



Alternatives Analysis
SOUTH CENTRAL CORRIDOR
Locally Preferred Alternative Report

April 2014





Table of Contents

Executive Summary	ES-1
1. Introduction	1
1.1 Study Context	1
1.2 Study Area Definition	1
2. Purpose and Need	3
2.1 Purpose of the Project	3
2.2 Need for the Project	3
3. Existing and Planned Conditions	6
3.1 Transportation and Infrastructure	6
3.2 Existing and Planned Land Use	11
3.3 Environmental Considerations	15
3.4 Socioeconomic Highlights	16
4. Alternatives Considered	19
4.1 Modal Alternatives	19
4.2 Alignment Alternatives	21
5. Tiered Screening of Technology and Alignment Alternatives	28
5.1 Tier 1 Screening	28
5.2 Tier 2 Evaluation	33
6. Refinement of the Leading Alternative	45
6.1 Engineering Constraints	45
6.2 Input from the Community	51
6.3 Traffic Analysis	55
7. Recommended LPA	61
7.1 Summary	61
7.2 Planning-Level Capital Cost Estimates	63
8. New Starts Performance Evaluation	66
8.1 Existing Land Use	66
8.2 Cost-Effectiveness	67
8.3 Mobility Improvement	68
8.4 Project Justification Summary	69

List of Figures

Figure 1 – Study Area	2
Figure 2 –Transportation Facility Classification.....	7
Figure 3 – Existing Lane and Intersection Configuration.....	8
Figure 4 – Community Facilities and Services	12
Figure 5 – Redevelopment Susceptibility	14
Figure 6 – 2010 Automobile Ownership	18
Figure 7 – 2031 Automobile Ownership	18
Figure 8 – Modal Alternatives.....	20
Figure 9 – Alignment Alternatives #1, #2 and #3.....	23
Figure 10 – Alignment Alternatives #4, #5 and #6.....	24
Figure 11 – Alignment Alternatives #7, #8 and #9.....	26
Figure 12 – Alignment Alternatives #10A and #10B.....	27
Figure 13 – Alternatives Analysis Process	28
Figure 14 – Tier 1 Alignment Alternatives Carried Forward for Additional Study.....	32
Figure 15 – Major Engineering Challenges to Leading Alternative.....	46
Figure 16 – Illustrative Concepts of Central Avenue/Baseline Road Station Area	53
Figure 17 – Forecast Year 2035 Roadway Segment PM Peak LOS: No-Build and Build Conditions	57
Figure 18 – Year 2035 LRT Build Scenario: Forecast PM Peak Hour Traffic Volume, Absolute Change from No-Build Condition.....	58
Figure 19 – Year 2035 LRT Build Scenario: Forecast PM Peak Hour Traffic Volume, Percent Change from No-Build Condition	59
Figure 20 – LPA Characteristics.....	62



List of Tables

Table 1 – Tier 1 Recommendations	30
Table 2 – Tier 2 Evaluation Categories, Criteria and Performance Measures.....	34
Table 3 – Detailed Tier 2 Evaluation Matrix.....	38
Table 4 – Tier 2 Evaluation Summary Matrix	41
Table 5 – Existing Widths and Number of Lanes	45
Table 6 – Existing Roadway Width and Vertical Clearance at Grade Separations.....	47
Table 7 – Selected Assumptions Used in Capital Cost Estimates.....	63
Table 8 – South Central LPA Estimated Capital Costs (millions of year-of-expenditure dollars).....	65
Table 9 – New Starts Evaluation: Existing Land Use	67
Table 10 – New Starts Evaluation: Cost Effectiveness.....	68
Table 11 – New Starts Evaluation: Mobility Improvements	69
Table 12 – Summary Evaluation: New Starts Project Justification Criteria.....	69

Appendices

Appendix A Community Working Group Members

Appendix B Other Meetings and Events (held or scheduled as of 11/19/2013)



List of Abbreviations

AA	Alternatives Analysis
APS	Arizona Public Service
BRT	Bus Rapid Transit
CBD	Central Business District
COP	City of Phoenix
CP/EV	Central Phoenix/East Valley
CWG	Community Working Group
DCM	Design Criteria Manual
EPA	Environmental Protection Agency
FTA	Federal Transit Administration
HCT	High Capacity Transit
LOS	Level of Service
LPA	Locally Preferred Alternative
LRT	Light Rail Transit
MAG	Maricopa Association of Governments
MSC	Modern Streetcar
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NFL	National Football League
O&M	Operating and Maintenance
PRC	Phoenix Revitalization Corporation
ROW	Right-of-way
RTP	Regional Transportation Plan
SRP	Salt River Project
UPRR	Union Pacific Railroad
V/C	Volume to capacity ratio
YMCA	Young Men's Christian Association

Executive Summary

In 2011, Valley Metro and the City of Phoenix began efforts to assess the feasibility of extending light rail transit (LRT) from Downtown Phoenix to Baseline Road along the South Central Corridor. Following the award of a planning grant from the Federal Transit Administration (FTA) in 2012, Valley Metro expanded the feasibility study into an Alternatives Analysis (AA) to evaluate both transit technologies and alignments for High Capacity Transit (HCT) in the South Central Corridor. This document represents the culmination of those efforts, including the selection of a Locally Preferred Alternative (LPA) and an evaluation of its expected performance under the FTA's New Starts program.

Study Area

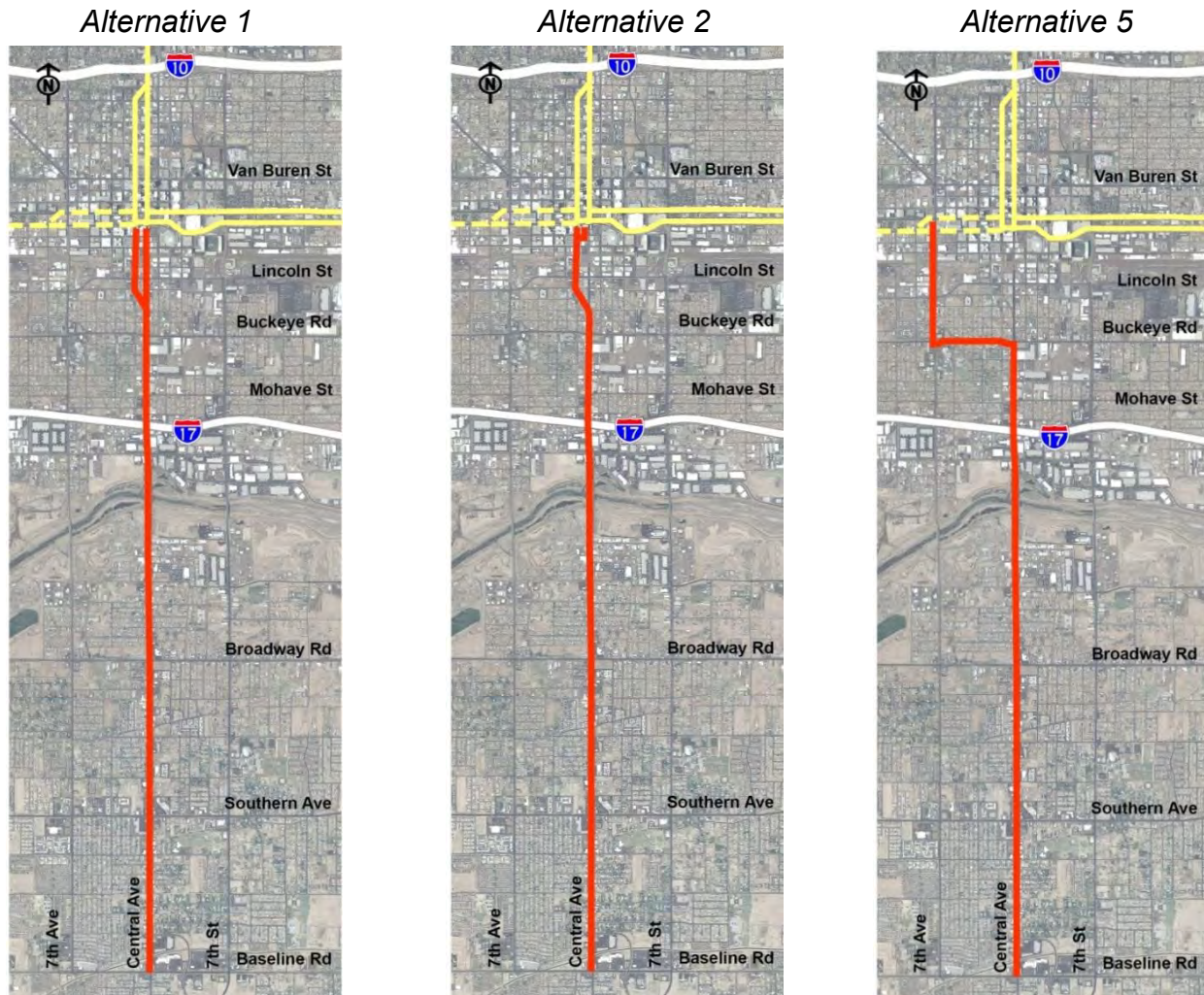
The study area for the analysis is centered on Central Avenue, the primary corridor of South Central Phoenix, from the existing LRT line at Washington and Jefferson streets to Baseline Road. The study area extends to 12th Street and 15th Avenue to the east and west, and to the I-10 and Dobbins Road to the north and south respectively.

Alternatives Considered

Three different HCT modes were considered for the South Central Corridor: LRT, Modern Streetcar (MSC), and Bus Rapid Transit (BRT). As each mode varies in purpose, market type, operating environment, spacing of stops, capital costs, and capacity, it was essential to identify the transit technology that best fit the needs of the study area. In addition to the modal alternatives, eleven alignment alternatives were developed for consideration. The alternatives explored using portions of 7th Avenue, 1st Avenue, Central Avenue, and 7th Street to travel south from Downtown Phoenix, eventually rejoining Central Avenue at either Hadley Street, Lincoln Street, Buckeye Rd, Mohave Street, or Broadway Rd. All alternatives considered featured two way service from Broadway Road to Baseline Road.

To evaluate the universe of alternatives, Valley Metro applied a two-tiered screening process that involved both a technical analysis and input from the community. Extensive efforts were made to ensure community involvement, including the creation of a Community Working Group (CWG) of selected South Central Phoenix stakeholders and several rounds of public meetings. The first round of technical analysis and community input narrowed the universe of alternatives to three alignment alternatives, with all modes being considered for each (with the exception of BRT in alternative 2). The alignment alternatives carried forward for Tier 2 evaluation are depicted in **Figure ES-1** below.

Figure ES-1. Tier 2 Alignment Alternatives



The tier 2 evaluation involved a much more detailed technical analysis of the remaining modal/alignment alternatives. The alternatives were evaluated for their performance in ten broad categories, with several evaluation criteria for each. After extensive analysis and public involvement efforts, LRT on alignment Alternative 2 emerged as the leading alternative and was carried forward for further refinement as the likely LPA.

Recommended LPA

The recommended LPA involves extending two LRT tracks from Downtown Phoenix to Baseline Rd, generally along Central Avenue (**Figure ES-2**). Southbound tracks from Downtown would extend on 1st Avenue until merging onto Central Avenue at Hadley Street. The northbound track may either be located on 1st Avenue or Central Avenue from Hadley Street to Madison Street, depending on the results of subsequent traffic,

Figure ES-2. Locally Preferred Alternative (LPA)





engineering, and right-of-way studies. Should the northbound alignment lie on 1st Avenue in this area, it would return to Central Avenue via Madison Street.

From Hadley Street to Baseline Rd, LRT would operate two-way service with both tracks located in the median of Central Avenue. Exceptions may occur at the I-17 underpass and the Salt River Bridge due to unique site constraints. LRT would operate along the entire alignment in a dedicated guideway, with other vehicles able to make left turns or U-turns across the tracks at designated locations only under signal protection. Stations are proposed at or near the four arterial cross street intersections in the corridor (Buckeye Road, Broadway Road, Southern Avenue, and Baseline Road) and at one collector street, Lincoln Street. Additional stations will be considered at Watkins Street, the Nina Mason Pulliam Audubon Center, and Roeser Road in later phases of the project.

New Starts Performance Evaluation

The FTA’s New Starts program is the primary grant program for funding major transit capital investments. Thus, it was important to determine how the South Central LPA may perform under the program’s criteria. The New Starts program is broken into two components: project justification and local financial commitment. Each component is weighted equally, accounting for 50% of a project’s overall rating. These components are further broken down into several criteria. Ratings for each criterion are qualitative and range from low to high, with high representing the best performance. As funding sources for the South Central project have yet to be identified, an evaluation of the local financial commitment component could not be completed. However, an evaluation of the project justification component and its 6 equally-weighted criteria—existing land use, cost effectiveness, mobility improvements, economic development, environmental benefits, and congestion relief—was performed, the results of which are summarized in **Table ES-1** below.

Table ES-1. Summary Evaluation: New Starts Project Justification Criteria

Criteria	2010	2010/2030 Average
Land Use	Medium-Low	Medium
Economic Development	Medium-Low	Medium-Low
Cost-Effectiveness	Low	Low
Environmental Benefits	Medium	Medium
Congestion Relief	Medium	Medium
Mobility Improvement	Low	Medium-Low
Overall Project Justification	Medium-Low	Medium

1.0 Introduction

1.1 Study Context

Valley Metro is responsible for the design, construction and operation of the region's high capacity transit (HCT) system. The region has 20 miles of existing regional light rail in service in 2013, and 37.7 miles of new HCT service scheduled to be in place by 2031. The South Central Corridor (study area) is not part of the planned 57.7-mile system, but is currently documented in the Maricopa Association of Governments (MAG) *Unified Planning Work Program* as a study to determine the feasibility of HCT along the South Central Corridor. Valley Metro and the City of Phoenix (COP) have been coordinating since 2011 to assess the feasibility of extending light rail transit (LRT) from Downtown Phoenix across the Salt River and through the South Central portion of the city to Baseline Road. Subsequently, at the beginning of 2012, Valley Metro applied for and received a planning grant from the Federal Transit Administration (FTA) to expand the feasibility study into an Alternatives Analysis (AA) to evaluate various transit modes (technologies) and alignments for HCT in the South Central Corridor. The AA is the first step in a rigorous and competitive process that may culminate in federal funding for design and construction of a major transit investment under the New or Small Starts program. The result of the AA will be a Locally Preferred Alternative (LPA), consisting of a preferred transit mode (or technology) and a preferred alignment that best meets the mobility needs of the region and the expectations of the community.

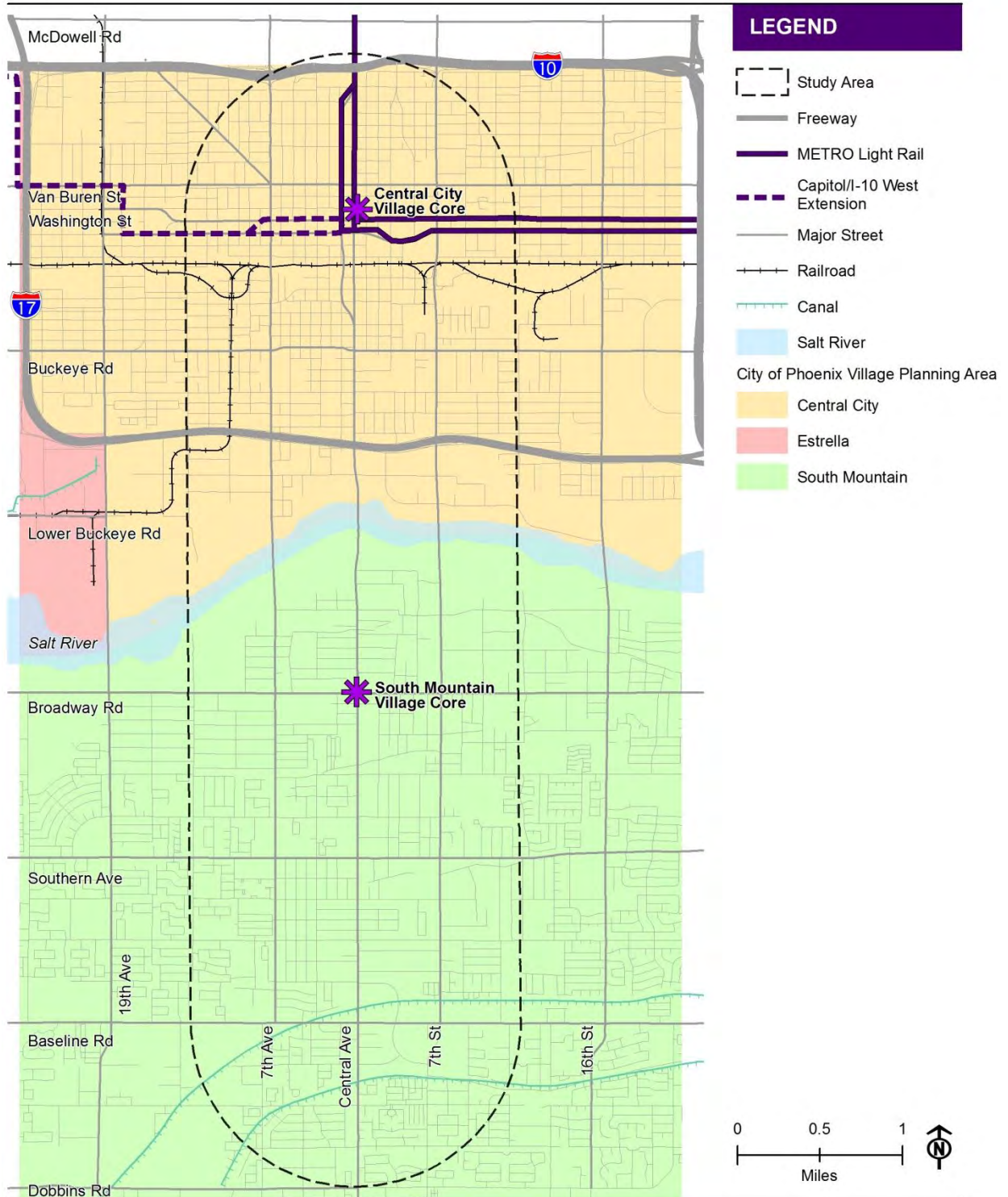
1.2 Study Area Definition

Figure 1 illustrates the study area identified for this AA. The study area is centered on Central Avenue – the main street of South Central Phoenix – from the existing LRT line at Washington and Jefferson streets approximately five miles south to Baseline Road. The boundaries are defined to the north by I-10, to the south by Dobbins Road, to the east by 12th Street, and to the west by 15th Avenue.

Study Coordination

Valley Metro organized biweekly coordination meetings with COP staff beginning in February, 2012. The meetings – subsequently changed to monthly – involved COP staff from Public Transit, Street Transportation, Neighborhood Services, Planning, Economic Development, and the City Manager's Office. These meetings provided opportunities to discuss potential technical and transit operations issues, community business concerns, economic development opportunities\issues, urban design concepts, and public outreach strategies. Valley Metro also coordinated with MAG staff on the travel forecasting methodology used in this study. A concurrent Public Involvement Program (discussed in Chapter 6, Section 6.2) supported the development, evaluation, and selection of alternative alignments and transit modes.

Figure 1 – Study Area



Sources: City of Phoenix, Valley Metro

2.0 Purpose and Need

2.1 Purpose of the Project

The primary purpose of an enhanced public transportation investment in the South Central Avenue corridor is to develop an efficient and effective transportation connection between South Central Phoenix and the regional light rail system. This will provide South Central Phoenix residents with improved access to regional activity centers and intercity air and bus travel. An enhanced public transportation investment should, to the greatest extent possible:

1. Ensure access to reliable public transit service in the study area.
2. Serve the area's transit dependent population.
3. Address capacity issues generated by growing travel demand.
4. Provide incentives for economic development.
5. Complement area plans that call for sustainable and livable transportation options.

2.2 Need for the Project

Existing and future population, employment and travel demand growth show a strong need to develop HCT in South Central Phoenix. Travel patterns show a future need for improved access to activity centers and destinations in Phoenix (including the Downtown core) and the East Valley. The MAG 2010 regional travel demand model indicates that by the year 2031, a 26 percent increase (from 2010) in daily person trips, by all modes, will occur between South Central Phoenix and destinations along North Central Avenue. By the same year, a 19 percent increase in trips is expected between South Central Phoenix and the Sky Harbor/Tempe area.

Many South Central Phoenix Corridor residents walk to reach their destinations and to access public transit. The MAG 2010 regional travel demand model shows that 14 percent of the study area residents walk or bike to work – a much higher proportion than the Maricopa County figure of 2.4 percent (according to the American Community Survey for 2008 through 2012). Data from the Valley Metro 2010-2011 *On-Board Survey* indicate that 93 percent of those who ride the three north-south routes in the corridor (routes 0, 7, and 8 on Central Avenue, 7th Street, and 7th Avenue) walk to access the bus. These three routes regularly experience travel delays and are beginning to operate at full capacity.

Traffic data show that future motorized travel in the corridor is expected to remain high and to create peak demand that approaches or exceeds capacity at some locations. Year 2030 traffic model results show that several arterial intersections are expected to experience greater levels of traffic congestion. Peak PM period traffic model results provided in the MAG *Regional Transportation Plan (RTP) 2010 Update* show that even with planned transportation improvements, a number of intersections in the South

Central Corridor will experience at-capacity and over-capacity levels of service (LOS E and F) by 2030 including:

- 7th Street at Baseline, Broadway and Buckeye Roads, and at Van Buren Street
- Central Avenue at Broadway and Buckeye Roads, and at Van Buren Street
- 7th Avenue at Baseline, Broadway and Buckeye Roads, and at Van Buren Street

With regard to transit capacity in the corridor, high service frequency (10 minutes) has not prevented local buses on Route 0, Central Avenue, from exceeding their capacity during peak travel hours. COP Public Transit has confirmed that some trips experience overcrowding. The highest passenger load was observed on a northbound Route 0 trip with 56 passengers, or 160 percent of seated capacity, documented at Hadley Street and Central Avenue during the AM peak period.

