DESIGNING TRANSIT ACCESSIBLE COMMUNITIES study

June, 2013



Final Report

MARICOPA ASSOCIATION of GOVERNMENTS

Table Of Contents

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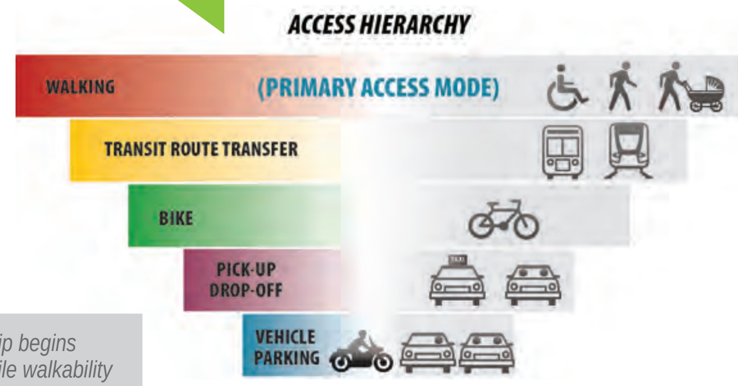
1.0 Introduction

Currently in the Maricopa Association of Governments (MAG) region, approximately 97 percent of all transit users approach the transit system by walking, biking, carpooling, or via kiss-and-ride; the remaining three percent drive alone and park in designated lots. Of all transit users, about 90 percent of them approach the system strictly by walking or bicycling. Regardless of the initial approach to transit, all connecting trips at the destination are made at the pedestrian level. Therefore, while there should be efforts to balance accessibility for all users, pedestrian connectivity should be addressed for all modes. Accessibility, for this study, is not defined as the ability to access transit service generally, but rather eliminating barriers transit patrons face as they access transit stops.

Typically, the average transit user is willing to walk one-quarter (¼) mile to a station or stop, although external factors can affect this distance. There are both soft and hard factors that affect the experience of the pedestrian transit user. Hard factors include the street design, land use, and frequency of transit service. Soft factors include weather protection, landscaping, social experience, and personal safety. MAG and its partners have conducted various previous studies related to transit user needs and transit facilities. Key studies include the Sustainable Transportation and Land Use Integration Study, the Regional Transit Framework Study, Regional Public Transit Authority (RPTA) Bus Stop Handbook (1993), Complete Streets Guide (2011), and the MAG Pedestrian Policies and Design Guidelines. The Designing Transit Accessible Communities Study (DTAC) is intended to augment findings and recommendations of these previous studies to provide guidance that can be utilized by agencies in the MAG region to improve the safety, comfort, and experience of pedestrians and bicyclists accessing transit.

"Transit Accessibility is… the segment of an individual trip that occurs between an origin or destination point and the transit system."

-Source: American Public Transit Association



"With rare exceptions, every transit trip begins and ends with a walk. As a result, while walkability benefits from good transit, good transit relies absolutely on walkability."

"These fixes simply give pedestrians a fighting chance, while also embracing bikes, enhancing transit, and making [downtown] living attractive to a broader range of people. Most are not expensive – some require little more than yellow paint. Each one individually makes a difference; collectively, they can transform a city and the lives of its residents."

- Source: Walkable City: How Downtown Can Save America, One Step at a Time, Jeff Speck, 2012

Jeff Speck outlines ten steps to walkability:

1. *Put cars in their place*
2. *Mix the uses*
3. *Get the parking right*
4. *Let transit work*
5. *Protect the pedestrian*
6. *Welcome bikes*
7. *Shape the spaces*
8. *Plant trees*
9. *Make friendly and unique building faces*
10. *Pick your winners*

An intercept survey was conducted at five case study locations during this project. Of those surveyed, 88% arrived via:

- walking (61%),
- bicycle (22%), or
- public transit (5%).

Important factors affecting transit accessibility are addresssed in this study and include:

- lighting
- information signage
- wayfinding
- seating
- shelter
- shading
- adjacent land use
- bicycle access
- bicycle parking
- pedestrian crossing
- sidewalk

1.1 Purpose of Study

Transit stops are the gateways to public transportation. Each one welcomes riders into the system and provides a transition point of entry into the community. The Valley Metro Fact Sheet (Issue 6, July 2009 – June 2010) indicates there are over 7,000 bus stops serving over 55.5 million bus boardings annually. Therefore, it is important that the bus stops provide a consistent, safe, and accessible environment. Currently, bus stops in the MAG region give riders mixed messages, depending on accessibility and how safe each stop feels. MAG and its partners understand that safe and accessible transit stops are an integral part of the public transit system. As such, MAG has initiated this study to furnish member agencies with additional tools and guidance to promote and sustain better planning associated with improving existing deficiencies and deploying future stops that are more accessible and supportive of adjacent neighborhood needs. Despite how transit patrons primarily arrive at a stop, in the end all are pedestrians. Thus, this study will focus on challenges faced by pedestrians and bicyclists as they access transit at the stop level. Goals of the study include:

- identify challenges faced by users getting to transit;
- recommend improvement concepts, polices, and guidelines to enhance transit accessibility;
- provide a toolkit of measures and strategies for local governments to create transit accessible and livable neighborhoods; and
- identify options and provide a regional framework for applying for federal grants.

1.2 Local & Regional Implementation Strategies

The resulting deliverable of this study is a regionally significant toolkit that provides guidance on best practices for designing transit accessible communities (see Chapter 6). The following list provides an overview of implementation strategies for local and regional agencies. These strategies should be considered when implementing multi-modal improvements in transit catchment areas and when addressing transit accessibility issues in future and existing programs. The strategies are divided into four primary categories: Prioritize, Outreach, Funding, and Policy and Guidance.

TABLE 1: Local & Regional Implementation Strategies

Local	Prioritize	*Identify the projects/locations that have the great need and put them in a plan. In the event that regional or federal grants are made available, it puts your agency in a greater position of competing for gaining funding when it is in a plan.*
		Identify gaps in the system. Accessibility is only as good as the weakest link.
		Start with "low hanging fruit" that can be implemented at a low nominal cost. Signs and paint can provide a great deal of utility to the transit user at a nominal cost.
	Outreach	*Talk to your clients. They are the individuals on the street waiting for transit. Conduct your outreach at the ground level. Be willing to experience transit as the local transit user.*
		Work with advocacy groups and businesses to understand the economic, social and health benefits of Transit Accessible Communities.
		Talk to your partners. Communicate with all those involved in the decision making process in order to maximize everyone's expertise.
	Funding	*Identify discretionary funding sources to utilize in joint projects when they do occur. Improvements are less costly when done at the time of the retrofit and redevelopment, even if the agency has to pay for the cost. A small budget can go a long way in those situations.*
	Policy and Guidelines	*Incorporate guidelines or codes that can leverage improvements from new or redevelopments such as additional easements or right-of-way.*
		Review, analyze and update codes to support livable communities (DTAC, Complete Streets, Transportation Master Plan, etc.)
Regional	Prioritize	*Prioritize regional transit accessibility corridors and neighborhoods.*
		Incorporate strategies and projects into the Regional Transportation Plan.
		Identify conflicts between current policies and transit accessibility design concepts.
	Outreach	*Continue regional best practices workshop discussions and outreach efforts.*
		Coordinate with agency staff and leaders to align local policies with transit accessible design concepts.
	Funding	*Include funding for Transit Accessibility and Complete Streets in future regional funding priorities and Regional Transportation Plans.*
	Policy and Guidelines	*Identify elements that can be incorporated into the MAG Specs and Details guidebook.*

1.3 Outreach

Stakeholder Outreach

Stakeholder outreach was designed to gain knowledge and address concerns to interested parties throughout the region. MAG identified 38 stakeholders to participate in the study that represented four primary groups: Special Needs, Facilities, Human Services, and Transportation. Techniques used to engage the stakeholders included committees, workshops, and interviews. From the stakeholder information, communication techniques and MAG review/ acceptance processes were followed to incorporate the findings of these meetings into the plan. The stakeholders met at key milestones in the process as determined by the project team and the Technical Working Group (TWG).

Technical Working Groups

The Technical Working Groups (TWG) consisted of members from 6 different MAG committees: Bike and Pedestrian, POPTAC, Transit, Street, Elderly and Disability, and Safety. The role of the TWG was to provide technical guidance to the study team during the conduct of the study. Initially, the TWG provided input on the project goals and objectives that fed into the technical work of categorizing the metropolitan area bus stops. From there the TWG directed the study team efforts for the case studies, stop field reviews and transit user survey. Towards the conclusion of the project, the TWG provided key input on the Transit Accessibility Toolkit elements including lighting, signage, wayfinding, seating, shelters, shade, adjacent land use, bicycle access, bicycle parking, pedestrian crossings, and sidewalk considerations.

Stakeholder Involvement Techniques

MAG Committees: The committees were used to inform and solicit input from various MAG committees as needed including Transit, Bicycle and Pedestrian, Human Services, Street, Population Technical Advisory (POPTAC), Transportation Review, Transportation Policy, Management, and Regional Council.

Workshops: The purposes of the workshops are to solicit or address specific issues or concerns. The goal for participants was to work cooperatively to find innovative solutions to an issue(s) in a setting where quick, open and candid discussion is encouraged.

Workshop 1

MAG identified key stakeholders from the region to actively participate in a study workshop. The first stakeholder workshop was convened February 7, 2012, to solicit input and expertise from largely local agency staff. Workshop 1 provided an overview of the study to the group to establish a familiarity with project goals and objectives. The larger group was then divided into four smaller groups to better engage each member. Approximately 35 participants attended the workshop. They were assembled into focus group settings, where they were asked to engage in a facilitated discussion about several key topics related to accessing bus stops.

The stakeholder workshop yielded significant insights into issues related to accessing bus transit by a variety of groups, including the general population, the elderly, and the disabled. Issues identified during the stakeholder workshop provided a framework for exploring the characteristics and qualities of access to bus stops during the case study process. The key issues or topic areas identified during the stakeholder workshop include the following:

- American with Disabilities Act (ADA)
- Bicycle Facilities
- Sidewalk/Walkability
- Street Crossings
- Funding
- Policy
- Environment
- Information Systems
- Transit Systems
- Bus Stop Areas

Following the general session, each stakeholder group reconvened in a separate room with a designated Group Facilitator and a DTAC Study Team member to discuss various transit accessibility issues. Group participants were encouraged to provide input to the study at this time. To help foster discussion among the group members, a list of questions was provided to focus their comments (Table 2). However, each Group Facilitator was free to explore other pertinent issues as they arose. Each group provided a series of comments, issues, and concerns that were recorded by the Group Facilitator; these responses are summarized in Table 3.

TABLE 2: Focus Group Topic for Discussion

Project Goal	Question
1. Identify the challenges faced by users getting to transit.	What are transit users' challenges in accessing transit?
	How can these challenges be addressed?
2. Recommend improvements, polices and guidelines to enhance transit accessibility.	What type of bicycle and pedestrian facilities should be provided near transit stops in the MAG region?
	What does ADA not address when considering bus/transit stops?
3. Provide measures and strategies helpful in creating transit accessible neighborhoods.	What obstacles do communities face in planning and implementing transit accessibility improvements?
	What ideas do you have to help communities better plan and implement improvements for transit accessibility?
4. Provide a cost analysis and framework for funding options and prioritization of improvements.	If the region were to invest in transit accessibility improvements, what would you list as the most important criteria in prioritizing improvements and why?
	What are the challenges in funding accessibility improvements and how can we overcome them?

TABLE 3: Summary of Workshop 1 Breakout Sessions

Issue	Facilities	Human Services	Special Needs	Transportation
Americans with Disabilities Act (ADA)	• Accessible path of travel – someone with disabilities. • Provide ample areas for those maneuvering onto the bus with wheelchairs or mobility devices. • Provide a pad for convenient waiting. • Improve "stop" network, minimize specialized ADA transport. • Recent stops are of higher standard, need to retrofit and agree on one uniform standard.	• No safe place to accommodate a transfer of paratransit users to fixed route bus (i.e. Hospital and Sun City Route 106) • ¾ mile is the limit those with disability can traverse, when there are no other fixed routes in the area. • The larger metro areas around the light rail transit (LRT) get better transit amenities than those outside the area. • Mobility Center is good, lessens anxiety for those accessing transit with special needs.	• Those with special needs take longer to access transit. It seems a long distance to travel. • Dial-A-Ride is not reliable to arrive on time. • Not all stops are ADA compliant. • Have volunteers help those with disabilities access transit. • If federal government classifies someone as disabled, they should qualify for transit assistance and not just rely on the Mobility Center for training. • Increase ADA compliance in areas with significant amounts of older populations.	• Dial-A-Ride provides a safety net. • Access for wheel chairs • Gated communities have green belts to access bus stops more easily; however, these are not always ADA accessible.
Bicycle	• Have bike lanes linked to bus stops -collector/arterial. • Local streets are bikeable. • Need racks installed at bus stops in case bus rack is full and bike must be secured.	• Racks on busses are desirable and fill up fast. • Lack of bike paths near bus stops and transit in general.		• LRT is crowded with bikes. • Bike racks on transit vehicles often are full. • Bike to transit is an issue especially for transit dependent; design to increase bike storage capacity. • Bike sharing program. • Bike lockers. • More frequent service can reduce crowding and capacity issues.

Issue	Facilities	Human Services	Special Needs	Transportation
Sidewalk/ Walkability	• Improve safety of sidewalks (8th most dangerous for pedestrians in USA). • Too spread out and too many traffic lanes (not walkable). • Streetscape Scottsdale has high standards, calling for 10 foot sidewalks; five-foot categories give a pleasant and safe feel. • Provide wider and smoother sidewalks. • Avoid rough spots (i.e. decorative or excessively winding).	• Continuous sidewalk is missing in many areas. • Distance too long between stops. • Lack of trails near bus stops. • Improve transitions from areas without sidewalk to sidewalks with smooth surfaces.	• Stray animals make pedestrians and those with disabilities feel uncomfortable walking to transit. • Differences in the terrain surrounding the area (i.e. gravel, grass, incomplete sidewalks).	• More density increases need for pedestrian access. • Lack of accessible sidewalks. • Master planned communities lack interconnectivity. • Historical areas want to remain rural (bridal paths, no sidewalk improvements, etc), but they are in the heart of the city. • Difficult to cross streets (especially seniors and disabled). • Short signal phases. • Wide, car focused streets. • Road construction detours pedestrians. • Obstacles in public right-of-way.
Street Crossing	• High intensity Activated crosswalk (HAWK) signaling system is safer than mid-block crossings. • Too many lanes to cross at wide arterials and collectors. • Too few mid-block crossings.	• Few mid-block stops have crosswalks or have safe crossing areas nearby, particularly along arterials and wider streets. • Utilize HAWK signaling system at mid-block crossings to create higher awareness. • Crossing time at traffic signals not long enough for seniors.	• Mid-block stops tend to not be close to a signal or safe crossing. • Pedestrians are forced to cross wide, multi-lane arterials, particularly at mid block crossing, where traffic signals do not exist. • Transfer times are too short when crossing wide arterials. • Motorists are inattentive to transit patrons crossing unsignalized crosswalks. • Wide streets are a barrier to pedestrians and those with disabilities.	• Signal timing for pedestrians. • Engineers must be more aware of pedestrians. • Traffic calming to reduce vehicle speeds. • HAWK – rethink need to move pedestrian crossings.
Funding	• Mesa prepared a “Bus Stop Improvement Plan,” but Congestion Management and Air Quality (CMAQ) Improvement Program will not fund ADA only plans. • Bus stop improvements have a point system or warrant for Phoenix area. Does a project meet the warrant (criteria)? Is it worthwhile to try for federal grants for highest priority projects or wait for major street or land use projects?	• Funding tends to go to the population centers and leaves the outskirts without sufficient improvement funding.	• Funding for stops. • Operational cost to maintain is high, especially if trash containers, water fountains were added.	• Adopt a Bus Program. • Gasoline money/use of Highway User Revenue Fund (HURF). • Next Prop 400 bus improvements. • Need for flexible funding programs. • Currently tough economic times. • Address: Better shelter design, pedestrian focused design guidelines, education of users and officials, change people’s perspective (buses aren’t just a social service). • Consider stop location early on, collaboration between all parties. • Funding has been traditionally auto-focused - distribute more money to transit.

Issue	Facilities	Human Services	Special Needs	Transportation
Policy	• ADA ramp compliance issues. • Stop shading. • No region wide standard. • Need to prioritize: safety, communication, shade, lighting, benches, distance between stops, land use design and transit stop locations, and smooth continuous sidewalk.	• Unincorporated areas may be lower priority for stop improvements.	• Encourage policy makers to talk with and take into account the needs of transit users. • Develop regional level policy for stop design and placement. • Need standardized regional policy for stop placement. • Include mobility issues in conversation.	• Promote implementation of the "Complete Streets" concept to benefit all users. • Bike racks on transit vehicles (i.e. bikes on board program).
Environment		• Weather protection is needed at stops. • Shelters and shading are important to those using medication with sun exposure and heat exposure side effects.	• Have volunteers provide water at stops frequented by those with special needs or seniors. • Better shade needed around stops. • Extreme temperatures can be fatal for persons with a disability.	• Misters to deal with the heat. • Shade needed.
Information System	• Develop a master database of bus stops that are ADA accessible. • Stop locator needs to include interactive web based map to look at each site not just list the stop. • The system needs to add attributes of the stops. • Each city needs to maintain its own database. • Transit accessible communities should be identified, (not all communities are served by transit). • NEXT STOP is good, gives real time arrival of next bus.		• Have drivers and others assist those with special needs or disabilities in understanding how to use the bus.	• Remove mystery; make transit service information more accessible.
Transit System	• Get feedback from users.	• Too far between stops. Consider making more mid block stops to shorten distance to nearest stop.	• Not enough transit connectivity to outlying unserved communities. • No transit service to Sun City. • Not enough options for transit in the Northwest Valley and the outlining areas of the region. • Coordinate route timetables with adjoining cities – some neighboring cities have differing headways on same street making transfers more difficult. • Consider placement of transfers points, both ADA and non-ADA, across jurisdictional boundaries. • Explore "same as" models.	• More density increases need for enhanced pedestrian access. • More frequent service reduces crowding and capacity issues. • Way finding challenges. • Infrequent service. • Car focused transportation system. • Need for "complete" streets, transit friendly. • "Road diet" to reduce street size and lower speeds in neighborhoods to increase safety.

Issue	Facilities	Human Services	Special Needs	Transportation
Stops	• Shade stops only every mile or transfer point. • Standardize color of stops, tan structures, blue signs. Some stops don't look like stops. • Encourage cities to improve stops during general plan updates. • Local communities should upgrade stops. • Encourage private partnerships to build stops. • Every area has different stop designs which make it difficult to look unified. • When upgrading stops consider; location wait time, number of boardings, if it is a transfer stop, and maintenance costs. • If art shelters are built they should be mobile so that they can be relocated if the stop becomes obsolete.	• Need covered seating to get out of sun or inclement weather. • Lighting should be provided at stops. • Too far between stops. Consider making more mid block stops to shorten distance to nearest stop.	• Poor shelter design does not block the sun. • Make sure all stops are ADA accessible (improved or otherwise). • Place stops closer to entrances to medical facilities to shorten walking distance for those with special needs. • Optimize the distance between stops to increase travel time and improve efficiency. • Place stops at large activity centers. • Inventory all stops to document what amenities they have, and the usage. • Seating is important to the elderly and those with special needs. • Revisit usage of stops – demographic change. • Standardize stops to assist with maintenance.	• Material/composition can be uncomfortable; metal heats up. • Braille at bus stops. • Provide misters to deal with the heat. • Orient amenities to provide shelter and shade. • Some locations don't have the space in the ROW for a bus stop. • Somewhere to sit is important.

Workshop 2

Workshop 2 was held at the MAG offices on April 11, 2013. The goal of this workshop was to conduct a charrette-style exercise where participants would identify transit accessibility improvements at the case study locations while considering the constraints of a limited budget. The stakeholder participants were divided into smaller groups to conduct this exercise. Groups were provided an aerial print of the case study catchment area, case study location survey results and photographs, a table with case study characteristics and constraints, a budget sheet, a laptop to use Google Earth for additional information gathering and calculate their budget, stickers with symbols representing improvements, and the Transit Accessibility Toolkit. Figures 1-5 illustrates the results of this workshop exercise.

