles)	6.5	10	16.5
Round-trip travel time (minutes)*	65.0	66.2	
Vehicles needed (does not include 2 spares)	11	11	22
Peak-hour capacity (165/vehicle)	1,815	1,815	3,630
Peak-hour capacity needed			4,140
Difference			-510 (-12%)
Vehicle trips/day	154	154	
Vehicle miles/day	998	1,536	2,534
Annual vehicle miles (Annualization = 300)			760,320
Vehicle hours/day (16 hr/day)			352
Annual vehicle hours (Annualization = 300)			105,600
Annual O&M costs ($195/veh/hr YoE)			$20,592,000
Annual O&M cost/track mile (34 track miles)			$640,000

Source: COA & URS Corporation, 2010.
*12 mph average speed on shared segments and 25mph average speed on semi-exclusive segments.

Table 6-3. Operating Plan and Costs: 10-Minute Peak/10-Minute Off-Peak Headways

	Route A	Route B	Totals
Length (one-way route miles)	6.5	10	16.5
Round-trip travel time (minutes)*	65.0	66.2	
Vehicles needed (does not include 2 spares)	13	14	27
Peak-hour capacity (165/vehicle)	2,145	2,310	4,455
Peak-hour capacity needed			4,140
Difference			315 (+8%)
Vehicle trips/day	192	192	
Vehicle miles/day	1,248	1,920	3,168
Annual vehicle miles (Annualization = 300)			950,400
Vehicle hours/day (16 hr/day)			432
Annual vehicle hours (Annualization = 300)			129,600
Annual O&M costs ($195/veh/hr YoE)			$25,272,000
Annual O&M cost/track mile (34 track miles)			$785,455

Source: COA & URS Corporation, 2010.
*12 mph average speed on shared segments and 25mph average speed on semi-exclusive segments.

[5] Federal Transit Administration, 2010, *National Transit Database*, http://www.ntdprogram.gov/ntdprogram/, accessed June 15, 2010.

Table 6-4. Operating Plan and Costs: 7.5-Minute Peak/10-Minute Off-Peak Headways

	Route A	Route B	Totals
Length (one-way route miles)	6.5	10	16.5
Round-trip travel time (minutes)*	65.0	66.2	
Vehicles needed (does not include 2 spares)	18	18	36
Peak-hour capacity (165/vehicle)	2,970	2,970	5,940
Peak-hour capacity needed			4,140
Difference			1,800 (+43%)
Vehicle trips/day	256	256	
Vehicle miles/day	1,664	2,560	4,224
Annual vehicle miles (Annualization = 300)			1,267,200
Vehicle hours/day (16 hr/day)			576
Annual vehicle hours (Annualization = 300)			172,800
Annual O&M costs ($195/veh/hr YoE)			$33,696,000
Annual O&M cost/track mile (34 track miles)			$1,047,273

Source: COA & URS Corporation, 2010.
*12 mph average speed on shared segments and 25mph average speed on semi-exclusive segments.

Operations Summary

The operations analysis shows that a typical 10-minute peak/off-peak headway scenario running two-car consists (or train sets) meets capacity needs in 2030 under standard loading assumptions, while a 12.5-minute peak headway scenario does not quite meet capacity requirements. Both scenarios have reasonable operating costs, both in absolute terms ($21 million to $25 million), and on a per-track-mile basis when compared with the national average for recent streetcar systems. The 7.5-minute peak headway scenario is not needed for capacity requirements and is considerably more expensive than the other two scenarios.

As noted earlier, vehicles in this exercise are assumed to accommodate 165 passengers at AW2 loading during peak hour service. Changes to this assumption can improve the ability of the 12.5-minute peak scenario to meet the projected demand in 2030.

These scenarios should be subject to more analysis in future phases of the project to more accurately forecast ridership and to determine capacity.

Outstanding Issues

Despite the arrival at a recommended Locally Preferred Alternative, this study, as well as its predecessors, still has some unresolved issues. The Locally Preferred Alternative map shown in Figure 6-1 includes two alignment segments (indicated by dashed line) with viable alternatives. Additionally, a potential maintenance facility site has been identified, but further investigation is recommended before a final selection is made.

Alignment Options

As noted, there are two alignment segments for which there remain alternatives:

- The use of either Congress Avenue or Brazos Street as a primary route for the Urban Rail alignment on the east side of downtown; and
- How to cross Lady Bird Lake, whether on one of the existing bridges or constructing a new bridge.

East CBD – Congress Avenue vs. Brazos Street

One issue involves the designation of a core alignment through the east side of downtown. Previous studies have designated Congress Avenue as the spine of the system; however, subsequent public outreach and evaluation by the project team have established Brazos Street as a viable alternative. Table 6-5 documents the advantages and disadvantages of these two alignment options.

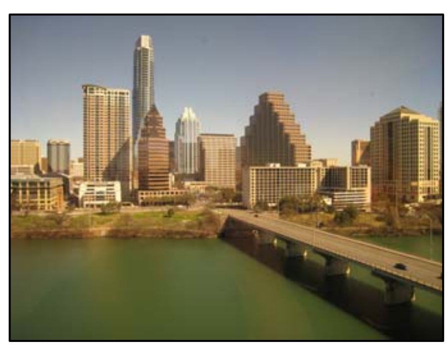
Table 6-5. Analysis of Using Congress Avenue vs. Brazos Street

Alignment	Advantages	Disadvantages
Congress Ave.	• More retail and activity center focus. • Considered as Texas' "Main Street". • Closer to newly developing residential complexes and hotels. • Closer to employment core of downtown. • Provides opportunity to shift bus traffic off Congress to Brazos or other parallel streets. • Allows focus of development and redevelopment in already developed corridor. • Has support of downtown stakeholders. • Designated as "First Phase Urban Rail Priority Street" under Downtown Austin Plan.	• Parades on Congress could interfere with Urban Rail operations and vice versa. • An Urban Rail system on Congress could displace buses to other streets, requiring rider adjustments to a new system. • Angled parking on Congress is incompatible with Urban Rail operations (though the parking scheme could be modified). • Crown and changes in the street's profile present design challenges. • Farther from Red Line commuter rail station. • Focuses significant amount of new transit activity on Congress in addition to existing traffic.
Brazos St.	• Closer to commuter rail station • Provides opportunity to limit additional transit traffic on Congress. • Provides additional new development opportunities to another street in downtown. • Assumed as a "mixed mode" street under the Great Streets Master Plan. • Designated as an "Alternative Urban Rail Alignment" under Downtown Austin Plan.	• Abundance of parking garage entrances and exits could be problematic. • One-way traffic on Brazos would require the loss of at least one traffic lane for contraflow Urban Rail operations. • Contains alleys and delivery entrances for buildings that front on Congress.

Source: URS Corporation, 2010.

Recommendation

This study recommends that Congress Avenue be used for the primary Urban Rail alignment on the east side of downtown. Its proximity to activity centers and businesses provides a built-in ridership base. Its perception as Texas' "Main Street" gives it a unique ability to integrate an Urban Rail system that will enhance ridership, development, and support among local residences, businesses, and visitors. If Brazos undergoes a two-way conversion, its viability as the East CBD alignment would be enhanced.



Lady Bird Lake Crossing – Existing Bridge vs. New Bridge

Another key issue is the alignment across Lady Bird Lake. This study includes only a conceptual examination of advantages and disadvantages associated with the identified options: retrofit/rehabilitate either existing bridge (Congress Avenue or South 1st Street) or construct a new bridge (potentially transit, bicycle, and pedestrian modes only) between South 1st Street and Trinity Street. Table 6-6 summarizes some of the key issues surrounding the use either of the existing bridges or the development of a new bridge.

Table 6-6. Consideration of Lady Bird Lake Crossing Options

Option	Advantages	Disadvantages
Existing Bridge	• Potentially lower costs unless major reconstruction required • Provides direct access to Auditorium Shores area and other activity centers • Could be implemented more quickly than construction of a new bridge	• Potential impacts to bat habitat for Congress Ave. bridge • Major traffic engineering issues at intersections with Cesar Chavez • Addition of a new transit mode on already-congested bridges could increase congestion • Construction disruption on severely-congested auto facility • Construction may require extended closing of bridge • Higher risk that construction problems would have significant impacts to vulnerable network
New Bridge	• Could connect with potential new developments • Could allow buses to use new facility and lessen congestion on existing bridges • Would provide major new pedestrian/bicycle facility across Lady Bird Lake • Fewer construction impacts on traffic • Provides redundancy to existing corridor • Does not require extensive closure during construction. • Potential for signature multi-modal structure crossing LBL • Lower risk that construction problems would impact network	• Likely higher cost than reconstructing existing bridge • Longer construction time than reusing existing bridge

Source: URS Corporation, 2010.

Recommendation

At this point in the study process, no recommendation is made on the use of either existing bridge or the development of a new bridge. It is recommended that the structural and potential environmental impacts for any option be studied further during the NEPA process.

Maintenance Facility Options

An Urban Rail system, like other passenger rail systems, requires one or more maintenance and storage facilities; the exact number and location will depend on the specific alignment and length of the system. Traditionally, maintenance facilities for similar systems have been located on parcels from two to five acres in size depending on the number of vehicles in the fleet. Activities that could be performed at such a facility include:

- Vehicle storage and layover;
- Operator reporting and dispatching;
- System operations supervision;
- Daily maintenance, such as interior and exterior cleaning;
- Inspections, including daily safety inspections, and long-term periodic inspections;
- Running repairs or light maintenance such as replacing broken glass or indicator lights, door malfunctions, and similar activities;
- Component change-out, including major components such as motors;
- Vehicle unscheduled and daily repairs; and
- Parts and materials storage.