In order to address the above needs, the locally preferred alternative must:

- 1. Improve the Reliability of Transit Service in the Study Area:** Recent data from monthly ridership reports and the 2010-11 Valley Metro *On-Board Survey* indicate that the three north-south routes in the study area together produce more than 1,000 daily passenger trips per corridor mile. The data indicate that 53 percent of 220 sampled bus trips on routes 0, 7, and 8 in the study area experience delays of two minutes or more. High-capacity transit services operating in a semi-exclusive guideway can substantially increase both reliability and speed compared with local buses.
- 2. Improve Mobility for a Transit-Dependent Population:** The study area's population is considered highly transit-dependent. Some 14 percent of study area residents walk or bike to school and work. The area has a larger number of households with incomes under the poverty level and a larger number of persons too young to obtain a drivers' license than the county as a whole. The Valley Metro *2010-11 On-Board Survey* paints a picture of the study area's high level of transit-dependency through the following statistics associated with the three north-south bus routes in the corridor:
 - 93 percent of customers walk or ride bicycles to access the bus (versus 91 percent regionally for "bus-only" linked transit trips)
 - 56 percent come from households with no auto (versus 48 percent)
 - 69 percent are not licensed to drive (versus 56 percent)
- 3. Address Existing and Future Capacity Issues:** Recent Valley Metro ride check data indicate that some bus trips in the study area experiencing passenger load rates as high as 160 percent on a fleet of 35-seat buses operating every 10 minutes (on Route 0, the most heavily traveled of the three north-south routes). The MAG 2010 regional travel demand model projects that the number of daily person trips originating from the study area will increase. Between 2010 and

2031, the number of such trips from the study area to the north is expected to grow by 26 percent, while the number of trips to Phoenix Sky Harbor International Airport and the Tempe area, including Arizona State University, will grow by 19 percent.

4. Promote Economic Development: The study area's location near Downtown Phoenix, Sky Harbor International Airport, and the regional surface transportation system creates the potential for improved connection to transportation services to support the expansion of local business access to new markets. An efficient and effective transit service will contribute to the area's desirability as a place to live and work and support other public and private investments. Community plans that support redevelopment or new investment in the study area include:

- Phoenix General Plan Update (Public Hearing Draft)
- Rio Salado Beyond the Banks Area Plan (2003)
- Hope VI Special Redevelopment Plan (2003)
- Target Area B (2004)
- Downtown Plan (2008)

5. Demonstrate Compatibility with Community Sustainability and Livability Goals: Many of the community plans in the study area (as listed above) call for development to contribute to a sustainable and livable future for the region. HCT will contribute to the number of modal choices in the study area and provide a reliable alternative to automobile travel. The study area's current public transit service does not encourage sustainable and livable development for the following reasons:

- Existing local bus shelters and stops are unlikely to attract high-density, mixed-use development often found along HCT corridors.
- Local bus services do not provide competitive travel time with the auto for those who have a choice.
- The study area has limited pedestrian and bicycle connections. HCT stations will provide opportunities to create connections to pedestrian pathways and bicycle facilities.
- HCT service may encourage some people to leave their own vehicles behind, possibly reducing traffic congestion and making for a more pedestrian-scale street system.

3.0 Existing and Planned Conditions

This section summarizes pertinent current conditions in the study area.

3.1 Transportation and Infrastructure

Central Avenue is a minor arterial street that forms the north-south central spine of Phoenix. The roadway connects the Sunnyslope community to the north with Phoenix South Mountain Park, and serves as a critical access route to both Downtown Phoenix and the Midtown high-rise office district north of Downtown.

The street system in the South Central Corridor follows the urban grid pattern, with arterial streets spaced one mile apart and collector streets at many of the half-mile intervals. Central Avenue is an exception, however, in that it is a minor arterial spaced at the half-mile line between 7th Avenue and 7th Street, which are the one-mile arterials.

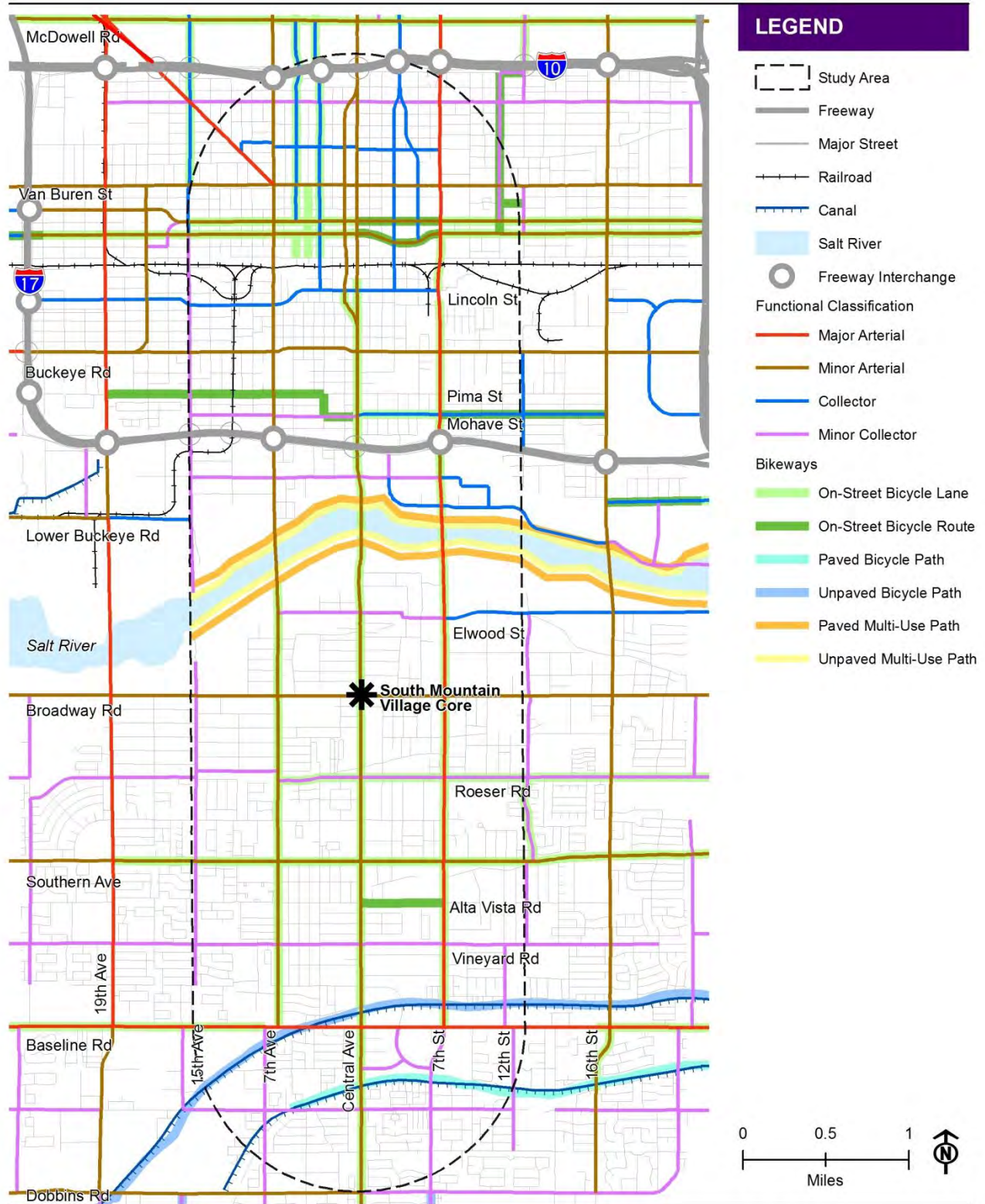
On-street bicycle lanes or marked routes are present on Central Avenue throughout the corridor, and portions of other adjacent and intersecting corridors. Paved and unpaved pathways are also present parallel to the Salt River (within the Rio Salado Project) and canals in the South Central Corridor.

Existing Lane and Intersection Configuration

Between Portland and Hadley Streets, Central Avenue and 1st Avenue form a one-way couplet northbound and southbound, respectively. Within the study area, Central Avenue has three through traffic lanes in the one-way (northbound) section between Washington Street and Hadley Street and four through lanes (two per direction) in the two-way section between Hadley Street and Baseline Road. 1st Avenue north of Buchanan Street has three through (southbound) lanes; from Buchanan to the Central Avenue merge at Hadley Street, it has two through lanes. 7th Street and 7th Avenue are both typically four-lane sections, with 7th Street expanding to six lanes north of Interstate 17 (I-17), the Maricopa Freeway. **Figure 2** shows the functional classification of major roadways, as well as the locations of bikeways. The number of lanes, median type, and traffic signal locations are illustrated in **Figure 3**.

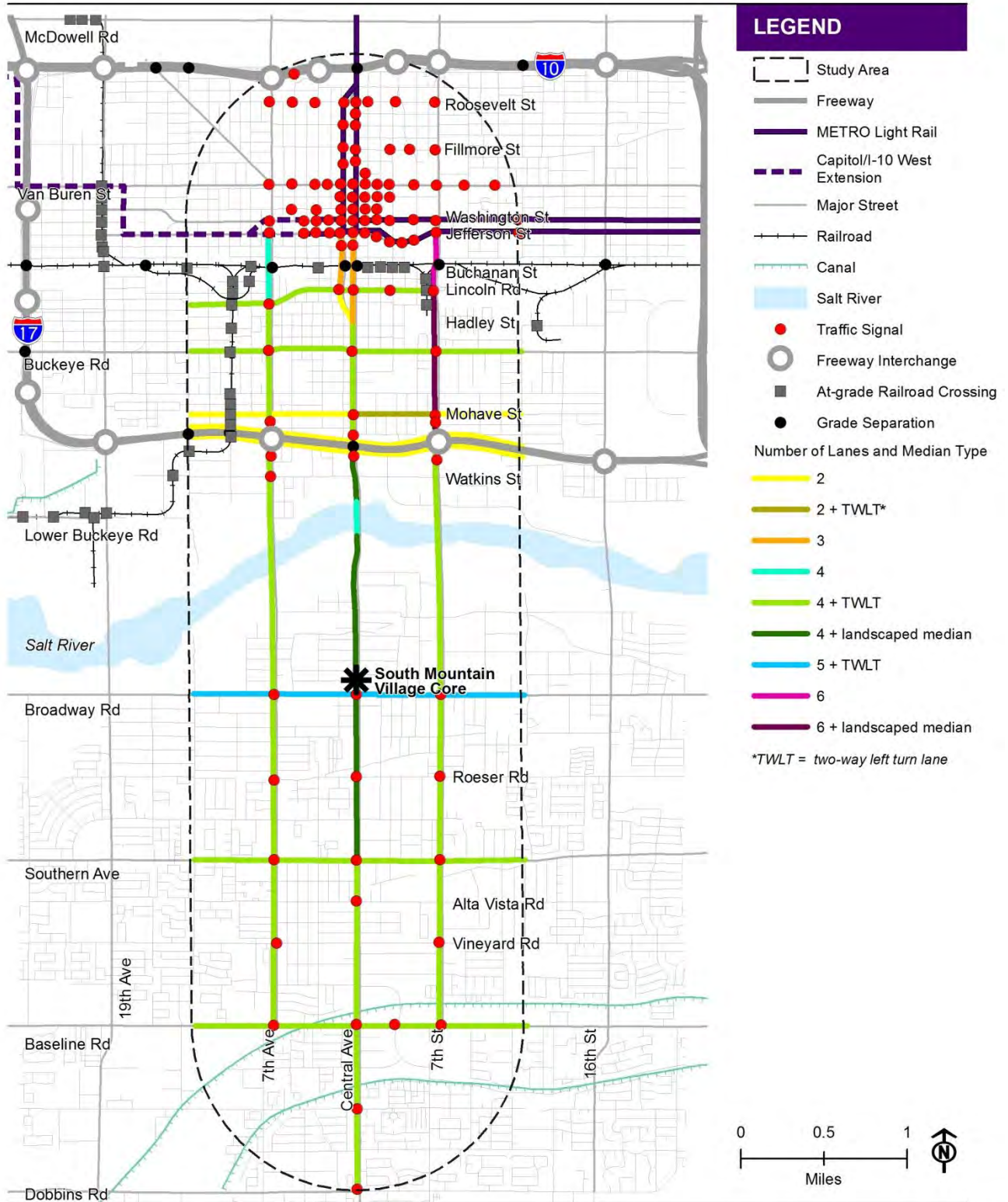
Several crossings of the Union Pacific Railroad (UPRR) Phoenix Subdivision and the Burlington Northern Santa Fe (BNSF) Railway (Phoenix Subdivision and Sidewinder Spur) exist in the South Central Corridor, including underpasses of the UPRR at Central and 1st Avenues and bridges at 7th Street and 7th Avenue, as well as several at-grade crossings, including crossings of spur lines. Central Avenue, 7th Street, and 7th Avenue are bridged across the Salt River.

Figure 2 –Transportation Facility Classification



Sources: City of Phoenix, Valley Metro, and MAG

Figure 3 – Existing Lane and Intersection Configuration



Sources: City of Phoenix and Valley Metro team

I-17 runs on a generally east-west path across the South Central Corridor, several blocks north of the Salt River. This six-lane freeway, one of the oldest in the Phoenix area, was constructed on an elevated embankment approximately 30 feet above street level. Diamond traffic interchanges are located at 7th Street and 7th Avenue. Frontage roads on both sides of I-17 connect the Central Avenue underpass with both interchanges.

Existing Transit Services and Facilities

Several bus routes provide connections between adjoining communities and the South Central Corridor. These include Route 0, which travels the length of Central Avenue from Sunnyslope in the north to Dobbins Road in the south, and routes 7 and 8, which run parallel to Route 0 on 7th Street and 7th Avenue. Many local bus routes intersect the corridor, with many meeting in Downtown Phoenix at Central Station, and five (routes 0, 7, 8, 45 and 52) serving the 4.5-acre Ed Pastor Transit Center at Central Avenue and Broadway Road. Local buses generally stop every one-fourth mile, with passenger shelters or benches provided at many stops. Bus bays (pullouts) also exist at some major stops, which are most often located at the far side of an intersection. Weekday headways (service frequencies) are generally 10 to 30 minutes during peak travel periods and 20 to 30 minutes at other times. Weekend service operates every 30 to 60 minutes.

In addition, the COP has begun RAPID (express bus) service along South Central Avenue, connecting the recently opened park-and-ride lot at 27th Avenue/Baseline Road with Downtown and the State Capitol. The Central South Mountain RAPID offers five inbound trips in the AM peak period and five outbound trips in the PM peak period, with intermediate stops along Central Avenue at Broadway Road, Southern Avenue and Baseline Road.

In the study area, the existing Central Phoenix/East Valley (CP/EV) LRT alignment runs along Central Avenue (and, in a one-way couplet, 1st Avenue) from Camelback Road to Washington Street, and then turns in a one-way couplet eastbound along Jefferson Street and westbound along Washington between Downtown and 24th Street, where it then converts to two-way on Washington to connect with Tempe and Mesa. Current LRT weekday headways are 12 minutes all day until 8:00 PM and 20 minutes at other times, with trains operating approximately 19 hours Sunday through Thursday and 22 hours Friday and Saturday. The LRT line connects to several bus routes at Central Station. The proposed Capitol/I-10 West Light Rail Extension of the regional light rail system would connect the existing CP/EV to the western portion of Phoenix, via the State Capitol and the I-10 corridor.

Planned Transportation Improvements

Several transit system improvements are planned or proposed for the South Central Corridor study area. Of particular significance for this study, in the short term the COP

will design and construct a new East Baseline park-and-ride lot near 24th Street and Baseline Road for the use of transit riders and carpoolers. This facility will serve three local bus routes immediately and is intended to feed higher-capacity service in the future. Construction is scheduled for fiscal year 2014 in the COP 2014-2018 *Capital Improvement Program*. In addition, the COP is exploring a South Mountain circulator route in the event more funding becomes available. Details of the circulator have not been planned at this time.

The COP Planning Department recently completed a final Environmental Assessment and Project Assessment to identify alternatives for extending, widening, and improving the Broadway Road corridor from 67th Avenue to 7th Street. The alternatives considered included: widening the road symmetrically, widening to the north, widening to the south, and a hybrid of these three to minimize impacts. The hybrid alignment was selected as the preferred alternative. In the South Central Avenue Corridor, the existing alignment would remain, with some reconstruction of intersections. At Central Avenue, Broadway Road would be widened on the south, likely requiring some new right-of-way.

In early 2014, MAG is initiating an I-10 and I-17 Corridor Master Plan or “Spine Study” extending from SR 101L in Phoenix to SR 202L in Chandler. This multimodal transportation study will investigate short-term actions and long-term strategies to improve mobility and increase capacity in this critical corridor.

Public and Private Utilities

The following public utility providers have infrastructure, generally located in public rights-of-way, in the study area:

- **Electrical power:** Arizona Public Service (APS) (serves area north of Salt River), Salt River Project (SRP) (serves area south of Salt River)
- **Irrigation:** SRP Water, private utility companies
- **Heating/cooling:** Chill Water, NRG Thermal, APS, SRP
- **Natural gas:** Southwest Gas
- **Potable water and sewer:** City of Phoenix
- **Telecommunications:** Cox Communications, CenturyLink, Verizon, AT&T, AboveNet

The following private utility providers have infrastructure located in the UPRR right-of-way:

- **Jet fuel:** Kinder Morgan
- **Telecommunications:** MCI, Level3 Communications, AT&T

3.2 Existing and Planned Land Use

Land uses in the corridor are quite diverse today, and are expected to remain so in the future, according to the 2002 *Phoenix General Plan*. Between Downtown and the Salt River, the corridor has residential neighborhoods and areas with substantial industrial uses. South of the river, there is a mix of low- to medium-density residential neighborhoods, commercial uses, and public facilities serving the South Central community.

An update of the 2002 Phoenix General Plan is currently underway. The visioning process is complete and preliminary planning largely maintains the 2002 goals for South Mountain Village, including intensifying the Village Core, expanding commercial development and increasing densities along Central Avenue, maintaining business park/industrial uses north and south of I-17, and continuing to convert incompatible land uses within the Sky Harbor noise contours to non-residential uses.

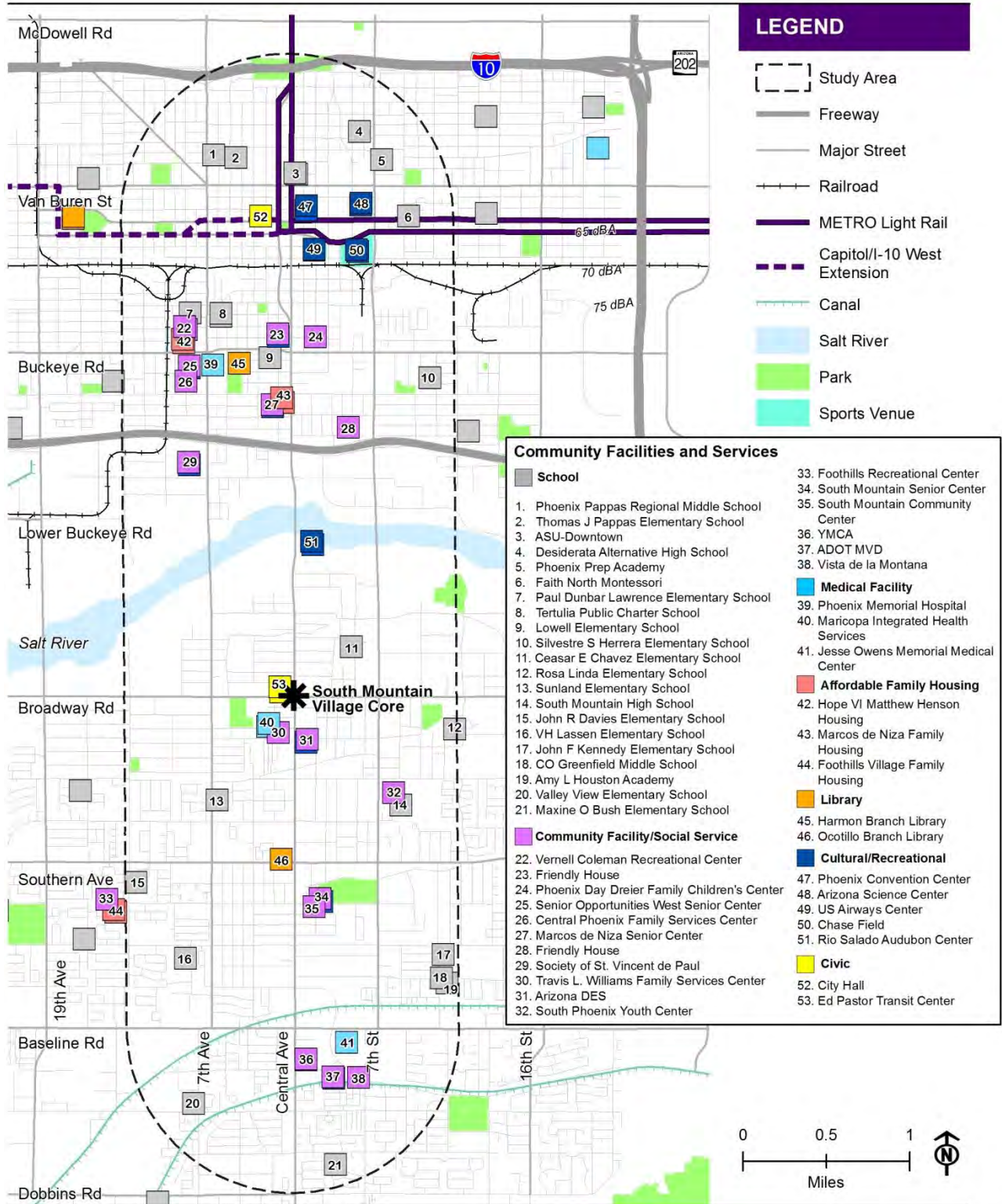
Community Facilities

The South Central Corridor has a high concentration of community facilities and services, including educational and civic facilities, transit centers, medical facilities, social services, affordable housing locations, and cultural/recreational facilities. These facilities, as well as parks, are mapped and labeled on **Figure 4**.