FIGURE 1: 16th Street & Thomas Road Workshop Results (Urban Core)

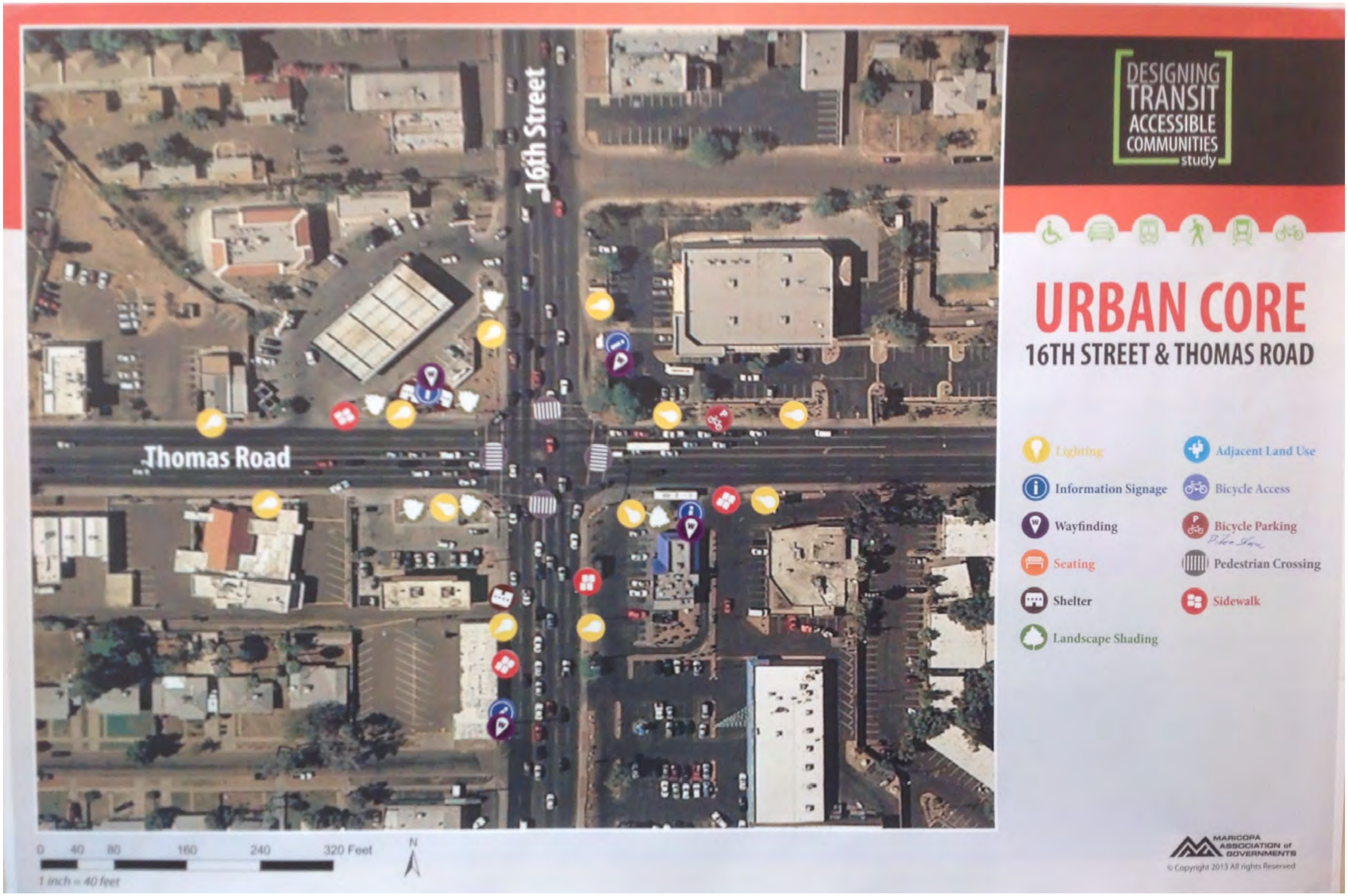


FIGURE 2: 90th Street & Shea Boulevard Workshop Results (Urban Retail)

FIGURE 3: 19th Street & Southern Avenue Workshop Results (Urban Residential)

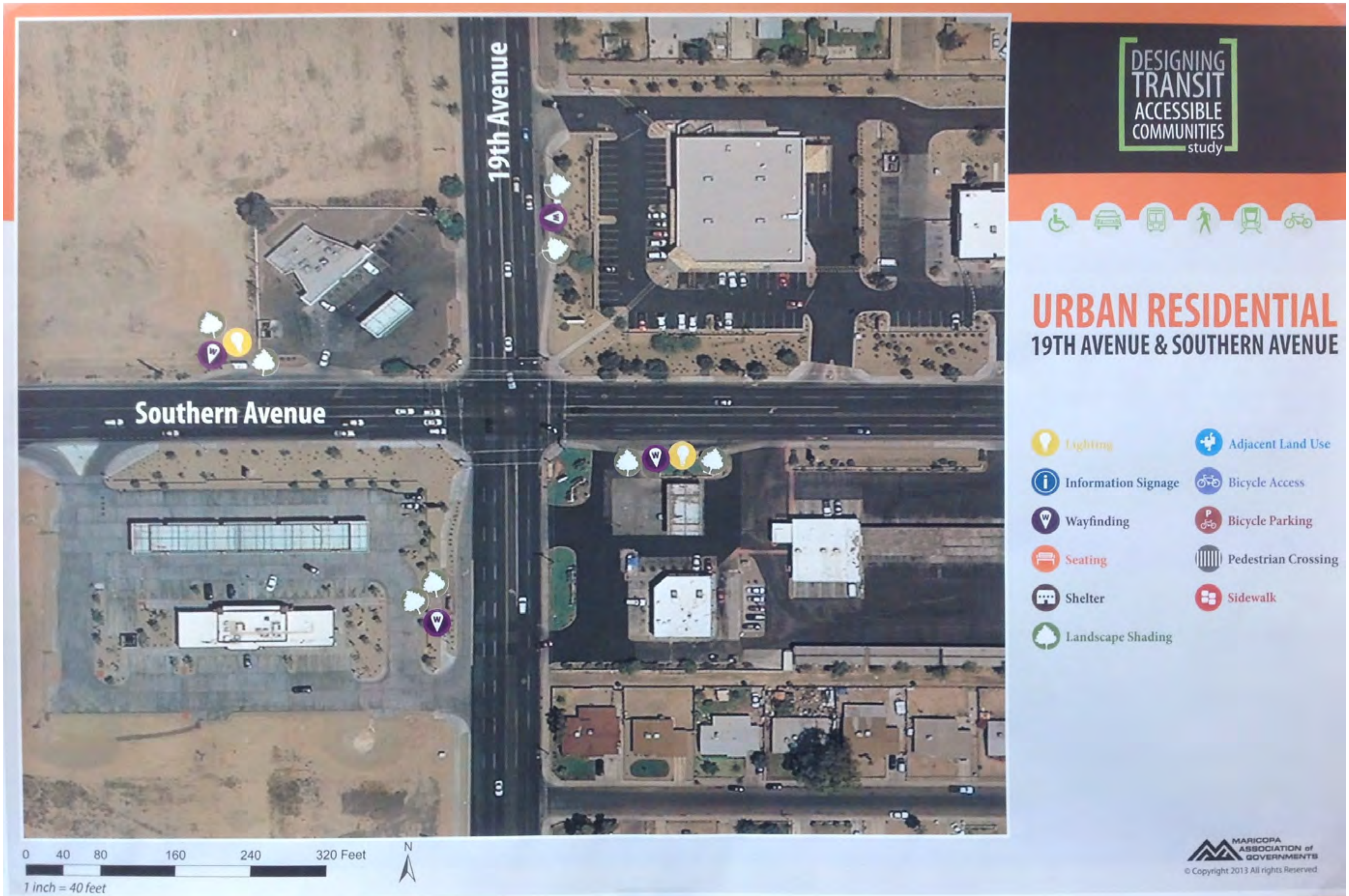


FIGURE 4: 75th Street & Bell Road Workshop Results (Suburban Retail)

FIGURE 5: Elliot Road & Lakeview Drive Workshop Results (Suburban Residential)

Intercept Surveys

In addition to obtaining input from local agency stakeholders, an intercept survey was developed and administered in person at the five case study bus stop locations. The survey primarily was focused on asking bus riders about their experience accessing – both arriving to and departing from – bus stops. The survey questions generally fell into the following topic areas:

- Mode of access to the bus stop
- Trip purpose
- Trip origin/destination
- Estimated travel distance and time to the bus stop
- Desired improvements for the route to/from the bus stop
- Level of comfort and safety while traveling to/from the bus stop
- Demographic information

Table 4 summarizes the total number of surveys collected by case study location. As shown, a total of 221 surveys were collected, with 188 "Arriving To" surveys and 33 "Departing From" surveys. A majority of the surveys, or 109 surveys, were collected at the 16th Street and Thomas Road case study location, with the next highest rate of survey collection, 55 surveys, occurring at the 19th Avenue and Southern Avenue case study location.

TABLE 4: Number of Surveys Collected by Case Study Location

Case Study Location	Number of "Arriving To" Surveys	Number of "Departing From" Surveys	Total Surveys
16th Street & Thomas Road	101	8	109
19th Avenue & Southern Avenue	45	10	55
90th Street at Scottsdale Fiesta *(south of Shea Boulevard)*	9	6	15
75th Avenue & Bell Road	26	8	34
Elliot Road & Lakeview Drive *(alternative locations at 46th & Broadway and 67th & Baywood)*	7	1	8
TOTAL SURVEYS	188	33	221

Source: Chen Ryan Associates; July 2012.

Table 5 presents survey respondent's ranking of bicycle and pedestrian enhancement types by bus stop category. The percentage value reflects the portion of total survey respondents who agreed that the specific enhancement type would "likely" or "very likely" influence more frequent walking or cycling to bus transit stops. For each bus stop category, the proposed bicycle/pedestrian elements are presented in order of decreasing influence.

TABLE 5: Transit Rider Survey Results: Bicycle/Pedestrian Element Rankings by Bus Stop Category

Urban Core		Urban Residential		Urban Retail		Suburban Retail		Suburban Residential	
Shade Trees	57%	Streetlights	70%	Shade Trees	89%	Bus schedule Information	41%	Shade Trees	72%
Bus Schedule Information	52%	Bus Schedule Information	69%	Streetlights	78%	Shade Trees	37%	Bus Schedule Information	72%
Streetlights	42%	Shade Trees	65%	Bus Schedule Information	56%	Bicycle Lanes	34%	Streetlights	57%
Bicycle Parking	39%	Bicycle Lanes	53%	Medians	56%	Bicycle Parking	30%	Landscaping	43%
Bicycle Lanes	39%	Landscaping	49%	Bicycle Lanes	56%	Curb Extensions	26%	Curb Extensions	43%
Landscaping	38%	Curb Extensions	47%	Bicycle Parking	56%	Streetlights	19%	Art	29%
Curb Extensions	37%	Bicycle Parking	42%	Landscaping	44%	Landscaping	19%	Bicycle Parking	29%
Decorative Pavement	29%	Decorative Pavement	40%	Decorative Pavement	33%	Art	15%	Bicycle Lanes	29%
Art	28%	Art	31%	Curb Extensions	22%	Decorative Pavement	11%	Decorative Pavement	29%
Medians	28%	Medians	31%	Art	11%	Medians	7%	Medians	29%

Source: Chen Ryan Associates; October 2012.

2.0 Existing Conditions Summary *(Working Paper 1)*

In 1985, the Arizona Legislature passed a law enabling the citizens of Maricopa County to vote on a sales tax increase to fund regional transportation improvements. The law also provided for creation of the Regional Public Transportation Authority (RPTA), now known as Valley Metro/RPTA. Elected officials from local governments comprise the RPTA Board of Directors. Public transportation in the Valley now includes several different modes of travel and services provided under the Valley Metro brand, including:

- METRO light rail;
- Valley Metro LINK;
- RAPID service;
- Express Bus;
- Local-limited stop service;
- local route service;
- neighborhood circulators; and
- rural connectors.

There are 54 park-and-ride lots and more than 7,000 transit stops throughout the metro area that support commuting patterns throughout the valley, providing linkages for more than 69,600,000 boardings per year (July 1, 2009 – June 30, 2010). In addition, there are other transportation and mobility opportunities that have been devised to accommodate the segment of the traveling public with special needs. Dial a Ride systems provide special access/mobility options for those without vehicles or who are significantly disadvantaged, handicapped or disabled, and are unable to provide for their own transportation. Working Paper 1 discusses the importance of pedestrian connectivity for all transportation modes. In the MAG region approximately 90% of all transit users approach the system by walking or biking. Regardless of how transit users approach a system, all connecting trips are made at a pedestrian level. Street design, land use, transit frequency, weather, landscaping, social factors, and safety play a significant role in pedestrian comfort. Transit stops are the gateways to public transportation. To enhance transit riders' experience, bus stops should welcome and transition riders into a community; they should provide a convenient, safe, and accessible environment to all users.

The focus of this paper is on safe and accessible transit stops which are an integral part of the public transit system. The paper documents existing transit conditions, organizes data for analysis, and sets the foundation for pursuing categorization of bus stops with case studies.

3.0 Bus Stop Categorization *(Working Paper 2)*

Working Paper 2 defines bus stop categorizations so groupings of bus stop areas can be established for the MAG region. The categorizations are intended to create prototypical pedestrian and bicycle improvement concepts that could be developed and recommended. This working paper describes the methodology employed to develop categorizations of bus stops in local jurisdictions within the MAG region. The paper is divided into three sections: Previous Studies, Methodology, and Analysis Results. These sections summarize related studies and techniques and describe the methodology to present new categories and information found during the analysis and selection process. Table 6 summarizes the variables used to categorize the bus stops in the valley. Figures 6-13 displays each of the categorization input variables for the MAG region. A summary interpretation of each figure follows.

TABLE 6: Bus Stop Categorization Variables

Project Goal	Question	
Transit/Bike/ Pedestrian Demand	1. 2010 Population per Acre by Census Block Group	American Community Survey -- US Census
	2. 2009 Employment per Acre by Census Block Group	Longitudinal Employer-Household Dynamics (LEHD) Program -- US Census
	3. Sum of Population and Employment by Census Block Group	(see above)
	4. Presence of Retail	MAG Land Use
	5. 2010 Density of Zero-Vehicle Households by Census Block Group	American Community Survey -- US Census
Bus Service Quality	6. Number of Routes per Bus Stop Area	MAG GIS
	7. Location of Bus Stop at Arterial-Arterial Intersection	MAG GIS
	8. Frequency of Bus Service at Bus Stop Area for all Routes	MAG Transit Frequency

Source: Chen Ryan Associates; May 2012.

Figure 6 shows the density of the 2010 population by census block group. As shown in Table 2, population density in the MAG region ranges from 0 to 32.1 persons per acre by census block group, with a mean density of 7.8 persons per acre. The eight data ranges were defined using the Natural Breaks classification method in ArcEditor.

Figure 7 shows the density of 2009 employment by census block group. Employment density in the MAG region ranges from 0 to 93.8 jobs per acre, with a mean density of 5.7 jobs per acre. The eight data ranges in Figure 2 were defined using the Natural Breaks classification method in Arc Editor 10.

Figure 8 shows the presence of retail land use across the MAG region in 2009. Presence of retail in the quarter-mile buffer was included as a dichotomous variable in the cluster analysis, i.e., as “yes” (1) or “no” (0) retail within the buffer.

Figure 9 shows the density of zero-vehicle households (HHs) in 2010 by census block group. The density of zero vehicle households in the MAG region ranges from 0 to 4.1 HHs per acre, with a mean density of 0.32 HHs per acre. A value of zero for this variable means that all households in the census block group have at least one vehicle.

The eight data ranges in Figure 2 were defined using the Natural Breaks classification method in ArcEditor 10.

Figure 10 shows the density of population and employment by census block group. This variable was used to reflect transit “trip end” potential. In other words, the location of a person’s residence or work place is a good approximation of the majority of potential transit trip origins and destinations that might occur across the region. The density of the sum of population and employment ranges from 0 to about 101 persons and jobs per acre by census block group. The seven data ranges in Figure 5 were defined using the Natural Breaks classification method in ArcEditor 10.

Figure 11 shows the number of routes by bus stop across the MAG region. This variable is a measure of transit service quality, assuming that a greater number of routes serving a given bus stop would provide higher levels of system connectivity. The number of routes by bus stop ranges from 1 to 12 routes, with a mean of 1.2.

Figure 12 shows those bus stops across the MAG region situated at arterial-arterial intersection locations. This was used as a measure of the quality of bus transit service. Like the presence of retail land use, the presence of a route or routes at an arterial arterial intersection was included as a dichotomous variable in the cluster analysis, i.e., as “yes” (1) or “no” (0) route serving the intersection.

Figure 13 shows the frequency of service by bus stop. For purposes of this study, high frequency bus service was defined as an operating headway of 20 minute or less at the bus stop. Routes passing bus stops were classified into four operational categories, including: Multiple All Day, High Frequency Routes; a Single All Day, High Frequency Routes; High Frequency Service during the Peak Periods Only; and No High Frequency Routes.