Maintenance facilities generally include interior track, repair pits, jacks and cranes as needed, and related facilities. As with stations, exterior design of maintenance facilities can be as simple or sophisticated as budgetary resources allow or as local design standards dictate.

Consideration should be given to neighborhood acceptance of Urban Rail maintenance facilities by integrating other community-based uses into the facility or parcel. Transit maintenance facilities of any type often encounter community resistance, so that facilities usually are located in less-desirable quasi-industrial or underutilized areas. Owners can enhance the desirability of such facilities by including public amenities such as streetcar museums or maintenance viewing rooms or by adding functions to the building such as police substations, recreation centers, community meeting rooms, or even other transit-oriented development components such as retail, office, or residential development.

As part of this project, Baer Engineering was tasked with examining potential locations for an Urban Rail maintenance facility site. In late 2009, Baer staff developed a long list of 22 potential sites for a facility using basic criteria developed by URS as part of its *Basis of Design Memo*. After consultation with City staff, 19 of the 22 sites were eliminated from further consideration due to price, alternative non-transit development potential, and size. The three remaining sites are:

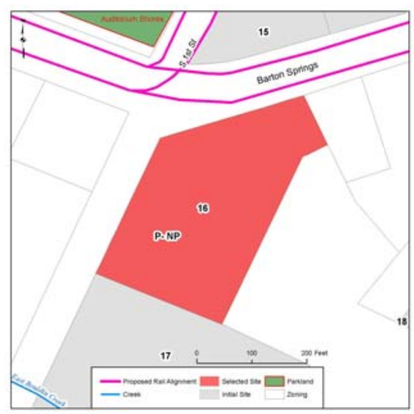
- 10th to 11th Streets between Guadalupe and Lavaca;
- 9th to 10th Streets between Guadalupe and Lavaca; and
- One Texas Center parking lot.

10th to 11th Streets between Guadalupe and Lavaca

Both sites between Guadalupe and Lavaca have the same key issues. They both encompass entire city blocks (approximately two acres each), which allows for proper configuration and adequate space for the facility; and they border the potential Urban Rail alignments on Guadalupe and Lavaca, providing easy vehicular flow into and out of the facility without requiring a non-revenue track. Both sites are in the Woolridge Park Capitol View Corridor, which restricts the height of buildings on these parcels. If either of the sites were selected, the City would need to consider requesting a variance from the City ordinance (City Council Chapter 25-2, Appendix A) and the State law (Texas Government Code Chapter 3151) to allow development of an Urban Rail facility.

9th to 10th Streets between Guadalupe and Lavaca

The site at One Texas Center on the south side of Lady Bird Lake is approximately 2.13 acres in size. The site's linear configuration (compared with the roughly square configurations of the two sites between Guadalupe and Lavaca) provides more facility access and design flexibility. The City owns this parcel, which contains a customer parking lot at present, so substantial time (in terms of land acquisition) and financial savings could be realized here. Given the potential for savings and the significant constraints at the two Guadalupe and Lavaca sites, this site was used for system planning and cost estimation purposes. Further consideration should be given to incorporating additional City uses into a facility at this site, including replacement of the displaced customer parking with possibly integrated, structured parking. It is worth noting that there is considerable un-met demand for special event parking in this area of the city. As there is also a need for affordable housing near downtown, a facility at this site also presents an opportunity to integrate a residential component.



One Texas Center

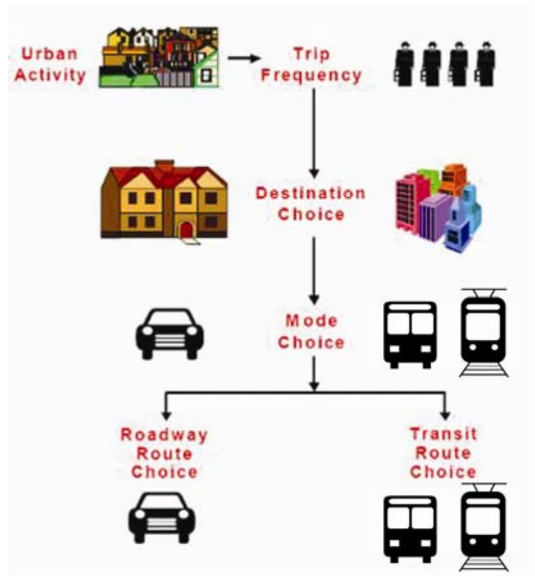
Recommendation

Given the significant financial challenges the City faces to acquire and develop any property within the CBD, the One Texas Center site presents the best option identified thus far. It is advised that additional study be conducted to provide a final recommendation. The *Urban Rail Conceptual Engineering Documents*, published separately and available from www.austinstrategicmobility.com, include the initial maintenance facility site selection report developed for the *Central Austin Transit Study*.

Ridership

Introduction

The methodology used for estimating ridership of the proposed Urban Rail system involves the use of a *derivative* of Capital Area Metropolitan Planning Organization's (CAMPO) 2035 regional Travel Demand Model (TDM). The CAMPO model is a complex multimodal tool that can be used to help predict where trips are going to occur within the transportation network and where the demand is for increased infrastructure and improvements. In the simplest terms, the CAMPO model turns people and employees into trips, finds their origin and destination and assigns them a path to complete their trip (see adjacent graphic). The trips are daily so it accounts for home to work, home to shopping and back to home. The most current version of the travel demand model includes the entire transit network, including the City of Austin's proposed Urban Rail line, Capital Metro's Red and Green Lines, and Lone Star Rail District's Regional Rail Line. This transit network forms the foundation of the ridership estimates prepared for Urban Rail.



The following section describes the basic theory of the travel demand model. Later sections will describe the specific assumptions and adjustments that were made based on a post processing technique called "5D".

Basic Model Theory

By creating and using a travel demand model, one is attempting to produce a mathematical representation of an individual's actual decision-making process:

> *Why to make a trip → When to make the trip → Where to make the trip → How to make the trip → What route to follow to complete the trip.*

These individual choices are then combined so that aggregate impacts can be determined. The model structure should also be manageable and supported with obtainable data.

As a project develops, travel demand models may be used to make planning level decisions regarding future transportation needs. The models estimate the overall demand on roadway and transit systems based on the proposed land uses. Models are also used to answer questions such as capacity required within a given roadway or transit route. However, travel demand models are best suited to provide a relative comparison between different alternatives.

Four-Step Modeling Process

The model is comprised of a series of mathematical equations that simulate travel across the overall transportation network. This macroscopic process encompasses the four (4) primary steps taken to estimate travel demand from a given land use and transportation network. The four steps in this approach are as follows:

- *Trip Generation* – the estimation of the number of trip-ends for each zone within the model. More detail on the trip generation process is included in the following section.
- *Trip Distribution* – the estimation of the number of trips between each zone pair.
- *Modal Split* – the prediction of the number of trips made by each mode of transportation between each zone pair. Prior to the assignment process the combined 24-hour person-trip transit table is factored to produce 24-hour peak and off-peak person-trip tables and a peak 3-hour person-trip table.
- *Traffic/Transit Assignment* – this trip assignment step determines the amount of traffic trips that is loaded onto the transportation network through path-building, and is also used to determine network performance. Likewise during this trip assignment step, the model examines transit and walkable trips, tabulating those according to a person's ability to walk between transit stops and trip origin/destinations. The resulting transit person-trip tables are then assigned to the appropriate off-peak or peak transit modes.

Overview of 5D Transit Post Process

To assist in the planning process for the proposed Urban Rail System the consultant team completed a series of alternative travel demand model runs to determine future ridership potential. In order to produce greater detail from the base travel demand model, the team conducted additional post processing, using the 5D process. The 5D's – Density, Diversity, Design, and Distance/Destination – were developed from over 50 national case studies completed by Metropolitan Planning Organizations, Council of Governments, and Federal agencies looking at the effects that these basic characteristics have on transit ridership. Currently, a majority of these case studies are being aggregated in the active NCHRP Report 08-61, "Travel Demand Forecasting: Parameters and Techniques."[6]

In the 5D mode choice, each of the five characteristics affects ridership according to its elasticity. For instance, the closer a person is to transit the more likely they are to ride transit. These characteristics are then used to determine travel times and to estimate ridership. The process adds additional refinement to the person-to-vehicle trip conversion step that exists within the travel demand model. The process was developed as an additional layer to the person-to-vehicle trip conversion step that exists within the travel demand model since many of these local system elements are not accounted for in the current travel demand model.

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[6] NCHRP, 2010, "Travel Demand Forecasting: Parameters and Techniques ", NCHRP 08-61 [Active], http://144.171.11.40/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=937

The travel demand model produces person trips for the entire region then distributes these trips amongst all travel modes (auto, transit, bike, and walk), based primarily on travel time and cost. The 5D process further refines the regional transit trip distributions according to additional factors used to determine potential transit ridership along the Urban Rail line. They include:

Distance/Destination

After each model run, predicted travel times were used to generate trip tables of constrained travel times (often called skims). These skims were used as input into a mode choice routine and compared with transit travel times. These travel times were used to evaluate the likelihood that individuals will select transit over a personal vehicle based on the total travel time of the trip. The distance factor also looks at the availability of alternative modes near the traveler's beginning or end point.