The corridor has over twenty educational facilities, including elementary, middle and high schools in the Murphy Elementary, Pappas, Phoenix Elementary, Phoenix Union High School, and Roosevelt Elementary school districts. Phoenix City Hall is located in the heart of Downtown Phoenix, Phoenix Convention Center, Arizona Science Center, US Airways Center, and Chase Field – among numerous other governmental, private office, entertainment and cultural facilities are located within the corridor. Several community facilities/social services exist south of the river. The Phoenix Memorial Hospital, Maricopa Integrated Health Services, and Jesse Owens Memorial Medical Center are three major medical facilities in the South Central Corridor.

The Nina Mason Pulliam Rio Salado Audubon Center serves as a recreational facility and nature center for the entire region, just south of the Salt River on the east side of Central Avenue. Although not shown in the figure because of its location south of Dobbins Road, the 16,500-acre Phoenix South Mountain Park, with its main entrance at the south end of Central Avenue, is the largest municipal park in the United States, a Phoenix Point of Pride, and a nationally renowned recreational treasure.

Figure 4 – Community Facilities and Services



Sources: City of Phoenix and Valley Metro team

The corridor also contains the Harmon and Ocotillo Phoenix Public Library branches, several senior/youth/family service centers, and three affordable housing developments – two of which are clusters of historic public housing projects that have been redeveloped into affordable housing/mixed-use neighborhoods: the Marcos de Niza family housing and Hope VI Matthew Henson housing complexes.

Historic Resources

Several properties in the South Central study area are listed either in the Phoenix Register or the National Register of Historic Places. Other resources include properties along Central Avenue, 1st Avenue, and 1st Street that the City of Phoenix has determined to be historically eligible, but are not yet officially registered as historic sites or districts.

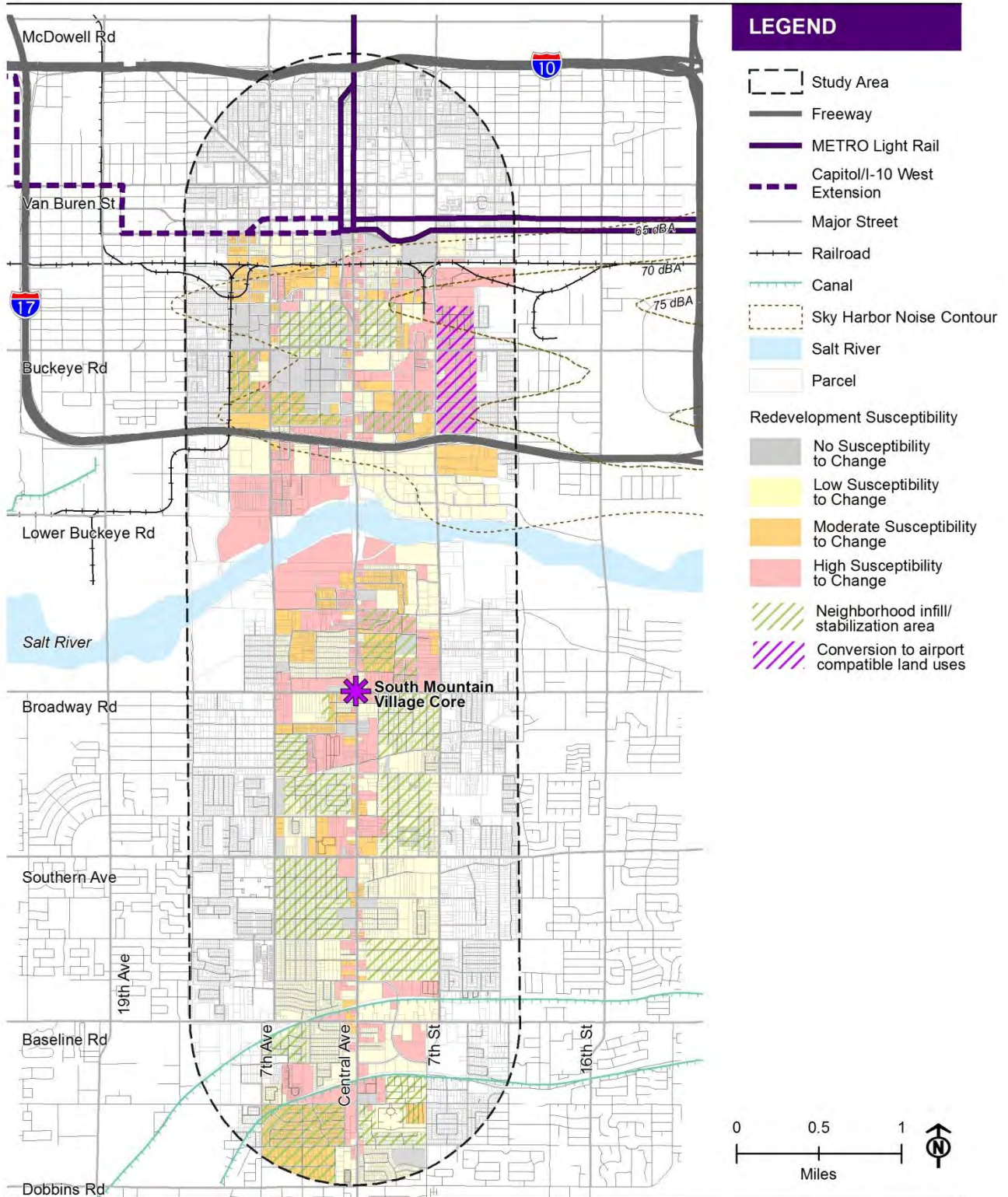
Redevelopment Susceptibility

Although historically the South Central Corridor has been economically deprived, it has recently become the focus of several redevelopment opportunities. The restoration of the Salt River has turned the Rio Salado area into a major riparian habitat and recreational amenity. The Matthew Henson, Hope VI Revitalization Program was the COP's initial revitalization effort, converting the original public housing project into new housing, a community resource center, and a youth center. The Marcos de Niza family housing project has also been converted into family housing with several social service amenities, such as a senior center.

The project team conducted a windshield survey of the corridor to determine the redevelopment susceptibility of parcels between 7th Street and 7th Avenue. **Figure 5** illustrates the findings.

- **No susceptibility to change:** Includes buildings in excellent condition or historic areas not likely to change, such as recently redeveloped areas and stable neighborhood facilities.
- **Low susceptibility to change:** Includes buildings in good condition or newly constructed buildings requiring minimal change.
- **Moderate susceptibility to change:** Includes partially vacated or deteriorated buildings/parcels, and lots marginally used. A few parcels fronting Central Avenue fall in this category, with a large cluster located between Pima Street and I-17, and another between the Salt River and Broadway Road.
- **High susceptibility to change:** Includes vacant, underutilized or deteriorated parcels/buildings. Several vacant properties exist in the corridor that fall into this category, as well as deteriorated commercial buildings or uses not compatible with the vision for the South Central Corridor. This also includes two former landfill sites south of the Salt River, spanning Central Avenue.

Figure 5 – Redevelopment Susceptibility



Sources: City of Phoenix and Valley Metro team

As an overlay to these categories, neighborhoods ripe for infill, intensification or revitalization/stabilization have been noted, based on a field survey and a review of recent neighborhood redevelopment plans. The Nuestro Barrio area is earmarked for conversion to more airport-compatible uses, as it is located within the noise contours of Sky Harbor Airport.

3.3 Environmental Considerations

Drainage/Water Resources

The Salt River and its floodway are the biggest drainage considerations in the South Central Corridor. This area is considered both a riparian and a wetland area. A few concentrated areas of 100-year floodplains exist along the Salt River in the corridor, near 15th Avenue, as well as south of the Western Canal corridor, located in the vicinity of Baseline Road. Outside the corridor, areas of 100-year floodplains are generally located adjacent to major infrastructure alignments, such as UPRR spurs or I-17. Any alternatives that consider widening existing bridges over the Salt River will have to be mindful of Section 404 permitting, as the entire corridor – bank to bank – is considered jurisdictional water by the U.S. Army Corps of Engineers. Many wells are scattered throughout the study area, as well as concentrations of underground storage tanks clustered at major intersections.

Biological Resources

The Rio Salado Habitat Restoration Area has approximately 200 types of birds residing along the Salt River in the study area. None are federally-listed as threatened or endangered. Most of the birds are protected from harm by the Migratory Bird Treaty Act, and the Bald and Golden eagles are protected under the federal Bald and Golden Eagle Act. In 2009, the City of Phoenix drafted a Safe Harbor Agreement for endangered habitat reintroduction/maintenance into the Rio Salado area (for Brown Pelicans, Southwestern Willow Flycatchers, Yuma Clapper Rails, and Bald Eagles). Not all of these species are still considered “threatened or endangered.” Additionally, with the anticipated habitat restoration of Rio Salado, reintroduction of two endangered fish species could occur in the future (Gila topminnow and desert pupfish).

The entire Salt River corridor is identified as a potential habitat linkage zone by the Arizona Wildlife Linkages Workgroup. Linkage zones are seen as significant wildlife movement corridors that contribute to the diversity of species moving between large tracts of protected land.

Air Quality

The National Ambient Air Quality Standards (NAAQS) were first established in 1970 under the Clean Air Act. Six pollutants were placed under regulation and limits placed on acceptable ambient concentrations. The Clean Air Act Amendments of 1990

authorized the U.S. Environmental Protection Agency (EPA) to designate those areas that have not met the NAAQS as nonattainment. The project area lies within nonattainment areas for eight-hour ozone and PM₁₀. The study area is also in a maintenance area for carbon monoxide. Major sources of carbon monoxide, ozone and PM₁₀ include vehicular emissions, service stations, and resuspension of road dust.

3.4 Socioeconomic Highlights

Minority and Low-Income Population

Most census tracts in the South Central Corridor have a minority population of over 75 percent, according to the 2010 U.S. Census. The exceptions are the Downtown Phoenix central business district, including the area adjacent to the existing CP/EV and proposed Capitol/I-10 West Light Rail Extension, and the area between I-17 and the Salt River. Despite these variations, the South Central Corridor has a higher proportion of minorities than Maricopa County as a whole, which averages 42 percent.

The prevalence of low-income households in the corridor was assessed by the percent of the population exceeding the 150 percent poverty level, based on 2012 American Community Survey five-year estimates for the years 2008-2012. Overall, more than half of the census tracts in the study corridor have 50 percent or more residents that exceed the 150 percent poverty threshold (generally located between Van Buren Street and Broadway Road); all study area census tracts include at least 25 percent exceeding the poverty threshold. There are two areas with high concentrations of low-income residents, ranging from 77 to 87 percent population exceeding the 150 percent poverty threshold: the area bounded by 7th Avenue, 19th Avenue, Van Buren Street, and Buckeye Road; and the area bounded by 7th Street, 7th Avenue, Buckeye Road, and the Salt River. Both of these areas include Hope VI or affordable housing communities, including the Matthew Henson and Marcos de Niza communities.

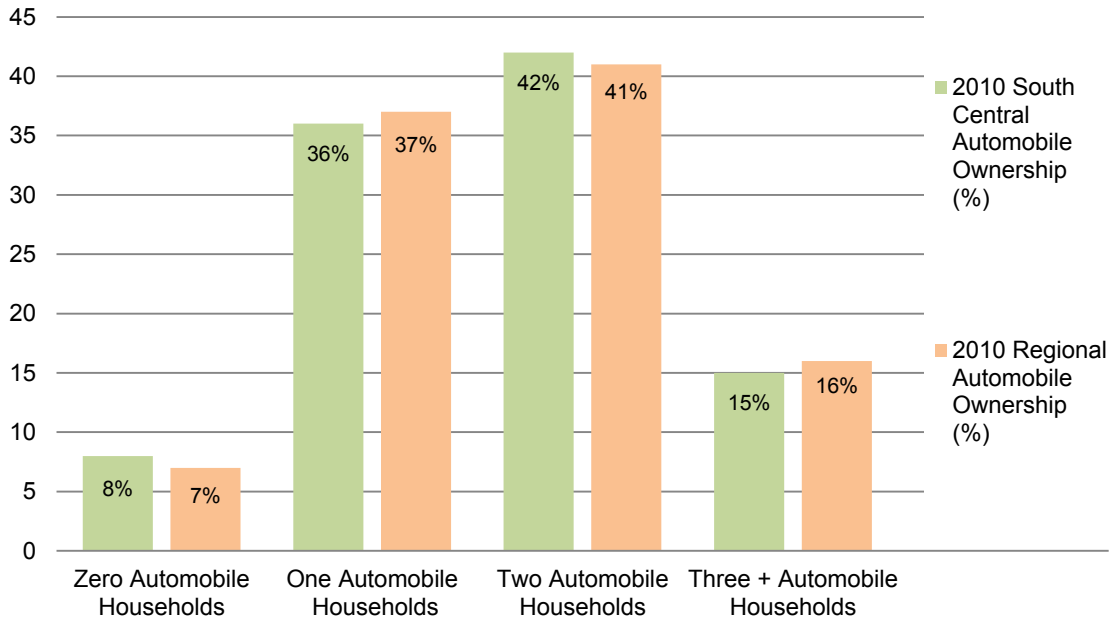
Age, Disability and Automobile Ownership

A review of elderly (over 65 years of age) and young (under 16 years of age) persons was conducted to understand the population that may be transit-dependent, in that they may not be able or legally qualified to drive. The study area has a prevalence of elderly persons between five and eight percent – far less than the Maricopa County average of twelve percent. However, in regards to the youth population, the entire study area outside the Downtown core has a higher-than-average percent (approximately 25 to 35 percent) of the population under 16 years of age. The total across the region is 24 percent.

Auto ownership rates in the South Central Corridor today are also lower than in the county as a whole. In 2010, zero-auto households comprised eight percent of the total in the study area and seven percent in the region (**Figure 6**). This gap is expected to double, from one percent to two percent, by 2031 (**Figure 7**). Also by 2031, the

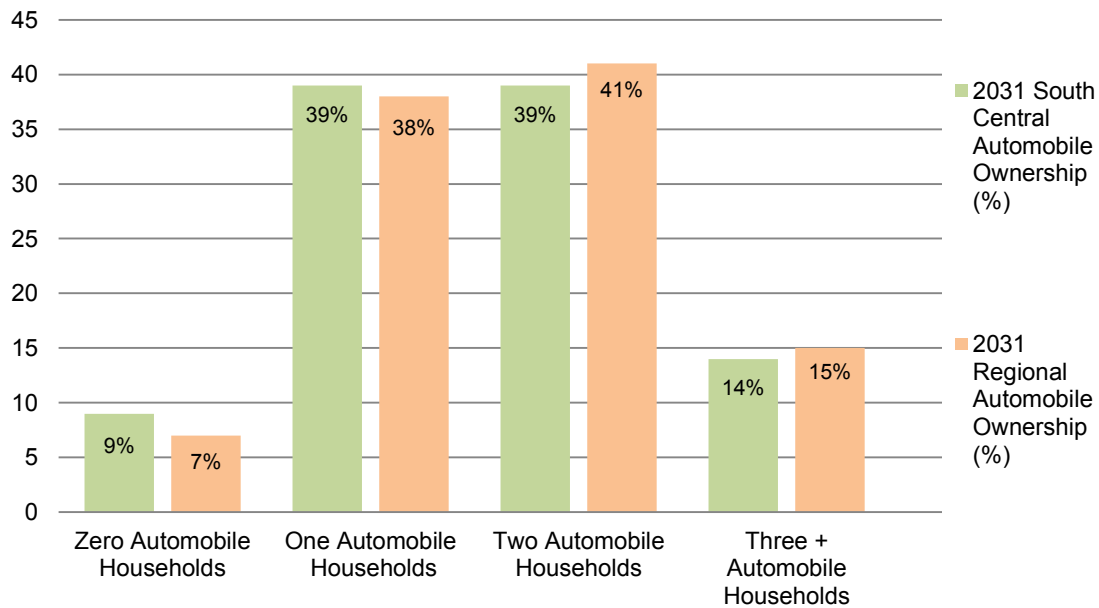
proportion of households with fewer than two vehicles is expected to rise to 48 percent in the study area (from 44 percent in 2010), versus 45 percent in Maricopa County (also from 44 percent in 2010). This growing divergence in auto ownership between the study corridor and the region points to increasing transit-dependence and hence, to demands for higher-capacity transit in the South Central Corridor.

Figure 6 – 2010 Automobile Ownership



Source: MAG Travel Demand Model, 2011

Figure 7 – 2031 Automobile Ownership



Source: MAG Travel Demand Model, 2011

4.0 Alternatives Considered

Besides the modal and alignment “Build” alternatives described below, the AA also considered a “No-Build” alternative that involves no substantial changes to existing transit services in the study area.

4.1 Modal Alternatives

This section describes the three HCT modes considered for the South Central Corridor. For all modes, only at-grade (primarily on-street) alignment options were analyzed, because of the excessive cost of elevating or burying the guideway. Other modes, such as heavy rail transit, were excluded at the outset due to a high cost and the fact that it does not meet the purpose and need.

Light Rail Transit (LRT)

This urban rail mode operates in many American cities, including Phoenix on the CP/EV route. **Figure 8** compares salient characteristics of LRT with those of other modes considered for the South Central Corridor.


In the figure, “higher-speed” means a higher average travel speed than the local buses that currently operate in the South Central Corridor. The principal reasons for the speed advantage of LRT are:

- Fewer stops than local buses for passenger loading and unloading,
- Reduced dwell time, because fare collection usually occurs off the vehicle and boarding can occur rapidly through multiple doors,
- Use of a semi-exclusive (dedicated) rail guideway, which motor vehicles may cross only at designated intersections under signal protection, and
- Usually, some priority given to transit vehicles at signalized intersections.

Distinctive LRT characteristics include:

- LRT can operate in trains of two or more cars linked together. Two-car trains are typical on the CP/EV line, although station platforms are long enough for three-car trains. This coupling ability, along with high-capacity rail vehicles, allows substantial operating efficiencies in high-demand corridors.
- Vehicles draw electric motive power from overhead wires.
- Many systems, including CP/EV, use low-platform vehicles for convenient, level boarding of wheelchair passengers.
- Vehicles usually have doors on both sides, allowing passenger stops at either center-platform or side-platform stations.

Figure 8 – Modal Alternatives

	Light Rail Transit	Modern Streetcar	Bus Rapid Transit
Purpose / Market Type	Higher-speed, high-demand regional connections	Moderate-speed, moderate-demand local or regional connections	Higher-speed, high-demand local or regional connections
Operating Environment	Dedicated or semi-dedicated guideway	Semi-dedicated guideway or arterial streets in mixed traffic	Semi-dedicated guideway or arterial streets in mixed traffic
Spacing of Stops	Approximately every one-half to one mile or longer	Approximately every one-fourth to one-half mile	Approximately every one-half to one mile or longer
Typical Capital Cost per Route Mile	\$60 - \$90 million per mile	\$40 - \$60 million per mile	\$1 - \$15 million per mile
Typical Gross Operating Cost per Passenger Boarding*	\$2.50 - \$6.30 per passenger	\$3.60 - \$9.40 per passenger	\$2.70 - \$8.70 per passenger
Passenger Capacity per Vehicle	Approximately 180 - 200 per car	Approximately 130 - 160 per car	Approximately 60 - 90 per bus
			

Source: AECOM/HDR; August, 2012

* 2010 National Transit Database. BRT data based on typical fixed route bus costs.

Modern Streetcar (MSC)

The streetcar was the predecessor of LRT, operating in dozens of American cities from the late nineteenth century through the World War II era. By 1960, buses replaced streetcars in most cities. The modern streetcar, on the other hand, is a recent entrant to the transit scene in the U.S. This more streamlined version of the traditional streetcar operates in Portland, Seattle, and Tacoma. Many other projects, including one in Tucson, are in construction, design, or planning. A modern streetcar line was approved as a Locally Preferred Alternative in Tempe, and is currently undergoing advanced planning and design work, led by Valley Metro.

Like LRT, MSC is an urban rail mode in which vehicles draw electric power from overhead wires. Differences from LRT include:

- Vehicles tend to be smaller and lighter than LRT cars, and stops are usually less elaborate than LRT stations.
- Vehicles typically operate singly, rather than in trains.
- Streetcars often, but not always, run in mixed traffic, sharing a lane with other vehicles much as local buses do.
- MSC is more likely than LRT to operate in the curb lanes.
- The fare system may be designed for either on-board or off-vehicle collection.
- Boarding may take place through one door or multiple doors.
- Travel speed is typically closer to a local bus than to LRT, due to more frequent stops and operation in mixed-traffic (shared) lanes.