FIGURE 6: 2010 Population Densities By Census Block Group

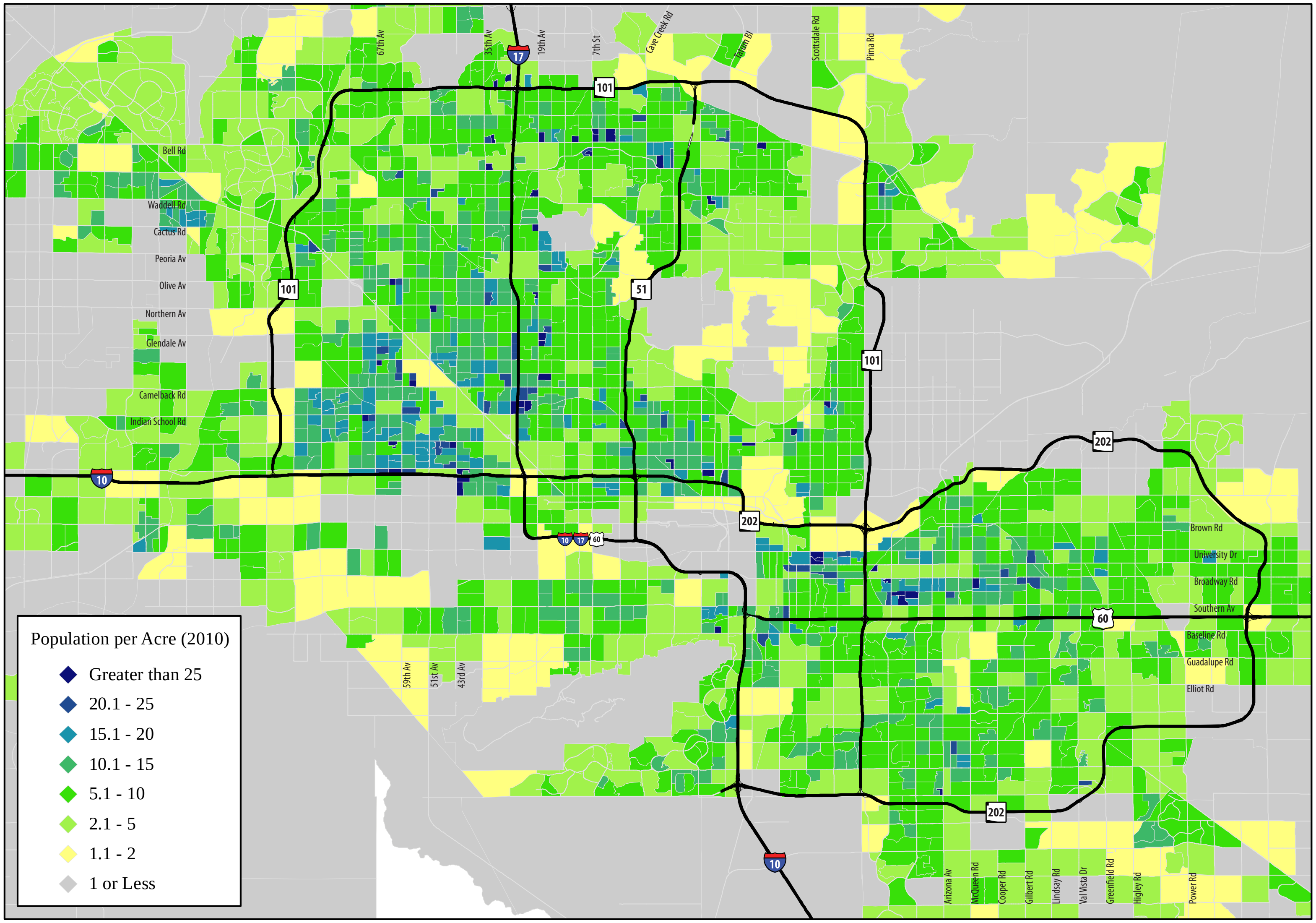


FIGURE 7: 2009 Employment Densities by Census Block Group

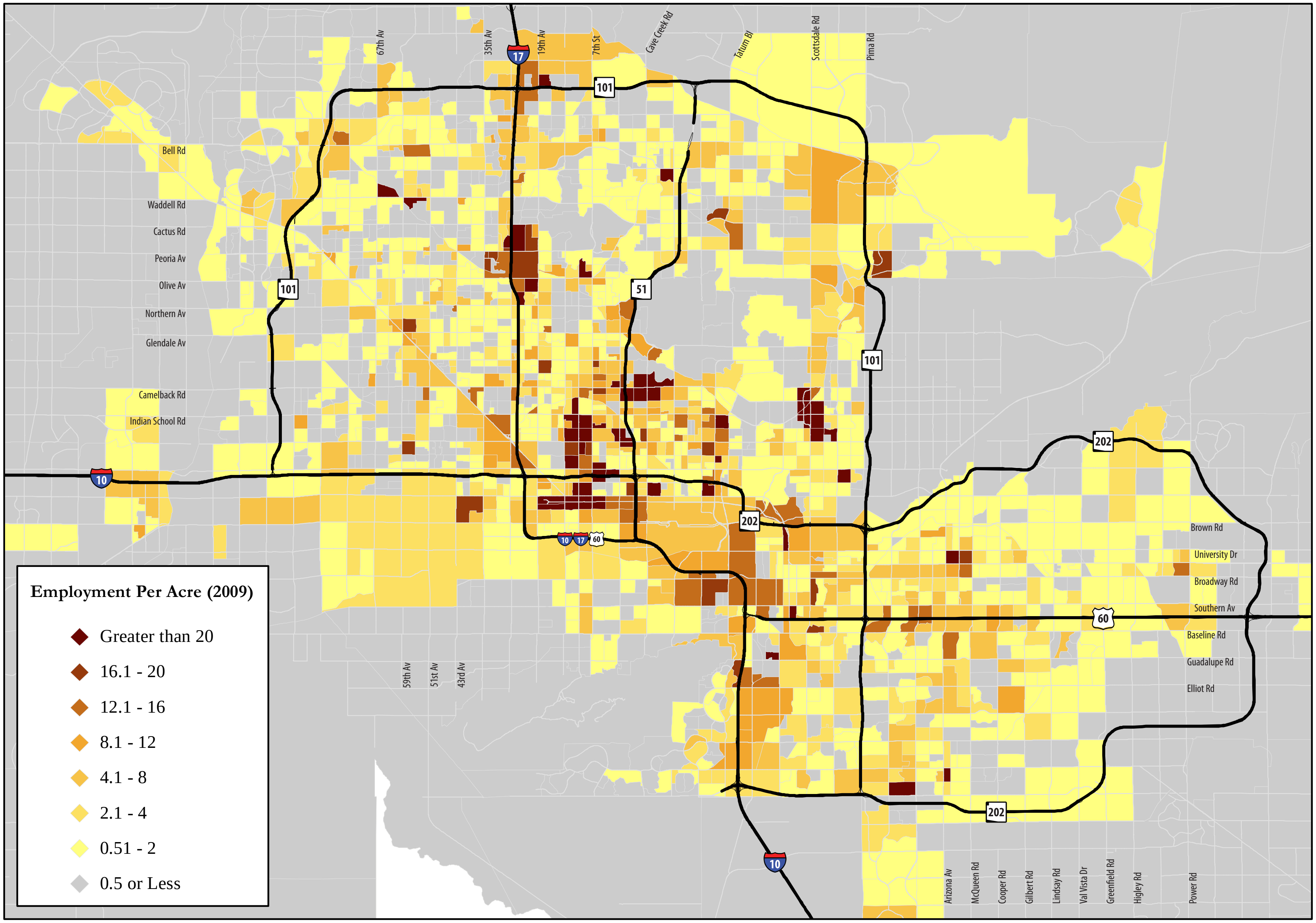


FIGURE 8: 2009 Retail Land Use

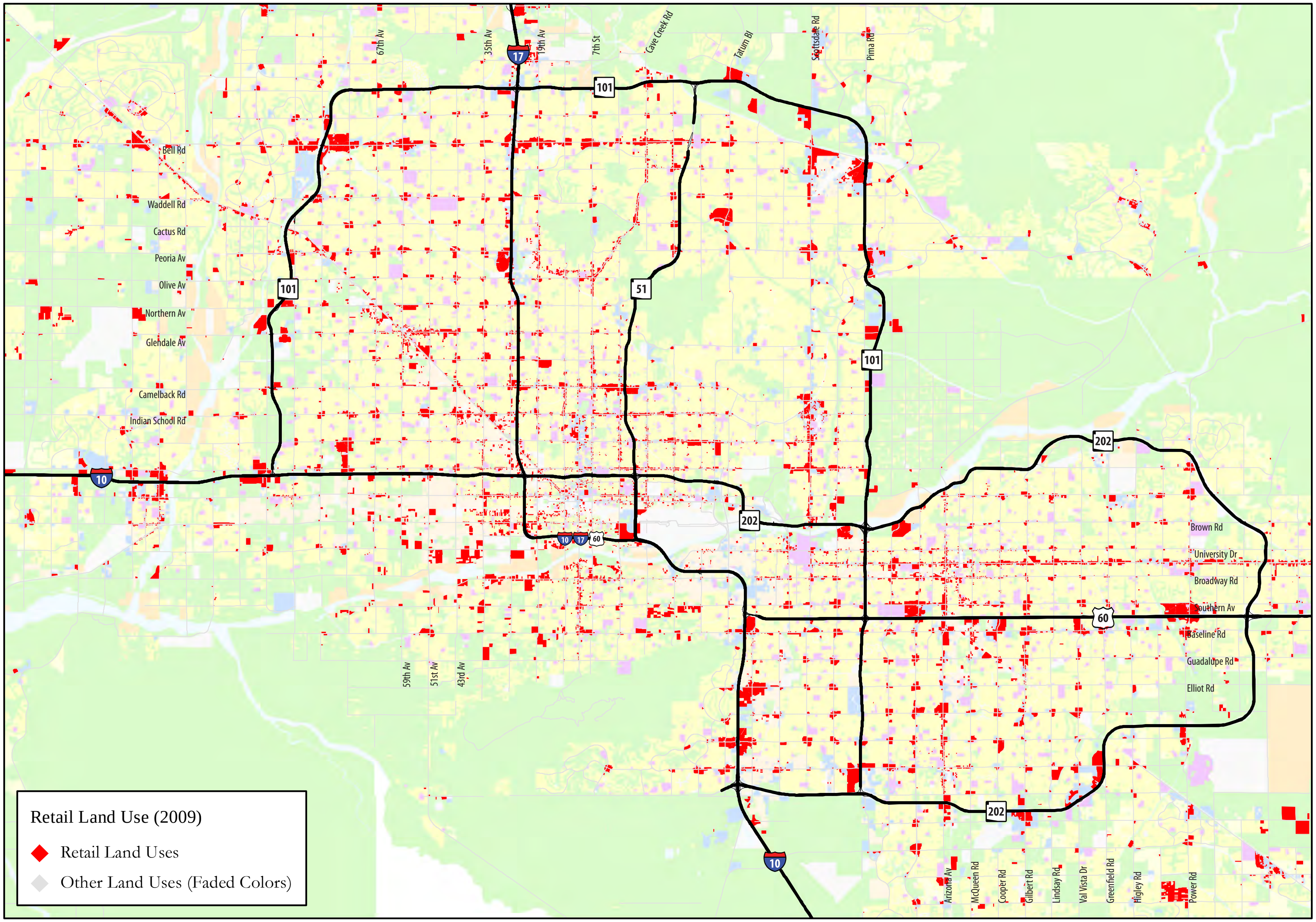


FIGURE 9: 2010 Density of Zero Vehicle Households by Census Block Group

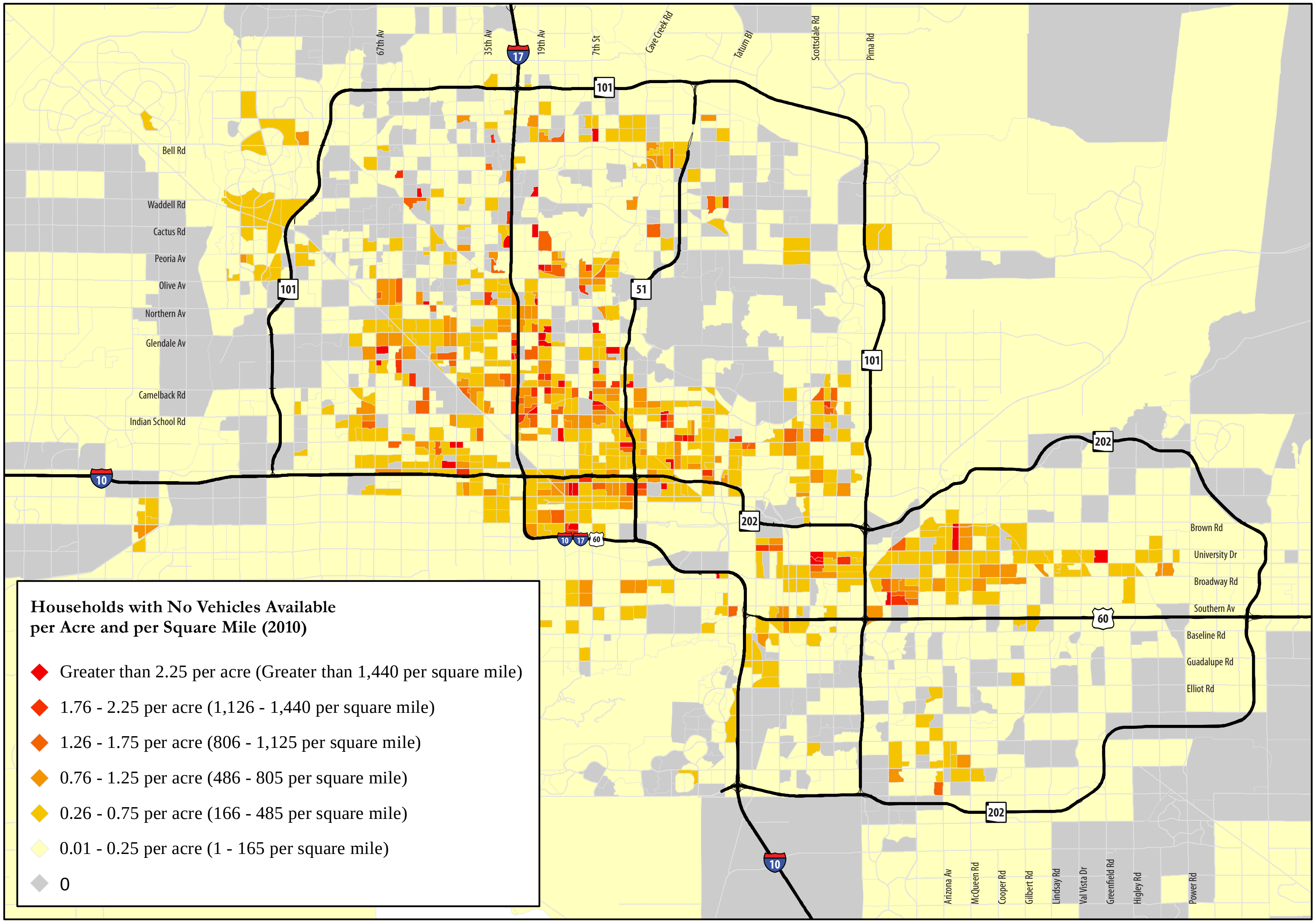


FIGURE 10: Total Sum of Population and Employment by Census Block Group

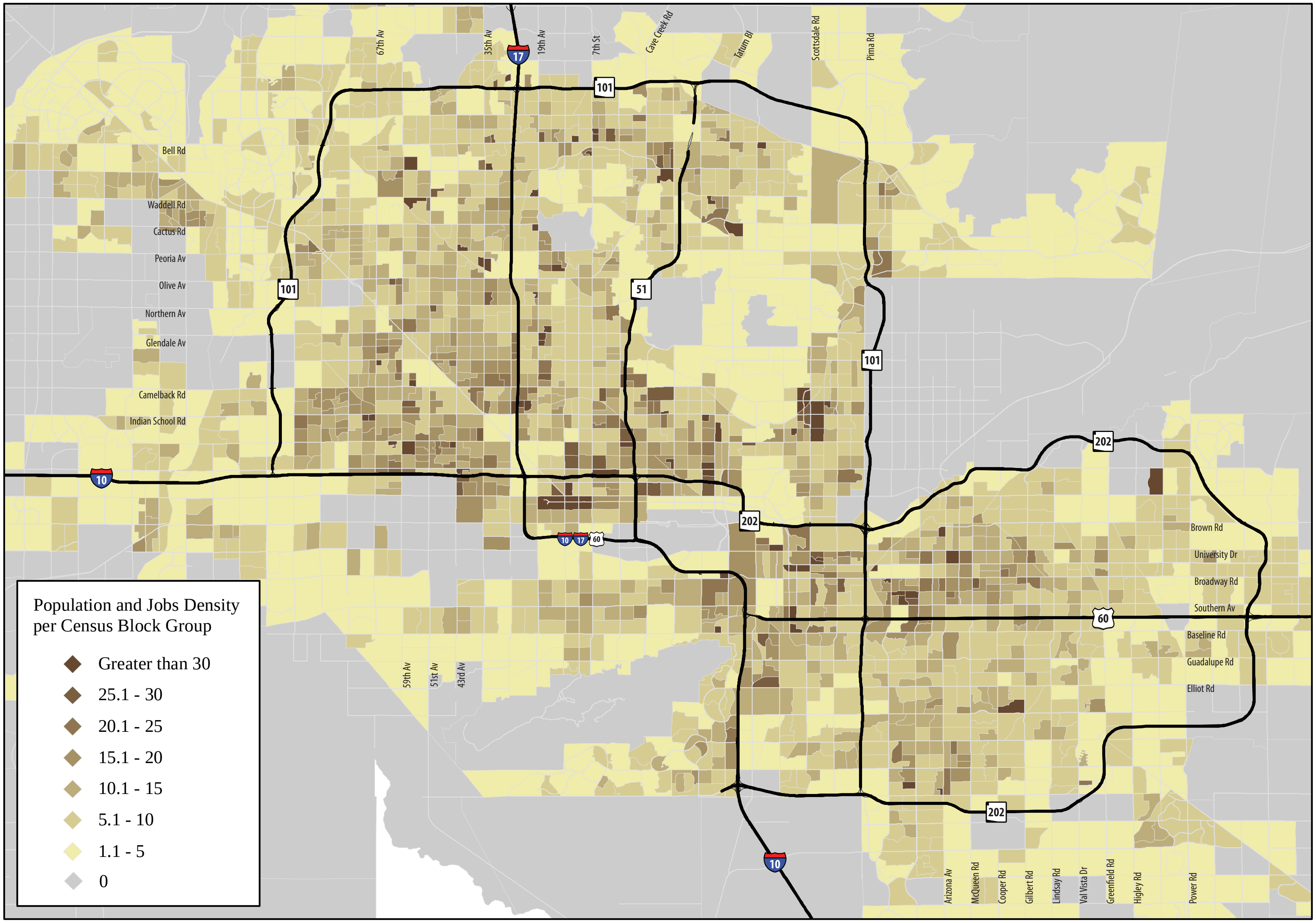


FIGURE 11: Number of Routes Per Bus Stop Area

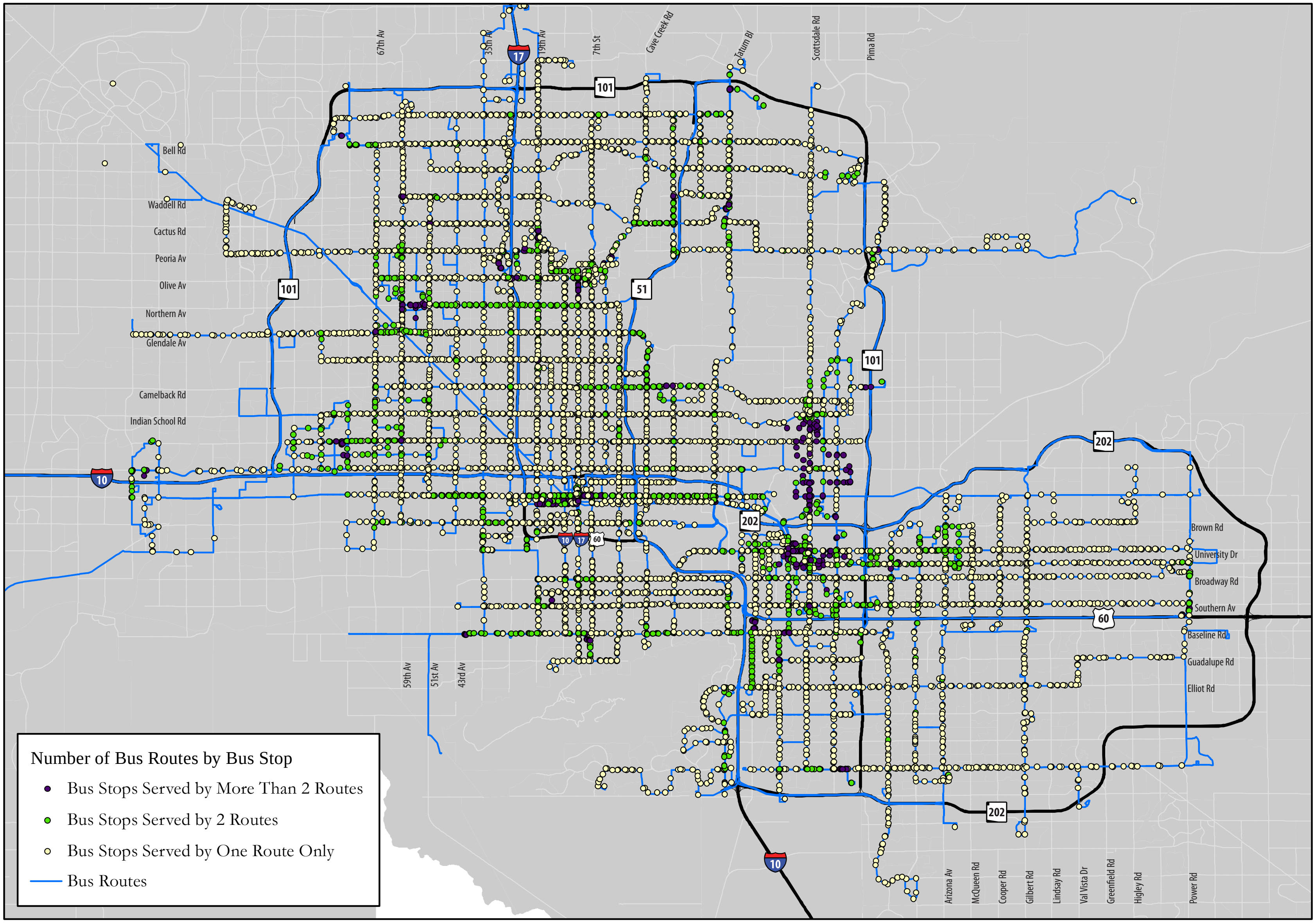


FIGURE 12: Locations of Bus Stop Areas At Arterial-Arterial Intersections

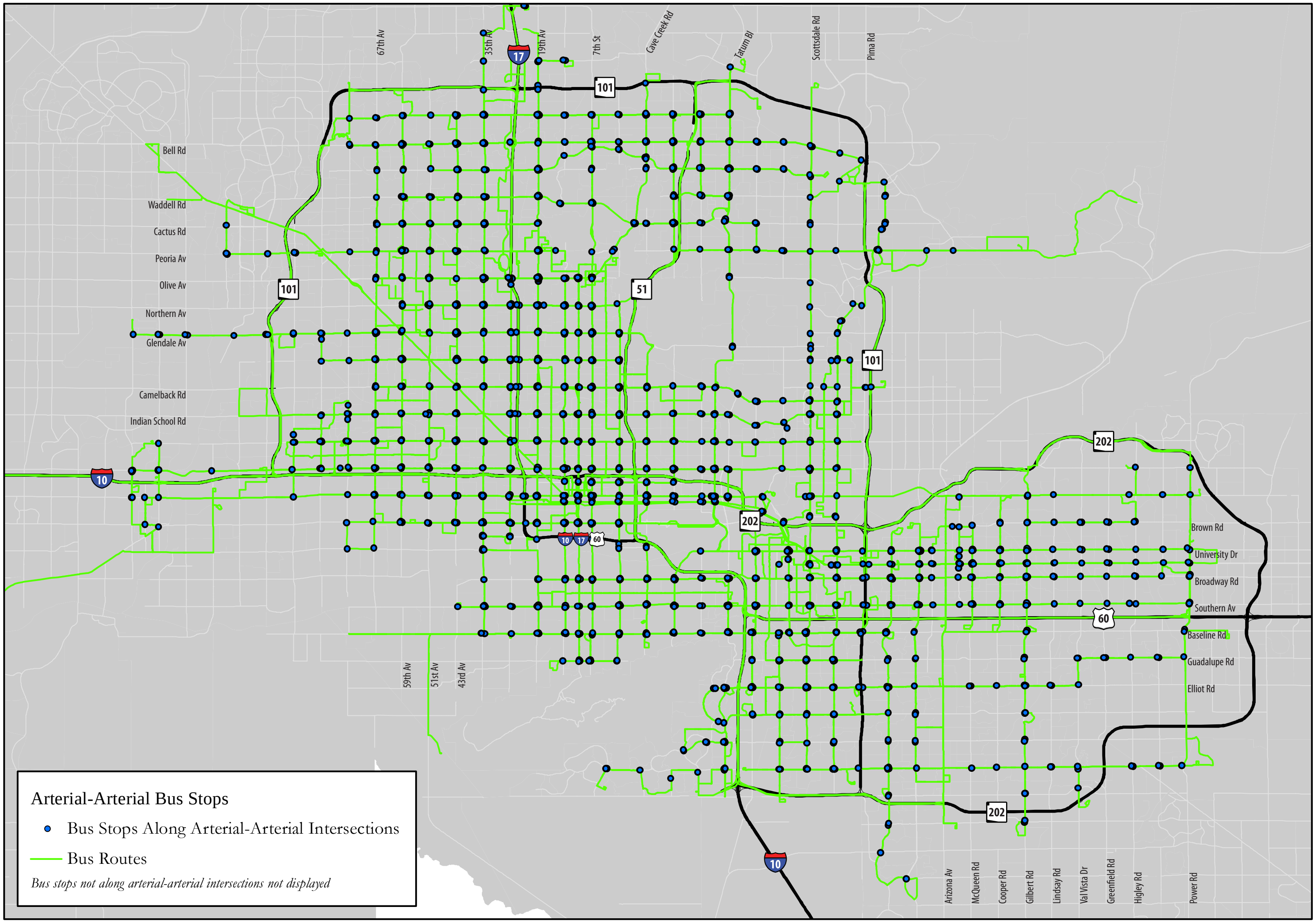
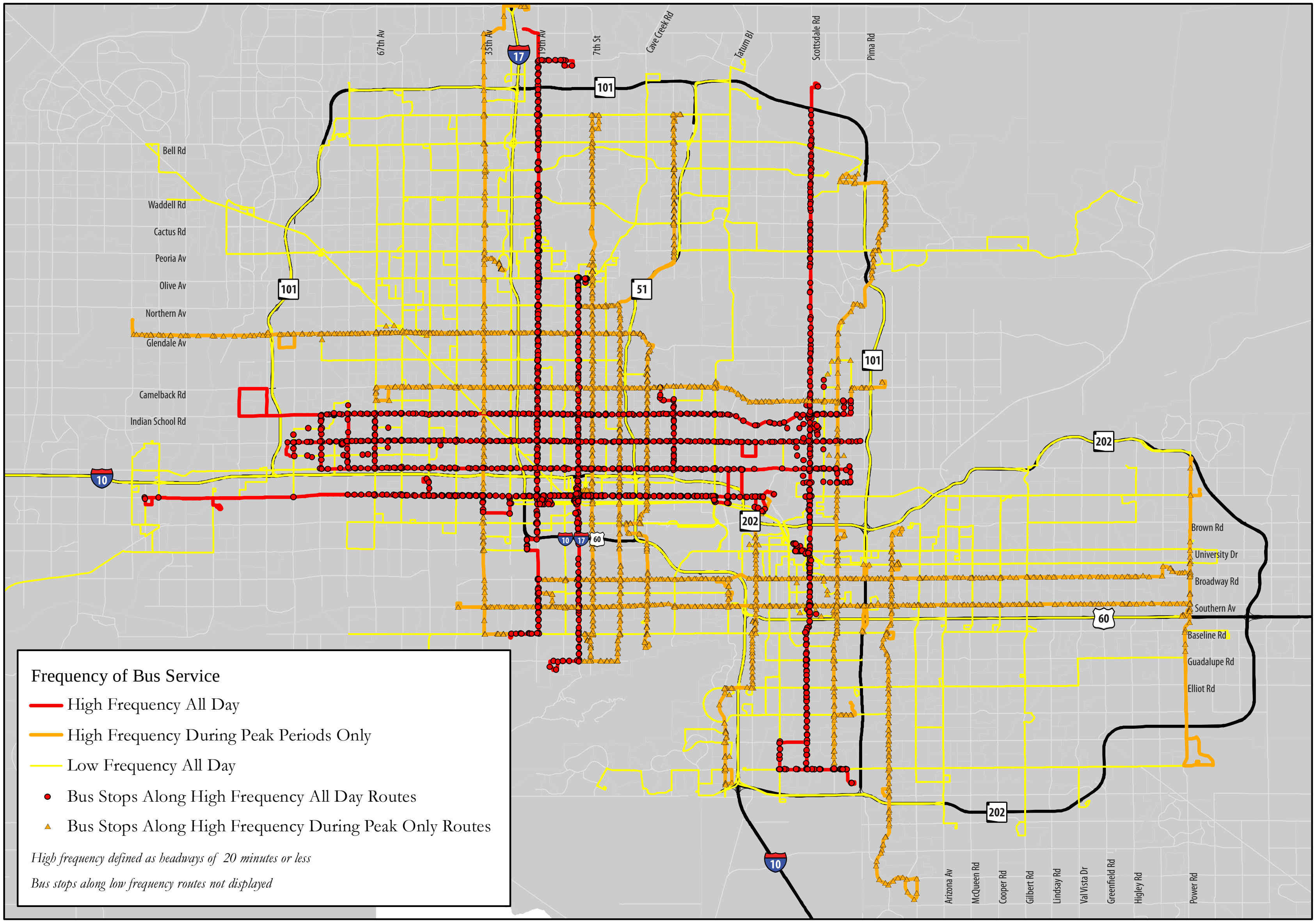


FIGURE 13: Frequency of Bus Transit Route Service at Bus Stop Areas



Given the broad geographic scope and the sheer number of locations considered (over 7,000 bus stop areas across the MAG region), a statistical cluster analysis was considered to be the most appropriate method for identifying categories of bus stop areas.

Table 7 shows how each model run performed relative to two key factors used to assess the reliability of cluster analysis output, namely: the number of clusters and the silhouette measure. Number of clusters provides an indication of how many natural or meaningful groupings can be identified within the database. The MAG DTAC study team looked for approximately five to 10 clusters or categories of bus stops to support development of a reasonable number of prototypes to characterize the different bus stop areas. The silhouette measure, as calculated with the statistical software SPSS, provides an indication of the cohesion or strength within groupings and the degree of separation between groupings, e.g., bus stops A D in Group 1 are very similar and differ notably from bus stops H-M in Group 5. The value of the silhouette measure ranges from 0 to 1: '1' represents perfect clustering and '0' represents no clustering.

Table 7 presents these output measures as a way to support the assessment of each model run and determine which provides the most reliable representation of similarities and differences among and between groups of bus stops. As shown in Table 7, a total of ten model runs were performed to identify two runs that provided both a desirable number of clusters and a high silhouette measure. Model Run #10 was selected as the cluster model for use in defining transit bus stop area categories.

Resulting from Model Run #10 was a breakdown of seven initial categories which were later simplified into five categories. A brief interpretation of each of the seven bus stop categories is provided below, and summarized in Table 8. Figure 14 depicts how each bus stop included in this analysis was categorized.

TABLE 7: Demand, Transit System Service, and Combined Variables for Cluster Model Runs #1--#10 with Number of Clusters and Silhouette Measure

Run #	Pop. Den.	Emp. Den.	Zero VEH HH Den	Retail	Pop. + Emp. Den	# of Routes	Freq.	Art. - Art.	# of Clusters	Silhouette Measure (cohesion & separation)
	Demand			Transit System					Cluster Assessment	
1	✓	✓	✓	✓					2	Good (0.7)
2	✓	✓	✓						2	Fair (0.5)
3			✓		✓				2	Good (0.7)
4			✓	✓	✓				3	Good (0.8)
5						✓	✓	✓	10	Good (0.8)
6			✓	✓	✓	✓	✓	✓	2	Fair (0.5)
7			✓	✓	✓	✓	✓		5	Fair (0.4)
8			✓		✓		✓		3	Good (0.7)
9					✓		✓		4	Good (0.8)
10				✓	✓		✓		7	Very Good (0.9)

Source: Chen Ryan Associates; May 2012.

TABLE 8: Hierarchy of Bus Stop Area Categories

Category Ranking	Category Name	Defining Characteristics	# of Stops	% of Total
1	Metropolitan Core	Some Retail; Very High Employment; Multiple High Frequency Transit	223	4%
2	Urban Transit Corridors	Retail; High Frequency Transit; High Population and Employment	675	12%
3	Suburban Transit Corridors	No Retail; High Frequency Transit; Medium Population and Employment	456	8%
4	Suburban Peak Hour Transit Corridors	Retail; Limited High Frequency Transit; High Population and Employment	865	15%
5	Suburban Transit Connectors	Retail; No High Frequency Transit; Medium Population and Employment	1,302	22%
6	Low Suburban Peak Hour Transit Corridors	Retail; No High Frequency Transit; Low Population and Employment	653	11%
7	Low Suburban Transit Connectors	No Retail; No High Frequency Transit; Low Population and Employment	1,648	28%

Source: Chen Ryan Associates; May 2012.

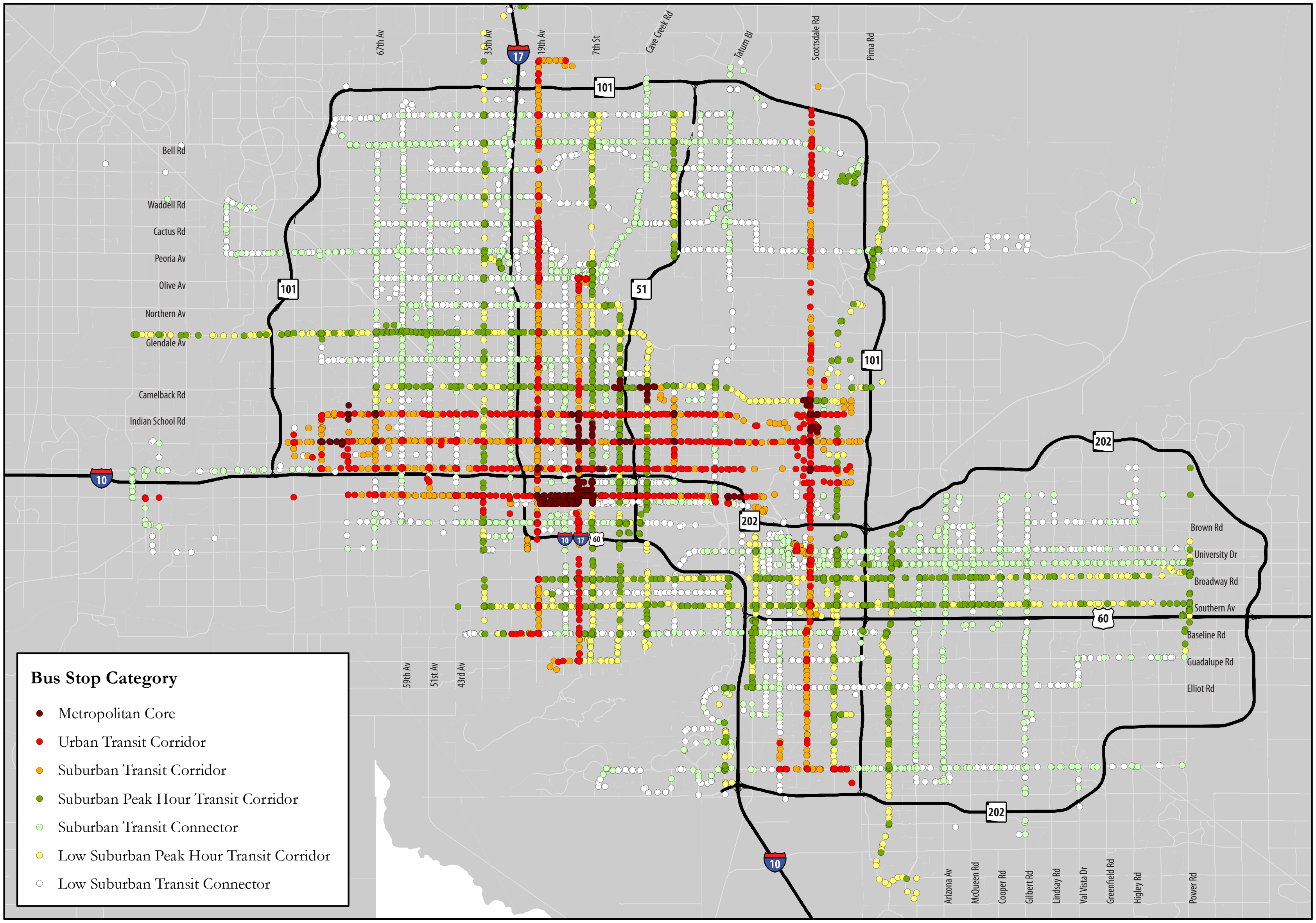
- **Metropolitan Core:** Bus stop areas have some retail land use, along with very high employment (ranging from 0.5 jobs per acre to 94 jobs per acre) and multiple all-day, high frequency transit routes. Four percent of the bus stop areas across the MAG region fall into this category.
- **Urban Transit Corridor:** Bus stop areas have retail land uses, at least one all day, high frequency transit route service, and a relatively high density of population and employment (ranging from 2 persons + jobs per acre to 36 persons + jobs per acre). This category accounts for 12 percent of all bus stop areas.
- **Suburban Transit Corridor**: Bus stop areas in this category are similar to those related to the Urban Transit Corridor, except there is no retail land use present, and the mean density of population and employment is lower than for a Urban Transit Corridor (12 persons + jobs per acre versus 13 persons + jobs per acre). Eight percent of all bus stop areas fall into this category.
- **Suburban Peak Hour Transit Corridor:** Bus stop areas have retail land use present, high frequency transit route service confined to peak periods only, and high population and employment density. This category accounts for 15 percent of all bus stop areas in the MAG region.
- **Suburban Transit Connectors:** Bus stop areas in this category have retail land use present and medium population and employment density; however, there are no high frequency transit routes serving these locations. This type of bus stop area accounts for the second highest share – 22 percent – of all bus stop areas in the MAG region.
- **Low Suburban Peak Hour Transit Corridor:** Bus stop areas have no retail land use present, high frequency transit route service limited to the peak period, and, importantly, low population and employment density (ranging from 0.5 to 23 persons + jobs per acre, with a mean value of 11). Eleven percent of all bus stop areas fall into this bus stop area category.
- **Low Suburban Transit Connector:** Bus stop areas have no retail land use present, no high frequency transit route service, and low population and employment density. This category is the most common type of bus stop area, accounting for the greatest share of bus stop areas in the MAG region. Twenty eight percent, or 1,648 bus stop areas, fall within this category.