Density

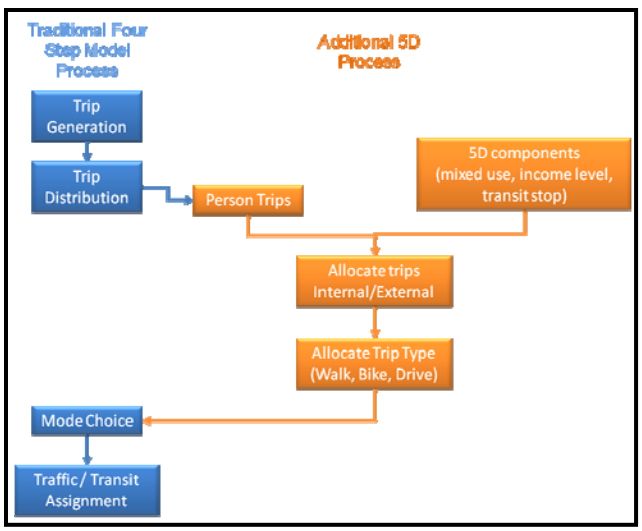
Each demographic scenario contains household and employment density which plays a major role in the time it takes to get to a transit station. Less dense developments often have fewer streets and larger lot sizes which translate to reduced access to transit.

Diversity

The diversity factor evaluates the balance of housing and jobs, in the vicinity of the traveler, as well as demographic inputs, such as the number of available vehicles per household, to determine if travelers are more or less likely to be transit-dependent.

Design

Developments that have a mix of uses (i.e., residential, employment, retail, etc.) within walking or biking distance from each other have the ability to reduce overall auto travel demand and often result in increased transit trips. Standard practice assumes that on average, a single household generates ten auto trips per day. Of those ten trips only two to four are home to work trips. In walkable, mixed-use developments, typically between 12 to 40 percent of the remaining trips are satisfied by walking or biking. The 5D process refines the mode choice development step by applying design characteristics (intensity/density, walkability/mixed-use, etc.) to the outputs with factors based on national and localized data.



The resulting person trip shift derived from the 5D process is then reintroduced into the travel demand model as the "Transit Assignment".

Application of 5D Post Process

The adjacent graphic illustrates how the 5D process fits into typical four step model process. Specifically the process begins by targeting the unassigned model-generated person trips. These trips have not yet been assigned to Walk, Transit, or Vehicle but are distributed by type. The process starts when the model selects areas that are within a walk, bike or drive shed (¼ mile, ½ mile, 1 mile, respectively). The process then targets specific trip types in the model. For instance Home Based Work Trips tend to favor transit more than a Non Home Based Other trip type. Therefore the 5D process will assign a higher percentage of trips from the Home Base Work Trips to transit. The additional factor that 5D adds includes development. At this point in the process Traffic Analysis Zones are given increased transit capture rates based on Density, Diversity, Design, and Distance/Destinations.

This process yields more realistic ridership numbers than the regional model alone, providing better information to decision makers. Table 6-7 below compares the results obtained directly from the CAMPO TDM (i.e., no post processing) with those generated from the 5D process.

Ridership Forecast

A derivative CAMPO TDM was used to estimate ridership for the Urban Rail and Better Bus (i.e., Build and TDM) alternatives at a point in the future – 2030 – in which the full system, or LPA, would be in operation, and according to the CAMPO TDM 2030 demographics. The forecast year is also consistent with that used for the CMTA Alternatives Evaluation and Downtown Austin Plan, which provides for realistic comparisons. Both the Urban Rail and Better Bus alternatives were modeled along the same alignments with the same basic operating assumptions.

Table 6-7 shows the full system ridership estimates for both the Build and TSM alternatives.

Table 6-7. Ridership Estimates by Mode and Post Processing Method

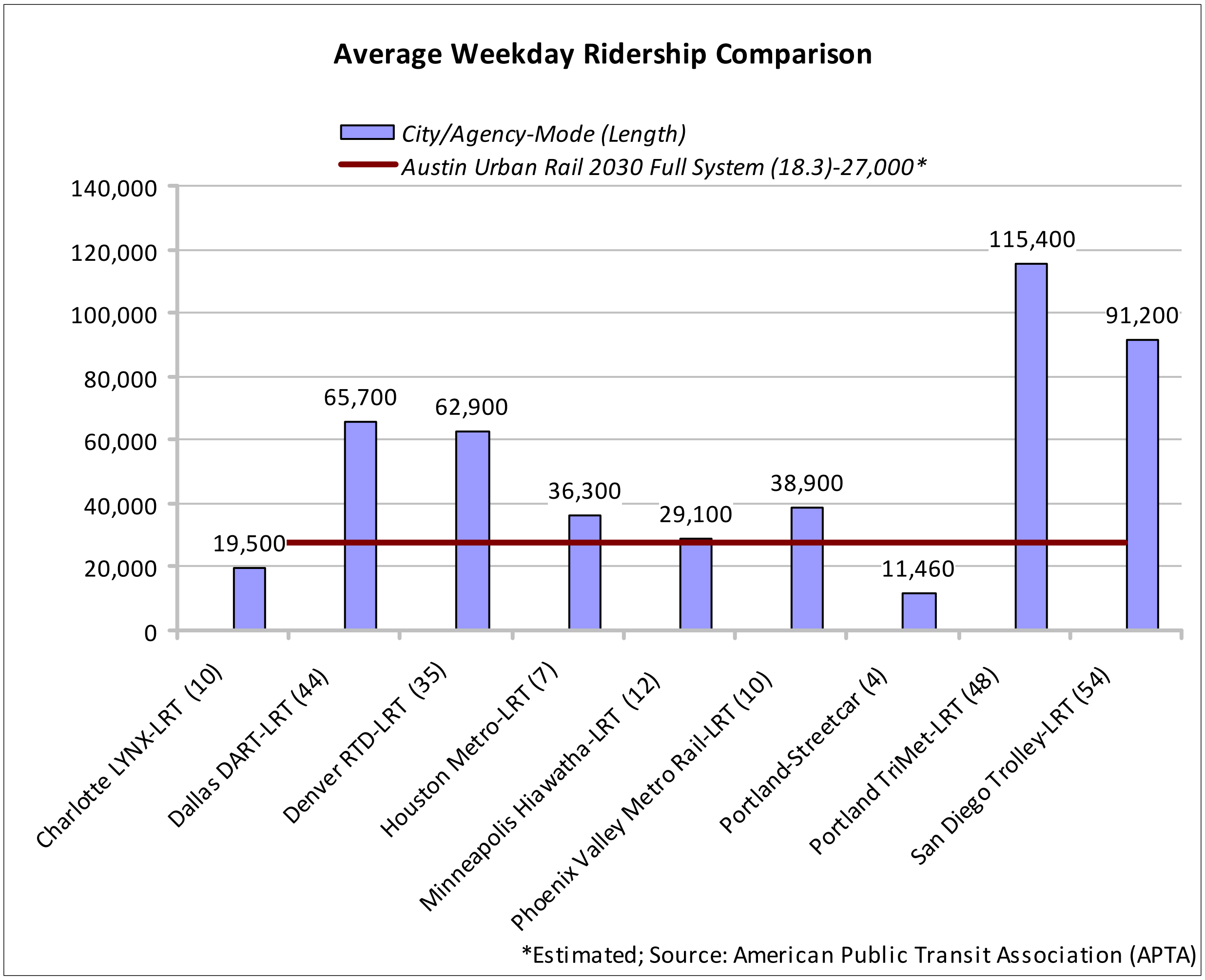
Route	CAMPO TDM	With 5D Post Process	Segment Length
2030 Full System			16.5 route miles
Urban Rail	17,800	27,600	
Better Bus	5,500	9,000	

These ridership forecasts are viewed as conservative and could be surpassed in Austin. Similar cities and metro areas have successfully implemented urban rail-type transit systems that have exceeded these ridership projections in Austin.

Comparison with Other Cities

When comparing the Urban Rail alternative's ridership projections with actual ridership numbers from similar U.S. cities, it is clear that estimations generated via the 5D process are realistic. Figure 6-5 compares average weekday ridership numbers for various Urban Rail-type streetcar and light rail systems with the estimate for Austin. These represent good benchmarks for Urban Rail's ridership potential.

Figure 6-5. 2009 Average Weekday Rail Ridership Comparison



Source: COA & Kimley-Horn and Associates, Inc., 2010.

Ridership Summary

This analysis builds upon a derivative of the 2035 CAMPO forecasting model and its demographic forecasts to provide a conceptual ridership estimation. The findings are indicative of the general scale of ridership attainable by the proposed Urban Rail system and are valid for comparison of investment alternatives. This realistic, though preliminary, forecast indicates there is good overall ridership potential for the Urban Rail alternative versus Better Bus. The addition of the 5D process does appear to capture the well-documented ability of rail transit to encourage compact, higher-density development along its route.

Locally Preferred Alternative Summary Characteristics

As a result of the conceptual and detailed evaluations, the recommended Locally Preferred Alternative (LPA) is Urban Rail, on the alignment as illustrated above in Figure 6-1, with the following characteristics:

Length:	33.8 track miles, 16.5 route miles
Capital Cost:	$955 million in first quarter 2010 dollars or $1.3 billion in year-of-expenditure (YoE) dollars* at $37.2 million YoE per track mile.
Operations Cost:	Approximately $25 million YoE per year.
Ridership:	Average weekday ridership projected to be approximately 27,600 by 2030.
Operations Plan:	Two crossing routes (6.5 and 10 route miles each), with 10-minute peak/off-peak headways, using 27 vehicles (plus 2 spares), with service 16 hours a day/5 days a week and reduced service on weekends and holidays.
Travel Time:	Approximately 32 – 33 minutes from end-to-end for both routes.

(* Regional transportation plans require year of expenditure (YoE) estimates that account for inflation.)