Bus Rapid Transit (BRT)

Bus rapid transit is a relatively new mode, although various forms of it now operate in several American cities. BRT buses operate faster than conventional local bus service, and can offer higher capacities with articulated buses and high service frequencies. BRT can operate on surface streets or on freeways; throughout the day or (especially with freeway BRT) during peak periods only. On-street or arterial BRT typically stops every mile, as opposed to every one-fourth mile for local buses. Arterial BRT is the type considered for the South Central Corridor. This type of BRT may operate in mixed traffic like a streetcar, in semi-exclusive lanes like LRT, or in a mix of both.

4.2 Alignment Alternatives

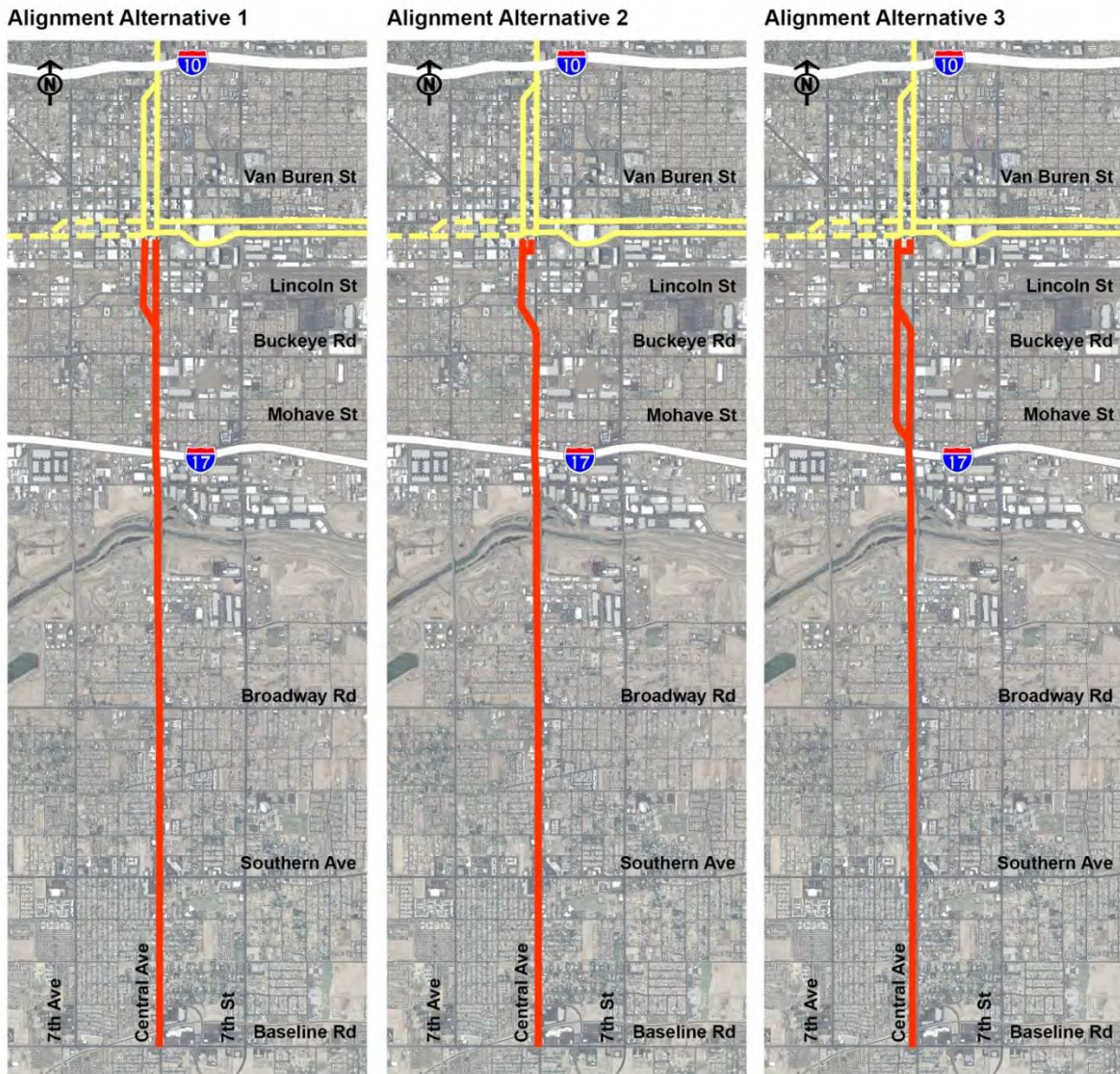
Valley Metro initially defined four groups of alignment alternatives, with a total of eleven alignments. All of these alternatives (numbered from 1 to 11) would extend from Downtown Phoenix, near the CP/EV LRT line, to South Central Phoenix near Central Avenue and Baseline Road. If rail – particularly LRT – is chosen, the alignment alternatives would offer the possibility of a direct interline with other LRT routes: either the North Central Avenue portion of the CP/EV line, the Washington and Jefferson Street tracks to the East Valley, or the planned Capitol/I-10 West line.

Central Avenue/1st Avenue Alignments

Three alignments, numbered 1 through 3 and depicted in **Figure 9**, would use a combination of Central Avenue and 1st Avenue for their entire length. Currently, Central Avenue carries northbound motorized traffic from Hadley Street through Downtown to Portland Street, while 1st Avenue carries southbound traffic through the same area. At Hadley Street, 1st Avenue merges eastward onto Central Avenue, which continues south as a two-way arterial.

- **Alignment #1:** From Downtown Phoenix, southbound service would use 1st Avenue to cross under Jackson Street and the UPRR – using the existing underpasses – and then merge eastward onto Central Avenue at Hadley Street. Northbound service would use Central Avenue throughout, including the existing Central Avenue underpasses. In other words, there would be a one-way couplet north of Hadley Street and two-way service on Central Avenue south of that point.
- **Alignment #2:** Both northbound and southbound service would use 1st Avenue from Hadley Street to Madison Street. This would require contraflow operation (against the flow of motorized traffic) of northbound transit on 1st Avenue under Jackson Street and the UPRR. It would also require northbound transit vehicles to turn east for one block at Madison Street in order to rejoin Central Avenue and begin following the one-way couplet. From Hadley Street south, this alternative is identical to #1.
- **Alignment #3:** In the northbound direction, this alignment is identical to #2. The southbound route, however, instead of merging east onto Central Avenue at Hadley Street, would remain on 1st Avenue (a local neighborhood street south of this point), for an additional nine blocks, or approximately 0.6 mile, to Apache Street, where right-of-way is available so that southbound service could merge east onto Central Avenue just north of I-17. From Apache Street south, this alignment in both directions is identical to alignment alternatives #1 and #2.

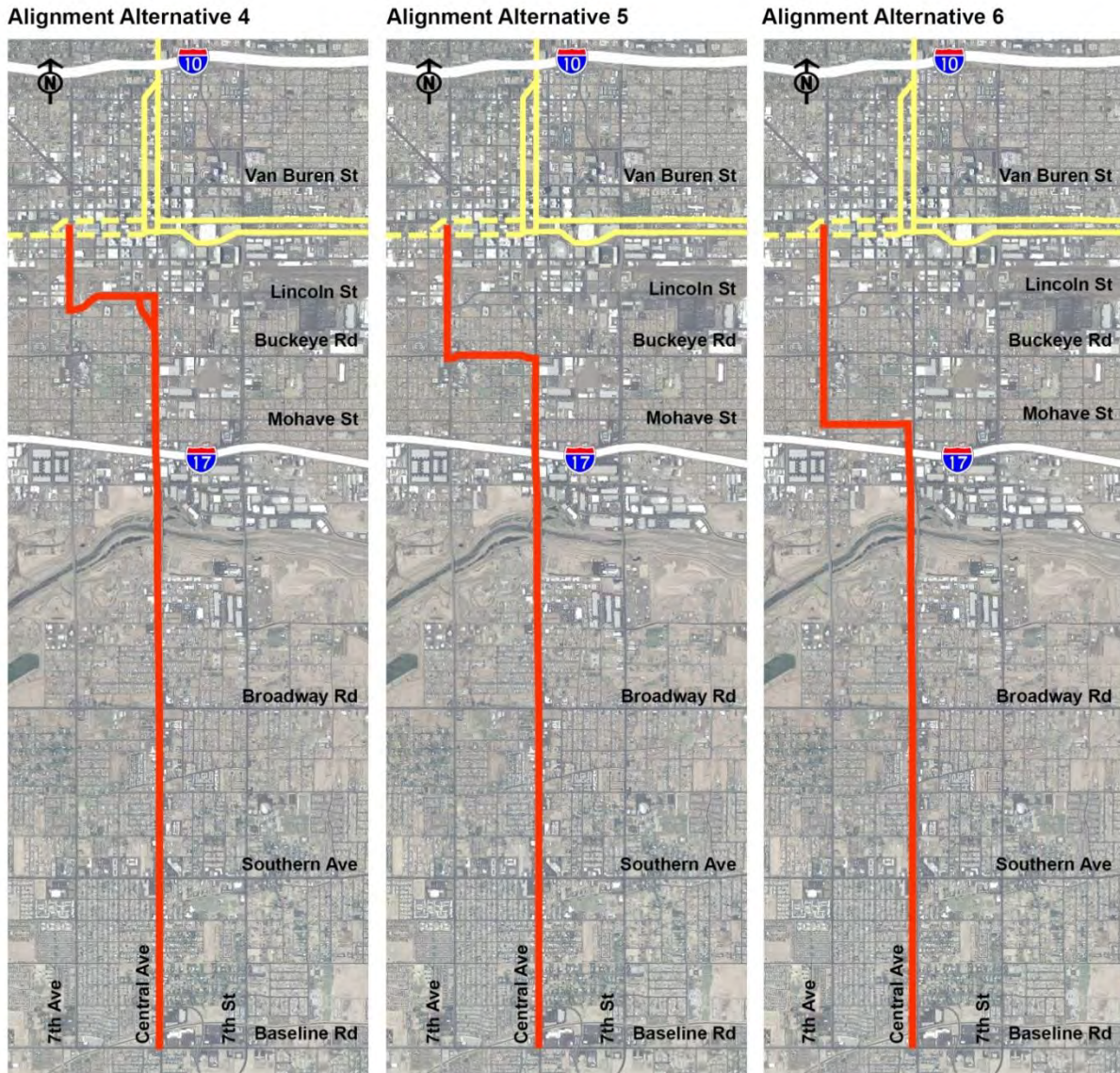
Figure 9 – Alignment Alternatives #1, #2 and #3



Alignments Using 7th Avenue North of Salt River

From I-17 to the southern end of the corridor, the three alignment alternatives shown in **Figure 10** (#4, #5 and #6), are identical to #1, #2 and #3, using South Central Avenue in both directions of travel. North of I-17, however, they would use some portion of 7th Avenue instead of Central Avenue and 1st Avenue. At some point south of the UPRR, each would use a different street to shift east to Central Avenue.

Figure 10 – Alignment Alternatives #4, #5 and #6



- Alignment #4:** From 7th Avenue and Washington/Jefferson streets, just north of the UPRR, this alignment would bridge the tracks and use West Grant Street (which soon becomes West Lincoln Street) to reach Central and 1st avenues. It would then split for two blocks to use 1st Avenue (southbound) and Central Avenue (northbound) to the Hadley Street merge. Alignment #4, along with #5 and #6, would use Washington and Jefferson streets to detour to 7th Avenue from the heart of Downtown Phoenix. A future station at 7th Avenue and West Jefferson Street might one day serve both the South Central and planned Phoenix West HCT corridors. (The latter will connect Downtown to the State Capitol and eventually continue west in the I-10 Corridor.)

- **Alignment #5:** This alternative is similar to #4, except that West Buckeye Road instead of West Grant/Lincoln streets would carry the HCT route from 7th Avenue to Central Avenue. The 7th Avenue portion would be approximately 0.3 miles longer than in Alternative #4.
- **Alignment #6:** This alternative is similar to Alternative #5, except that the 7th Avenue segment would be extended south approximately 0.4 miles to West Mohave Street, which would carry the alignment east to Central Avenue.

Alignments Using 7th Street North of Salt River

These three alignments – #7, #8 and #9 – are mirror images of alignments #4, #5 and #6. All would connect 7th Street near East Washington and Jefferson streets (where the existing CP/EV LRT line runs east-west, but has no station) to the south end of the corridor, at or near Central Avenue and Baseline Road (**Figure 11**).

- **Alignment #7:** From 7th Street and Washington/Jefferson streets, just north of the UPRR and east of Chase Field, this alignment would bridge the tracks and then turn west onto East Lincoln Street, immediately south of the tracks. After using Lincoln Street to reach Central Avenue, the alignment would use Central Avenue to the south end of the corridor.
- **Alignment #8:** This alignment is similar to #7, except that East Buckeye Road instead of Lincoln Street would carry the HCT route from 7th Street to Central Avenue. Therefore, the 7th Street portion of this route would be approximately 0.3 miles longer, extending from Washington and Jefferson streets to Buckeye Road.
- **Alignment #9:** This alignment is similar to Alternative #8, except that the 7th Street segment would be extended south yet again, approximately 0.4 miles from Buckeye Road to East Mohave Street, which would carry the alignment west to Central Avenue.

Alignments Using 7th Street or 7th Avenue North of Broadway Road

- **Alignments #10A and #10B:** These alignments (illustrated in **Figure 12**) are the only ones that do not use Central Avenue for the full distance from I-17 to Baseline Road. Instead, they would begin on either 7th Avenue (#10A) or 7th Street (#10B), and use one of those streets from Jefferson Street south to Broadway Road. From there, they would proceed east from 7th Avenue (#10A) or west from 7th Street (#10B) to the Ed Pastor Transit Center at Central Avenue and Broadway Road. The southernmost portion of the route would follow Central Avenue from Broadway Road to Baseline Road.

None of the alignments on 7th Avenue or 7th Street would continue south on either of these streets south of Broadway Road. The Valley Metro team, along with staff from the COP, recognized early on that no HCT alternative could succeed without serving the South Mountain Village core, focused along Central Avenue between Broadway Road and Baseline Road, with its hub near the intersection of Central Avenue and Broadway Road, the location of the Ed Pastor Transit Center. Hence, every alignment alternative used Central Avenue from Broadway Road south.

Figure 11 – Alignment Alternatives #7, #8 and #9

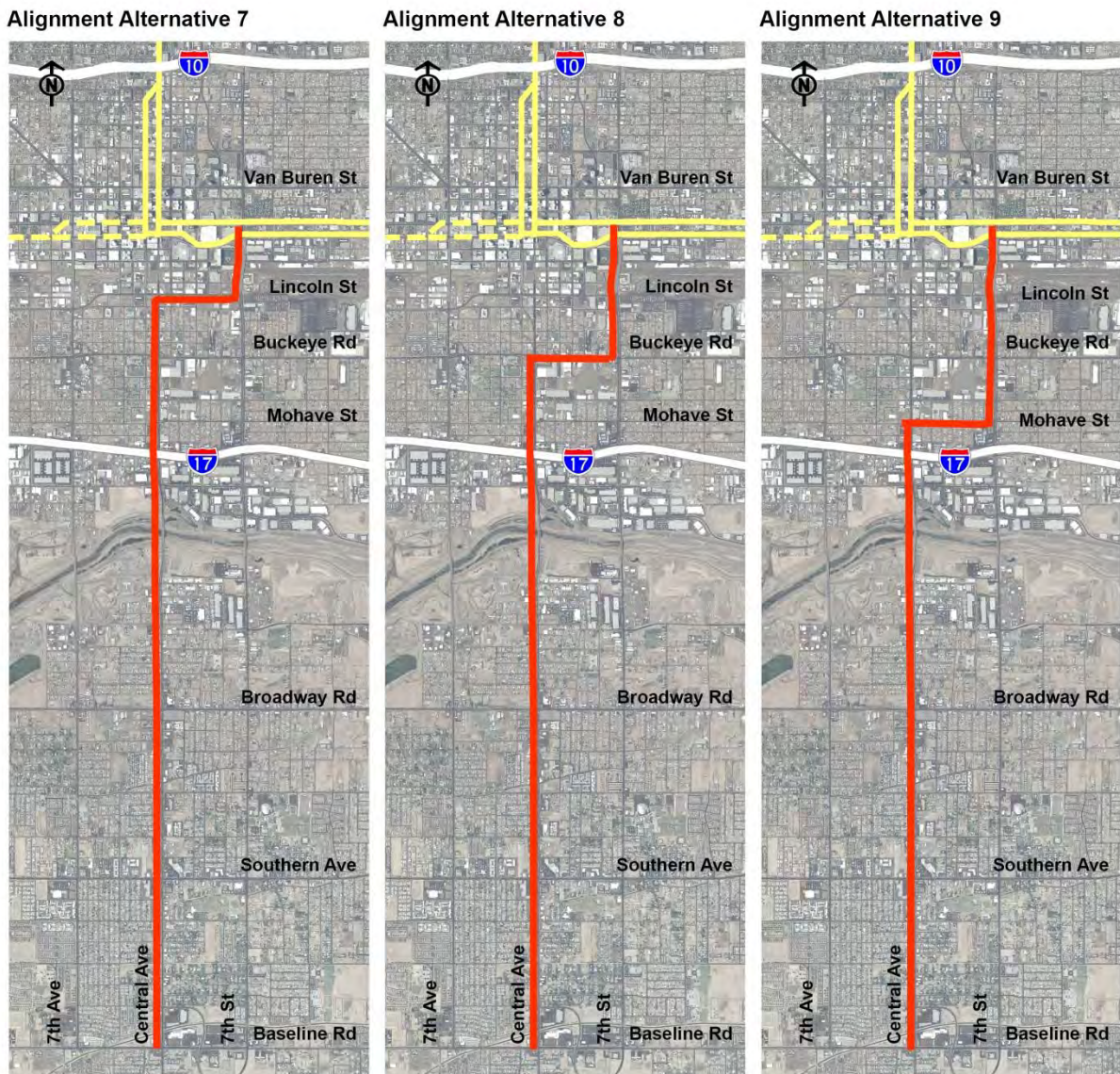


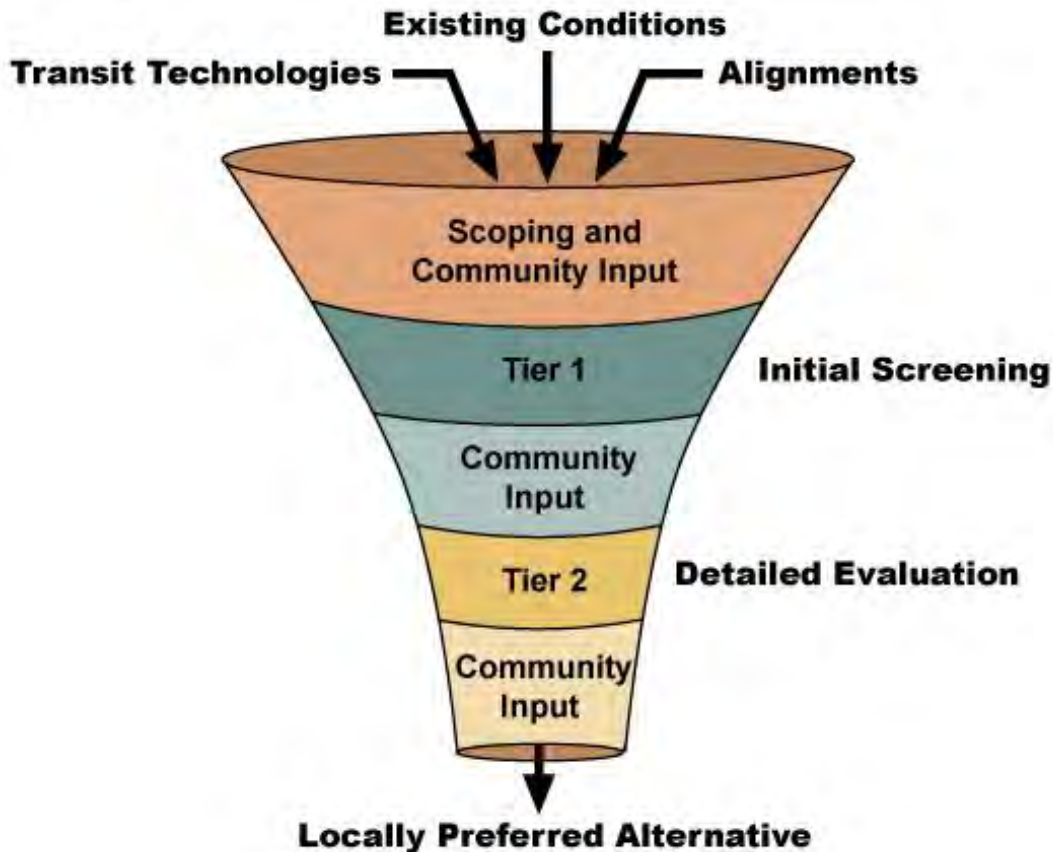
Figure 12 – Alignment Alternatives #10A and #10B



5.0 Tiered Screening of Technology and Alignment Alternatives

Valley Metro applied a two-level (two-tiered) screening and evaluation process to evaluate mode and alignment alternatives in the AA. Tier 1 screened modes and alignments separately. Tier 2 then evaluated, in greater detail, those alternatives that performed best in Tier 1. **Figure 13** illustrates the process by which the full set of alternatives will be screened down to an LPA.

Figure 13 – Alternatives Analysis Process



5.1 Tier 1 Screening

The Tier 1 screening consisted of two separate, non-quantitative analyses: screenings of the three modal alternatives and of the eleven alignment alternatives. Valley Metro selected the following criteria for the screenings of both the modal and alignment alternatives:

- Potential for New Ridership
- Physical and Engineering Constraints
- Transit-Oriented Land Use and Economic Development Potential

- Transportation Network Integrity and Functionality
- Cost (Capital and Operating)

The rating system for the Tier 1 screening of both mode and alignment alternatives was a simple “filled circle, half-filled circle, and empty circle” scale, with ● the best and ○ the worst rating. The separate *Tier 1 Evaluation Report* shows detailed evaluation matrices for both the modal and alignment alternatives.