After the categories were reviewed by the TWG and the DTAC study team, some of categories were collapsed. Additionally, all categories were renamed to better reflect the built environment of the bus stop's catchment area. In particular, the Metropolitan Core and Urban Transit Corridor categories were collapsed into one category and renamed Urban Core. Also, the Suburban Transit Connector and Low Suburban Transit Connector were collapsed and renamed Suburban Residential. Subsequent to consolidation of bus stop area categories, five locations were selected as case study locations to be field-checked for reasonableness. Table 9 displays the final typology of bus stop area categories and locations selected for case study analysis.

TABLE 9: Final Case Study Locations

Category Ranking	Category Name	Location
1	Urban Core	16th Street & Thomas Road, Phoenix
2	Urban Retail	90th Street, South of Shea Boulevard, Scottsdale
3	Urban Residential	19th Avenue & Southern Avenue, Phoenix
4	Suburban Retail	75th Avenue & Bell Road, Glendale
5	Suburban Residential	Elliot Road & Lakeview Drive, Gilbert

FIGURE 14: Summary of Bus Stop Categorization Process



4.0 Case Studies *(Working Paper 3)*

One of the initial tasks for this project was to create an inventory of available digital data types, including socio-economic, transportation infrastructure, land use, and travel data. The data collection effort is documented in Working Paper 1. A subset of these data types was used during the categorization process. The subset included: population density, employment density, vehicle ownership rates, land uses, bus stops, and bus transit service frequencies (see figures 6-13). This information was helpful in establishing the context for the case study locations as defined by the built environment and transportation system elements. These general characteristics were mapped and tabulated for each of the case study locations to establish an overall sense of each bus stop category's catchment area.

Working Paper 3 presents the results of case study analysis that were used to provide a basis for identifying opportunities and constraints at bus stops in the MAG region. Case studies consisted of two components:

- surveying bus system patrons to evaluate their experience associated with access to the bus stop and use of the bus transit system (see section 1.2.7), and
- field reviews and photography to verify the physical conditions associated with the three geographic points: the bus stop, the immediate vicinity of the stop, and patron catchment area.

The MAG DTAC study team employed field reconnaissance to verify and establish the validity and reliability of information gathered through the data collection process. Each of the selected case study locations (as well as preliminary candidate locations) was visited to (1) acquire knowledge of their specific land use and transportation attributes and (2) obtain a photographic record of the location's features. The field review process was supplemented with examination of aerial photography available on the internet through Google Earth and Bing maps. This work established a foundation for developing a toolkit of improvements that can enhance the comfort and safety of patrons of the Valley Metro bus system, as they travel to and from bus stops. Figures 15-24 illustrate the case study analysis conducted by the consultant team and confirmed by the TWG.

The case studies are intended to uncover issues and opportunities related to the specific bus stop areas, riders' experiences accessing bus stops, and the general catchment areas within a ¼ mile to two mile area of the bus stop. This section summarizes issues and opportunities identified during the field reviews and through the team's survey of bus riders. Based upon the field reviews and the stakeholder and bus transit user's input, issues and opportunities at the case study locations were identified within the following general topic areas:

- Shading, Landscaping, Weather Protection
- Waiting Areas, Bus Shelters and Stop Location
- Safety and Security
- Access to/from Bus Stop and Adjacent Land Uses

4.1 16th Street & Thomas Road *(Urban Core)*

Figure 15 illustrates the case study analysis conducted for the Urban Core bus stop category, located at 16th Street and Thomas Avenue in the City of Phoenix.

- 16th Street is a 5-lane, north-south arterial in central Phoenix. It currently carries an average daily traffic (ADT) volume of approximately 27,000 vehicles per day (vpd) at a posted speed of 35 miles per hour (mph). This roadway is an important north-south connector between the Dreamy Draw area of north central Phoenix and the central business district (CBD). The cross-section measures approximately 72 and consists of two lanes in the both direction with a center left turn lane.
- Thomas Road is 6-lane east-west urban arterial currently with and ADT of 36,000 vpd at a posted speed limit of 35 mph. This roadway provides an important connection between the Phoenix Uptown area and West Phoenix, Avondale, and Litchfield Park to the west and East Phoenix and Scottsdale to the east. The cross-section measures approximately 76 feet east of 16th Street and 84 feet west of 16th Street. The roadway consists of two lanes in the westbound direction, three lanes in the eastbound direction, and a center left-turn lane.

There are far-side bus stops with shelters on each of the intersection legs. There are diagonal curb ramps accommodating wheelchairs at each of the intersection corners. Each leg of the intersection has a standard cross-walk and a pedestrian signal head indicating the walk phases.

Five-foot sidewalks are consistently found throughout the bus stop area. With the exception of a short segment on the south side of Thomas Road west of 16th Street, sidewalks are directly adjacent to vehicle travel lanes creating a fairly uncomfortable experience for pedestrians. There are no landscaping strips or on street parking to buffer pedestrians from the high-volume of vehicular traffic along these two roadways. In addition, there are no bike lanes in this bus study area.

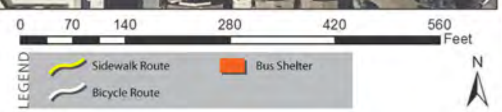
Land uses immediately adjacent to this bus stop location include: a small shopping center with a Burger King, a Walgreens Drug Store, and two gas station/convenience markets. Land uses generally are set back from the sidewalks, requiring pedestrians to traverse the parking lots or landscaped areas to access buildings.

Figure 16 displays a comprehensive overview of the findings within each topic areas at the 16th & Thomas case study location, with associated issues and opportunities.