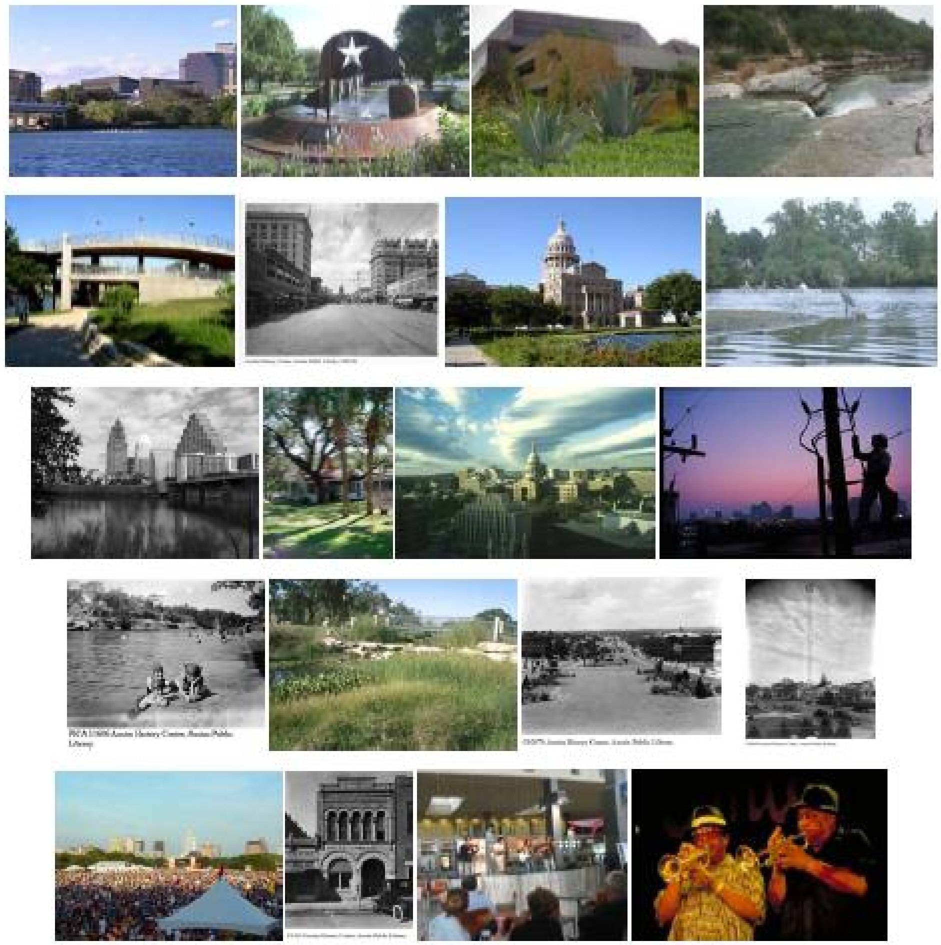


PHOTO CREDITS (L to R): City of Austin photo; Photo by Karen Grotefend, City of Austin; City of Austin photo; Photo by Mike Lyday, Watershed Protection and Development Review Department; Photo by Karen Grotefend, City of Austin; Austin History Center, Austin Public Library C00138 Photo; Photo by Bob Parker; Photo by Mike Lyday, City of Austin Watershed Protection and Development Review Department; Photo by Bob Parker, Austin Fire Department; Photo by Victor Ovalle, City of Austin Parks and Recreation Department; Photo by Mike Lyday, Watershed Protection and Development Review Department; Photo courtesy of Austin Energy; Austin History Center photo; Photo by Mike Lyday, Watershed Protection and Development Review Department; Austin History Center photo; Austin History Center photo; Photo by Victor Ovalle, City of Austin Parks and Recreation Department; Austin History Center photo; Photo by Jim Halbrook, Department of Aviation; City of Austin Parks and Recreation Department

7. Other Implementation Issues

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7. Other Implementation Issues

Introduction

This chapter summarizes many of the design and implementation issues related to Urban Rail, including:

- A summary of recent Urban Rail-like streetcar systems around the country;
- An overview of Urban Rail vehicle options;
- A summary of design issues related to Urban Rail passenger stops;
- A review of how Urban Rail can be integrated into the transportation and street network of Austin; and
- A summary of Urban Rail systems elements.

Recent Urban Rail-Like Streetcar Systems in the U.S.

This section summarizes the experiences and characteristics of streetcar systems throughout the U.S. that have implementation characteristics similar to those of Urban Rail. While there are at least fifteen or twenty cities with some form of streetcar service in this country, the majority of those systems are either heritage systems with long histories of service (including San Francisco, New Orleans, and Philadelphia) or tourist-oriented systems that do not serve a traditional daily mobility or commute trip market (such as the Little Rock River Rail or the Tampa Trolley, both of which use vintage replica vehicles). There are only three cities with recent experiences in Urban Rail construction and operations that are comparable models for potential systems in Austin:

- Portland, Oregon
- Seattle, Washington
- Tacoma, Washington

The next few pages are fact sheets on each of those systems, followed by a comprehensive table that summarizes many implementation and operating characteristics of those systems.

Portland Streetcar

The Portland streetcar opened its initial segment in July 2001 as a single-track counterclockwise loop from the Legacy Good Samaritan Hospital in Northwest Portland to Portland State University. This 4.8-track-mile system was constructed for approximately $55 million (or $11.9 million per track mile). The streetcar was seen as an option to help redevelop downtown Portland and its surrounding neighborhoods, and as a way to connect the north and south sides of town, which were previously bisected by a freeway off ramp. The area known as the Pearl District was rezoned from 15 units per acres to 125 units an acre and was to include parks, affordable housing, and the demolition of an elevated freeway off-ramp. Additional extensions to the south waterfront redevelopment area added four more track miles to the system. Total construction cost for the system stands at $103 million, or $12.9 million per mile. Total daily ridership is approximately 11,000. Its current annual operating cost is approximately $5.5 million.

System Description

Portland uses a modern streetcar for its system. The system is four route miles long with eight miles of track that loop through downtown Portland connecting the South Waterfront District to the Pearl District and Northwest Portland (refer to Figure 7-2 for a system map). There are 46 stops; with connections to the MAX light rail system, Portland Aerial Tram, and Tri-Met buses. The streetcar runs with 12 to 15 minute headways from 5:30 a.m. to 11:45 p.m. Monday through Thursday, 5:30 a.m. to 12:00 a.m. Friday, 7:15 a.m. to 11:45 p.m. Saturday and Sunday from 7:15 a.m. to 10:30 p.m.

Table 7-1. Portland Streetcar System Summary

Portland Streetcar Summary	
System length (track miles)	4 route miles; 8 track miles
System Cost	$103 million
Cost per mile	$12.9 million
Annual O&M cost	$5.5 million
Vehicle	Skoda (Modern)
Size	66' long x 8' wide
Vehicle capacity	140 (30 seats)
Ridership	~11,000 per day
Right-of-way	Mixed-flow
Operating rationale	Local/limited stop
Station/stop spacing	3-4 blocks
Fare collection	On-board (free in Fareless Square)
Owner/Operator	Portland Streetcar Inc./Tri-Met

Table 7-2. Portland Streetcar Funding Sources

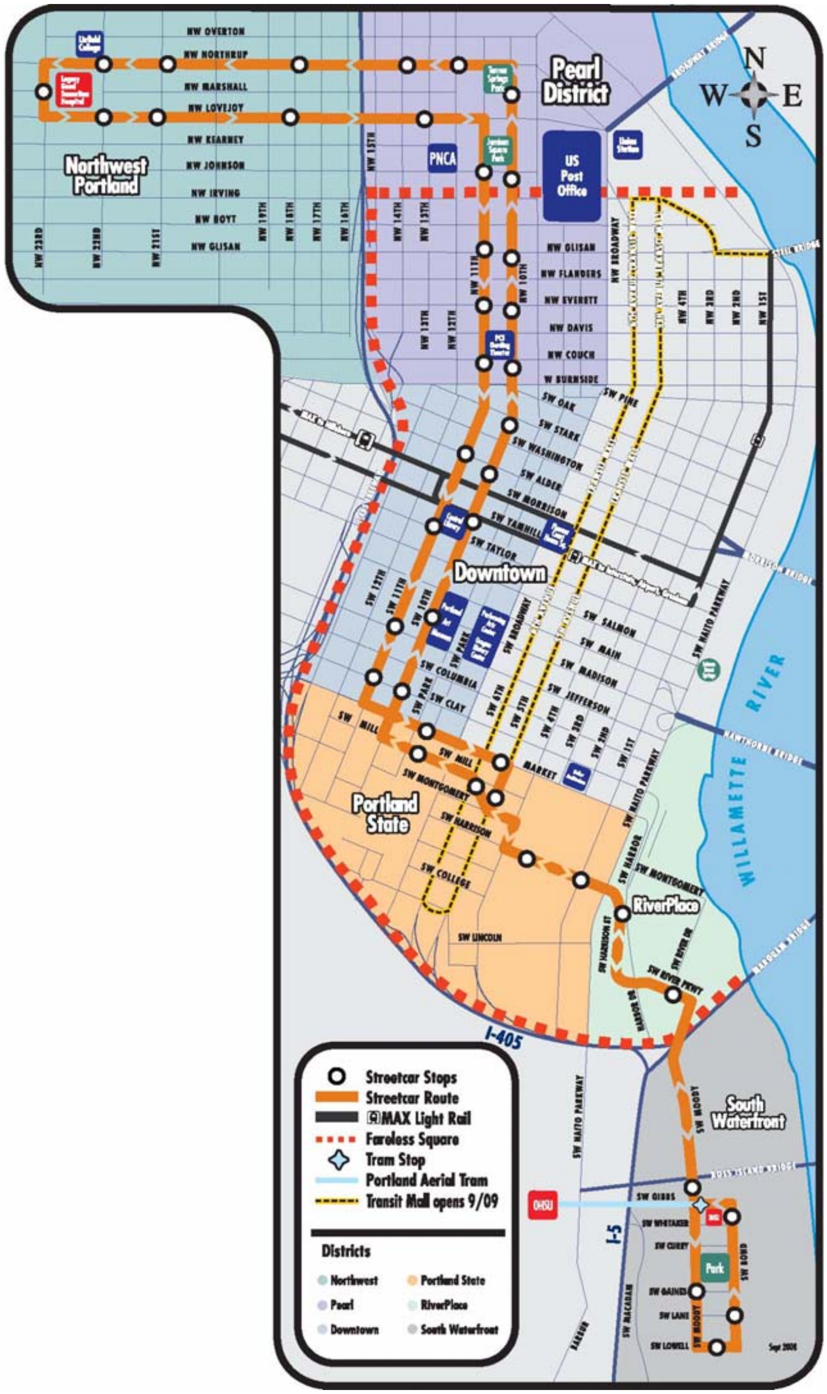
Portland Streetcar Funding Sources (millions)	
Capital	
City General Fund	$1.8
City Parking Bonds	$28.6
City Parking Fund	$2.0
City Transportation Fund	$1.7
Connect Oregon Funds	$2.1
FTA Funds	$5.0
Local Improvement District	$19.4
Regional transportation funds	$10.0
Tax Increment Financing	$21.5
US HUD Grant	$1.95
Other	$8.9
TOTAL	**$103**
Operating	
Tri-Met	$3.3
Portland DOT (gas tax, vehicle registration, parking fee revenues)	$1.8
Fares/sponsors/promotions	$0.4
TOTAL	**$5.5**