Alignment/Modal Alternatives Recommended for Tier 2 Evaluation

Table 1 provides a detailed summary of the Tier 1 screening recommendations. Those alternatives recommended for Tier 2 evaluation are *italicized* in the table. **Figure 14** illustrates the resulting alignment alternatives for the Tier 2 evaluation (Alternative 1 - LRT, MSC or BRT; Alternative 2 - LRT or MSC; and Alternative 5 - LRT, MSC or BRT).

- Alignments #1 and #2, the highest rated of the Tier 1 alignments, were carried forward to Tier 2. LRT and MSC were evaluated with both alignments. However, the feasibility of bringing rail through the Central Avenue railroad underpass requires further study in the environmental and design phases of the project.
- Alignment #2 is feasible for all modes, but was carried forward only with LRT and MSC. Because BRT is known to be feasible in a split alignment (#1), using both Central and 1st Avenues under the UPRR and Jackson Street, there was no need to introduce the complication of contraflow (northbound) bus operation on 1st Avenue.
- South of Hadley Street, Alignment #3 would use 1st Avenue, which becomes a local street that would require substantial right-of-way acquisition to become the route for southbound HCT. Because more right-of-way is available one block away on Central Avenue, and because of community concerns about the disruption of established neighborhoods that a 1st Avenue route to Apache Street would cause, Valley Metro dropped Alignment #3 at the end of Tier 1.
- Among the eight alignment alternatives that would use some portion of 7th Avenue or 7th Street, only Alignment #5 was recommended for further analysis in Tier 2. This route had the highest ratings of these eight alternatives. Apart from the neighborhoods and facilities served, Buckeye Road is a minor arterial street that would be more suitable for HCT than Grant/Lincoln Street or Mohave Street.



Table 1 – Tier 1 Recommendations

Technology and Alignment	Dedicated Guideway or Mixed Traffic?	Recommendation for Tier 2	Evaluation Summary
LRT #1	Dedicated	Evaluate	Avoids contraflow operation and northbound detour; may be feasible despite Central Ave. underpass
MSC #1	Mixed	Evaluate	
BRT #1	Dedicated or Mixed	Evaluate	Avoids contraflow operation and northbound detour
LRT #2 (#2A in Tier 2)	Dedicated	Evaluate	Uses major streets to serve most direct route connecting Downtown with S. Central destinations
MSC #2 (#2B in Tier 2)	Mixed	Evaluate	Similar to #2A; possibly lower cost and greater community penetration
BRT #2	Dedicated or Mixed	Eliminate	Contraflow and northbound detour unnecessary with BRT
LRT #3	Dedicated	Eliminate	Excessive neighborhood disruption and right-of-way cost to use local street (1 st Ave, Hadley St. to Apache St.)
MSC #3	Mixed		
BRT #3	Dedicated or Mixed		
LRT #4	Dedicated	Eliminate	Adds capital cost including 7 th Ave. UPRR overpass construction, travel time and operating cost with no offsetting benefit to riders (versus #1, #2 and #3)
MSC #4	Mixed		
BRT #4	Dedicated or Mixed		
LRT #5 (#5A in Tier 2)	Dedicated	Evaluate	Serves additional housing, employment and services along 7 th Ave; 7 th Ave. UPRR overpass construction for LRT or MSC will increase project costs; uses Buckeye Rd. arterial, most logical east-west street for return to Central Ave.
MSC #5 (#5B in Tier 2)	Mixed		
BRT #5 (#5C in Tier 2)	Dedicated or Mixed		



Table 1 – Tier 1 Recommendations (continued)

Technology and Alignment	Dedicated Guideway or Mixed Traffic?	Recommendation for Tier 2	Evaluation Summary
LRT #6	Dedicated	Eliminate	No advantages over #5, and uses Mohave St., a minor collector poorly suited for HCT; 7 th Ave. UPRR overpass construction for LRT or MSC will increase project costs
MSC #6	Mixed		
BRT #6	Dedicated or Mixed		
LRT #7	Dedicated	Eliminate	7 th St. route serves fewer trip ends than Central/1 st or 7 th Ave.; no station at 7 th St. junction with existing LRT; 7 th St. UPRR overpass construction for LRT or MSC will increase project costs
MSC #7	Mixed		
BRT #7	Dedicated or Mixed		
LRT #8	Dedicated	Eliminate	7 th St. route serves fewer trip ends than Central/1 st or 7 th Ave.; no station at 7 th St. junction with existing LRT; 7 th St. UPRR overpass construction for LRT or MSC will increase project costs
MSC #8	Mixed		
BRT #8	Dedicated or Mixed		
LRT #9	Dedicated	Eliminate	7 th St. route serves fewer people than Central/1 st or 7 th Ave.; no rail station at 7 th St.; 7 th St. UPRR overpass construction for LRT or MSC will increase project costs
MSC #9	Mixed		
BRT #9	Dedicated or Mixed		
LRT #10A or #10B	Dedicated	Eliminate	7 th St. and 7 th Ave. river crossings more difficult than at Central Ave.; misses Rio Salado development potential near Audubon Center; greatest traffic impact on mile-grid arterials; no ridership advantages over #1, #2 or #5; 7 th St. and 7 th Ave. UPRR overpass construction for LRT or MSC will increase costs
MSC #10A or #10B	Mixed		
BRT #10A or #10B	Dedicated or Mixed		Misses Rio Salado development potential near Audubon Center; greatest impingement on mile-grid arterials; no ridership advantages over #1, #2 or #5

Alternatives recommended for more detailed evaluation in Tier 2 are shown in *italics*.

Source: Valley Metro Project Team

Figure 14 – Tier 1 Alignment Alternatives Carried Forward for Additional Study

Alternative 1



Alternative 2



Alternative 5



5.2 Tier 2 Evaluation

Evaluation Criteria and Procedure

Table 2 defines the ten categories or types of criteria used to evaluate the Tier 2 alternatives. Those marked with an asterisk (*) are included (some in slightly different form) among the FTA New Starts/Small Starts project evaluation criteria discussed in Chapter 8. These categories and their relationships to elements of the Purpose and Need for the project are:

1. **Mobility Improvement***: Improve transit service reliability; improve mobility for the transit-dependent population; address existing and future capacity issues.
2. **Access**: Ensure access to reliable transit service; serve the area's transit-dependent population; address existing and future capacity issues.
3. **Traffic Impacts***: address existing and future capacity issues
4. **Right-of-way Impacts**: Demonstrate compatibility with community sustainability and livability goals.
5. **Environmental Impacts***: Complement area plans that call for sustainable and livable transportation options; demonstrate compatibility with community sustainability and livability goals.
6. **Land Use and Economic Development***: Incentivize economic development; demonstrate compatibility with community sustainability and livability goals.
7. **Capital and Operating Cost**
8. **Cost-Effectiveness***
9. **Operating Efficiencies** (as defined in Table 2)
10. **Community Support**: Demonstrate compatibility with community sustainability and livability goals.

For each of the ten broad categories, the Valley Metro team established at least one – and often several – evaluation criteria. A total of twenty-three criteria pertain to the ten categories. The next step, documented in Table 2, was to specify performance measures by which each criterion was applied to the alternatives.

The team defined quantitative performance measures where this was reasonable, considering the prescribed level of analysis and the availability of data at this stage of project development. Many aspects of performance had to be assessed non-quantitatively, and the team did so as appropriate.



Table 2 – Tier 2 Evaluation Categories, Criteria and Performance Measures

Categories		Evaluation Criteria	Performance Measures
1	Mobility Improvements: How well would each Build alternative solve the transportation problem to be addressed by this project, by comparison with No-Build?	M1. Daily boardings on the project, with each trip by a transit-dependent person counted twice	Projected daily project boardings in the horizon year (2031), with each trip by a zero-auto household member counted twice
		M2. Capacity per project operating unit (bus, train or streetcar)	Typical range of “comfort capacity” (seated and standing) per vehicle
		M3. Peak period travel time	Typical peak hour transit travel time (minutes) from Downtown Phoenix to Baseline Road
		M4. Connectivity with other regional high-capacity transit	Non-quantitative assessment of ease and flexibility of (a) direct interline with other existing and planned regional HCT routes, and (b) seamless transfers if interlining is infeasible
2	Access: How well does the alternative provide access to people, jobs and other modes of transportation?	A5. Population in the service area	Number of residents within one-half mile of a potential station
		A6. Employment in the service area	Number of full-time employees within one-half mile of a potential station
		A7. Amount of publicly-supported housing in the service area	Number of existing units within one-half mile of a potential station
		A8. Access to and from HCT service in the corridor	a. Number of daily connections with other routes at potential stations b. Number of bikeways and multi-use paths serving potential stations
3	Traffic Impacts: How would the alternative affect peak hour traffic flow along the selected alignment?	T9. Direct impact on roadway capacity for non-transit vehicle trips	Potential number of lane miles lost to general traffic use; reported as a range for LRT and BRT depending on whether converted traffic lanes are replaced
		T10. Potential interference between HCT and other street traffic	Non-quantitative analysis based on mode and route characteristics

Table 2 – Tier 2 Evaluation Categories, Criteria and Performance Measures (continued)

Categories		Evaluation Criteria	Performance Measures
4	Right-of-Way Impacts: How would the alternative permanently affect property owners, tenants and users along the alignment?	R11. Total right-of-way acquisition	Right-of-way potentially acquired (square feet), reported as a range depending on whether traffic lanes are replaced
		R12. Total building acquisition	Number of buildings potentially acquired, reported as a range depending on lane replacement
		R12A. Total residential acquisition	Number of residences potentially acquired, reported as a range depending on lane replacement
5	Environmental Impacts: What would be the expected effects on the environment?	E13. Effect on historic and cultural resources	Number of listed or eligible sites located adjacent to alignment
		E14. Section 4(f) resources	Non-quantitative identification of properties that may require avoidance if a reasonable alternative exists.
		E15. Effect on wetlands and riparian habitats in the Rio Salado area	Non-quantitative assessment of impacts due to bridge reconstruction and other actions associated with the alternative
6	Land Use and Economic Development: To what extent will the alternative enhance additional, transit-supportive development in the South Central Corridor?	LE16. Consistency with adopted local (citywide, area and corridor) plans	Non-quantitative comparison with land use, economic development and transportation plans adopted in the last ten years
		LE17. Support for COP vision for the South Mountain and Central City Villages (including the Central City South community)	Non-quantitative assessment, in consultation with COP Planning and Development staff
		LE18. Potential stimulation of redevelopment and infill projects at opportunity sites in station influence areas	Non-quantitative assessment, in consultation with COP Planning and Development staff



Table 2 – Tier 2 Evaluation Categories, Criteria and Performance Measures (continued)

Categories		Evaluation Criteria	Performance Measures
7	Cost: How much would the alternative cost, both to construct and to operate/maintain?	C19. Capital cost (2012 dollars)	Estimated cost of infrastructure, vehicles, facilities, equipment and right-of-way—annualized over the project life cycle
		C20. Operating and maintenance (O&M) cost	Estimated annual cost of operating the South Central portion of the regional HCT network
8	Cost-Effectiveness: How would the cost of the alternative compare with its ridership?	CE21. Cost per HCT trip (boarding) in the corridor	Non-quantitative assessment by mode
9	Operating Efficiencies: What effect would the alternative have on the efficiency with which the transit system provides transportation?	OE22. Incremental cost per incremental unit of service offered, under existing conditions and in the horizon year 2031	Project-caused change in annual O&M cost divided by the project-caused change in annual place-miles of transit service. (Place-miles = vehicle capacity x revenue miles, summed over all vehicles in the fleet)
10	Community Support: Is the alternative consistent with input from the community?	CS23. Expressed public and stakeholder support	Assessment of input from the community, including input during past studies and in response to previous transit investment studies

Source: Valley Metro project team

As in Tier 1, each alternative was rated on a simple three-point scale: ● (filled circle) for the best-performing alternatives, ○ (empty circle) for the worst, and ◐ (half-filled circle) for those in between. **Table 3** is the detailed matrix showing how each alternative fares on every criterion and performance measure, with an explanation or a numerical result for each rating symbol.

LRT and MSC using Central Avenue northbound and 1st Avenue southbound under the UPRR were not evaluated in Tier 2, despite the Tier 1 recommendation to carry these alternatives forward. Preliminary work done early in the study appeared to rule out rail in the Central Avenue/UPRR/Jackson Street underpass, for reasons discussed in the chapter on Existing Engineering Constraints. Subsequently, however, further investigation of the Central Avenue underpass reopened the possibility of rail transit on this alignment. Therefore, *this option, using LRT, will be carried forward as part of the LPA and studied in the detailed environmental evaluation.*

Additional details, supporting some of the numerical estimates in Table 3, can be found in the *Tier 2 Evaluation Report*.

Summary and Conclusion

Table 4 summarizes the Tier 2 evaluation presented in Table 3. Results for each evaluation category are combined in a single row, with one exception. Ridership on the project (Criterion M1) is so crucial that the Valley Metro team separated it from the other three mobility criteria in the summary table. Each category (including ridership on the project, separate from the other mobility criteria) now has its own rating of high (●), intermediate (◐), or low (○). A new summary row is provided at the bottom of this table.

Among the Build alternatives evaluated in Tier 2, Alignment 2, with LRT on Central and 1st avenues, is by far the strongest performer. It has five top ratings (●), whereas no other alternative has more than two. Because of its modal and alignment characteristics, this alternative holds out the likelihood of high ridership and positive impacts on land use and economic development. In addition, LRT on or near Central Avenue has so far garnered more community support than any other alternative. (As noted above, Alternative 1, with northbound LRT remaining on Central Avenue under the UPRR and Jackson Street, will receive consideration as a variant in the subsequent National Environmental Policy Act [NEPA] process and conceptual engineering.)

Table 3 – Detailed Tier 2 Evaluation Matrix

Criteria/ Performance Measures		Evaluation of Alternatives						No-Build
		1 BRT— Central/1 st Ave. couplet under UPRR*	2 LRT—1 st Ave. in both directions under UPRR	2 MSC—1 st Ave. in both directions under UPRR	5 LRT—Detour via 7 th Ave. and Buckeye Rd.	5 MSC—Detour via 7 th Ave. and Buckeye Rd.	5 BRT—Detour via 7 th Ave. and Buckeye Rd.	
1 – Mobility Improvements	M1—Daily boardings ^a on project	● 9,400	● 11,100	○ 6,000	● 11,400	○ 4,800	● 9,300	No project
	M2—Project capacity per bus or trainset ^b	○ 60-90	● 175-525	● 130-175	● 175-525	● 130-175	○ 60-90	No project
	M3—Peak travel time ^c (min)	● 17	● 17	● 25	● 22	○ 33	● 22	22
	M4—Connectivity with regional HCT	○ No interline potential with No-Build LRT lines; good transfer if BRT terminates at Central Station	● Good interline and transfer options to No-Build LRT system	● If built as hybrid system, could interline with No-Build LRT services	○ Connection with Phoenix West LRT challenged by physical constraints on Wash/Jeff near 7 th Ave	○ Same option as 2B, but with challenges similar to 5A	● No potential interline with No-Build LRT lines; good transfer if BRT terminates at Central Station	No interline; similar to current condition
2 – Access	A5—Population within ½ mile of a potential station ^a	○ 42,000	○ 42,000	● 47,000	● 48,000	● 53,000	● 48,000	None
	A6—Employment within ½ mile of a potential station ^a	○ 71,000	○ 71,000	○ 73,000	● 78,000	● 80,000	● 78,000	None
	A7—Publicly-supported housing units within ½ mile of a potential station ^d	○ 1,200	○ 1,200	○ 1,200	● 1,500	● 1,500	● 1,500	None
	A8A—Daily connections to HCT in corridor ^{a, e}	○ 1,600	○ 1,600	● 1,800	● 2,000	● 2,700	● 2,000	0
	A8B—Number of pathway and bikeway connections	○ 4	○ 4	● 5	○ 4	● 6	○ 4	0
3 – Traffic Impacts	T9—Lane miles potentially lost to general traffic	○ 0 to 8 ^f	○ 0 to 9.4	● 0	○ 0 to 10.6	● 0	○ 0 to 8 ^f	0
	T10—Potential interference with other street traffic	● Minimal due to operational flexibility of buses and lack of turns on alignment	● Short segment has northbound detour with contraflow segment and multiple turns	○ High potential for conflicts and interference due to shared-lane operation	● Similar to Alt. 2A, but with longer detour and more turns	○ Similar to Alt. 2B	● Moderate: buses are operationally flexible and can use existing UPRR bridge, but detour and additional turns create more conflicts than in (1)	No impact
4 – ROW Impacts	R11—Right-of-way potentially acquired (sq. ft.)	● 13,000-335,000	● 13,000-415,000	● 0	○ 285,000-646,000	● 0	● 13,000-335,000	0
	R12—Total buildings potentially acquired	● 0-42	● 0-47	● 0	○ 37-79	● 0	● 0-42	0
	R12A—Residences potentially acquired	● 0	● 0	● 0	○ 12	● 0	● 0	0

Table 3 – Detailed Tier 2 Evaluation Matrix (continued)

Criteria/ Performance Measures		Evaluation of Alternatives						No-Build
		1 BRT— Central/1 st Ave. couplet under UPRR*	2 LRT—1 st Ave. in both directions under UPRR	2 MSC—1 st Ave. in both directions under UPRR	5 LRT—Detour via 7 th Ave. and Buckeye Rd.	5 MSC—Detour via 7 th Ave. and Buckeye Rd.	5 BRT—Detour via 7 th Ave. and Buckeye Rd.	
5 – Environmental Impacts	E13—Listed or eligible historic sites adjacent to alignment ⁹	○ 38 listed or eligible sites, with 2 historic districts	● 26 sites, including 2 districts	● 26 sites, including 2 districts	● 15 sites, including 3 districts	● 15 sites, including 3 districts	● 15 sites, including 3 districts	No effect
	E14—Other 4(f) properties for avoidance	● Additional bus service would have no impact	● Potential impact to Rio Salado Habitat Restoration Area facility and trails	● Potential impact to Rio Salado Habitat Restoration Area facility and trails	● Potential impact to Rio Salado Habitat Restoration Area facility and trails	● Potential impact to Rio Salado Habitat Restoration Area facility and trails	● Additional bus service would have no impact	No impact
	E15—Impact on wetlands, riparian habitats	● Use of buses means minimal impact to Rio Salado	○ Central Ave. bridge rehab to support tracks may cause impacts to Rio Salado	○ Central Ave. bridge rehab to support tracks may cause impacts to Rio Salado	○ Central Ave. bridge rehab to support tracks may cause impacts to Rio Salado	○ Central Ave. bridge rehab to support tracks may cause impacts to Rio Salado	● Use of buses means minimal impact to Rio Salado	No impact
6 – Land Use and Economic Development	LE16—Consistency with adopted local plans	● Support in past planning documents and specific area plans for HCT along Central Ave. and higher-intensity development at major intersections (potential station areas); plans focus highest transit investment along Central Ave.	● Similar to Alt. 1	● Similar to Alt. 1	● Less support in planning documents and specific area plans for HCT and higher-intensity development along 7 th Ave.; plans focus highest transit investment along Central Ave.	● Less support in planning documents and specific area plans for HCT and higher-intensity development along 7 th Ave.; plans focus highest transit investment along Central Ave.	● Less support in planning documents and area plans for HCT and higher-intensity development along 7 th Ave.; plans focus highest transit investment along Central Ave.	N/A
	LE17—Support for COP vision for urban villages	● Support for HCT along Central Ave. from South Mountain and Central City Village planning committees, but less for BRT than LRT	● Support for HCT along Central Ave. from South Mountain and Central City Village planning committees; highest support for LRT	● Support for HCT along Central Ave. from South Mountain and Central City Village planning committees, but less for MSC than LRT	● Alignment on 7th Ave. does not support Village vision and values as much as on Central Ave.; highest support for LRT	○ Alignment on 7th Ave. does not support Village vision and values as much as on Central Ave.; less support for MSC than LRT	○ Alignment on 7th Ave. does not support Village vision and values as much as on Central Ave.; less support for BRT than LRT	None
	LE18—Stimulation of redevelopment and infill in station influence areas	○ Typically less for bus than for rail investment	● Many opportunities for redevelopment (vacant parcels, underutilized land, poor building conditions, infill, neighborhood stabilization) within half-mile station influence areas	● Many opportunities for redevelopment (vacant parcels, underutilized land, poor building conditions, infill, neighborhood stabilization) within half-mile station influence areas	● Many opportunities for redevelopment (vacant parcels, underutilized land, poor building conditions, infill, neighborhood stabilization) within half-mile station influence areas	● Many opportunities for redevelopment (vacant parcels, underutilized land, poor building conditions, infill, neighborhood stabilization) within half-mile station influence areas	○ Typically less for bus than for rail investment	None
7 – Cost	C19—Capital cost/year (\$000) ^h	● \$4,040	○ \$18,430 - \$18,570	● \$14,660	○ \$24,147-\$24,287	○ \$19,184	● \$4,160	0
	C20—O&M cost/year (\$000)	● \$2,591	● \$9,441	● \$10,067	○ \$12,274	○ \$13,087	● \$3,368	0



Table 3 – Detailed Tier 2 Evaluation Matrix (continued)

Criteria/ Performance Measures		Evaluation of Alternatives						No-Build
		1 BRT— Central/1 st Ave. couplet under UPRR*	2 LRT—1 st Ave. in both directions under UPRR	2 MSC—1 st Ave. in both directions under UPRR	5 LRT—Detour via 7 th Ave. and Buckeye Rd.	5 MSC—Detour via 7 th Ave. and Buckeye Rd.	5 BRT—Detour via 7 th Ave. and Buckeye Rd.	
8 – Cost Effectiveness	CE21—Cost-Effectiveness (cost per HCT boarding) ⁱ	● Lowest cost and high ridership	● Highest ridership coupled with highest capital cost	○ High capital cost and highest operating cost; low ridership	● Highest ridership coupled with highest capital cost	○ High capital cost and highest operating cost; low ridership	● Lowest cost and high ridership	N/A
9 – Operating Efficiencies	OE22—Operating efficiencies (new O&M cost/ place mile of new service)	● \$0.12	● \$0.07	○ \$0.24	● \$0.07	○ \$0.23	● \$0.12	N/A
10 – Community Support	CS23—Community support ⁱ	○ High for alignment; low for mode	● High for alignment and mode	● High for alignment; low for mode	● Low for alignment; high for mode	○ Low for alignment; low for mode	○ Low for alignment; low for mode	Little or none

* Although, as explained in the text, LRT and MSC on Alignment 1 were not evaluated in Tier 2, they will be studied in future phases as part of the LPA.