FIGURE 15: 16th Street & Thomas Road Case Study Analysis (*Urban Core Location*)

16th/Thomas

Date: 6/15/2012




① SB Bus Stop


② EB Bus Stop


③ WB Bus Stop


④ NB Bus Stop


⑤ Pedestrians Crossing Thomas

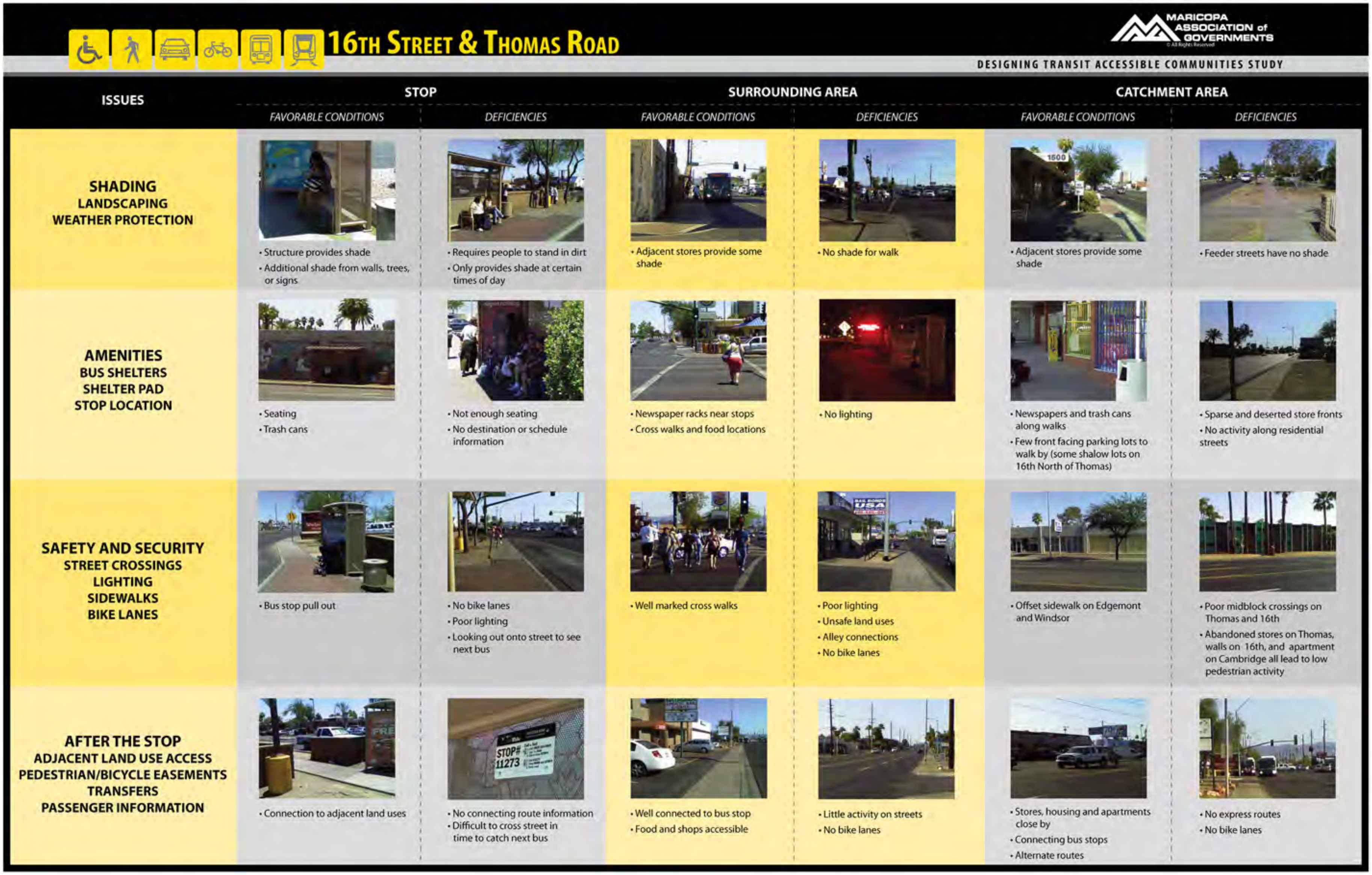

⑥ Bus Patron Looking for Bus


⑦ Shade and Seating Near EB Bus Stop


⑧ Bike on Sidewalk


⑨ Pedestrian Access to Adjacent Development

FIGURE 16: 16th Street & Thomas Road Case Study Analysis (*Urban Core Location*)



4.2 90th Street & Shea Boulevard *(Urban Retail)*

Figure 17 illustrates the case study analysis conducted for the Urban Retail bus stop category, located at 90th Street and Shea Boulevard in the City of Scottsdale.

- 90th Street is a 4-lane, north-south arterial in the City of Scottsdale with an ADT of 19,200 vpd at a posted speed limit of 40 mph. This roadway is a critical north-south link between SR 101/Pima Freeway and Shea Boulevard. It is provides access to the Scottsdale Fiesta Shopping Center, Scottsdale Healthcare North Campus, and numerous commercial enterprises developed in concert with McCormick Ranch, one of the first master planned communities in the country. The cross-section measures 78-84 feet north of Mountain View Road and consists of two lanes in both directions with a center median and multiple right and left-turn bays. South of Mountain View Road, the roadway has a 70 foot, 5 lane cross-section, which consists of two lanes in each direction and a center left-turn lane. North of Shea Boulevard, the roadway has a two-lane cross-section and the speed limit drops to 25 mph. This portion of 90th Street serves commercial properties.

- Shea Boulevard is a six lane east west arterial roadway with an ADT of 60,150 vpd at a posted speed limit of 45 mph. Shea Boulevard is a major regional roadway, connecting with SR 101/Pima Freeway and SR 51/Piestewa Freeway. It also connects Fountain Hills, 10 miles to the east with Scottsdale and Phoenix. The roadway cross-section measures 140 feet north and consists of three lanes in both directions with a center median and dedicated right and left-turn bays; double left-turn bays are provided in the westbound direction at 90th Street.

Eight-foot sidewalks are consistently found throughout the case study location area. Sidewalks typically are five feet south of Mountain View Road. Sidewalks are, for the most part, directly adjacent to the vehicular travel lanes, causing a fairly uncomfortable experience for pedestrian movements. There is ample amount of landscaping in the bus stop area; however, the landscaped strips are between the sidewalks and adjacent buildings. There is no on street parking to buffer the pedestrian from high-volume of vehicular traffic along these two roadways. In addition, there are no bike lanes in this case study location area.

Adjacent land uses include a shopping center, gas station/convenience markets, restaurants, and a major hospital complex. Land uses generally are set back from the sidewalks, requiring pedestrians to traverse landscaped buffer areas and parking lots to access buildings.

Figure 18 displays a comprehensive overview of the findings within each topic areas at the 90th and Shea case study location, with associated issues and opportunities.

FIGURE 17: 90th Street & Shea Boulevard Case Study Analysis *(Urban Retail Location)*

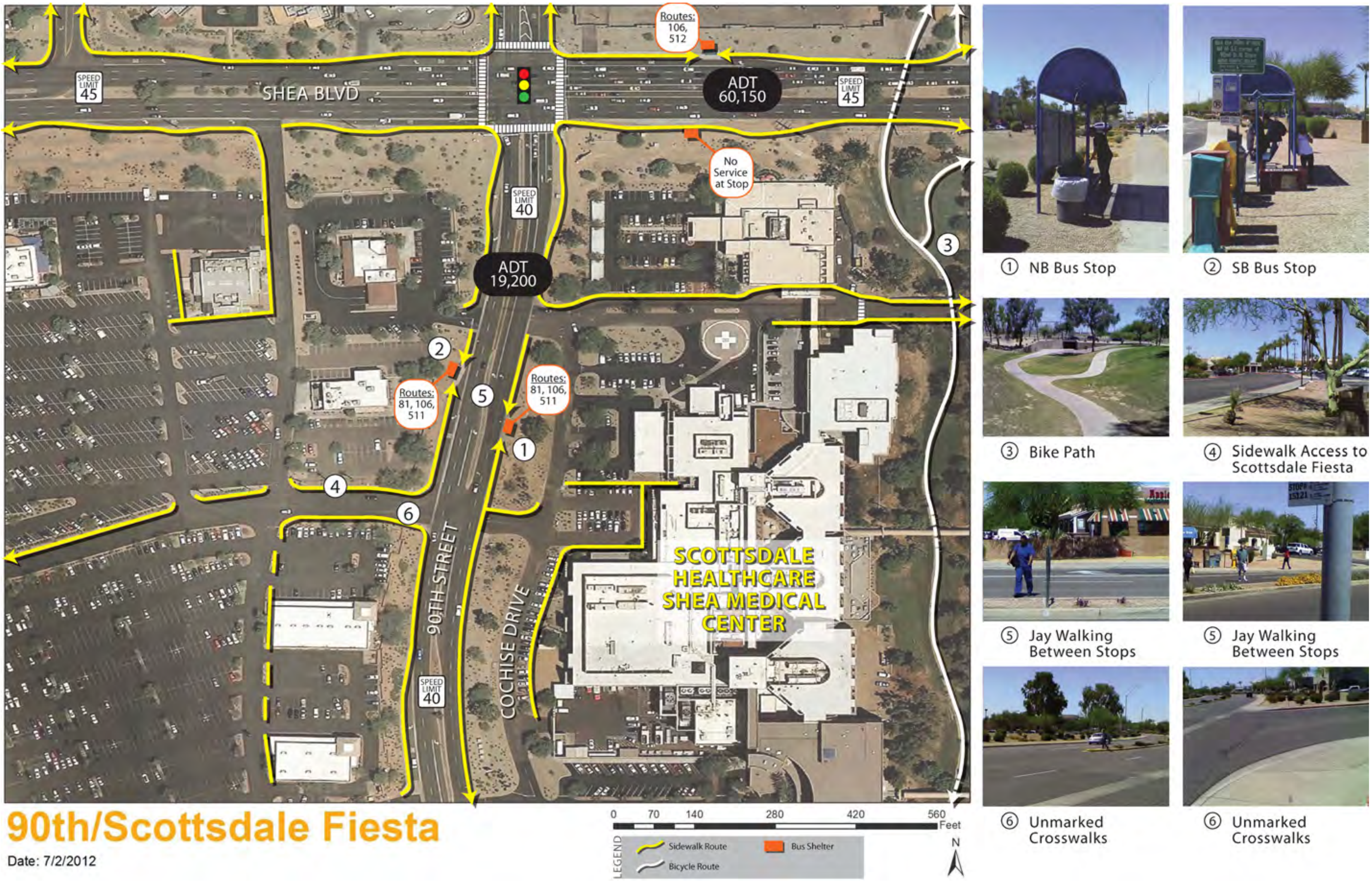
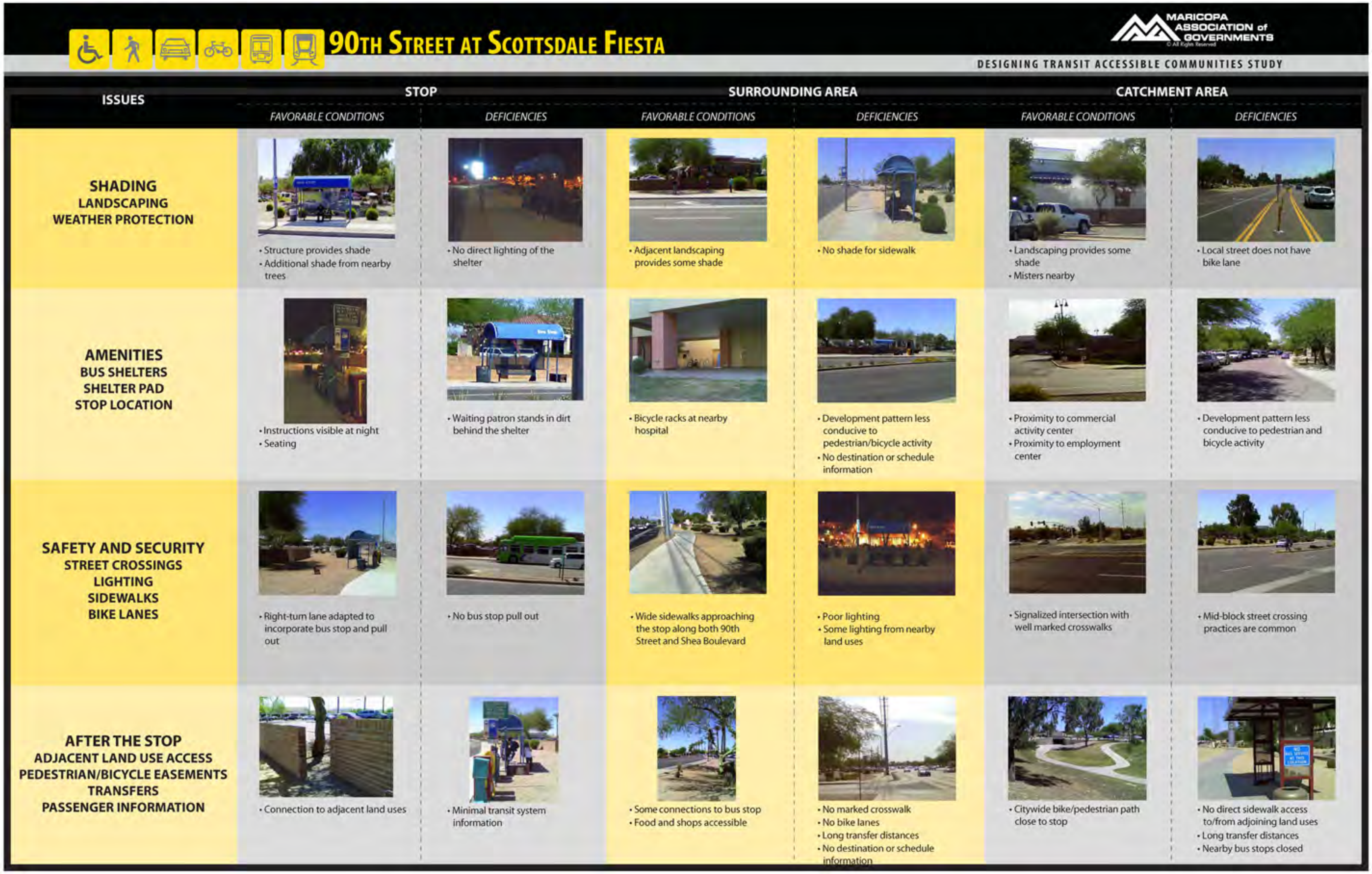


FIGURE 18: 90th Street & Shea Boulevard Case Study Analysis (*Urban Retail Location*)



90TH STREET AT SCOTTSDALE FIESTA

MARICOPA ASSOCIATION of GOVERNMENTS

DESIGNING TRANSIT ACCESSIBLE COMMUNITIES STUDY

ISSUES	STOP		SURROUNDING AREA		CATCHMENT AREA	
	FAVORABLE CONDITIONS	*DEFICIENCIES*	*FAVORABLE CONDITIONS*	*DEFICIENCIES*	*FAVORABLE CONDITIONS*	*DEFICIENCIES*
SHADING **LANDSCAPING** **WEATHER PROTECTION**	• Structure provides shade • Additional shade from nearby trees	• No direct lighting of the shelter	• Adjacent landscaping provides some shade	• No shade for sidewalk	• Landscaping provides some shade • Misters nearby	• Local street does not have bike lane
AMENITIES **BUS SHELTERS** **SHELTER PAD** **STOP LOCATION**	• Instructions visible at night • Seating	• Waiting patron stands in dirt behind the shelter	• Bicycle racks at nearby hospital	• Development pattern less conducive to pedestrian/bicycle activity • No destination or schedule information	• Proximity to commercial activity center • Proximity to employment center	• Development pattern less conducive to pedestrian and bicycle activity
SAFETY AND SECURITY **STREET CROSSINGS** **LIGHTING** **SIDEWALKS** **BIKE LANES**	• Right-turn lane adapted to incorporate bus stop and pull out	• No bus stop pull out	• Wide sidewalks approaching the stop along both 90th Street and Shea Boulevard	• Poor lighting • Some lighting from nearby land uses	• Signalized intersection with well marked crosswalks	• Mid-block street crossing practices are common
AFTER THE STOP **ADJACENT LAND USE ACCESS** **PEDESTRIAN/BICYCLE EASEMENTS** **TRANSFERS** **PASSENGER INFORMATION**	• Connection to adjacent land uses	• Minimal transit system information	• Some connections to bus stop • Food and shops accessible	• No marked crosswalk • No bike lanes • Long transfer distances • No destination or schedule information	• Citywide bike/pedestrian path close to stop	• No direct sidewalk access to/from adjoining land uses • Long transfer distances • Nearby bus stops closed

4.3 19th Avenue & Southern Avenue *(Urban Residential)*

Figure 19 illustrates the case study analysis conducted for the Urban Residential bus stop category, located at 19th Avenue and Southern Avenue in the City of Phoenix.

- 19th Avenue is a 5/6-lane, north south arterial, currently carrying an average daily traffic (ADT) volume of approximately 25,409 vpd at a posted speed of 40 mph north of Southern Avenue and 45 mph south of Southern Avenue. This roadway is an important north-south arterial for South Phoenix, providing access to the State Capitol area, the Arizona State Fairgrounds, and industrial/commercial employment centers at Peoria Avenue and the Deer Valley Airport. The cross-section measures approximately 76 feet north of Southern Avenue and 84 feet south of Southern Avenue. North of Southern Avenue, the roadway consists of three lanes in the southbound direction and two lanes in the northbound direction with a center left-turn lane. South of Southern Avenue, the roadway has two lanes in both directions, with a center left-turn lane.
- Southern Avenue is a 4-lane east-west urban arterial with an ADT of 14,230 vpd at a posted speed limit of 45 mph west of 19th Avenue and 40 mph east of 19th Avenue. This roadway is an important arterial for South Phoenix, providing access to the Phoenix CBD, the industrial area of southeast Phoenix/ west Tempe, Tempe, and Mesa. The cross-section measures approximately 76 feet east of 16th Street and 84 feet west of 16th Street. The roadway consists of two lanes in the westbound direction, three lanes in the eastbound direction, and a center left-turn lane. In addition, there are bike lanes on the north and south sides of the roadway.

There are far-side bus stops with shelters and bus pull outs on each of the intersection legs. There are two perpendicular curb ramps accommodating wheelchairs at each of the intersection corners. Each leg of the intersection legs has a standard cross-walk and a pedestrian signal head indicating the pedestrian walk phases.

Five-foot sidewalks are consistently found throughout the bus stop area. However, sidewalks are directly adjacent to vehicular travel lanes, causing a fairly uncomfortable experience for pedestrians. There are no landscaping strips or on street parking to buffer pedestrian movements from high-speed, high-volume vehicular traffic along these two roadways. Bike lanes have been provided only on Southern Avenue.

Adjacent land uses include three gas station/ convenience markets on three corners and a Walgreens on the fourth corner. Land uses generally are set back from the sidewalk requiring pedestrians to traverse the parking lots and landscaping to access buildings. The Walgreens on the northeast corner of the intersection has direct sidewalk access from the intersection corner to the building site, thereby making pedestrian access more comfortable.

Figure 20 displays a comprehensive overview of the findings within each topic areas at the 19th and Southern case study location, with associated issues and opportunities.

FIGURE 19: 19th Avenue & Southern Avenue Case Study Analysis (*Urban Residential Location*)

FIGURE 20: 19th Avenue & Southern Avenue Case Study Analysis *(Urban Residential Location)*

19TH AVENUE & SOUTHERN AVENUE

MARICOPA ASSOCIATION of GOVERNMENTS

DESIGNING TRANSIT ACCESSIBLE COMMUNITIES STUDY

ISSUES	STOP – *Favorable Conditions*	STOP – *Deficiencies*	SURROUNDING AREA – *Favorable Conditions*	SURROUNDING AREA – *Deficiencies*	CATCHMENT AREA – *Favorable Conditions*	CATCHMENT AREA – *Deficiencies*
SHADING **LANDSCAPING** **WEATHER PROTECTION**	 • Shaded bench	 • Not good for all times of day • No landscape shading	 • Some arterial streets have partial shade	 • Little to no shade for walk	 • Some arterial streets have partial shade	 • Residential streets have no shading • Mostly emply lots • Few trees provide little shade
AMENITIES **BUS SHELTERS** **SHELTER PAD** **STOP LOCATION**	 • Advertising • Trash cans • Complete transit system signage	 • Not enough seating • No real time bus information • No newspapers	 • Some landscaping • Detached sidewalks • Convenience stores	 • Empty lots	 • Alleys to the North provide connectivity and relocate trash barrels • Detached sidewalks	 • Empty lots • No activity along streets • No landscaping • No bike lanes
SAFETY AND SECURITY **STREET CROSSINGS** **LIGHTING** **SIDEWALKS** **BIKE LANES**	 • Bus stop pull out • Detached sidewalks	 • No bike lanes or bike racks	 • Adjacent stores provide good lighting • Preferred land uses	 • Poor lighting after store hours	 • Pedestrian crosswalks • Eastbound bike lanes • Traffic calming devices in neighborhoods to the West	 • Inactive streets
AFTER THE STOP **ADJACENT LAND USE ACCESS** **PEDESTRIAN/BICYCLE EASEMENTS** **TRANSFERS** **PASSENGER INFORMATION**	 • Network map provided	 • Some locations with attached sidewalk	 • Connection to adjacent land use • Good crosswalks	 • Crossing signage but no crosswalk	 • Eastbound bike lanes • Large tracts of vacant/ undeveloped property	 • Primarily used for transfers and not origins/destinations • Neighborhood entrances not easily accessed

4.4 75th Avenue & Bell Road *(Suburban Retail)*

Figure 21 illustrates the case study analysis conducted for the Suburban Retail bus stop category, located at 75th Avenue and Bell Road in the City of Glendale.