Future Expansion

The Portland Streetcar Loop project will add another 3.3 miles to the system (6.7 track miles) at a cost of $147 million (or $21.9 million per track mile); this extension will cross the Willamette River and serve the Lloyd District to the east of downtown.

The proposed Lake Oswego to Portland six-mile southern extension is currently undergoing a Draft Environmental Impact Statement. The extension is proposed for an existing railroad right-of-way corridor purchased by a consortium of local governments in 1988. While the intent has been to operate rail transit on this line, the Willamette Shore Trolley heritage streetcar has been running a generally seasonal, excursion-type service. The proposed streetcar service would likely operate at higher speeds – as a 'Rapid Streetcar' – in the dedicated right-of-way. Service may begin as early as 2016.

Figure 7-1. Portland Streetcar System Map



Source: www.portlandstreetcar.org

Seattle Streetcar

The Seattle South Lake Union streetcar is a 1.3-route-mile system that was proposed as a transportation investment for the South Lake Union District by local developers after seeing the success of initial development in the area around the Portland streetcar line. Property owners in the neighborhood south of Lake Union wanted a way to increase the redevelopment of the industrial nature of the area into a biosciences hub. Planning for the streetcar system began in 2003, with financing approved in 2005 and construction initiated in 2006. The streetcar system began operation in December 2007. The streetcar line connects downtown Seattle with the South Lake Union District and the Denny Triangle area. The initial 1.3-mile system (2.6 track miles) cost $52.1 million, or $20.1 million per track mile. The system currently serves approximately 1,000 riders per day. Its current annual operating cost is approximately $2.5 million.

System Description

Seattle uses a modern streetcar for its system. The system is 1.3 route miles long running from Westlake and 7th north to Fairview and Campus Drive (refer to Figure 7-2 for a system map). There are 11 stops on the 2.6 track-mile route, and at the southern end, the streetcar connects with the monorail to Seattle Center and Link Light Rail. The streetcar runs with 15 minute headways from 6 a.m. to 9 p.m. Monday through Thursday, 6 a.m. to 11 p.m. Friday and Saturday, and Sunday from 10 a.m. to 7 p.m.

Table 7-3. Seattle Streetcar System Summary

Seattle South Lake Union Streetcar	
System length (track miles)	1.3 route miles; 2.6 track miles
System Cost	$52.1 million
Cost per mile	$20.1million
Annual O&M cost	$2.5 million
Vehicle	Skoda (Modern)
Size	66’ long x 8’ wide
Vehicle capacity	140 (27 seats)
Ridership	~1,000 per day
Right-of-way	Mixed-flow
Operating rationale	Local/limited stop
Station/stop spacing	2-3 blocks
Fare collection	Off-board
Owner/Operator	City of Seattle/King County Metro

Table 7-4. Seattle Streetcar Funding Sources

Seattle South Lake Union Streetcar Funding Sources (millions)	
Capital	
Local Improvement District	$25.7
Federal Funds	$14.9
State grants	$3.0
Surplus property sale proceeds	$8.5
TOTAL	**$52.1**
Operating	
King County Metro	$2.0
Sponsorships	$0.5
TOTAL	**$2.5**

Future Expansion

In November 2008, voters in the Seattle area approved a second streetcar line (to the First Hill and Capitol Hill neighborhoods) as part of a regional transportation measure; in December 2008, the Seattle city council voted to create a multi-line streetcar network with three additional extensions, though no specific funding was identified for those additional lines.

Figure 7-2. Seattle South Lake Union Streetcar Map

Source: www.seattlestreetcar.org

Tacoma Link

The Tacoma Link system is a fare-free 1.6-route-mile system (2.4 track miles) that is called "light rail" by its owner/operator (Sound Transit) but is actually a modern streetcar system. The system was designed as a downtown circulator to connect major activity and transit centers in downtown Tacoma starting at the Tacoma Dome (including the Sounder commuter rail system) and ending at the Theatre District to the north. In addition to being a connector, the system was designed to facilitate economic development in the downtown and surrounding area as well as reduce street and parking congestion. The Tacoma system began operation in August 2003. It was constructed at a cost of $78.2 million, or $32.6 million per track mile (primarily because the trackwork and related construction were built to light rail standards), and currently carries approximately 3,000 riders per day. Its annual operations cost is approximately $3 million.

System Description

Tacoma uses a modern streetcar for its system. The system is 1.6 route miles long (2.4 track miles) running from the Tacoma Dome Station to the Theatre District/South 9th Street (refer to Figure 7-3 for a system map). There are five stations on the route; the southern end connects with Sounder Commuter Rail at the Tacoma Dome Station, as well as with local and regional buses. The streetcar runs with 10 minute headways from 5:20 a.m. to 10:10 p.m. Monday through Friday, 8 a.m. to 10:10 p.m. Saturday, and Sunday from 10:10 a.m. to 6 p.m.

Table 7-5. Tacoma Link System Summary

Tacoma Link	
System length (track miles)	1.6 route miles; 2.4 track miles
System Cost	$78.2 million
Cost per mile	$32.6 million
Annual O&M cost	$3 million
Vehicle	Skoda (Modern)
Size	66' long x 8' wide
Vehicle capacity	140 (30 seats)
Ridership	~3,000 per day
Right-of-way	Mixed-flow and dedicated
Operating rationale	Local/limited stop
Station/stop spacing	1/4 mile
Fare collection	Free
Owner/Operator	Sound Transit

Table 7-6. Tacoma Link Funding Sources

Tacoma Link Funding Sources (millions)	
Capital	
Sound Moves Regional Transit System Plan (sales tax and motor vehicle excise tax)	$78.2
Operating	
Sound Transit	$3.0

Future Expansion

Sound Transit is considering a number of extensions of the system, including to SeaTac Airport, as a result of the passage of a regional funding referendum in 2008.

Figure 7-3. Tacoma Link Streetcar Map

Source: www.soundtransit.org

Summary of Recent Urban Rail-Like Streetcar Systems in the U.S.

Table 7-1 summarizes the major cost and operating data of these three peer city Urban Rail-like systems.

Table 7-7. Summary of Urban Rail-Like Systems

	Portland	Seattle	Tacoma
Year Open/Ext Open	2001 / 2005	2007	2003
Length (route miles/track miles)	4 / 8	1.3 / 2.6	1.6 / 2.4
Capital Cost (original year of expenditure)	$103 million	$52.1 million	$78.2 million
Cost per mile (YoE)	$12.8 million	$20.1 million	$32.6 million
Annual O&M cost	$5.5 million	$2.5 million	$3 million
Annual fare revenue	$200,000	$275,185	$0
Recovery ratio	3.6%	11.2%	0%
Annual passenger miles	NA	378,200	871,778
Annual unlinked trips (total boardings)	4,000,000	413,300	860,349
Passenger trips/mile	NA	1.1	1.0
O&M cost/rider	$1.38	$5.95	$3.46
Annual veh rev mile	200,000	56,600	97,115
Trips/veh rev mile	20.0	7.3	8.9
O&M cost/veh rev mi	$27.50	$43.46	$30.68
Annual veh rev hrs	36,000	11,500	10,060
Trips/veh rev hours	111.1	35.9	85.5
O&M cost/veh rev hr	$152.78	$213.78	$296.21
Ridership	~11,000/day	~1,000/day	~3,000/day

Source: Street Smart, 2009 (Reconnecting America), Portland Streetcar, Inc., 2007 & 2008 NTDB data.

Overview of Urban Rail Vehicle Issues and Options

The choice of an Urban Rail vehicle for use in Austin represents one of the more important decisions the community can make. The vehicles used in the system are a critically important element in the overall image of the project, as they are the most visible element of the system. The vehicles used in this system will serve not only as a mode of transportation for residents and visitors of the area, but also as a community amenity and asset with the power to attract and focus development/redevelopment and even serve as an attraction or destination in its own right. Therefore, the performance and look of the chosen vehicle is vital to the overall success of the project.