^a Year 2031 forecast. Per the proposed FTA guidance, each trip by a transit-dependent person is counted twice in criteria M1 and CE 21. See discussion in the text.

^b Consists of a streetcar or LRV operating singly (for MSC); a train of one to three LRVs (for LRT).

^c LRT and BRT travel time assumes a corridor length of 5 miles (6.5 miles via 7th Avenue) and a travel speed of 18 mph. MSC travel time uses the same corridor lengths and a travel speed of 12.

^d Numbers are approximate because in two cases, the number of units is not available. These two projects would be served by all alternatives, however.

^e The number of local buses stopping daily at all stations, except existing LRT stations Downtown. All bus routes are assumed to operate 19 hours a day in 2031. Current peak period frequencies on Routes 7, 45 and 61 are assumed to apply all day in 2031.

^f BRT is assumed to operate in mixed traffic north of Buckeye Road.

^g Shows the number of historic properties adjacent to alignments. Proximity to HCT can have an adverse effect if it results in a direct or other adverse impact on those features of the property that make it historic. Simple proximity to HCT is not typically an adverse effect, and may be beneficial if the HCT increases resident and business interest in the community, thus potentially enhancing opportunities to restore rundown properties. Numbers are provided at this AA phase for comparison of where historic properties are concentrated. Actual effects would be evaluated during more detailed design phases.

^h Estimated infrastructure, facility and vehicle costs in 2012 dollars. Costs of acquiring right-of-way are not included. Ranges reflect 2-lane and 4-lane options for Central Avenue crossing over Salt River. Amortization of capital costs is based on a 12-year life for buses, a 25-year life for rail vehicles, and a 30-year life for fixed facilities.

ⁱ Comparisons in the matrix refer to the three modes.

^j Out of 75 respondents who expressed a preference (using feedback forms) through early December 2012, 52 prefer LRT, 10 MSC and 13 BRT.

Source: Valley Metro project team

Table 4 – Tier 2 Evaluation Summary Matrix

Criteria	Evaluation of Alternatives						
	1 BRT — Central/1 st Ave. couplet under UPRR*	2 LRT—1 st Ave. in both directions under UPRR	2 MSC — 1 st Ave. in both directions under UPRR	5 LRT — Detour via 7 th Ave. and Buckeye Rd.	5 MSC — Detour via 7 th Ave. and Buckeye Rd.	5 BRT — Detour via 7 th Ave. and Buckeye Rd.	No-Build
M1 —Mobility: Daily boardings ^a on project	● 9,000-11,000	● 11,000 or more	○ 4,000-6,000	● 11,000 or more	○ 4,000-6,000	● 9,000-11,000	No additional riders
M2-M4 — Mobility: all other criteria	● Relatively low vehicle capacity and limited regional connectivity; good travel time	● Highest vehicle capacity flexible train length, potential interline with other LRT lines; good travel time	● Moderate vehicle capacity, could interline with LRT if hybrid, but travel time 50% longer than LRT or BRT due to shared lanes, more stops	● Longer travel time than Alt. 2A, interline possible but with more engineering challenges	○ Similar to Alt. 2B, but much longer travel time due to detour via 7 th Ave., plus engineering challenges as great as Alt. 2A	● Similar to Alt. 1, but longer travel time due to detour via 7 th Ave.	No mobility benefits
A5-A8 —Access	○ Infrequent stops; population and employment less than 7 th Ave.	○ Infrequent stops; population and employment less than 7 th Ave.	● More frequent stops mean more access than other modes on Central	● Infrequent stops, but 7 th Ave. alignment reaches more people, jobs, facilities	● Combines access advantages of 7 th Ave. route and streetcar mode	● Infrequent access, but 7 th Ave. alignment reaches more people, jobs, facilities	N/A
T9-T10 —Traffic Impacts	● Minimal traffic conflicts, but capacity is lost with two-lane option	● Similar to Alt. 1 BRT, with short northbound detour and contraflow segment	○ Sharing of existing lanes means high conflict between transit and autos	● Similar to Alt. 2A, but with longer detour and more turns	○ Similar to Alt. 2B	● Similar to Alt. 1, but more turning movements cause some additional conflicts	No impact

Table 4 – Tier 2 Evaluation Summary Matrix (continued)

Criteria	Evaluation of Alternatives						No-Build
	1 BRT — Central/1 st Ave. couplet under UPRR*	2 LRT—1 st Ave. in both directions under UPRR	2 MSC — 1 st Ave. in both directions under UPRR	5 LRT — Detour via 7 th Ave. and Buckeye Rd.	5 MSC — Detour via 7 th Ave. and Buckeye Rd.	5 BRT — Detour via 7 th Ave. and Buckeye Rd.	
R11-R12— Right-of-way Impacts	● Moderate impacts expected if four traffic lanes are maintained	● Similar to Alt. 1 BRT	● Minimal impact	○ Greater than Alt. 2A due to new UPRR bridge and neighborhood impacts	● Substantial impact on nearby neighborhoods from new UPRR bridge	● Virtually the same as Alt.1, if BRT shares lanes from Buckeye Rd. north	No impact
E13-E15 — Environmental Impacts	● All alts. have similar overall impacts on historic, 4(f) and wetlands, habitats	● All alts. have similar overall impacts on historic, 4(f) and wetlands, habitats	● All alts. have similar overall impacts on historic, 4(f) and wetlands, habitats	● All alts. have similar overall impacts on historic, 4(f) and wetlands, habitats	● All alts. have similar overall impacts on historic, 4(f) and wetlands, habitats	● All alts. have similar overall impacts on historic, 4(f) and wetlands, habitats	No impact
LE16-18— Land Use and Economic Development	● Alignment supports community plans, but bus stimulates development less effectively than rail	● High consistency with plans and strong development potential due to mode and alignment	● Generally similar to LRT, but more stations could mean more development opportunities	● Not as consistent with land use and development plans as alignment that stays closer to Central Ave.	● Not as consistent with land use and development plans as alignment that stays closer to Central Ave.	○ Not as consistent with land use and development plans as alignment that stays closer to Central Ave.	No potential benefits
C19-20— Cost: annual capital and operating ^b	● \$6,000-\$8,000	● \$24,000-\$28,000	● \$24,000-\$28,000	○ \$32,000-\$37,000	○ \$32,000-\$37,000	● \$6,000-\$8,000	0
CE21 — Cost-Effectiveness	● High	● Medium	○ Low	● Medium	○ Low	● High	N/A



Table 4 – Tier 2 Evaluation Summary Matrix (continued)

Criteria	Evaluation of Alternatives						
	1 BRT — Central/1 st Ave. couplet under UPRR ^a	2 LRT—1 st Ave. in both directions under UPRR	2 MSC — 1 st Ave. in both directions under UPRR	5 LRT — Detour via 7 th Ave. and Buckeye Rd.	5 MSC — Detour via 7 th Ave. and Buckeye Rd.	5 BRT — Detour via 7 th Ave. and Buckeye Rd.	No-Build
OE22 — Operating efficiencies (FTA definition)	● \$0.12	● \$0.07	○ \$0.24	● \$0.07	○ \$0.23	● \$0.12	N/A
CS23— Community support	● Low for BRT mode but high for alignment	● High for mode and alignment	● High for alignment; low for mode	● High for mode; low for alignment	○ Low for mode and alignment	○ Low for mode and alignment	Little or none
Summary	● Relatively low cost and strong potential ridership, but little community support	● Offers strong community support, greatest ridership potential, economic development prospects and regional interlining	○ Less ridership than other modes; most severe traffic impacts; few mobility benefits versus local bus	○ Much greater cost than Alt. 2A; little additional ridership or community support for alignment	○ Similar to Alt. 2B, but with much higher cost	● Similar to Alt. 1, but detour raises costs and lowers ridership appeal; little support for alignment	No adverse effects, but also would not benefit local or regional mobility, or enhance economic development. Does not meet purpose of or need for project.

^a Although, as explained in the text, LRT and MSC on Alignment 1 were not evaluated in Tier 2, they will be studied in future phases as part of the LPA.

^a Year 2031 forecast. Per the proposed FTA guidance, each trip by a transit-dependent person is counted twice for mobility and cost-effectiveness.

^b In thousands of 2012 dollars. Right-of-way acquisition costs are not included.

Source: Valley Metro project team

In summary, the primary reasons for *not* choosing the BRT mode – despite its relatively low cost and high ridership potential – are:

- Lower predicted ridership than LRT
- Lack of operational flexibility to meet high peak travel demands efficiently
- Little history of stimulating desirable economic development and land use patterns
- Lack of ability to interline with other HCT in the region
- Low community support

Reasons for *not* choosing MSC include:

- By far the lowest predicted ridership of any mode
- Relatively high cost, causing poor cost-effectiveness
- Fixed guideway in mixed traffic brings operational, reliability and safety concerns
- More like existing local bus service than a vehicle to meet regional travel needs
- Ability to interline with regional LRT service is questionable
- Community support is lower than LRT

Reasons for *not* detouring service via the 7th Avenue alignment include:

- Excessive capital cost of bridging the UPRR at 7th Avenue (with LRT or MSC)
- The high cost of detouring brings little or no ridership gain, because the longer and less direct route discourages patronage
- May require excessive residential right-of-way acquisitions
- Central Avenue alignment is more compatible with local plans
- Central Avenue alignment brings equal or better development opportunities
- Alignment may complicate interline with existing and future LRT
- Relatively little community support

Based on the evaluation results and community support for LRT in the Central Avenue corridor, the Valley Metro team devoted the next phase of the AA to LRT alignment 2 (with 1 as a possible variant) as the “leading alternative,” or likely LPA, for the South Central Corridor. As the next chapter shows, this recommendation was investigated in more detail, shared with key agency and private stakeholders, and presented to the public.



6.0 Refinement of the Leading Alternative

6.1 Engineering Constraints

This section summarizes engineering barriers and constraints to the construction and operation of LRT along South Central Avenue (including 1st Avenue in the case of a one-way couplet). Obstacles such as low underpasses for highway and railroad bridge crossings, the structural integrity or capacity of bridges to handle large transit vehicles and infrastructure, utility relocations, and preservation of property access can delay design approvals, prolong construction, and add significantly to project costs. **Figure 15** illustrates the major challenges discussed in this section. Full details, including Valley Metro design standards for MSC and BRT as well as LRT (the leading modal alternative), can be found in the *Existing and Future Environment Report*.

Existing Street Configurations and Structures

Table 5 lists the roadway and right-of-way widths for the Central and 1st Avenue arterial segments. Each width displayed is the minimum width of the segment between the listed (east-west) cross streets. Where two numbers are displayed, such as 64/80, they refer to the roadway width or curb-to-curb distance (64 feet) and the total publicly owned right-of-way available (80 feet).

Table 5 – Existing Widths and Number of Lanes

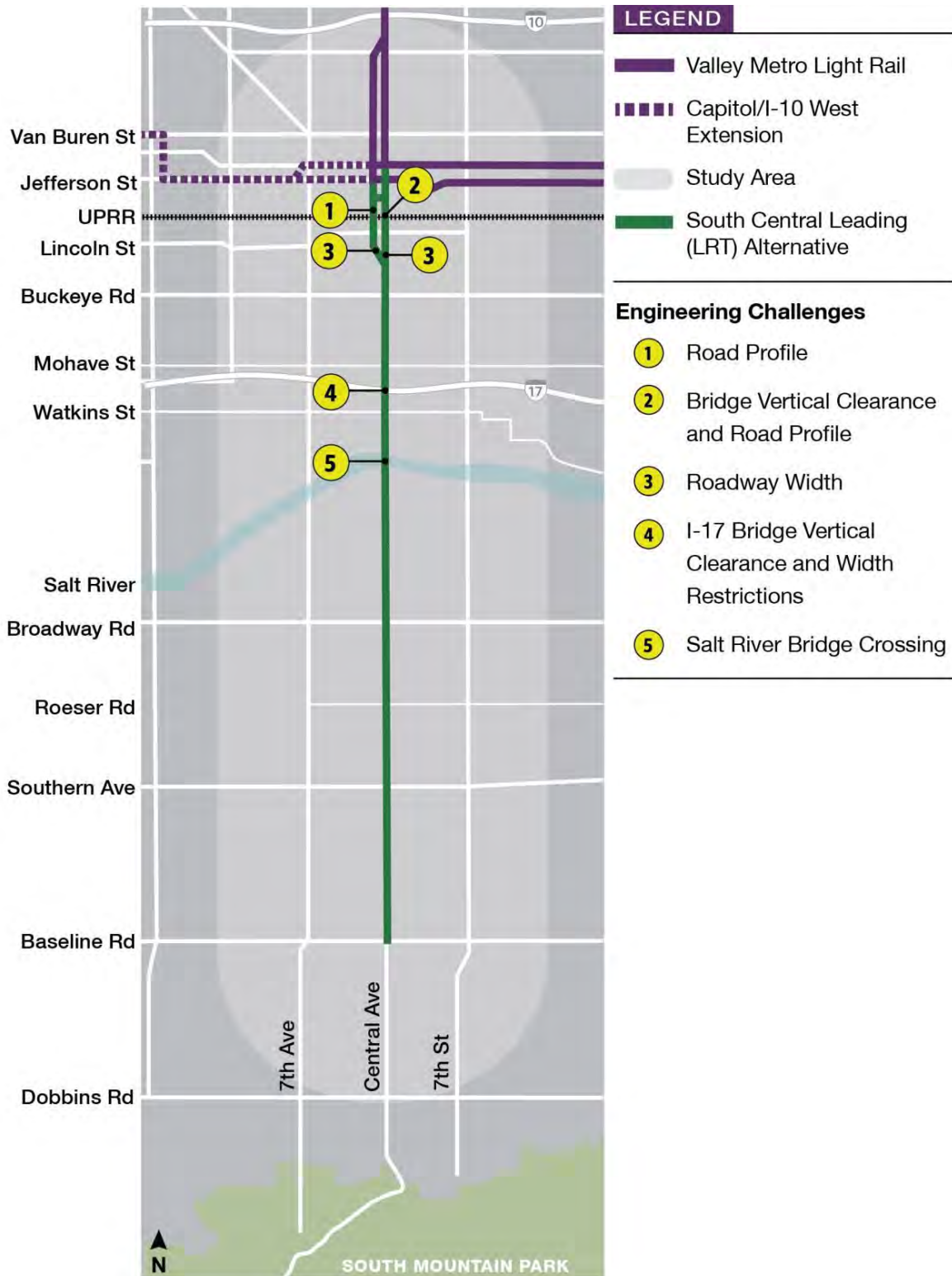
Roadway Segments	Typical Roadway Width/ Minimum Right-of-Way Width (feet)	
	1 st Ave.	Central Ave.
Jefferson St. to Lincoln St.	44 ¹	40 ¹
Lincoln St. to I-17	N/A	64/80
I-17 to Southern Ave.	N/A	76/100
Southern Ave. to Baseline Rd.	N/A	57/80
Roadway Segments	Number of Lanes	
	1 st Ave.	Central Ave.
Jefferson St. to Hadley St.	3 and 2 ²	3
Jefferson St. to Lincoln St.	N/A	N/A
Lincoln St. to I-17	4	4
I-17 to Baseline Rd.	4	4

¹Represents minimum right-of-way between Jefferson and Lincoln streets, where Central and 1st avenues pass under the UPRR and Jackson Street bridges.

²Between Jefferson and Hadley streets, southbound 1st Avenue contracts from three traffic lanes to two lanes south of Buchanan Street.

Sources: MAG and Valley Metro

Figure 15 – Major Engineering Challenges to Leading Alternative



The South Central Corridor also contains several bridges and underpasses. Jackson Street uses one pair of structures and the UPRR another to cross Central and 1st avenues on street-level bridges, with the two one-way, north-south streets passing below grade under the bridges. Farther south, I-17 uses an overpass to cross Central Avenue, and Central Avenue bridges the below-grade channel of the Salt River. The existing widths and vertical clearances of each bridge are provided in **Table 6**. (Vertical clearance refers to the vehicle height, including load, that can safely fit between the roadway surface and any overhead obstruction. According to *A Policy on Geometric Design of Highways and Streets* by the American Association of State Highway and Transportation Officials, the vertical clearance of all structures above the traveled way and shoulders should be at least one foot greater than the legal vehicle height.)

Table 6 – Existing Roadway Width and Vertical Clearance at Grade Separations

Bridge	Typical Roadway Width (feet) at Bridges	
	1 st Ave.	Central Ave.
UPRR and Jackson St.	44'	40'
I-17	N/A	104'
Salt River	N/A	64'
Bridge	Bridge Vertical Clearance (feet and inches) ¹	
	1 st Ave.	Central Ave.
CityScape (pedestrian)	N/A	13'-6"
UPRR and Jackson St.	15'-2"	14'
I-17	N/A	13'-11" to 14'-10" ²

¹Absolute minimum for LRT is 14 feet, 6 inches, according to Valley Metro design standards.

²The number is highest at the sides of the roadway and lowest at the center. LRT needs to be side-running at this location due to the 2% roadway crown, which provides adequate clearance at the sides, but not the median. LRT vehicle crossover can be accomplished with special intersection design and LRT-only signal phases.

Source: MAG

UPRR and Jackson Street Bridges over Central Avenue

The existing 14-foot vertical clearance of the Central Avenue underpass below Jackson Street and the UPRR presents challenges for LRT, which requires an absolute minimum vertical clearance of 14 feet-6 inches, according to Valley Metro design guidelines. Thus, the roadway grade would need to be lowered by at least six inches. This would in turn require lowering the profile (vertical alignment with respect to the adjacent terrain) of the roadway slope approaching the underpasses.

Additionally, the bridge pier structures and retaining wall embankments on the east and west sides of each bridge narrow Central Avenue significantly. Between Buchanan and Madison streets, the underpass entrances measure 45 feet wide, whereas the typical

width of Central Avenue is 64 feet. This width narrows further in the underpass, where the bridge embankments include sidewalks on both sides of the road and stairs for pedestrian access beneath the bridge structures. Within the portals, the roadway is approximately 40 feet wide, including a pier in the middle of the street that physically splits the three northbound lanes. However, this width may be sufficient to accommodate one LRT track if the number of general traffic lanes is reduced.

Further complicating the expansion or alteration of these bridges are the existing structures directly above them. The build lines of these properties abut the roadway right-of-way. Modifications to the underpasses or bridges, such as widening the roadway or lowering the profile to accommodate LRT, could affect these structures. Roadway widening could compromise the structural integrity of the buildings, likely requiring the acquisition of these parcels and demolition of the structures.

Just north of the UPRR and Jackson Street bridges, the CityScope development includes a pedestrian bridge above Central Avenue linking two sides of the complex. The vertical clearance of this bridge is 13 feet-6 inches, one foot less than Valley Metro's current design standard for LRT. LRT can functionally operate within a 13 foot-6 inch clearance; however, if desired a non-essential portion of the bottom of the bridge could be removed for additional clearance.

UPRR and Jackson Street Bridges over 1st Avenue

The alternative to using the Central Avenue underpass for the northbound LRT track is to place both tracks on 1st Avenue beneath Jackson Street and the UPRR. This option also presents challenges, although they appear less intractable than the vertical clearance issue at the Central Avenue underpass. At the intersection of Madison Street and 1st Avenue, the traffic lanes have a seven percent slope. Raising the southbound trackway to meet the Valley Metro maximum design standard of six percent (maximum) is one option, if this does not interfere with the vertical clearance requirements of the bridges. Conversely, a northbound (contraflow) trackway on 1st Avenue would incline at a six percent slope before turning east on Madison Street. This incline, although feasible, would combine with the subsequent turn onto Madison Street to slow LRT operating speeds. Moreover, LRT along 1st Avenue would likely require that the vertical profile and drainage near Madison Street be adjusted to meet current drainage standards.

Several additional feet of right-of-way width may be required under these bridges if both the northbound and southbound LRT tracks are built on 1st Avenue. Additional right-of-way is also expected to be needed along 1st Avenue in the transitional area between Grant and Hadley streets, even if the northbound LRT track is placed on Central Avenue under the UPRR and Jackson Street.

Central Avenue, Hadley Street to I-17

On its two-way segment from Hadley Street to I-17, Central Avenue's existing right-of-way width is insufficient for LRT, *if the existing number of general traffic lanes is maintained*. Here the typical width of Central Avenue is 64 feet (curb-to-curb) within 80 feet of right-of-way. Currently, this portion of Central Avenue contains four traffic lanes (and a two-way left turn lane), which are flanked by northbound and southbound striped bike lanes. Two LRT tracks would require an additional 18 feet of right-of-way, or 98 total (80 + 18), to keep the existing two travel lanes per direction, as currently envisioned for the segment from Downtown to I-17.