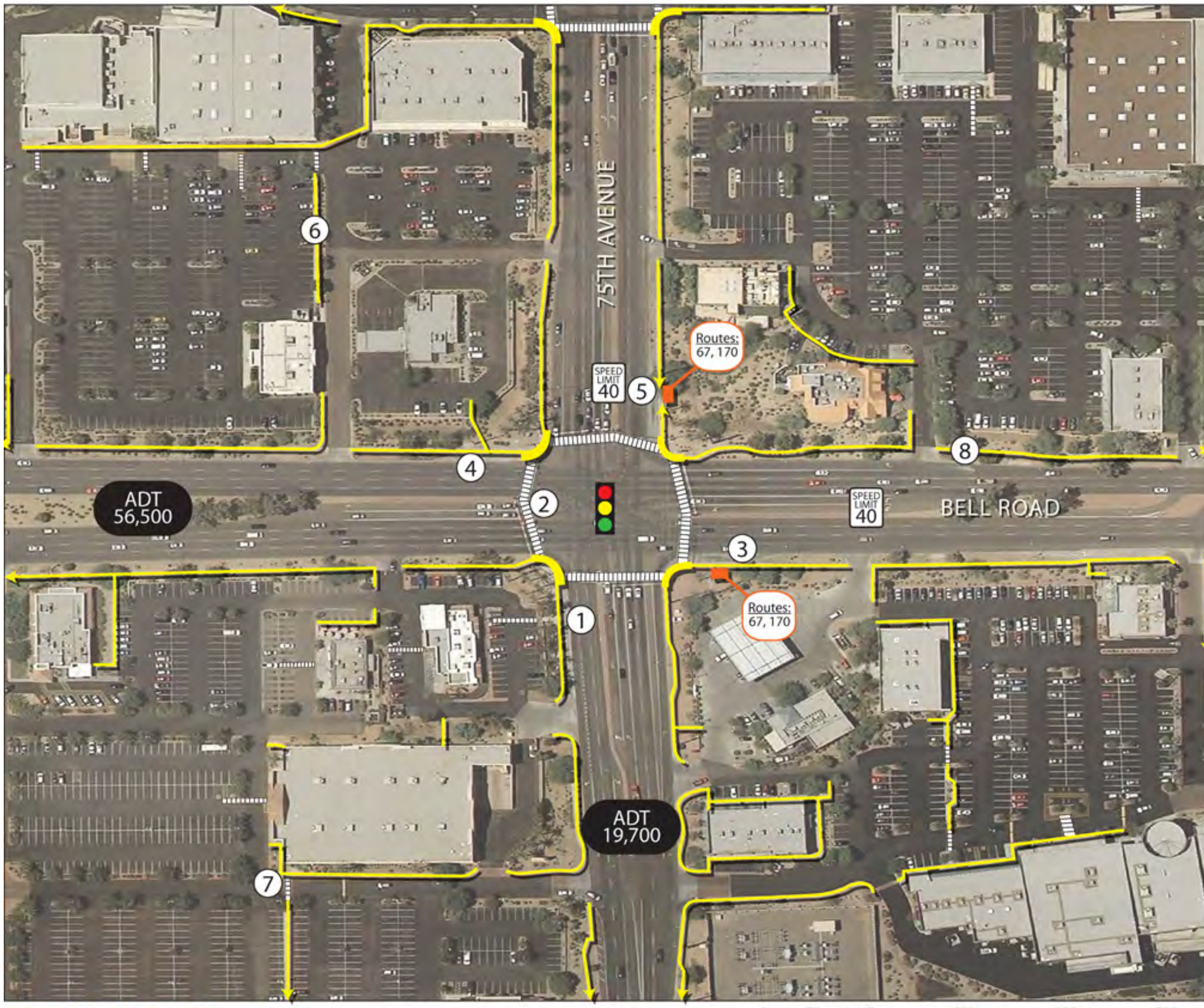
- 75th Avenue is a 4-lane, north-south arterial in the City of Glendale with an ADT of 19,700 vpd and a posted speed limit of 40 mph. This roadway is a critical north-south link between northern portions of Glendale and southern portions of Glendale between Camelback Road and Northern Avenue. It provides access to Arrowhead Towne Center on the north side of Bell Road and makes connections with SR 101/Agua Fria Freeway, US 60/Grand Avenue, and the I 10/Papago Freeway corridor in west Phoenix. The cross-section measures 130 feet north of Bell Road and consists of two lanes in the northbound directions and three lanes in the southbound direction with a center median and multiple right and left-turn bays. South of Bell Road, the roadway becomes a five-lane facility. The 135 foot cross-section at Bell Road narrows to 80 feet at the Skunk Creek Bridge, where there are two lanes in each direction with a center left-turn lane.
- Bell Road is an east west arterial roadway with an ADT of 56,500 vpd and a posted speed limit of 40 mph. This major regional roadway connects with SR 101/Agua Fria Freeway to the west and I 17/Black Canyon Freeway, SR 51/Piestewa Freeway, and SR 101/Pima Freeway to the east. As a major regional arterial, Bell Road is dominated by commercial development stretching from the Surprise and Glendale in the western portion to Phoenix and Scottsdale in the eastern portion. The roadway cross-section measures 145 feet east of 75th Avenue and consists of three lanes in both directions with a center median and dedicated right and left-turn bays. Double left-turn bays are provided in the westbound direction at 75th Avenue. West of 75th Avenue the cross-section expands to 190 feet, accommodating four lanes in both directions, right turn bays, and a median sufficiently wide to permit double left-turn bays at 75th Avenue, 83rd Avenue, and every intersection in between.

Sidewalks constructed six to seven feet in width are consistently found throughout the case study location area. Sidewalks on 75th Avenue, north of Bell Road, generally are separated from vehicular travel lanes by a landscaped buffer five to seven feet in width. South of Bell Road, this buffer is less consistent, and it disappears south of the Skunk Creek Bridge, which results in a less than favorable experience for the pedestrian. A five-foot pedestrian walkway has been incorporated on both sides of Skunk Creek Bridge. Sidewalks on Bell Road are separated from vehicular travel lanes by a 12 foot landscaped buffer, which buffers the pedestrian from high-speed, high-volume vehicular traffic. Bell Road crosses Skunk Creek east of 75th Avenue. This bridge does not include pedestrian walkways. There are no bike lanes in this case study location area.

Adjacent land uses include a regional mall, a power center, shopping centers, restaurants, and fast food establishments. Land uses generally are set back from the sidewalk area requiring pedestrians to traverse the landscaped areas and parking lots to access buildings.

Figure 22 displays a comprehensive overview of the findings within each topic areas at the 75th and Bell case study location, with associated issues and opportunities.

FIGURE 21: 75th Avenue & Bell Road Case Study Analysis (*Suburban Retail Location*)




① Connections to Adjacent Land Use


② Pedestrian Refuge


③ Bus Bay


④ Unused Bus Stop


⑤ NB Bus Stop


⑥ Pedestrian Passageway


⑦ Pedestrian Crosswalk


⑧ Detached Sidewalk

75th/Bell

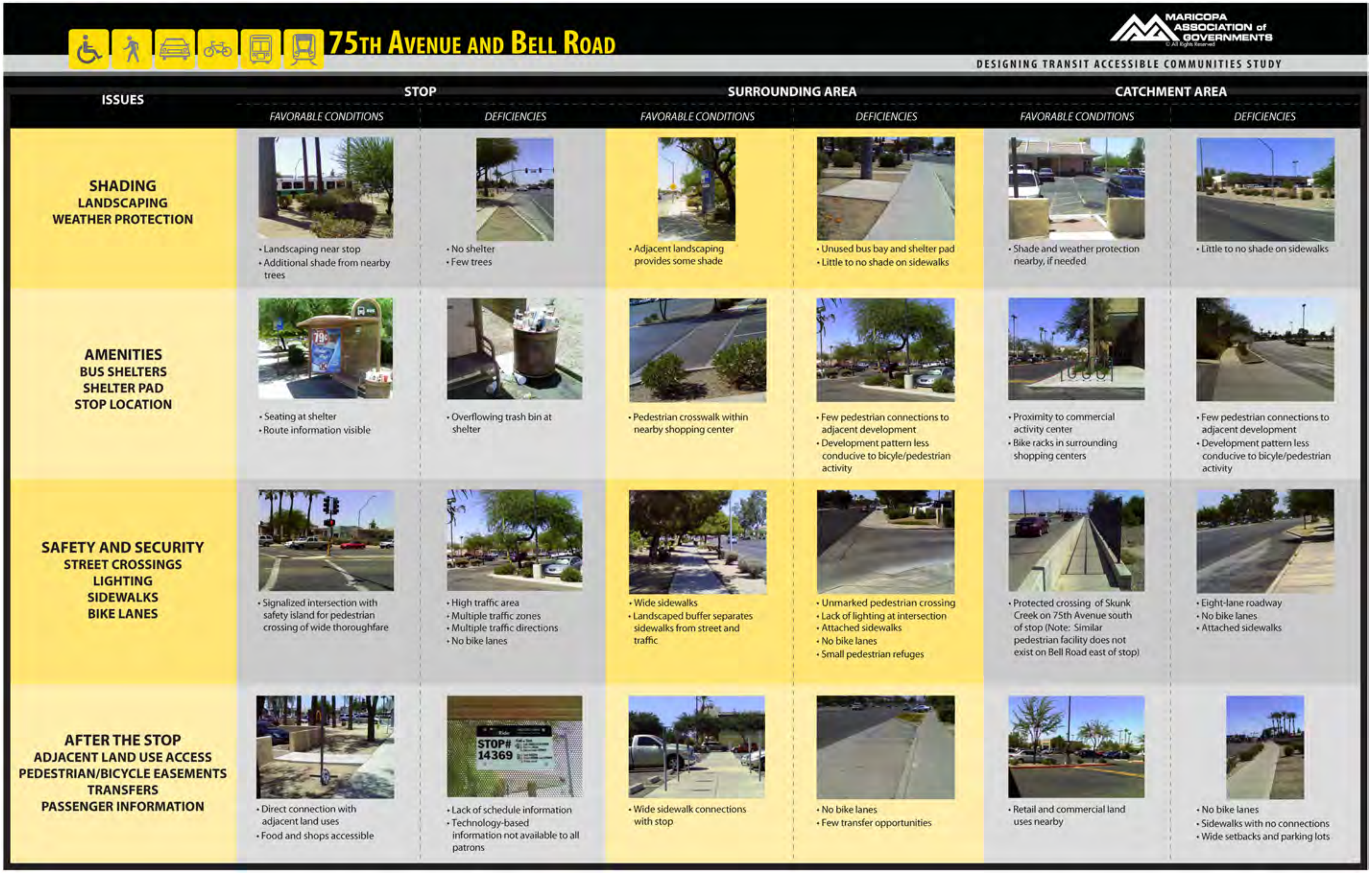
Date: 7/10/2012

0 70 140 280 420 560 Feet

LEGEND: Sidewalk Route; Bicycle Route; Bus Shelter

N

FIGURE 22: 75th Avenue & Bell Road Case Study Analysis (*Suburban Retail Location*)



75th Avenue and Bell Road

MARICOPA ASSOCIATION of GOVERNMENTS

DESIGNING TRANSIT ACCESSIBLE COMMUNITIES STUDY

ISSUES	STOP		SURROUNDING AREA		CATCHMENT AREA	
	FAVORABLE CONDITIONS	*DEFICIENCIES*	*FAVORABLE CONDITIONS*	*DEFICIENCIES*	*FAVORABLE CONDITIONS*	*DEFICIENCIES*
SHADING **LANDSCAPING** **WEATHER PROTECTION**	• Landscaping near stop • Additional shade from nearby trees	• No shelter • Few trees	• Adjacent landscaping provides some shade	• Unused bus bay and shelter pad • Little to no shade on sidewalks	• Shade and weather protection nearby, if needed	• Little to no shade on sidewalks
AMENITIES **BUS SHELTERS** **SHELTER PAD** **STOP LOCATION**	• Seating at shelter • Route information visible	• Overflowing trash bin at shelter	• Pedestrian crosswalk within nearby shopping center	• Few pedestrian connections to adjacent development • Development pattern less conducive to bicyle/pedestrian activity	• Proximity to commercial activity center • Bike racks in surrounding shopping centers	• Few pedestrian connections to adjacent development • Development pattern less conducive to bicyle/pedestrian activity
SAFETY AND SECURITY **STREET CROSSINGS** **LIGHTING** **SIDEWALKS** **BIKE LANES**	• Signalized intersection with safety island for pedestrian crossing of wide thoroughfare	• High traffic area • Multiple traffic zones • Multiple traffic directions • No bike lanes	• Wide sidewalks • Landscaped buffer separates sidewalks from street and traffic	• Unmarked pedestrian crossing • Lack of lighting at intersection • Attached sidewalks • No bike lanes • Small pedestrian refuges	• Protected crossing of Skunk Creek on 75th Avenue south of stop (Note: Similar pedestrian facility does not exist on Bell Road east of stop)	• Eight-lane roadway • No bike lanes • Attached sidewalks
AFTER THE STOP **ADJACENT LAND USE ACCESS** **PEDESTRIAN/BICYCLE EASEMENTS** **TRANSFERS** **PASSENGER INFORMATION**	• Direct connection with adjacent land uses • Food and shops accessible	• Lack of schedule information • Technology-based information not available to all patrons	• Wide sidewalk connections with stop	• No bike lanes • Few transfer opportunities	• Retail and commercial land uses nearby	• No bike lanes • Sidewalks with no connections • Wide setbacks and parking lots

4.5 Elliot Road & Lakeview Drive *(Suburban Residential)*

Figure 23 illustrates the case study analysis conducted for the Suburban Residential bus stop category, located at Elliot Road and Lakeview Drive in the City of Gilbert.

- Elliot Road is a 4-lane east-west arterial with an ADT of 17,697 vpd and a posted speed limit of 45 mph. Elliot Road is an important east-west arterial, connecting the eastern portions of Gilbert to Chandler to the east and Tempe and Phoenix to the west. The roadway connects with SR 202/Santan Freeway to the east and SR 101/Price Freeway and I 10/ Maricopa Freeway to the west. The roadway cross-section measures approximately 66 feet, accommodating two lanes in both directions with a center left-turn lane and bike lanes. The roadway has been developed within a right-of-way of 145 feet, which has allowed development of wide landscaped buffers on both sides of the roadway.
- Lakeview Drive is a two-lane roadway that extends less than one quarter mile north of the intersection with Elliot Road, transitioning into a loop road serving Wind Drift Development. It has a posted speed limit of 35 mph. Traffic levels on the north segment are associated with the residential development, and it has a posted speed limit of 35 mph. Lakeview Drive has a wide landscaped median developed within a cross-section of approximately 68 feet that expands to 92 feet at Elliot Road. The right-of-way ranges from 110 to 140 feet, allowing for wide landscaped buffers on both sides of the roadway. Bike lanes are provided on both sides of the roadway. South of Elliot Road, Lakeview Drive essentially is the entry drive for Gilbert High School with speed limit of 25 mph. Traffic levels are associated with Gilbert High School and, therefore, seasonal.

Five-foot sidewalks are consistently found throughout the case study location area. The sidewalks in this case study location have been developed with the landscaped buffers and, therefore, pedestrians are separated from moving traffic. The landscaped buffer provides pedestrians with a more comfortable walking experience, as they are not forced to travel adjacent to moving vehicular vehicles.

Adjacent land uses include Gilbert High School and single-family residential developments. Residential land uses mostly are walled off from the main roadway and landscaped buffers, where there are sidewalks. This requires residents of the area to ingress/egress their developments through limited points of access.

Figure 24 displays a comprehensive overview of the findings within each topic areas at the Elliot and Lakeview case study location, with associated issues and opportunities.

FIGURE 23: Elliot Road & Lakeview Drive Case Study Analysis (*Suburban Residential Location*)

① Bike Lane Adjacent to WB Bus Stop

② Bike Lane Adjacent to EB Bus Stop

③ Sidewalk on North Side of Elliot

④ EB Bus Stop

⑤ WB Bus Stop

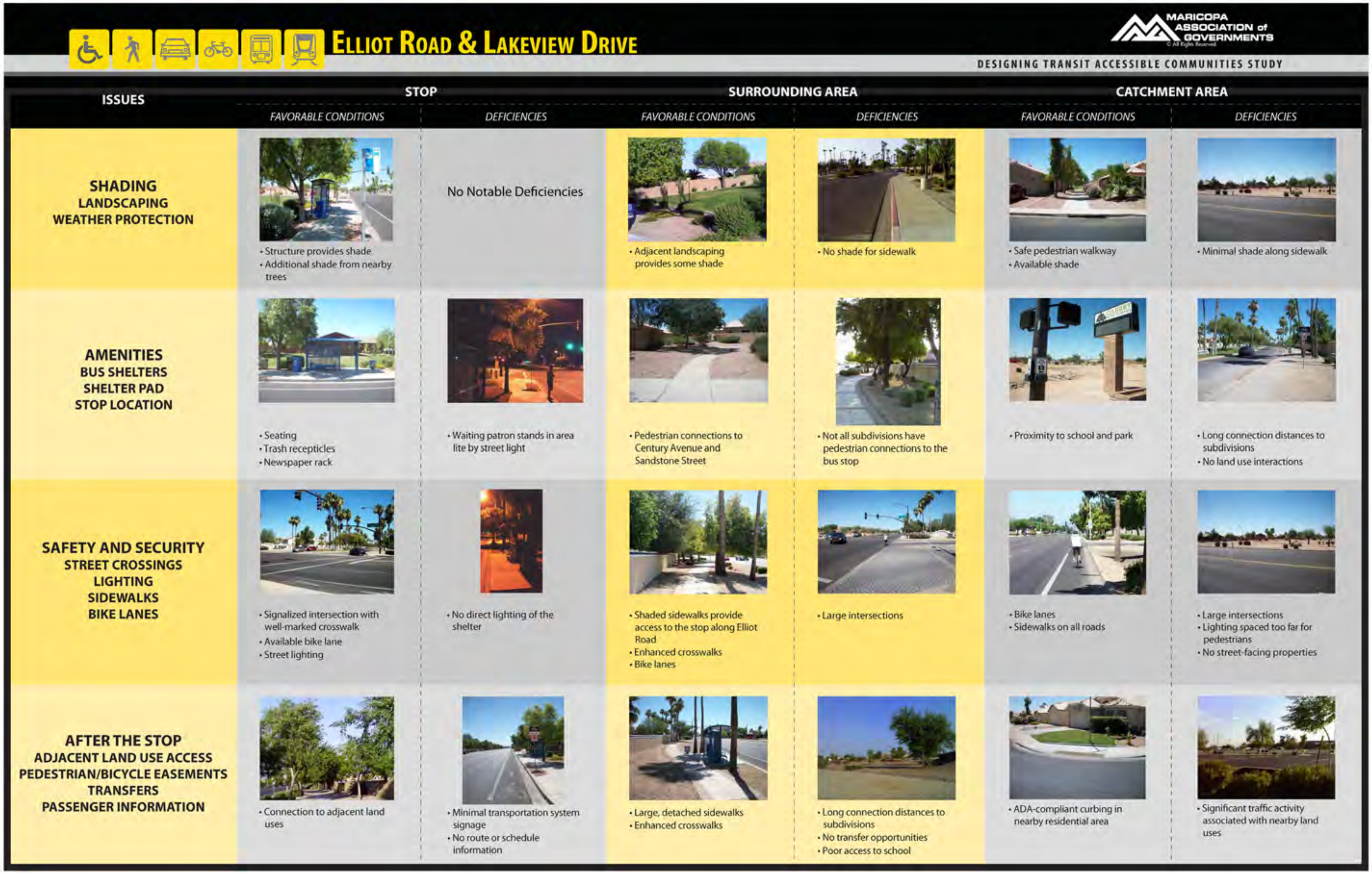
⑥ Pedestrian Access East of EB Bus Stop

⑦ Pedestrian Access to Val Vista Place Park

⑧ Lakeview Drive

⑨ Jogger on Elliot Road

FIGURE 24: Elliot Road & Lakeview Drive Case Study Analysis (*Suburban Residential Location*)



ELLIOT ROAD & LAKEVIEW DRIVE

MARICOPA ASSOCIATION of GOVERNMENTS

DESIGNING TRANSIT ACCESSIBLE COMMUNITIES STUDY

ISSUES	STOP		SURROUNDING AREA		CATCHMENT AREA	
	FAVORABLE CONDITIONS	DEFICIENCIES	FAVORABLE CONDITIONS	DEFICIENCIES	FAVORABLE CONDITIONS	DEFICIENCIES
SHADING LANDSCAPING WEATHER PROTECTION	• Structure provides shade • Additional shade from nearby trees	No Notable Deficiencies	• Adjacent landscaping provides some shade	• No shade for sidewalk	• Safe pedestrian walkway • Available shade	• Minimal shade along sidewalk
AMENITIES BUS SHELTERS SHELTER PAD STOP LOCATION	• Seating • Trash recepticles • Newspaper rack	• Waiting patron stands in area lite by street light	• Pedestrian connections to Century Avenue and Sandstone Street	• Not all subdivisions have pedestrian connections to the bus stop	• Proximity to school and park	• Long connection distances to subdivisions • No land use interactions
SAFETY AND SECURITY STREET CROSSINGS LIGHTING SIDEWALKS BIKE LANES	• Signalized intersection with well-marked crosswalk • Available bike lane • Street lighting	• No direct lighting of the shelter	• Shaded sidewalks provide access to the stop along Elliot Road • Enhanced crosswalks • Bike lanes	• Large intersections	• Bike lanes • Sidewalks on all roads	• Large intersections • Lighting spaced too far for pedestrians • No street-facing properties
AFTER THE STOP ADJACENT LAND USE ACCESS PEDESTRIAN/BICYCLE EASEMENTS TRANSFERS PASSENGER INFORMATION	• Connection to adjacent land uses	• Minimal transportation system signage • No route or schedule information	• Large, detached sidewalks • Enhanced crosswalks	• Long connection distances to subdivisions • No transfer opportunities • Poor access to school	• ADA-compliant curbing in nearby residential area	• Significant traffic activity associated with nearby land uses

5.0 Bus Stop Prototypes & Toolkit Development *(Working Paper 4)*

Working Paper 4 is divided into four sections: Developing Bus Stop Prototypes, Bus Stop Prototypes, Transit Accessibility Toolkit, and Implementation Checklist. These sections describe the development of prototypical bus stop areas or Bus Stop Prototypes for the MAG region. These Bus Stop Prototypes reflect optimal or recommended streetscape and roadway infrastructure improvements intended to support safe and comfortable bus stop accessibility via foot and by bicycle. Given the high rates of non-motorized access to the bus system found during the study, MAG recognizes the importance of supporting local agencies in their efforts to plan for environments that are safe, comfortable and inviting. Working Paper 4 defines the prototypes, a toolkit, and a checklist that provide a roadmap for improvements and new development for different bus stop areas throughout the region.