Vehicle Criteria

There are several important considerations that will impact the selection of an Urban Rail vehicle for the Austin system. Vehicle selection criteria fall into multiple categories: operational, performance, and aesthetic/contextual:

- Vehicles must be able to adapt to the nature of the service desired by the community. In other words, the local community should decide if it wants to focus on commuter transportation, special events and weekend transit, connections to activity centers, peak hour vs. off-peak service, and other sometimes competing operational characteristics, or if it wants to serve a number of (or all) of those potential types of trips and operational scenarios.
- Vehicles must have capacity and accommodations for all potential passengers and must include Americans with Disabilities Act (ADA) requirements.
- Vehicles must be able to operate in the local environment of Austin, including weather, topography, and roadway geometry.
- Vehicles should promote the image desired by the local community for the project. If the community wants to promote a more modern image (and higher capacity service) consistent with many recent Urban Rail/streetcar systems, it would focus on a modern vehicle (as opposed to a vintage replica vehicle like that used in Little Rock or Tampa or vintage restored vehicles such as those used in San Francisco).
- Vehicles must meet performance criteria for frequency of service, acceleration and deceleration rates, operating speeds, and track geometry, while operating within a given level of safety, comfort, and service reliability.

Specific issues to consider in the selection of an Urban Rail vehicle include:

- **The use of single-end vs. double-end equipment.** Single-end vehicles can only be operated in one direction. Double-end vehicles can move in both directions but could result in lower passenger capacity due to the requirement to construct an operator’s area on both ends. Modern Urban Rail vehicles are double-end vehicles.
- **The use of single-side vs. double-side vehicles.** Single-side vehicles (similar to most buses, which open on the right side for curbside pickup) provide slightly higher passenger capacity but are more limited in operational flexibility than double-side vehicles, which can load and unload passengers from either side or center platforms.

- **The use of consists.** Some manufacturers build vehicles with couplers that can be joined together to operate in sets (or "consists") of two or more. Coupling trains doubles or triples, etc. passenger capacity for a relatively modest increase in operating costs since the same operator can run a two-car consist as a single-car train. Manufacturers may offer the ability to couple as an option; however, streetcar/urban rail train lengths are often limited by city block lengths. With it's typically 300 feet long downtown blocks, Austin should be able to accommodate two-car sets of most modern urban rail-type trains.
- **Turning radius and other geometric considerations.** Modern streetcar/urban rail vehicles have a slightly larger turning radius than vintage replica vehicles (usually 60 to 66 feet), which generally requires curb cuts or other special designs to negotiate tight turns. Light rail vehicles require a minimum turning radius of 85 feet. Commuter rail vehicles, like the Red Line need even greater radii. The use of multiple-unit, or articulated, equipment allows for much greater capacity while maintaining the maneuverability of smaller, single-unit vehicles.
- **ADA compliance.** A distinct difference in many transit systems around the country is in the platform and vehicle boarding height. There are two types of vehicles available for use in Urban Rail transit systems, low floor and high floor.
    - Low floor vehicles are typically 70 percent low floor, while there are 100 percent low floor vehicles becoming more available. A 70 percent low floor vehicle has level boarding for all doors and may use bridge plates for ADA boarding. This allows platform heights to remain low and easily accessible.
    - High floor vehicles require high platforms, low platforms with a mini-high block section, powered lifts, or other means for ADA access. These appurtenances take up a portion of the platform. However, as seen in Salt Lake City, mini-high blocks on low platforms easily allow level boarding on high floor vehicles. In urban settings where right-of-way is limited, high platforms can be more obtrusive, generally incompatible, and result in less than desirable pedestrian access.
- **Fare collection systems.** Fare collection can be accomplished on- or off-board. On-board equipment is similar to typical fixed-route buses and is often found on restored or replica vehicles. On-board equipment can be a maintenance problem, be more costly to maintain, limit passenger capacity, and increase station dwell time. Off-board (point-of-purchase or "honor") systems can improve passenger flow, reduce dwell times, and increase capacity on vehicles but is a more expensive fare collection system. An efficient off-board fare collection option is through the use of coordinated parking pay stations, which can be programmed to distribute rail tickets, in addition to parking passes. The City of Austin has recently converted a large number of conventional single-space meters to pay stations downtown.
- **Propulsion.** Most streetcar/urban rail and light rail systems are powered by overhead electric lines, typically at 600 to 750 volts direct current (DC). However, at least three systems in the country are powered by non-electric propulsion systems. Tourist streetcar operations in Galveston, TX, and Denver, CO, use vehicles that are powered by diesel engines. A recently restored tourist system in Savannah, GA, uses biodiesel fuel. Diesel-powered vehicles obviously do not require the construction of an overhead wire system, resulting in some capital cost savings. However, there is additional pollution from a diesel propulsion system (though biodiesel can help mitigate pollutants, and diesel fuel and engines have strict pollution standards), they are noisier than electric-powered vehicles, and they have relatively poor acceleration when compared to electric-powered vehicles.

In addition, some companies worldwide are experimenting with battery power; Kawasaki has recently been advertising a new light rail vehicle that combines on-board regenerative battery propulsion that can reportedly travel six miles without connection to overhead catenaries. An early version of this system is being tested in Paris, though the cars do not include power-hungry air conditioning (like they would need in Austin). Bordeaux, France, is running a prototype in-ground power system manufactured by Alstom; however, it has experienced substantial maintenance issues and is very costly. Bombardier is reportedly testing a magnetic induction propulsion system in Europe, as well, which only powers the segment of track actually occupied by the vehicle. These new technologies, while unproven and currently more expensive, should be considered for their potential to provide operational flexibility and capital cost savings.

- **Buy America.** When vehicles are procured with Federal Transit Administration (FTA) funds, Buy America provisions apply. This means that the cost of the components and subcomponents produced in the United States must be at least 60 percent of the cost of the components of the rolling stock, and the vehicles must undergo final assembly in the U.S. Under certain circumstances, an agency can request a waiver from the Buy America requirements. An example would be if the technology is not sufficiently produced and available in the U.S. A non-availability waiver can be requested if no responsive and responsible bid is received offering an item produced in the United States.
- **Costs.** Independent of the manufacturer, several factors can influence the cost of a vehicle including order size, customization, and cab equipment, among others.
  - There are often opportunities for cities considering streetcar/urban rail vehicle purchases to work with other cities to standardize vehicles reduce the cost per unit.
  - Additional savings can be realized by minimizing vehicle customization. Hampton Roads Transit in Norfolk recently accomplished this by purchasing the exact same vehicle as Charlotte. By purchasing a fully proven vehicle with no customization, it reduces production cost for items such as, extensive qualification testing, documentation, training, manuals, etc. Ordering an exact vehicle designed for another property with proven equipment can measurably reduce the vehicle cost.
  - Cab equipment in each vehicle can also add significant cost. In order for some cab equipment to function, it requires additional wayside system equipment that does not add cost to the vehicle but adds to system costs. Often the wayside systems costs may be significantly more than the actual cost of the cab equipment. An economical approach for a starter system may be to purchase a vehicle capable of advanced features (TWC cab equipment) and defer installing the wayside communications infrastructure needed for it to function. The wayside communication system could be upgraded in the future as ridership grows and it becomes necessary for more advanced operations. However, this issue is related to light rail operations, rather than Urban Rail and streetcars.
- **Vehicle Procurement.** Regardless of the vehicle type, it is important to incorporate vehicle procurement in the project schedule. Before any work on vehicles begins the agency must undergo a request for proposal (RFP) and procurement process to select a vehicle manufacturer. This process can take up to a year from RFP issue to selecting a vehicle and issuing a Notice to Proceed (NTP) to the manufacturer. From NTP to the first vehicle off the assembly line, typical manufacturing times vary from 18 months to three years depending on the number of vehicles ordered, the customization of the vehicle, etc. The remaining vehicles could be delivered at a rate of two-to-four per month thereafter. These ranges are approximate for planning purposes

and will vary depending on the manufacturer and vehicle requirements. The agency should carefully evaluate the procurement process used in selecting a vehicle and manufacturer. It is advisable to consider requiring technical qualifications from vehicle manufacturers where reliability, quality assurance plans, vehicle history, and other issues can be evaluated properly. It is especially important to qualify manufacturers for low-bid proposals to ensure quality control.

- **Quality Assurance.** When vehicles are customized for an agency's particular needs, it is important to evaluate the manufacturer's quality assurance program and reliability history as some agencies have had a poor experience with unreliable vehicles. It is strongly advised to have significant agency oversight in the procurement process and manufacturing of the vehicles. Careful monitoring and inspection of the vehicles and testing is needed to ensure agency expectations are being satisfied.
- **Other Considerations.** An agency or municipality can be as creative as it wants when acquiring vehicles for its system. As the industry is trending towards low-floor vehicles, some agencies such as UTA in Salt Lake City are purchasing used high floor vehicles to refurbish and use on its system. It is also possible, as was accomplished successfully in Dallas (DART), to retrofit high floor vehicles to low floor vehicles. These are just a few examples of cost saving approaches that other agencies have taken to lower their capital costs.

Urban Rail Vehicle Options

Recent Urban Rail systems in Portland, Seattle, and Tacoma have used modern vehicles that are larger and longer than vintage restored or replica vehicles but are smaller than light rail vehicles, though their appearance more closely resembles light rail vehicles. Generally, they are approximately 66 feet long and are double-articulated to allow urban street operations. Portland, Tacoma, and Seattle are using cars manufactured in the Czech Republic by companies Inekon and Skoda, and this design is now being manufactured in the US by Oregon Iron Works.

A recent addition to the modern Urban Rail fleet is a still-larger modern vehicle being manufactured by Siemens, the S70 Ultra Short vehicle. It is approximately 79 feet long and is double-articulated to accommodate urban street running, and can handle a maximum passenger load of approximately 165 (AW2). This vehicle is slated for use in San Diego and Salt Lake City.