Additional right-of-way would be necessary at signalized intersections, particularly if an LRT station is located at the intersection (e.g., Buckeye Road or Lincoln Street). The design criteria and minimum width requirements (pursuant to Americans with Disabilities Act design standards) for station platforms would require additional street space for either a center platform or side platform station. Most of the current CP/EV line stations on Central Avenue are center platform stations, requiring the trackway to flare slightly outward approaching stations. This affects the configuration of the through travel lanes, requiring them to flare out at intersections as well. The need to maintain left turn bays, through lanes, bike lanes and sidewalks requires additional right-of-way width at intersections. Along Central Avenue south of Downtown, some properties have build lines at the edge of the current right-of-way. Even without a station at these intersections, the roadway must flare out to accommodate left turn bays.

Implementation of LRT along Central and 1st avenues using a semi-exclusive guideway between Jefferson Street and I-17 would result in access modifications to adjacent properties. Implementation of LRT or BRT in a semi-exclusive guideway would require traffic to make U-turns at major intersections for indirect access to abutting land uses and minor streets. It may be possible to implement mid-block left turns across the trackway, but this would likely require additional right-of-way and signal protection. A detailed evaluation of traffic and access to properties will be necessary once the alignment design is specified. Modifications to access may also have property acquisition implications.

Central Avenue Underpass at I-17

Approximately one mile south of the UPRR, I-17 passes above Central Avenue. The overpass is 104 feet wide, with a 14 feet-10 inch vertical clearance (4 inches more than the absolute minimum for LRT) above the exterior traffic lanes. No central pier supports the freeway bridge, allowing more design flexibility than would be available if a central pier existed. Thus, it would be possible to operate trains in the exterior traffic lanes with minimal alteration to the existing street. However, lowering the roadway grade by more than 7 inches would be necessary for LRT to operate beneath the center of the bridge, where the vertical clearance is only 13 feet-11 inches. This difference in clearance is

based on the “roadway crown” – a roadway drainage design feature to channel rain water to storm drain outlets.

Central Avenue, I-17 to Baseline Road

Central Avenue spans the Salt River on a 2,000-foot bridge. This bridge has four traffic lanes, bicycle lanes on both sides, and sidewalks, separated by concrete barriers. An analysis of the structural integrity and ability to support the weight of an LRT system determined that the bridge is structurally capable of supporting the tracks and vehicles, but would require significant bridge deck reconstruction. Construction of a two-way, dedicated LRT trackway would require removal of a portion of the bridge deck without disturbing the piers and converting the interior traffic lanes to LRT tracks. This would permanently reduce the number of lanes on the bridge to one northbound and one southbound for non-rail vehicles.

The project team evaluated the use of bridge plinths and ties on the Salt River Bridge for LRT as a means of saving cost on the reconstruction of the bridge, but the current deck structure is not capable of supporting the deadweight of plinths and ties plus the periodic weight of LRT vehicles. However, the bridge deck can be retrofitted to support LRT by strengthening the superstructure, abutments, and pier supports. Design concepts will be identified later during project development.

South of the Salt River, Central Avenue is a commercial business corridor, with small and medium businesses supported by surrounding residential neighborhoods. Along the corridor, left turn bays have been provided to allow access at mid-block cross streets connecting with adjacent neighborhoods. The numerous curb cuts, left turn bays, and driveway access points benefit businesses by providing enhanced access, although they impede mobility along Central Avenue by reducing the level of access management. An LRT alignment operating on Central Avenue between I-17 and Baseline Road must be sensitive to the resulting limitations on left turns and alterations to business access points. Modifications to access may also have property acquisition implications.

The remarks under “Central Avenue, Hadley Street to I-17” on the need for additional right-of-way at intersections and stations apply equally to this segment of Central Avenue. As Table 5 above indicates, at Southern Avenue the (minimum) existing right-of-way contracts from 100 to 80 feet. Therefore, the impacts of adding two LRT tracks to Central Avenue will likely be greatest on the southernmost mile, from Southern Avenue to Baseline Road – even if the number of general traffic lanes is reduced from two to one in each direction, as one current LRT development scenario contemplates.

6.2 Input from the Community

Community Working Group (CWG)

Background

The purpose of the CWG was to incorporate the views of selected South Central Phoenix stakeholders in the detailed LPA, arising from the leading alternative recommended after the Tier 2 evaluation. The CWG met monthly for six sessions during the spring and summer of 2013. Meetings were held the third Wednesday of the month, in the early evening, to maximize participation. Invited participants included, but were not limited to:

- Representatives of local businesses, both large and small
- Local residents
- Not-for-profit community and social service organizations
- Educational institutions and school districts
- Chambers of commerce
- Faith-based organizations

Appendix A lists the members of the CWG. Each meeting consisted of a brief recap of previous sessions, a presentation of new material, and either an open-ended discussion or a guided exercise, depending on the topic. The Valley Metro team emphasized the importance of reaching a consensus on specific recommendations to guide the technical work.

The CWG discussed the following components of the LPA, in accordance with the agenda prepared for each meeting:

- Lane configuration (primarily, two versus four through traffic lanes on Central Avenue)
- Station locations (using extensive prior work by the Valley Metro team, including a study of adjacent development potential at four prime station locations and a half-day station area planning workshop)
- Transit connections
- Park-and-ride locations
- Other physical and operational elements of the proposed LRT system

CWG Recommendations by Topic

Lane Configuration

- Maintain the existing two general traffic lanes per direction from Downtown Phoenix to approximately Watkins Street (south of I-17).
- From Watkins Street to Baseline Road, confine automotive traffic to one lane per direction, thereby allowing LRT to occupy part of the existing Salt River bridge (once reinforced for rail). *This recommendation remains subject to further technical analysis before the final roadway configuration can be determined.*

Station Locations

- CWG members were asked to vote on their primary and secondary station location preferences. The most preferred locations were at the four intersecting arterial streets coinciding with the Phoenix mile grid: Buckeye Road, Broadway Road, Southern Avenue, and Baseline Road. However, the Audubon (Pulliam) Center and Roeser Road received many secondary votes, with Lincoln Street placing third in this category.
- Explore a station at Audubon because of the high redevelopment potential of adjacent land, and to improve recreational access to a regional attraction.
- Investigate Roeser Road because it has a bus route and a station would serve a substantial transit-dependent population.
- Consider Lincoln Street because of its high redevelopment potential.
- Consider Watkins Street as a less isolated, north-of-the-river alternative to the Audubon Center.

The CWG's recommendation for stations at the four east-west arterial streets supports the results of the Valley Metro team's detailed work on station area development opportunities. This work included identification of existing land uses, redevelopment potential, and opportunities for transit-oriented development with a possible mix of higher-density uses at some locations. **Figure 16** shows an illustrative conceptual rendering of the proposed end-of-line station at Central Avenue and Baseline Road. Similar renderings were prepared for several major stations after a workshop involving diverse COP staff involved in transportation, community planning, economic development, and urban design.

Transit Connections

- Ensure convenient connections with east-west bus routes.
- Consider future route adjustments and circulator services to better connect the community with LRT.

Park-and-Ride Locations

- At minimum, consider a location at the proposed Baseline Road LRT terminus, to supplement the existing and planned facilities along Baseline at 27th Avenue and 24th Street. A park-and-ride at the terminus can capture riders early in their journeys.
- Consider also the availability of city-owned land near Ed Pastor Transit Center (to the west and southeast) for a park-and-ride.

Potential Extensions Suggested by CWG Members

- Consider extending the corridor south of Baseline Road, where more potential riders live (according to some CWG members).
- Extend into South Mountain Park, where some people feel that the development of new attractions could generate additional transit ridership.
- Consider an extension east on Baseline Road, to the planned 24th Street/Baseline park-and-ride or all the way to I-10.

Other

- Maintain bike lanes on Central Avenue and incorporate bike facilities, such as storage at park-and-rides, where applicable.
- Build consistency and continuity in median treatments.
- Consider other amenities in the street configurations to encourage a more active pedestrian environment. This might include a narrower street section and landscaped sidewalk setbacks.
- Consider installing a unique architectural feature as a gateway to the community.

Figure 16 – Illustrative Concepts of Central Avenue/Baseline Road Station Area



Other Community Involvement Activities

This summary, provided by the COP, describes highlights of the community involvement activities (other than the CWG) held throughout the South Central Corridor AA Study. From the outset of the study, Valley Metro and COP staff conducted extensive community and public outreach for the AA.

Valley Metro hosted four rounds of public meetings:

- Tier 1 (Initial Screening) – June 2012
- Tier 2 (Refined Screening) – October 2012
- Tier 2 Results – March 2013
- Recommended LPA – October 2013

Two meeting options were offered during each round, one in the northern part of the study area (Academia del Pueblo Elementary School) and farther south (South Mountain Community Center). All meetings were held in the early evening to maximize attendance. Each meeting included an open house at which Valley Metro team members circulated among attendees, interpreted display boards, answered questions, and encouraged public input. Approximately half an hour into the meeting, Valley Metro delivered a PowerPoint presentation, followed by questions and answers.

In addition to public meetings, City of Phoenix and Valley Metro staff attended and presented study information at numerous community events and organizations. **Appendix B** provides a list of the organizations, meetings, and events. As the appendix shows, staff met with some organizations and attended some events more than once.

At all public meetings and events, Valley Metro gave attendees a Project Update newsletter and asked them to complete a feedback form so staff could incorporate their input into the AA study. Valley Metro received more than 200 feedback forms throughout the process.

Valley Metro staff used traditional and non-traditional means of communication to promote the public meetings. Two weeks before each round of meetings, over 13,000 door hangers were distributed along the alignment. Fliers, e-mails and social media were also used. Staff worked with various community and business groups in the study area to inform stakeholders of the public meetings. The meetings also earned print, television, and social media coverage in both English and Spanish media outlets.

All meeting notifications, study documents, and presentation materials were provided in both English and Spanish. A Spanish language translator was available at all public meetings.

In addition, the Valley Metro team met biweekly with COP staff through most of the project. COP representatives were involved in decision-making as equal partners with Valley Metro. Participating departments varied, but typically included the City Manager's Office, Community and Economic Development, Planning and Development, Public Transit, Street Transportation, and the Village Planners for the Central City and South Mountain villages.

Conclusion

The results of the community feedback received at the public meetings, community events, stakeholder meetings, and CWG sessions showed strong support for LRT on Central Avenue from Baseline Road to Downtown Phoenix. On the basis of this support and the technical evaluation of alternatives, the Valley Metro team recommended this for adoption as the LPA.

As the AA study concludes in early 2014, Valley Metro staff will host additional community and business-related meetings to further discuss details of the project, including street configurations, bike lanes, landscaping, station locations, and park-and-rides, with the intent to finalize the AA, identifying project funding and preparing the South Central Corridor for inclusion in the RTP. Amendment of the RTP to include this major project will require approvals by the Phoenix City Council, the Valley Metro Board, MAG, and the State of Arizona.

6.3 Traffic Analysis

Methodology

The traffic analysis focused on traffic flow changes along 7th Avenue, Central Avenue, and 7th Street between Washington Street and Baseline Road. The assessment included an evaluation of estimated 2035 PM peak traffic volumes and projected traffic diversions due to a proposed reduction in the capacity of part of Central Avenue. The PM peak period was assumed to be the time of day with the heaviest traffic. The analysis compared two scenarios:

- **Scenario 1:** *2035 No-Build* – This scenario used the existing roadway number of lanes and traffic projections due to growth in the region and the study area to 2035. (The new version of the MAG travel demand model, on which the traffic analysis and LPA ridership forecasting were based, treats 2035 as the horizon year.)
- **Scenario 2:** *2035 Build, LRT with hybrid lane configuration on South Central Avenue (Build Hybrid)* – This scenario used the No-Build (same as existing) number of lanes for 7th Avenue and 7th Street, and added LRT along South Central Avenue to Baseline Road. *It assumed that Central Avenue will retain its*

current number of lanes from Downtown to a point just south of I-17 (e.g., Watkins Street), but will narrow to one general traffic lane in each direction south of that point, in order to accommodate LRT with minimal right-of-way acquisition and a strong orientation toward transit and non-motorized transportation. This is meant as a worst case scenario, since subsequent studies may determine that the existing number of general traffic lanes should be retained throughout the corridor. The 2035 model reflects the reduction in private vehicle capacity between Watkins Street and Baseline Road by diverting to 7th Street and 7th Avenue some of the traffic that would otherwise have used Central Avenue.

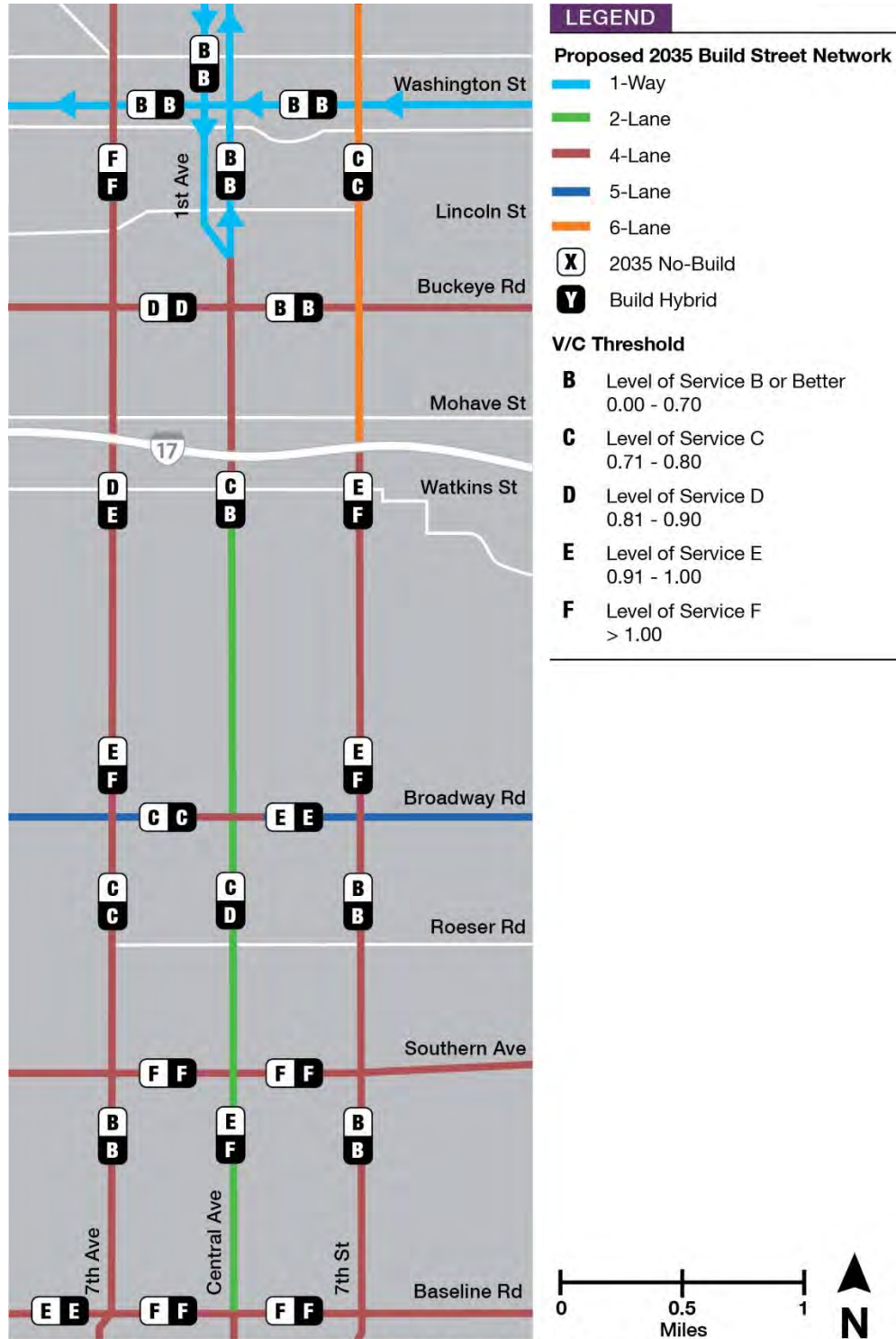
To understand the transportation impacts of the this project, a planning-level roadway segment level of service (LOS) analysis was conducted. An LOS of D or better – generally considered acceptable under urban conditions – is characterized by a volume to capacity ratio (V/C) of 0.90 or less. Congested levels of service reflect V/C of 0.91 to 1.00 (LOS E) or greater than 1.00 (LOS F).

Results

Analysis results are presented in the next three figures. **Figure 17** shows forecast 2035 PM peak hour LOS on major north-south and east-west streets under scenarios 1 (No-Build) and 2 (Build Hybrid). No-Build results are in the white boxes and Build results in the black ones. Some levels of service on Central Avenue, 7th Avenue and 7th Street decline by one level (from C to D, D to E, or E to F), if LRT is built on South Central Avenue and takes two traffic lanes in the southern portion of the corridor.

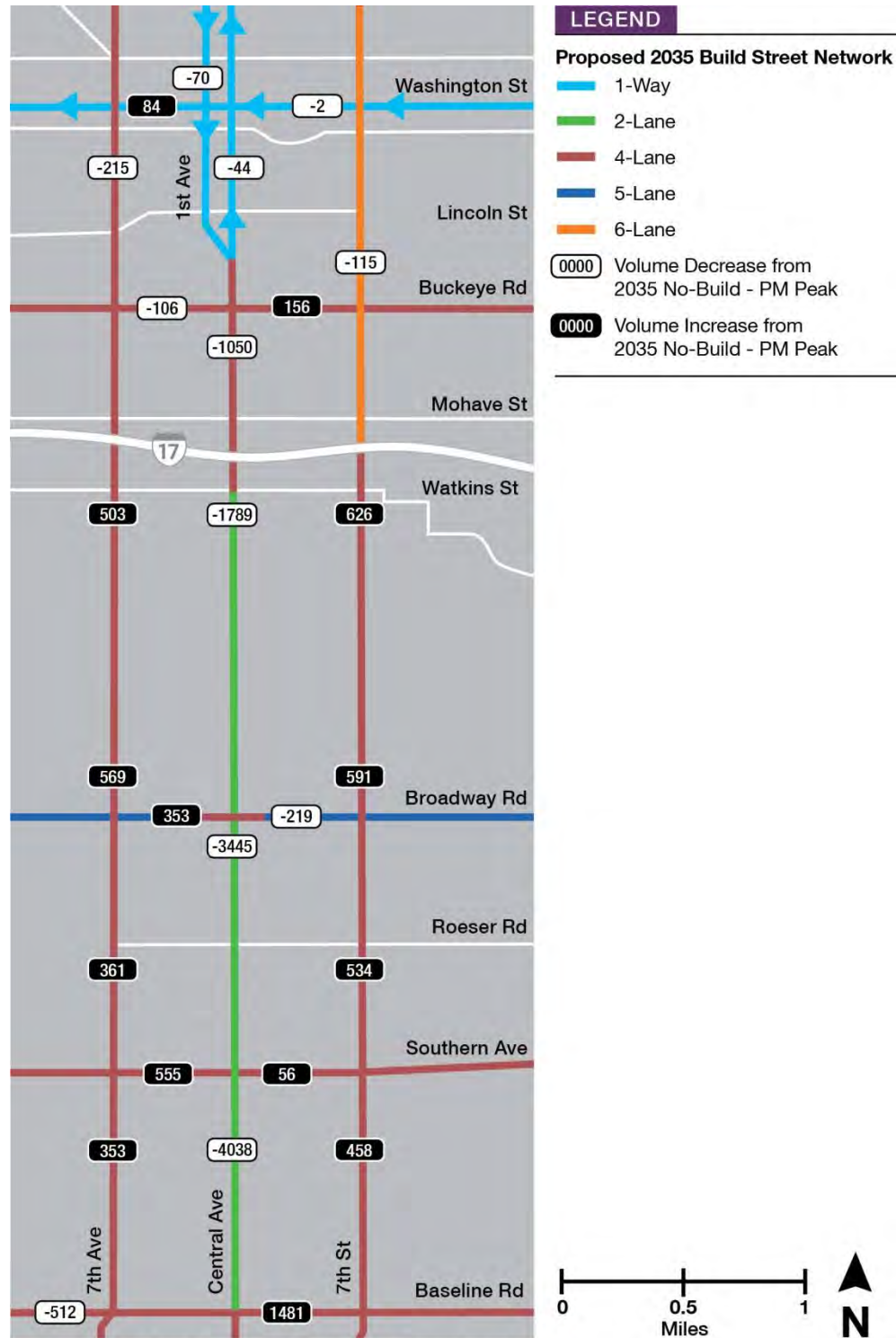
Figures 18 and 19 illustrate the Scenario 2 (Build Hybrid) increase or decrease in 2035 PM peak hour traffic from Scenario 1 (No-Build). Figure 18 shows the absolute change in number of vehicles, while Figure 19 shows the percent change. White boxes represent a decrease in traffic and black boxes signify an increase. The largest absolute and relative changes (decreases) are expected on Central Avenue south of I-17, as a result of the reduction in auto capacity along this segment. Traffic increases on 7th Avenue and 7th Street south of I-17 represent diversion from Central Avenue. However, the combined increases on the two parallel arterials are considerably lower than the corresponding decreases on Central Avenue, *suggesting that LRT would divert to transit some journeys that would have been made by auto under No-Build conditions.*

Figure 17 – Forecast Year 2035 Roadway Segment PM Peak LOS: No-Build and Build Conditions