The Bus Stop Prototypes presented in this section provide a framework for enhancing the comfort and safety of non-motorized travelers accessing the transit system. This section recognizes the constraints at the case study locations and attempts to give alternatives within those constraints. Not all stops will fit precisely into a single case study category. The following subsections describe each of the bus stop categories and presents the related Bus Stop Prototype with pedestrian and bicycle access improvement considerations. Previous working papers defined the process to categorize bus stops across the MAG region and the process of selecting case study locations.

Figures 25-29 and tables 11-15 illustrate the prototypical improvements at case study locations as conducted and confirmed by the DTAC study team. Table 10 provides descriptions for the symbols illustrated in tables 11-15; this table is comprehensive in nature and does not necessarily provide the specific improvement recommendations or exact locations. Each improvement type is elaborated upon in the Transit Accessibility Toolkit shown in Chapter 6.

TABLE 10: Prototype Improvement Considerations

Category Ranking	Category Name	Defining Characteristics
	Connection to Adjacent Use	Create pedestrian passageways where the street network provides few pedestrian and bicycle connection opportunities.
	Enhanced Sidewalk	10' wide sidewalks that are detached from driving lanes when adjacent to major street intersections or when adjacent to a bus stop provide greater mobility for pedestrians. In some locations an expanded bus pad could extend to back side of shelter to accommodate additional seating and shade opportunities. ADA and bicycle access to be provided along all off-street and on-street identified and designated routes.
	Crosswalk/ Reduced Corner Radii	Stripe crosswalks according to ADA standards and have a signalized crossing system, advanced yield lines, and wider cross walks that improve safety for pedestrians crossing the street. Some locations may allow for reduced turning radius at intersection. Pedestrian refuges are encouraged on multi-lane roadways with significant traffic volumes and intermediate- to high-travel speeds. Establish mid-block signalized pedestrian crossings in non-intersection high transit use locations.
	Lighting	Provide pedestrian-scale lighting near transit facility to improve safety. Pedestrian-scale lighting along off-street pedestrian and bicycle routes improve safety.
	Relocate Transit Stop / Unused Transit Shelter	Relocate bus stop to the intersection to ease route transfers and connections, to take advantage of existing lighting at the intersection, and/or to utilize existing setback space. Existing unused transit facilities exist within some bus stop catchment areas. Should the transit system be expanded, these existing facilities may provide ideal locations for future bus stops.
	Seating	Provide highly visible seating under a nearby shade tree improves pedestrian comfort. Lower walls provide additional seating in high transit usage areas.
	Landscape Shading	Provide shade trees to maximize shade along pedestrian/bicycle routes. In urban areas, provide shade trees with grates to establish a larger sidewalk space for strollers and pedestrians near transit stops. Trees maximize shade along pedestrian/bicycle routes.
	Bicycle Access	Bicycle lanes serve as an additional route of travel for bicyclists in a safe environment. The addition of a bicycle lane would require further narrowing of travel lanes which may not be feasible at all locations. Wayfinding directs cyclists to low traffic volume roadways/ collector streets.
	Bicycle Parking	Provide bicycle racks or other parking facilities where bicycle ridership is high.
	Bicycle/ Pedestrian Wayfinding	Wayfinding directs pedestrians or bicyclists to nearby destinations and pedestrian/bicycle friendly routes including nearby local/collector streets.
	Information Signage	Install improved signage at bus stops to notify riders of the bus schedule and the bus routes.
	Reduced Building Setback	Encourage buildings adjacent to transit stops to frame the street and maintain a minimal setback to allow for shade opportunities and improved pedestrian access. Locate surface parking to the side or back of building, not adjacent to the street.
	Maintenance	Additional improvements and repairs.

5.1 16th Street & Thomas Road *(Urban Core)*

An Urban Core bus stop area is highly accessible and primarily within the core metropolitan area. The area usually has a traditional street network and these bus stops types are typically located along arterial streets or within the urban core. The area has multi-family housing units as well as neighborhood retail with few parking spaces and is typically oriented toward the main arterials. This area is usually serviced by both low local, express, and circulatory transit service although high frequency service is the predominant service type. The area will have anywhere from low to high population density but all urban core bus stop types will have high employment density. This stop type makes up 15.4% of all the bus stops in the MAG region. The case study location for the Urban Core bus stop is 16th Street and Thomas Road. Figure 25 and Table 11 illustrates the optimal improvements at the 16th and Thomas case study location given existing constraints.

FIGURE 25: 16th Street & Thomas Road Prototype Improvements *(Urban Core Location)*

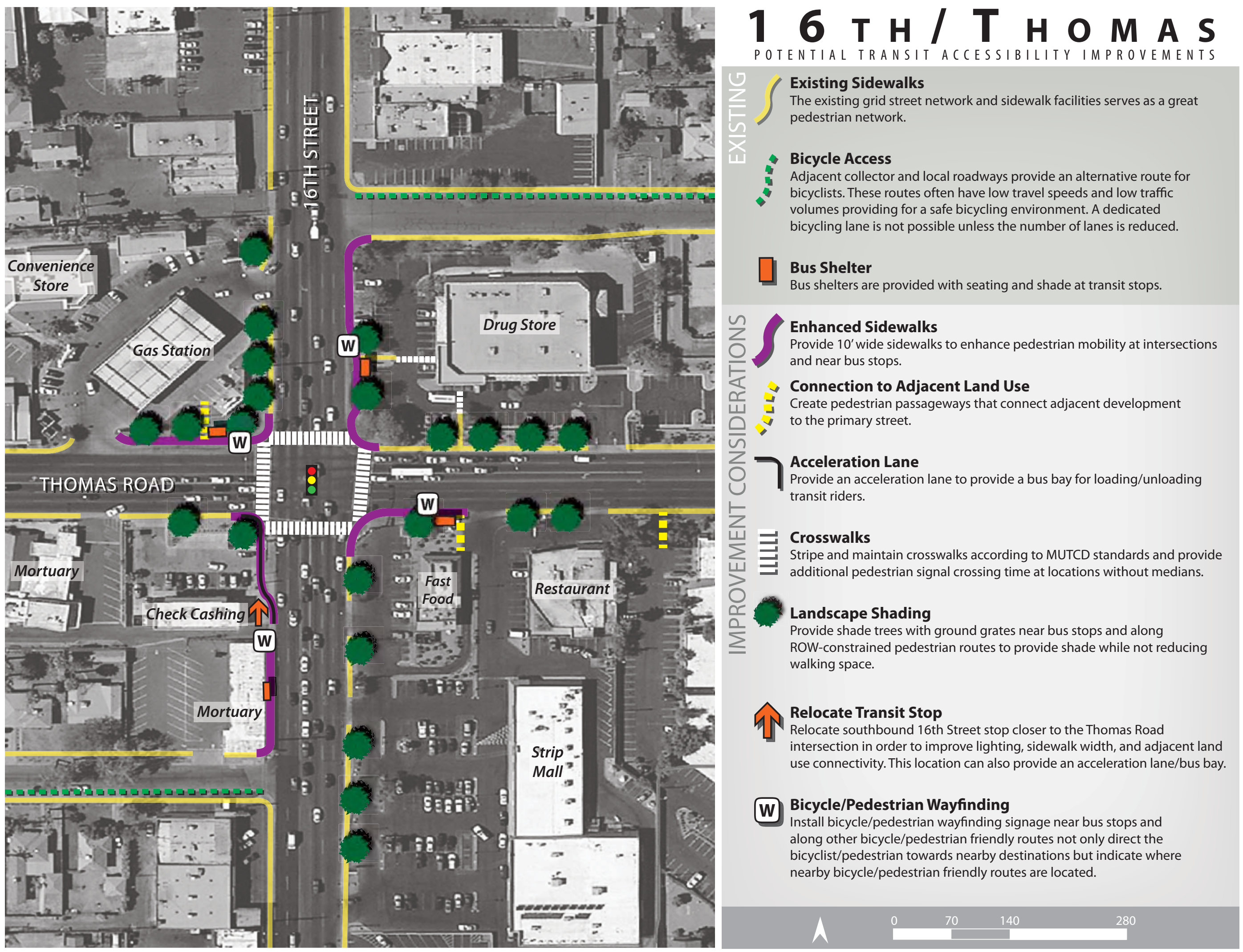


TABLE 11: 16th Street & Thomas Road Prototype Improvements *(Urban Core Location)*

Northbound 16th Street Stop

Northbound 16th Street Stop

Southbound 16th Street Stop

16th Street and Thomas Road Intersection

Northbound 16th Street Stop

5.2 90th Street & Shea Boulevard *(Urban Retail)*

An Urban Retail bus stop has retail land use present, high frequency transit route service confined to peak periods only, and medium population and employment density. This category accounts for 14.8% of all bus stop areas in the MAG region. The stop areas have a mix of traditional and conventional street networks and bus stops are concentrated along arterial streets. The surrounding land use is typically made up of medium-sized shopping centers and strip malls. The case study location for the Urban Retail bus stop is 90th Street and Shea Boulevard. Figure 26 and table 12 illustrate the optimal improvements at the 90th and Shea Boulevard case study location given existing constraints.

FIGURE 26: 90th Street & Shea Boulevard Prototype Improvements (Urban Retail Location)

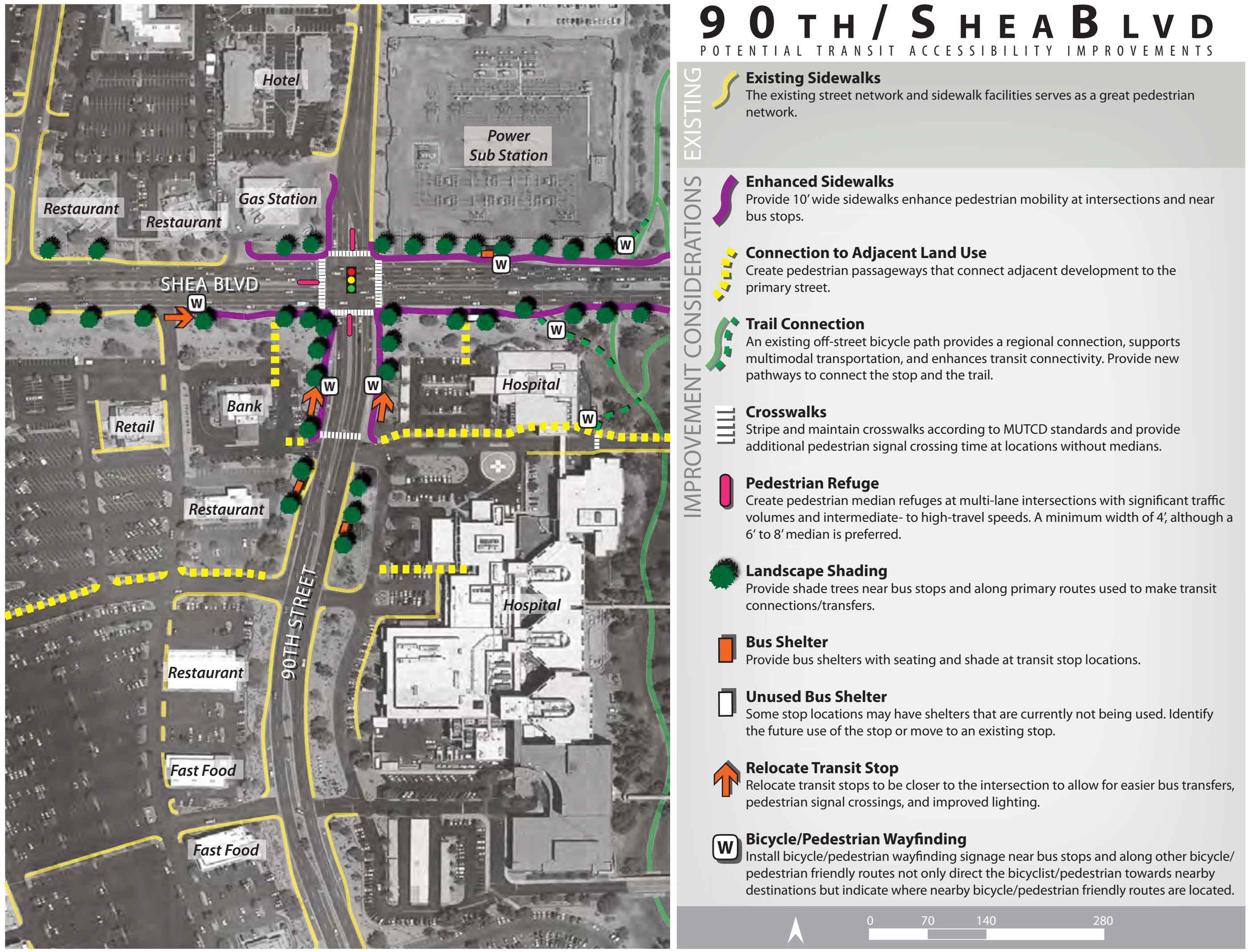
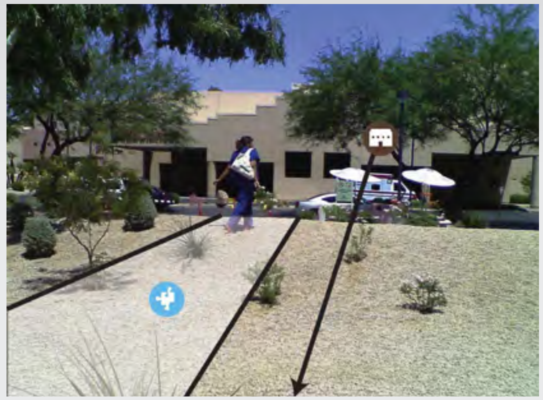
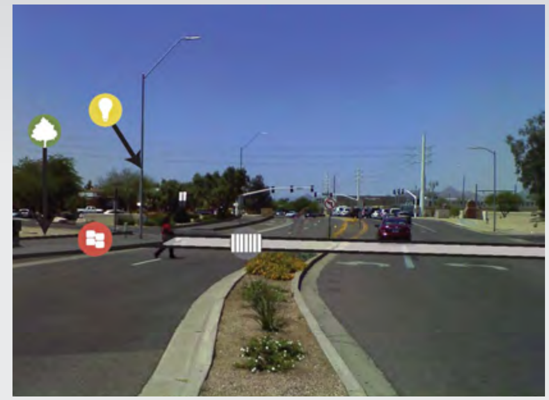


TABLE 12: 90th Street & Shea Boulevard Prototype Improvements *(Urban Retail Location)*

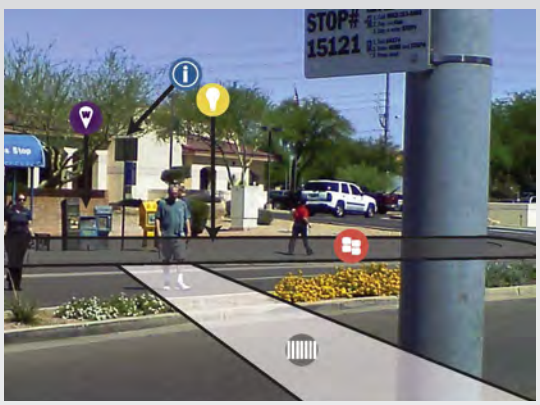
South of Shea Boulevard, Bicycle Path



90th Street at Scottsdale Healthcare



90th Street



Southbound 90th Street Stop

Southbound 90th Street Stop

Northbound 90th Street Stop

5.3 19th Avenue & Southern Avenue *(Urban Residential)*

An Urban Residential bus stop is similar to the Urban Core, except there is no retail land use present, and there is only a medium population and employment density. This category accounts for 7.8% of all bus stops in the MAG region. All bus stops in the Urban Residential category are served by just one all-day high frequency transit route. The surrounding area has a mix of traditional and conventional street networks with bus stops located along arterials streets. The area would have a mix of traditional neighborhoods with single- and multi-family homes. The case study location for the Urban Residential bus stop is 19th Avenue and Southern Avenue. Figures 27 and table 13 illustrate the optimal improvements at the 19th and Southern case study location given existing constraints.