Inekon/Skoda Streetcar in Tacoma

Siemens S70 Ultra Short Vehicle Proposed for Salt Lake City

Table 7-2 summarizes the major characteristics of the two modern Urban Rail-type vehicles in use or being procured today.

Table 7-8. Modern Urban Rail Vehicle Characteristics

Typical Characteristics	Inekon/Skoda	Siemens S70 Ultra Short
Configuration	Double-ended/Double-sided	Double-ended/Double-sided
Boarding characteristics	Low-floor center section for wheelchairs, carriages, bikes and standees	Low-floor center section for wheelchairs, carriages, bikes and standees
Size	66' long x 8'1" wide	79' long x 8'1" wide
Passenger capacity	140 (30 seats)	165 (60 seats)
Cost per vehicle	~$3.75 Million	~$4-4.5 Million
Geometry/curve minimum radius	60' minimum turning radius	66' minimum turning radius
Speed	Max 43 mph	Max 66 mph
Air-conditioned	Yes	Yes
ADA Accessible	Yes (level boarding with bridge plate, center doors)	Yes (level boarding, center doors)

Other Key Issues

Urban Rail Stations/Stops

An Urban Rail system's stations or passenger loading areas are the second most-visible components of the system after the vehicles. These facilities are the entrance or gateway to the system for the rider, and have the potential to become an essential part of the urban fabric and street environment. Therefore, they should be designed to fit into the character, scale, and style of the surrounding neighborhood. Several issues are important when considering Urban Rail stop locations and designs.

- In a developed urban area, Urban Rail stops generally are provided every two to four blocks, but can be slightly farther apart in less developed areas, much like traditional bus stops.
- Where possible, stations should be located near or adjacent to major cross-streets or near major activity centers and, if possible, a signalized intersection to facilitate Urban Rail movements through those intersections after passenger loading or unloading.

- The passenger loading areas should always be on tangent or straight tracks to facilitate ADA accessibility and passenger safety when loading. Therefore, stops work best when they are along traditional curb lines to avoid the need for the guideway to curve or divert to line up with a loading area. This means that passenger loading traditionally takes place in an active travel lane, and would be located on curb extensions where parking currently exists on the street, resulting in the loss of two to three parking spaces depending on the length of the platform.

- The selection of the vehicle obviously influences the design of the station, both in architectural style and in size. At approximately 65 feet in length, a modern vehicle would have a smaller passenger platform than an S70 Ultra Short vehicle that is approximately 79 feet or longer.
- Passenger loading areas should be designed to work well with surrounding pedestrian traffic as well; stations should not interfere with normal pedestrian activity on the adjacent sidewalk.

The design of the station can be as simple or complex as budgetary resources and local preferences allow. Passenger amenities can vary as well and can include items such as:

- Design should be emblematic of the system brand, yet reflect the character of its surroundings;
- Shelter or canopies for passenger protection from the elements;
- Seating may be desired but is not always required; more than likely, if local bus stops provide seating, Urban Rail stops would as well;

- Customer information, either printed schedule or system information or electronic schedule information, along with information on the local neighborhood;
- Other amenities such as trash cans, lighting and bike racks are usually provided at stops if space allows;
- Optional amenities include advertising panels, concessions and newspaper racks, pay telephones, public art, and other amenities are often provided.

As noted earlier, stations generally would be located near major cross-street intersections, preferably a signalized intersection to facilitate Urban Rail movement through the intersection. The figures below show three examples of typical station design.

- Figure 7-4 shows a stop example located at the far side of an intersection, and Figure 7-5 shows a stop example located at a near side of an intersection (near side refers to a stop location in advance of a signal or intersection; far side refers to a stop just past a signal or intersection. Typical transit operational schemes show a preference for far side stops so that transit vehicles can pass through an intersection before stopping for passenger boarding, minimizing travel time delays). Both of these examples show a ‘bulb-out’ in a parking lane to accommodate the passenger loading area. The passenger loading area dimension will vary depending on the exact size of the vehicle. Another design preference would be to locate the ends of the passenger loading area 30 to 50 feet away from an intersection to minimize traffic interference.

- Figure 7-6 shows a mid-block passenger stop. This type of station would most likely be designed to serve a major mid-block activity center or to minimize conflicts at a nearby intersection. This example shows a continuous curb line; obviously, this type of design could be integrated with parking as well.

Figure 7-4. Stop Example/Far Side of Intersection Platform

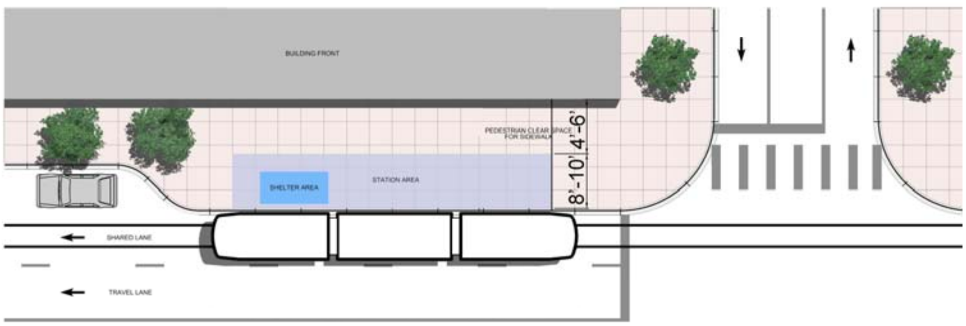


Figure 7-5. Stop Example/Near Side of an Intersection Platform

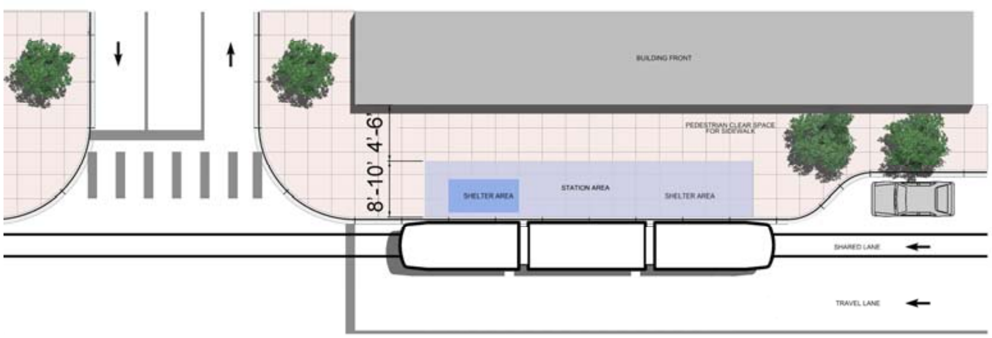
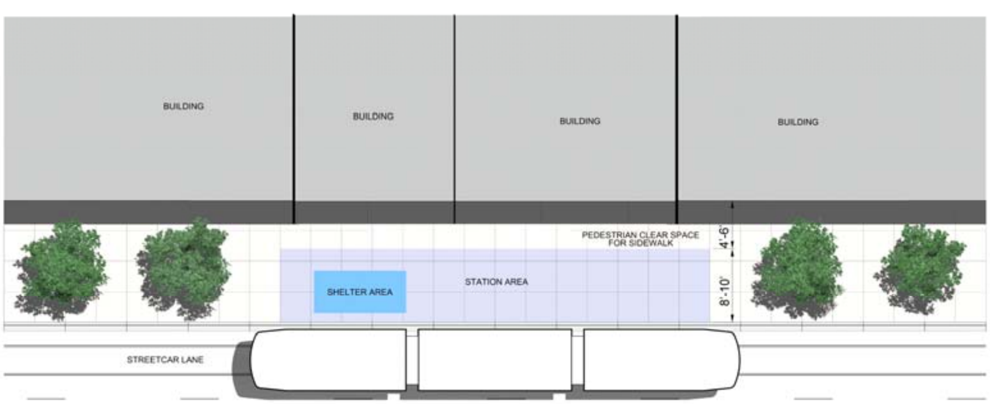


Figure 7-6. Stop Example/Mid-block Platform



Center platforms – which would be used only if an Urban Rail guideway were in the center of a street - are used in some instances, though this type of configuration does present other issues that should be taken into consideration. Center platforms can require either (a) the removal of a center turn lane or other significant changes to existing traffic configurations, or (b) additional right-of-way to accommodate existing traffic lanes, which could result in narrowing of lanes, sidewalks, curb lanes, or other redesign of the street where the Urban Rail vehicle is operating. Center platforms work best in lower-traffic areas; the example shown is from the Portland South Waterfront area.

Integration with the Transportation Network

An Urban Rail system falls within a broad range of transportation options for a community to consider. Figure 7-7 is a matrix that shows how Urban Rail fits into a variety of transportation scenarios, ranging from the low end of local service at slow speeds up to regional service at higher speeds.