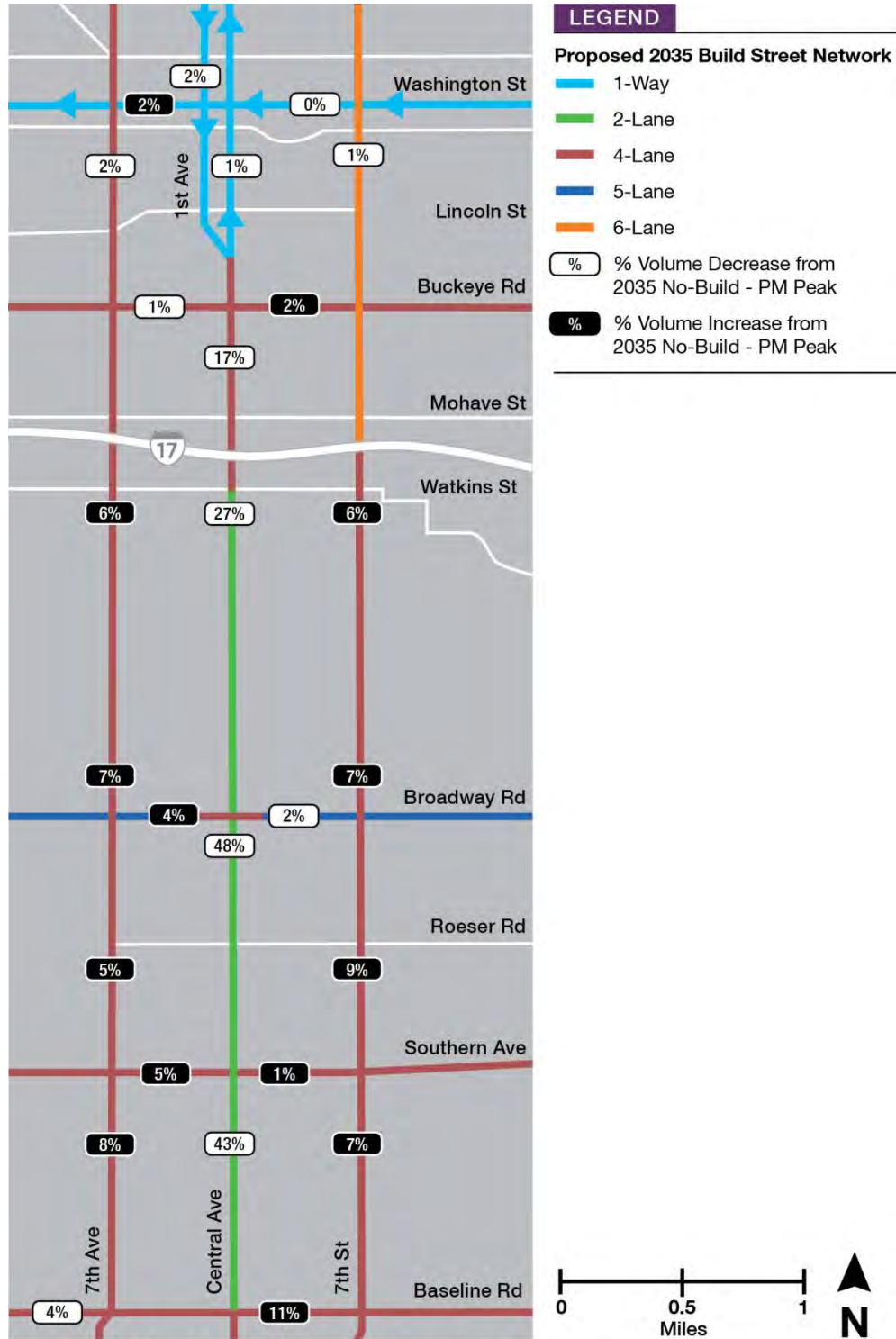
Source: METRO Travel Demand Model V/C (Volume to Capacity), December 2013

Figure 18 – Year 2035 LRT Build Scenario: Forecast PM Peak Hour Traffic Volume, Absolute Change from No-Build Condition



Source: METRO Travel Demand Model Volumes, December 2013

Figure 19 – Year 2035 LRT Build Scenario: Forecast PM Peak Hour Traffic Volume, Percent Change from No-Build Condition



Intersection Impacts

This study also reviewed the impacts of 2035 Scenario 2 (Build Hybrid) at two major intersections along South Central Avenue: Broadway Road and Baseline Road. These are two of the three busiest intersections on Central Avenue south of the Salt River. Broadway Road was selected because of its strategic location at the South Mountain Village core, as well as the many bus movements at the Ed Pastor Transit Center. (Today approximately 37 buses use the center or the intersection in the PM peak hour.) Baseline Road was selected as the most likely initial terminus of the LRT extension, which would require either a turnaround or an on-street reversal of trains. For each location, the Synchro® software Version 8 was used to evaluate PM peak hour LOS under three conditions: existing 2013, 2035 Scenario 1 (No-Build), and 2035 Scenario 2 (Build Hybrid). Although the traffic analysis generally assumed that signals will remain at their existing locations, strategically located roundabouts will be considered as part of the final roadway configuration.

The results show the same bottom line at both intersections: a 2013 PM peak LOS of C and a 2035 LOS of E under both the No-Build and Build Hybrid conditions. At Broadway Road, the average vehicle intersection delay is forecast to be five seconds (eight percent) higher under the Build Hybrid than the No-Build condition. Intersection delay at Baseline Road is actually forecast to be lower under the Build Hybrid than the No-Build scenario, possibly because of the reduced traffic volume on South Central Avenue. These estimates are based solely on the entering volumes and lane configurations of each intersection; they do not reflect possible effects of on-street LRT operations on auto traffic. Interactions between rail and automobile traffic will be addressed in later study phases. These phases will also contain traffic analyses of all signalized intersections along the proposed LRT route.

7.0 Recommended LPA

7.1 Summary

The recommended LPA consists of two LRT tracks extending generally along Central Avenue south from Downtown Phoenix (near the existing LRT turns at Washington and Jefferson streets) to Baseline Road, a distance of just under five miles. From Downtown to the existing Central/1st Avenue merge near Hadley Street, however, the southbound track would continue on 1st Avenue. From Hadley Street to Madison Street, the northbound track might be located on either 1st Avenue or Central Avenue, depending on the results of subsequent engineering, traffic, and right-of-way studies. If the northbound alignment lies on 1st Avenue in this area, it would require LRT operation against the flow of (one-way southbound) auto traffic. Further, Valley Metro would have to design and build a northbound LRT transition from Central Avenue to 1st Avenue. Northbound LRT would return to Central Avenue via Madison Street.

On the two-way portion of Central Avenue from Hadley Street to Baseline Road, both tracks would be located in the median of the street. Exceptions might occur at the I-17 underpass due to the roadway crown, and on the Salt River bridge. This bridge would have to be reinforced, as described in Section 6.1. LRT would operate along the entire alignment in a dedicated guideway, with other vehicles able to make left turns or U-turns across the tracks only at designated locations under signal protection.

Stations are proposed at or near intersections with the four arterial cross-streets: Buckeye Road, Broadway Road, Southern Avenue, and Baseline Road. Valley Metro is also exploring a station at one collector, Lincoln Street, with high neighborhood redevelopment potential. In subsequent phases of the project, additional stations will be considered at three locations: Watkins Street, the Nina Mason Pulliam Audubon Center, and Roeser Road. It is envisioned that a station may be provided at either Watkins Street or the Audubon Center, but not both. South Central stations, like those along existing LRT, will be built to accommodate three-car trains. Station configuration details (e.g., split platforms versus two-way center platform, north versus south side of the intersection) will be determined in the design phase. Other aspects to be established in later phases include location, size, and design of park-and-ride lots; interaction with access modes at each station; more detailed station area planning (by the COP); and interlining with other existing or planned LRT lines. **Figure 20** shows the envisioned gross characteristics of the proposed LPA.

Finally, while not a part of this project, possible extensions both east and west along Baseline Road and south toward South Mountain Park have been proposed for future study. An eastward or westward extension could bring HCT to additional communities and connect with park-and-rides at South 27th Avenue and South 24th Street. Some community members are strongly interested in a transit link to the recreational amenities of South Mountain Park via Dobbins Road.

Figure 20 – LPA Characteristics





7.2 Planning-Level Capital Cost Estimates

Valley Metro has prepared preliminary, planning-level capital cost estimates for two versions of the LPA: the Build Hybrid scenario described in Chapter 6, and a Build Four-Lane scenario preserving four through traffic lanes (two per direction) all the way from Downtown Phoenix to Baseline Road.

Table 7 lists some of the chief assumptions that were used to calculate capital costs of the proposed project under each South Central Avenue scenario. An annual inflation rate of three percent was assumed from now until the midpoint of a three-year construction period, a milestone assumed to be reached in mid-2024.

Table 7 – Selected Assumptions Used in Capital Cost Estimates

Category	Assumption
<i>Communications</i>	Based on Central Mesa LRT Extension; assume Supervisory Control & Data Acquisition,
<i>Environmental mitigation</i>	Potential mitigations, such as hazardous materials, are not included.
<i>Guideway</i>	Rail and track slab based on Gilbert Road extension in Mesa.
<i>Maintenance and support facilities</i>	Assumes no additional cost; use existing facilities with no expansion necessary.
<i>Noise and vibration</i>	Includes no costs for noise or vibration dampening.
<i>Parking</i>	Costs not included.
<i>Professional services</i>	Assumptions are based on recent Valley Metro experience.
<i>Public art</i>	Accounted for as 1% of construction cost.
<i>Right-of-way</i>	Planning-level costs based on rules of thumb; details to be established in subsequent study.
<i>Site civil – 2-lane/4-lane hybrid option</i>	Assumes significant sidewalk widening and landscaping on either side of the street, plus two roundabouts.
<i>Site civil – Full 4-lane option</i>	Assumes significant landscaping in the median.
<i>Special trackwork near LRT junctions</i>	Includes only trackwork necessary for South Central extension; does not include custom work at 1 st Avenue/Jefferson or Central/Washington.
<i>Stations</i>	Assumes \$2 million per platform.
<i>Track drains</i>	For mitigating storm water in selected areas only.



Table 7 – Selected Assumptions Used in Capital Cost Estimates (continued)

Category	Assumption
<i>Track mileage</i>	Includes all track proposed as part of the project, but no track that already exists as part of CP/EV, nor additional track to accommodate future extensions beyond Baseline Road.
<i>Traction power substations</i>	Assumed as one substation every route mile and \$1.5 million per substation.
<i>Train control</i>	Train signals and train-to-wayside communication loops will be provided where required.
<i>Unallocated contingency</i>	Assumed to be 15% of total project costs exclusive of professional services
<i>Utilities – Public</i>	Costs provided as a per-mile allowance.
<i>Utilities – Third-party</i>	Estimated per Valley Metro standards that assume utilities within the restricted utility area will be relocated.
<i>Vehicles</i>	Will match the existing Kinkisharyo fleet, with price escalated to year of expenditure.
<i>Year of expenditure</i>	Assumes 2025 opening year with three-year construction period; cost escalates 3% a year to midpoint of construction (mid-2024)

Source: Valley Metro, February 2014

Table 8 provides the capital cost summary in millions of year-of-expenditure dollars (assumes first year of revenue operations in 2025). The largest share of the cost for both options would be attributable to the following categories:

- Professional services (21 percent)
- Site work and special conditions (19 to 20 percent)
- Vehicles (12 to 13 percent)
- Guideway and tracks (12 percent)
- Systems (11 to 12 percent)
- Unallocated contingency (13 percent)

Opting for Build Four-Lane instead of Build Hybrid would add an estimated 14 percent to the cost of building the LPA.



Table 8 – South Central LPA Estimated Capital Costs (millions of year-of-expenditure dollars)¹

Capital Element	Roadway Configuration Option	
	Build Hybrid	Build Four-Lane
<i>Guideway and tracks</i>	\$54.131	\$61.452
<i>Stations, terminals, intermodal</i>	26.252	26.252
<i>Support facilities</i>	0	0
<i>Site work and special conditions</i>	91.612	99.923
<i>Systems</i>	56.422	56.644
<i>Right-of-way, land, existing improvements</i>	14.467	43.949
<i>Vehicles</i>	62.810	62.810
<i>Professional services</i>	99.273	109.354
<i>Unallocated contingency</i>	61.804	70.355
Total	\$466.771	\$530.739

1. Assumes first year of revenue operations in 2025

Source: Valley Metro, February 2014

8. New Starts Performance Evaluation

The current FTA New Starts evaluation criteria for major HCT projects, such as the recommended South Central LPA, give equal weight to project justification and local financial commitment. Ratings on each criterion are qualitative and range from low to high, with high representing the best performance.

The following criteria are weighted equally within the 50 percent share for project justification:

- Existing land use (covered in more detail in 8.1 below)
- Cost-effectiveness (covered in more detail in 8.2 below)
- Mobility improvement (covered in more detail in 8.3 below)
- Economic development
- Environmental benefits
- Congestion relief

The 50 percent based on local financial commitment is designed to ensure that the sponsoring agency, and the local jurisdictions it represents, can secure the necessary local funding for both capital costs and continuing operating costs of the transit investment. Local financial commitment is divided among three criteria:

- Current capital and operating condition (12.5 percent of the total)
- Commitment of capital and operating funds (12.5 percent)
- Reasonableness of estimates and assumptions (25 percent)

Evaluation of local financial commitment for the proposed South Central LPA cannot be performed until one or more local funding sources for the project are identified.

8.1 Existing Land Use

Table 9 summarizes the land use evaluation of the proposed LPA. Results are shown under both 2010 socioeconomic conditions and the average of 2010 and projected 2030 conditions. The resulting rating is Medium-Low for 2010 and Medium for 2010/2030.



Table 9 – New Starts Evaluation: Existing Land Use

Criteria	2010	2010/2030 Average
Employment rating	Medium	Medium
• Employees	109,400	131,600
Population density rating	Medium-Low	Medium
• Density (per square mile)	4,500	6,200
Parking cost rating	Medium	
• Average daily cost in Central Business District	\$10.64	
Parking supply rating	Low	
• Number of CBD spaces per employee	0.61	
Affordable housing rating	High	
• Proportion of affordable housing in corridor to county	6.50	
Land Use Rating	Medium-Low	Medium

Sources: MAG and City of Phoenix

8.2 Cost-Effectiveness

The FTA guidelines for cost-effectiveness ratings are based on annualized capital and operating costs divided by project boardings (unlinked passenger trips). Transit system costs are annualized in year-of-expenditure dollars using established life cycles for infrastructure, facilities, and equipment. The current FTA cost ranges are:

- High (best): Less than \$4.00 per boarding
- Medium-High: \$4.00 to \$5.99
- Medium: \$6.00 to \$9.99
- Medium-Low: \$10.00 to \$14.99
- Low (worst): \$15.00 or more

Table 10 summarizes the cost-effectiveness evaluation of the proposed LPA, with the number of dollars and annual boardings rounded to the nearest thousand. Results are shown for two modeled scenarios that differ in how South Central LRT is connected to the regional network. *Build Scenario 2.3* contains the No-Build LRT system, plus LRT in the South Central Avenue corridor from Baseline Road to Central Station, without interlining (i.e., a physical transfer would be required in Downtown Phoenix). *Build Scenario 2.4* adds interlining of the South Central LRT service with the existing CP/EV route from Downtown Phoenix north to 19th Avenue/Dunlap Avenue (using the 3.2-mile extension currently under construction). Under either Build scenario, the estimated cost-effectiveness of the South Central LRT is Low, whether based on hypothetical 2010 or average 2010/2030 ridership.



Table 10 – New Starts Evaluation: Cost-Effectiveness

Criteria	Year	
	2010	2010/2030 Average
Annualized capital and operating cost	\$41,784,000	\$41,784,000
Project boardings per weekday – Build Scenario 2.3	4,048	7,524
Project boardings per weekday – Build Scenario 2.4	5,862	8,431
Annual project boardings – Build Scenario 2.3*	1,218,000	2,265,000
Annual project boardings – Build Scenario 2.4*	1,764,000	2,538,000
Annualized cost per trip – Build Scenario 2.3	\$34.31	\$18.45
Annualized cost per trip – Build Scenario 2.4	\$23.69	\$16.46
Cost-Effectiveness Rating – Build Scenario 2.3	Low	Low
Cost-Effectiveness Rating – Build Scenario 2.4	Low	Low

*Based on an annualization factor of 301 weekday equivalents per year, consisting of actual weekdays plus weekends and holidays with lower ridership. Annual boardings are rounded to the nearest thousand.

Sources: MAG and Valley Metro project team

8.3 Mobility Improvement

The FTA performance measure for mobility improvement is the estimated number of annual boardings on the project, with boardings by transit-dependent persons counted twice. The established ranges are:

- High: At least 30 million
- Medium-High: At least 15 million but less than 30 million
- Medium: At least 5 million but less than 15 million
- Medium-Low: At least 2.5 million but less than 5 million
- Low: Less than 2.5 million

Table 11 shows the estimated daily and annual ridership of the proposed South Central LPA and its resulting FTA mobility rating. Results are provided for Build scenarios 2.3 and 2.4 under both 2010 and average 2010/2030 conditions. For the Mobility Improvement criterion *only*, project trips taken by transit-dependent riders are given double credit (counted twice), as Table 11 indicates. Under both Build scenarios, the FTA New Starts ratings are Low based on estimated 2010 ridership and Medium-Low based on the 2010/2030 average.



Table 11 – New Starts Evaluation: Mobility Improvement

Criteria	Build Scenario 2.3		Build Scenario 2.4	
	Year 2010	Avg. 2010-2030	Year 2010	Avg. 2010-2030
Actual project boardings per weekday (A)	4,048	7,524	5,862	8,431
Additional credit for transit-dependents (B)	1,336	2,483	1,934	2,782
Credited boardings per weekday (A + B)	5,384	10,007	7,796	11,213
Credited boardings per year*	1,621,000	3,012,000	2,347,000	3,375,000
Mobility Improvement	Low	Medium-Low	Low	Medium-Low

*Based on 301 weekday equivalents per year, consisting of actual weekdays plus weekends and holidays with lower ridership. Annual boardings are rounded to the nearest thousand.

Sources: MAG and Valley Metro project team

8.4 Project Justification Summary

Table 12 summarizes the currently estimated FTA ratings on the six project justification criteria. The overall ratings for these criteria are Medium-Low for 2010 and Medium for the average of years 2010 and 2030. Individual ratings range from Low to Medium.

Table 12 – Summary Evaluation: New Starts Project Justification Criteria

Criteria	2010	2010/2030 Average
Land Use	Medium-Low	Medium
Economic Development	Medium-Low	Medium-Low
Cost-Effectiveness	Low	Low
Environmental Benefits	Medium	Medium
Congestion Relief	Medium	Medium
Mobility Improvement	Low	Medium-Low
Overall Project Justification	Medium-Low	Medium

Source: Valley Metro project team

Appendix A Community Working Group Members

- Wendoly Abrego, Phoenix Revitalization Corporation
- Blanca Arrendondo, Hope VI
- Andres Contreras, Chicanos Por La Causa
- Margot Cordova, Friendly House
- Lupe Dominguez, St. Catherine of Sienna and St. Anthony's Churches
- Steve Glueck, South Mountain Laveen Chamber of Commerce
- Don Keuth, Phoenix Community Alliance
- Rosie Lopez, Resident
- Gaspar Mata, YMCA
- Pastor James Preston, Preston Funeral Homes/ Bethesda Community Baptist Church
- Elizabeth Pulido, Phoenix Elementary School
- Valerie Ramos, Audubon Center
- Victor Vidales, RE/MAX New Heights Realty/Resident
- Larry White, Lolo's Chicken and Waffles
- George Young, Target Area B/ South Mountain Village Planning Committee



Appendix B
Community Meetings and Events (held or scheduled as of
11/19/2013)

Organization or Event	Type	No. of Visits
Arizona Hispanic Chamber of Commerce	Business	1
Audubon Society	Community	1
Broadway Road Community Outreach Group	Business	1
Business Outreach Meetings	Business	2
Central City S. Community Connection Fair	Community Event	1
Central City Village Planning Committee	Community	3
Chicanos Por La Causa	Community	2
Del Rio Area Brownfields Planning Project	Community	1
District 8 Community Meeting	Community	1
Downtown Phoenix Inc.	Business	1
Downtown Voices Coalition	Community	7
Friendly House	Community	2
Friendly House Market on the Move	Community Event	1
Grant Park Holiday Celebration	Community Event	2
Grant Park Neighborhood Association	Community	1
Hope VI	Community	1
Hope VI/PRC Community Action Team	Community	3
Juneteenth	Community Event	2
Latino Institute Back to School Fair	Community Event	1
Lowell Elementary School	Education	1
Marcos de Niza Tenant Council Meeting	Community	1
NFL Yet Academy	Education	1
Phoenix Citizens Transit Commission	Community	4
Phoenix Community Alliance	Business	3
Phoenix Revitalization Corporation (PRC)	Business	3
Phoenix Union High School District	Education	1
Pilgrim Rest Baptist Church	Church	1
PRC Business & Faith Based Luncheon	Business	2
PRC/Central City South Tour	Business	1
St. Catherine of Sienna/St. Anthony's	Churches	1



Appendix B (continued)

Organization or Event	Type	No. of Visits
South Central GAIN	Community	1
South Mountain Festival of Thanksgiving	Community Event	2
South Mountain/Laveen Chamber of Comm.	Business	1
South Mountain/Laveen Fun Fest	Community Event	1
South Mountain Village Target Area B	Community	4
South Mountain Village Planning Committee	Community	4
Spirit of S. Mountain Community Awards	Community	1
Sustainable Communities Working Group	Community	1
Valle del Sol	Community	1
YMCA	Community	1