Figure 7-7. Urban Rail Integration into Transportation Network

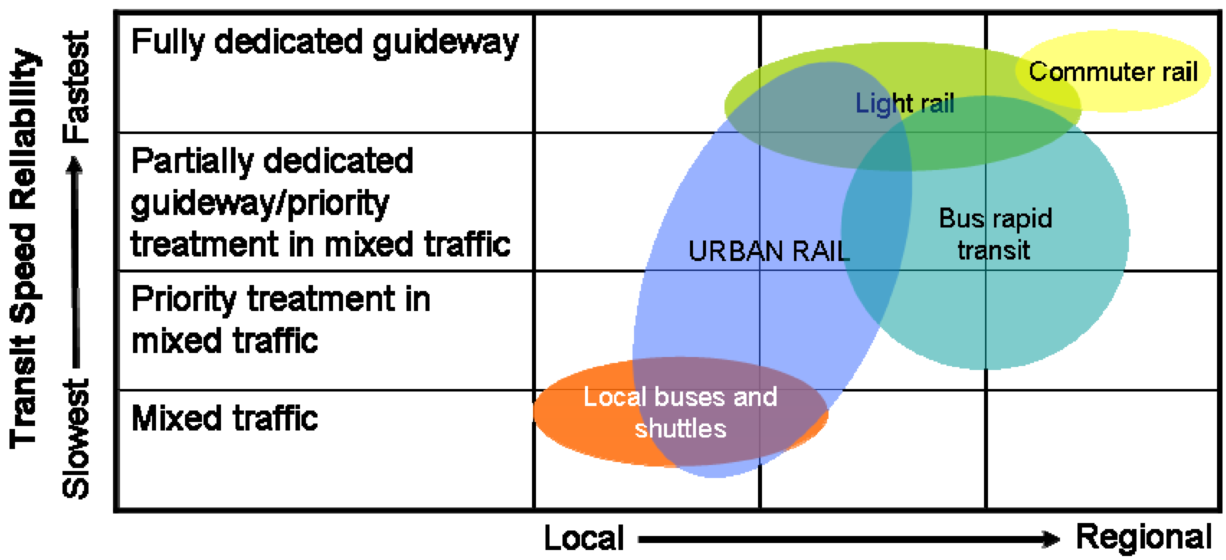


Figure 7-7 shows that local buses and shuttles provide relatively slow operating speeds, and focus almost entirely on local service, with some ability to receive priority treatment in mixed traffic. Bus Rapid Transit typically operates as a mixture of intra-city and longer-distance regional service, usually with priority treatment transitioning into semi-exclusive or exclusive guideways as speeds increase. Light rail can operate at relatively slow speeds in a localized urban environment in a semi-exclusive guideway, though its speeds and regional service ability increase as it moves into a fully dedicated guideway. Commuter rail and heavy rail are on the highest end of the spectrum, typically focused on regional service in a fully dedicated guideway, usually a railroad corridor.

Urban Rail is able to span several service scenarios. It can provide relatively localized service at slow speeds in mixed traffic, but it also can receive priority treatment for slightly higher speeds and can operate in semi-exclusive or exclusive guideways to provide even higher speeds, depending on station spacing. This flexibility is a cornerstone of the hybrid service that Urban Rail can provide in the proposed corridors.

One aspect of the flexibility of Urban Rail is its ability to function within existing travel lanes so that the vehicles share the right-of-way with autos, buses, and other vehicles. This minimizes costs (since a separate guideway is usually not required) while allowing maximum access to the system for the local community through frequent stops. The accompanying photos illustrate how Urban Rail can operate in a mixed-flow environment in several cities. Figures 7-8 through 7-9 are conceptual typical sections that illustrate Urban Rail guideways (and stops) in a couple of different street configurations.

Figure 7-8. Example of Urban Rail in-street, continuous center turn lane, no parking

Figure 7-9. Example of Urban Rail in-street, parking on both sides

Bicycle Considerations

While Urban Rail and bicycle facilities are, in general, mutually supportive, there are compatibility issues that need to be addressed during planning and design of Urban Rail-type systems. Portland, OR has a vibrant and growing cycling community, as well as a model streetcar system, and offers a wealth of lessons. In fact, the Lloyd District Transportation Management Association (LDTMA) commissioned a study to define the issues, best practices, and design solutions related to this modal interaction. This 2008 study, *BICYCLE INTERACTIONS AND STREETCARS: Lessons Learned and Recommendations*, by Alta Planning + Design, is available online at http://www.altaplanning.com/App_Content/files/pres_stud_docs/Bicycle_Streetcar_Memo.pdf.

Source: LDTMA, 2008.

The LDTMA report made the following recommendations:

• *Streetcar tracks and platforms should be center-running or left-running wherever possible.*

• *Bicycle facilities should be separated from streetcar tracks as much as possible by:*

a. *Developing a parallel, excellent bicycle facility.*

b. *Creating high-quality cycle tracks or bicycle lanes adjacent to streetcar tracks.*

c. *Offering 90 degree track crossings whenever possible, by positioning the bike lane or cycle track* *to cross at 90 degrees (see photo on page 9); signing and/or marking the best angle for tuning (see photo, above) and creating "Melbourne left turn" opportunities (see page 15).*

- *Develop a policy framework for future bicycle and streetcar integration, including:*
  - a. *Developing policies related to bicycle integration in streetcar planning processes.*
  - b. *Developing innovative design guidelines for integrated streetcar and bicycle facilities.*
  - c. *Developing performance measures to evaluate safety.*
- *Create supporting programs for education and wayfinding.*

The LDTMA study has provided the *Central Austin Transit Study* project team with valuable insight, which is currently being incorporated into the program. The recommended Urban Rail system plan, as designed to 10 to 15% in the *Urban Rail Conceptual Engineering Documents,* primarily utilizes right-running alignments with side platforms. As the conceptual design is advanced, there will be significant opportunities to incorporate potential conflict avoidance and mitigation strategies, including changes to the track assignment within the street, development of parallel but separate facilities, and consultation with Austin's own vibrant and growing bicycle community.

Urban Rail Systems Considerations

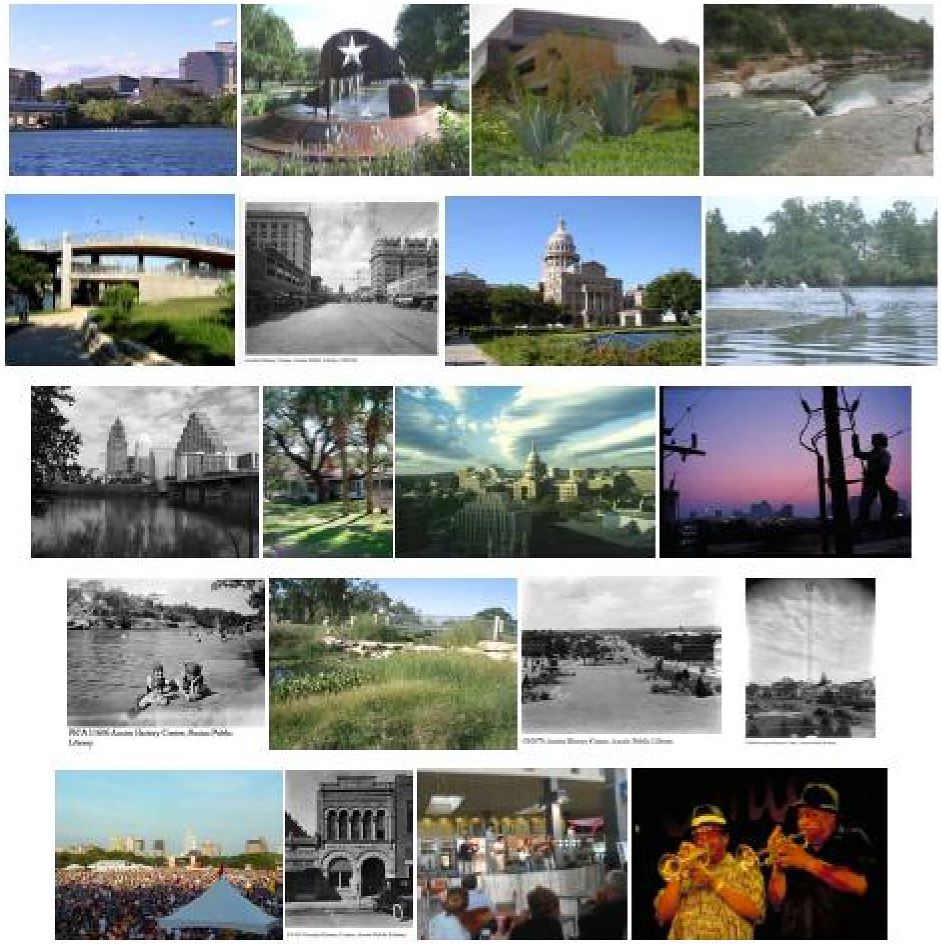
As noted earlier, most Urban Rail-type systems are powered by overhead electric wires; while new battery technology may provide alternatives in the future, electric power will likely be the propulsion system available for cities in the near to mid-term. Overhead electric power has a number of key factors and issues associated with it that should be taken into consideration in the planning and design of an Urban Rail system.

- Electric power for Urban Rail is generally 600 to 750 volts DC provided through overhead wires.
- Vehicles draw power from the overhead contact wire with either a spring-loaded trolley pole that straddles the wire, or a pantograph with a wide contact surface that slides along the wire. Modern vehicles traditionally use pantographs.
- Overhead wires are either single trolley wires hung from closely spaced poles or a catenary that is a double wire that allows longer spans and more efficient electrical power distribution.
- Small substations for electrical power distribution will be needed at intervals along the route, usually at half-mile or mile intervals.

- Electrical grounding is required to complete the DC circuit and allow a return current back to a substation. This is usually done by isolating the track from the ground with a rubber “boot” or other means.

Other systems elements and issues include:

- Signaling and communications to coordinate vehicle movements, which can include train-to-wayside communications (radios, in-street detection loops, or other means) that are integrated with local traffic signalization systems and Intelligent Transportation Systems, and vehicle location systems including GPS that allow tracking of vehicle movements and potentially a rider information system.
- Fare collection, which can be on-board, typical for vintage cars, requires fareboxes near the front doors. This can limit passenger capacity and increase boarding time, or off-board, requiring proof-of-payment with wayside ticketing and validation similar to most light rail systems. Under off-board fare collection, also known 'honor system', riders can enter through any door, reducing boarding times. Typically, roving fare inspectors check passengers for tickets. Interestingly, new City of Austin parking pay stations can be programmed to vend transit tickets as well, saving costs and reducing clutter in the right-of-way.



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