FIGURE 27: 19th Avenue & Southern Avenue Prototype Improvements *(Urban Residential Location)*

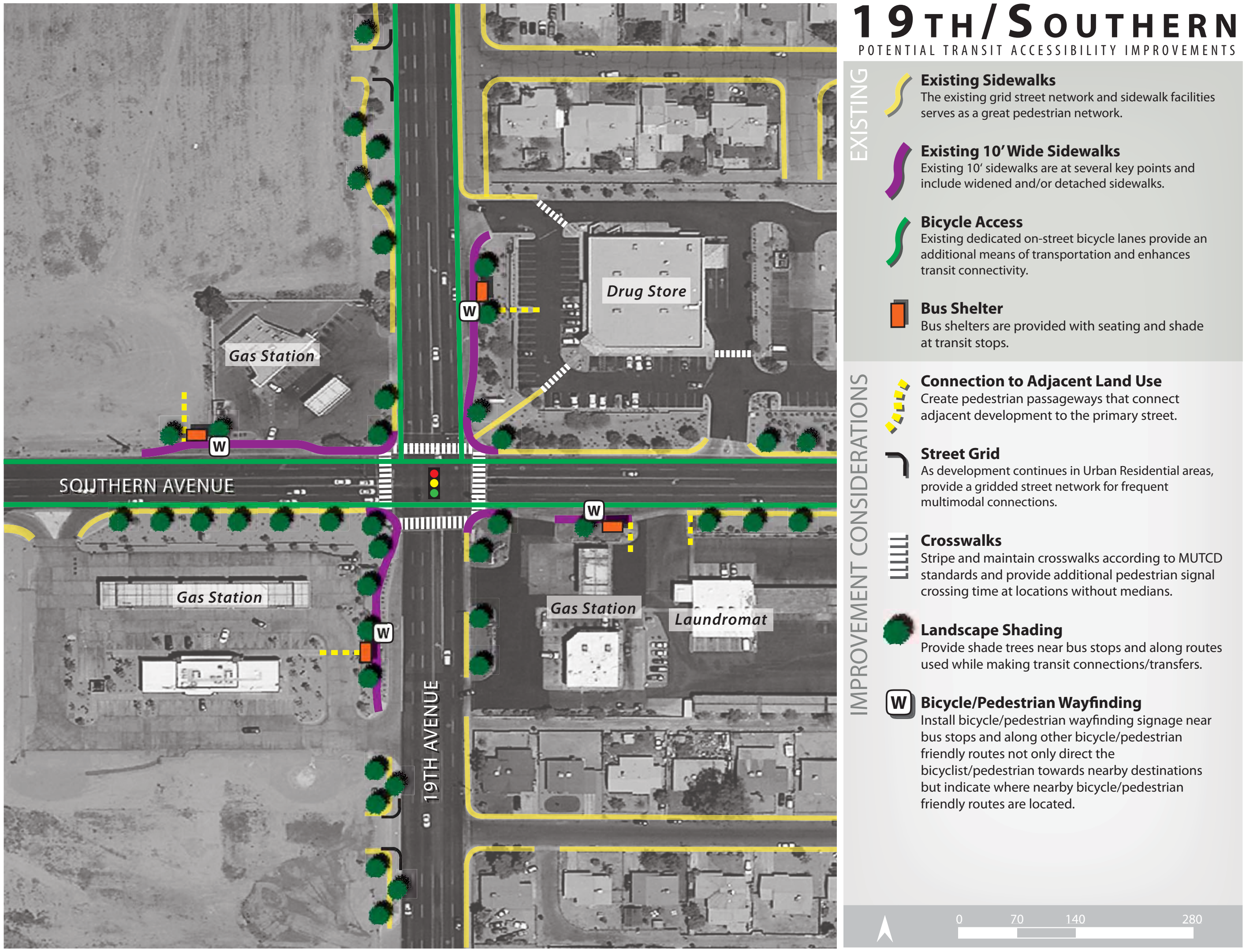


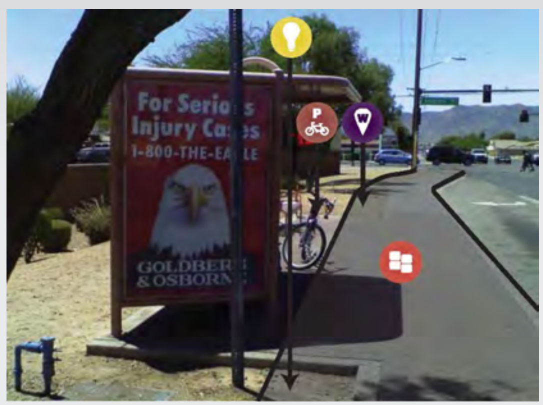
TABLE 13: 19th Avenue & Southern Avenue Prototype Improvements *(Urban Residential Location)*

Northbound 19th Street Stop

Southern Avenue Bicycle Access

Eastbound Southern Avenue Stop

Westbound Southern Avenue Stop



Northbound 19th Street Stop

5.4 17th Avenue & Bell Road *(Suburban Retail)*

A Suburban Retail bus stop area has retail land use present and low population and employment density; however, there are no high frequency transit routes serving these locations. This type of bus stop area accounts for the second highest share – 22.3% – of all bus stop areas in the MAG region. Surrounding these bus stop types is a conventional street network with nearby large shopping centers and big box stores with large parking areas. The stops are dispersed throughout the MAG region, with no geographic concentration. The case study location for the Suburban Retail bus stop is Bell Road and 75th Avenue. Figures 28 and table 14 illustrate the optimal improvements at the 75th and Bell case study location given existing constraints.

FIGURE 28: 75th Avenue & Bell Road Prototype Improvements *(Suburban Retail Location)*

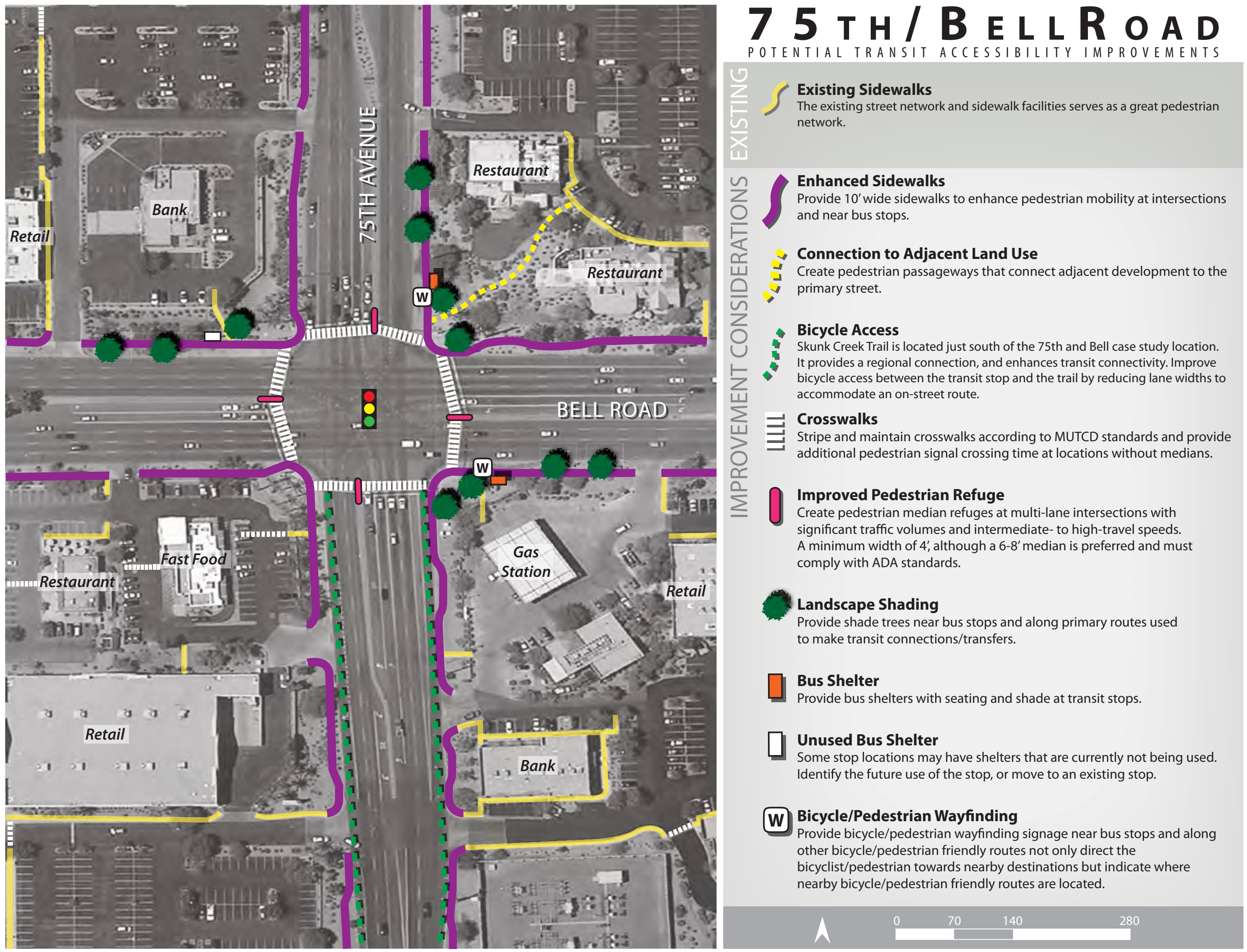
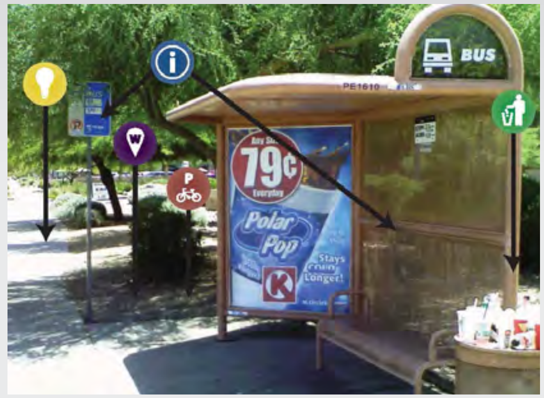


TABLE 14: 75th Avenue & Bell Road Prototype Improvements *(Suburban Retail Location)*

Eastbound Bell Road Stop



Eastbound Bell Road Stop

Bell Road Crossing

Future Westbound Bell Road Stop

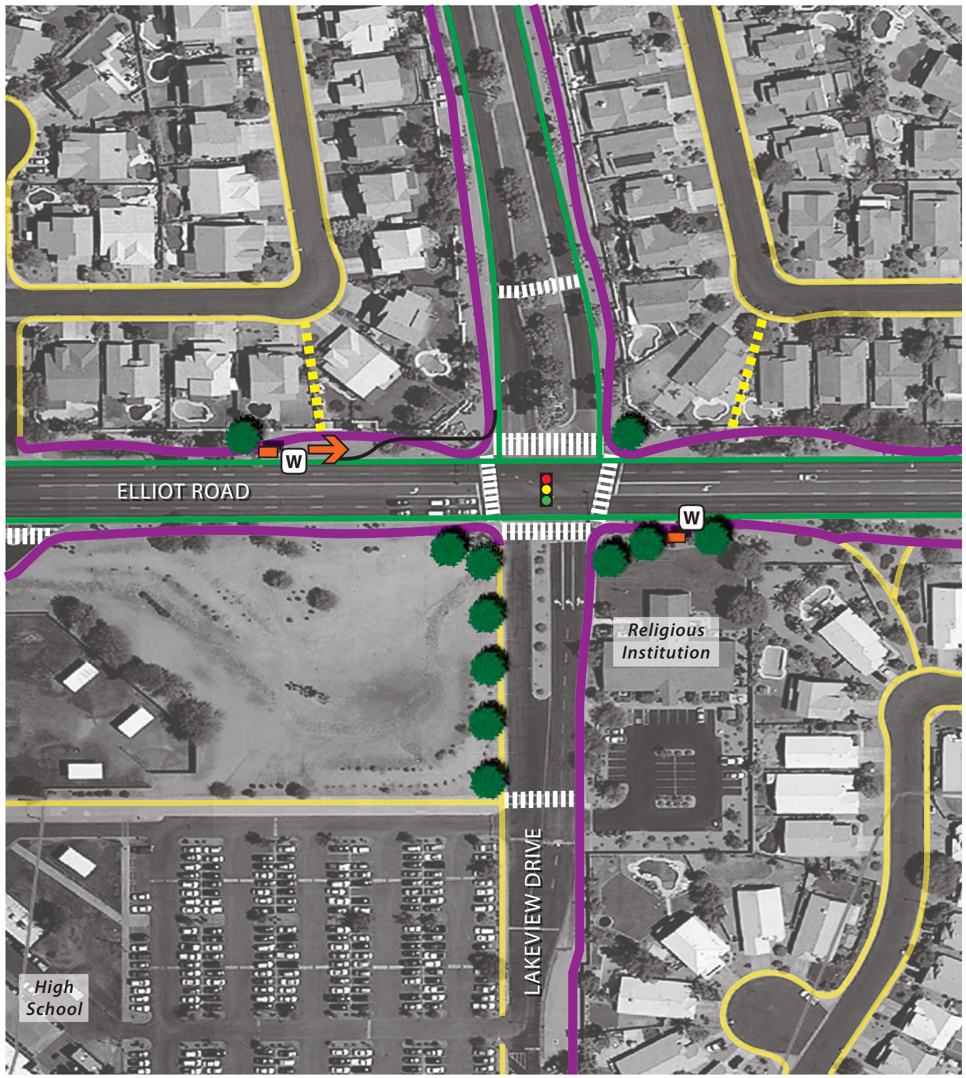
Northbound 75th Avenue Stop

Southwest Corner Pedestrian Access

5.5 Elliot Road & Lakeview Drive *(Suburban Residential)*

A Suburban Residential bus stop has no retail land use present. These stops are typically only serviced by limited stop, express service, or no local service at all. The surrounding area has low population and employment density. This category is the most common type of the bus stop types, accounting for the greatest share of bus stop areas in the MAG region; 39.5% of bus stops fall within this category. The surrounding area includes a conventional street network with master planned communities, many of which are gated or walled subdivisions. The Suburban Residential bus stops are typically dispersed throughout the MAG region and have no geographic concentration. The case study location for the Suburban Residential bus stop is Lakeview Drive and Elliot Road. Figures 29 and table 15 illustrate the optimal improvements at the Elliot and Lakeview case study location given existing constraints.

FIGURE 29: Elliot Road & Lakeview Drive Prototype Improvements *(Suburban Residential Location)*



ELLIOT/LAKEVIEW

POTENTIAL TRANSIT ACCESSIBILITY IMPROVEMENTS

EXISTING

Existing Sidewalks
The existing grid street network and sidewalk facilities serves as a great pedestrian network.

Bicycle Access
Existing dedicated on-street bicycle lanes provide an additional means of transportation and enhances connectivity to the transit system.

Bus Shelter
Bus shelters are provided with seating and shade at transit stops.

IMPROVEMENT CONSIDERATIONS

Enhanced Sidewalks
Provide 10' wide sidewalks to enhance pedestrian mobility at intersections and near bus stops.

Connection to Adjacent Land Use
Create pedestrian passageways that connect adjacent development to the primary street.

Acceleration Lane
Provide an acceleration lane to provide a bus bay for loading/unloading transit riders.

Crosswalks
Stripe and maintain crosswalks according to MUTCD standards and provide additional pedestrian signal crossing time at locations without medians.

Landscape Shading
Provide shade trees near bus stops and along routes used while making transit connections/transfers.

Relocate Bus Shelter
Relocate the existing westbound transit stop on Elliot Road closer to the intersection of Elliot Road and Lakeview Drive to ease route transfers, bus connections and to take advantage of existing lighting at the intersection.

Bicycle/Pedestrian Wayfinding
Install bicycle/pedestrian wayfinding signage near bus stops and along other bicycle/pedestrian friendly routes not only direct the bicyclist/pedestrian towards nearby destinations but indicate where nearby bicycle/pedestrian friendly routes are located.

0 70 140 280

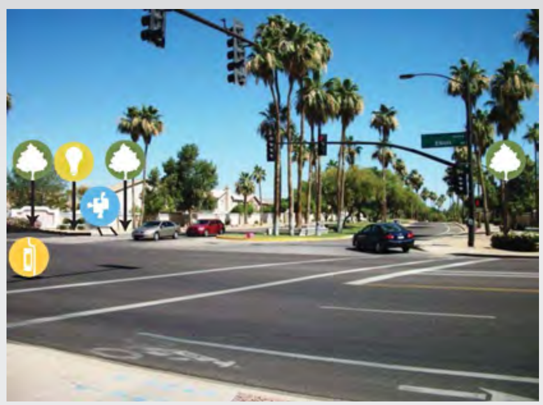
TABLE 15: Elliot Road & Lakeview Drive Prototype Improvements *(Suburban Residential Location)*

Eastbound Elliot Road Stop

Pedestrian Access to Park

Elliot Road Sidewalk

Elliot Road and Lakeview Drive Intersection



Elliot Road and Lakeview Drive Intersection

Southwest Corner

6.0 Transit Accessibility Toolkit

This section presents a toolkit of pedestrian and bicycle improvement recommendations linked to specific prototypes and intended to be used by local jurisdictions to support positive change in coordinating and integrating roadway and land use environments near bus stops. Involving professional staff from various organizations is paramount to the bus stop location's success. Consult with individuals from facilities, community/plan review, transportation/streets, and transit when coordinating improvements to bus stops and their catchment areas.

The improvement measures described in the toolkit were selected to address common access issues based on best practices nationally as well as more specific local access issues, particularly the need for shade at and around transit stops. The toolkit measures are organized into the following categories or elements:

- Lighting
- Information Signage
- Wayfinding
- Seating
- Shelter
- Landscape Shading
- Adjacent Land Use
- Bicycle Access
- Bicycle Parking
- Pedestrian Crossing
- Sidewalk

The toolkit includes discussions of applicability to different transit stop typologies and context-sensitive implementation strategies.

Transit stops are the gateways to public transportation. Each one welcomes riders into the system and provides a transition point for entry into the community. The Valley Metro Fact Sheet (Issue 6, July 2009 – June 2010) indicates there are over 7,000 bus stops serving over 55.5 million bus boardings annually. It is important, therefore, that the bus stops provide a consistent, safe, and accessible environment. Currently, bus stops in the MAG region give riders mixed messages, depending on accessibility and how safe each stop feels. MAG and its partners understand that safe and accessible transit stops are an integral part of the public transit system. As such, MAG has initiated this study to furnish member agencies with additional tools and guidelines to promote and sustain better planning associated with improving existing deficiencies and deploying future stops that are more accessible and supportive of adjacent neighborhood needs. Despite how transit patrons primarily arrive at a stop, in the end all are pedestrians. Thus, this study will focus on challenges faced by pedestrians and bicyclists as they access transit at the stop level.

"Transit Accessibility is... the segment of an individual trip that occurs between an origin or destination point and the transit system."

Source: American Public Transit Association

Lighting

Issue

Street and pedestrian lighting is an important feature at bus stops and nearby crossing locations for the safety and comfort of pedestrians and transit users. Additionally, adequate lighting promotes safety and security in urban areas and increases the quality of life of a community by extending the hours in which activities can safely take place along a street.

Importance

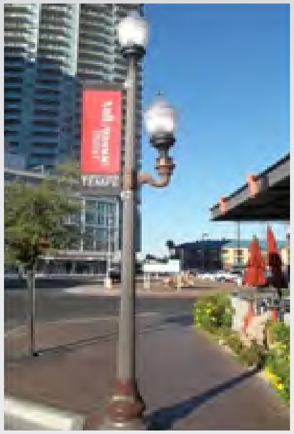
When asked "How likely is it that you would walk or ride a bicycle to this bus stop more frequently if there were more street lights?", **60% of the respondents cited that improved lighting would increase their likelihood of walking or riding a bicycle.**

At most case study locations, good pedestrian lighting was not provided. Instead lighting was provided by adjacent street lights which were often too far from the transit stop. Some stops provided a back lit advertisement which provides lighting within the shelter; however, many shelters of this design had advertisement lighting that was not in operation. Additionally, lighting in more urban areas might come from adjacent land use; however, in areas with larger setbacks this did not provide a good sense of security.

Improvement Considerations

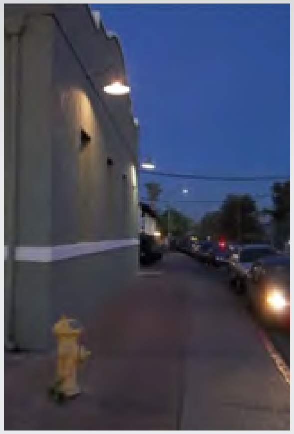
Pedestrian-oriented street lighting can be implemented using a variety of designs and configurations. The types of lighting shown below are higher cost and would be most appropriate for more urban bus stops.

Freestanding pedestrian-oriented lighting at bus stops.



Pedestrian light mounted to street light pole.

Attached to street light pole in catchment area.



Attached to building face in catchment area.

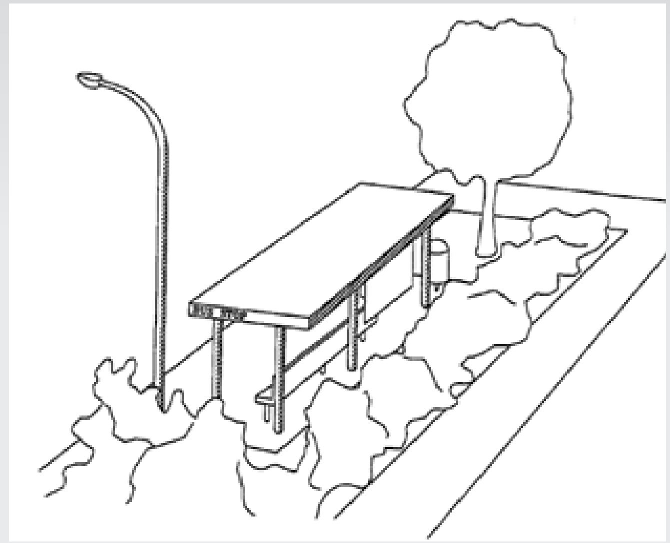
Freestanding Pedestrian Light | Freestanding pedestrian lighting is typically provided in addition to street lighting. These pedestrian lights must be located within closer proximity to each other so to minimize pedestrian dark areas; typically every 50' as opposed to a typical street light spacing of 200'.

Pedestrian Light Mounted to Street Light | A pedestrian lighting arm may be attached an existing street light pole using a special SS band designed for this purpose. In addition to mounting to existing street lights additional pedestrian lighting may be necessary. Pedestrian lights must be located within closer proximity to each other so to minimize pedestrian dark areas; typically every 50' as opposed to a typical street light spacing of 200'. Depending on the integrity of the existing street light pole and the method used for construction/installation, this method may be more costly than providing a freestanding pedestrian light.

Pedestrian Light Mounted to Building | Mounting pedestrian-scale lighting to building facades is a cost efficient technique as often that cost is paid by the developer or property owner. However, this strategy requires that local design guidelines require such lighting be installed. This lighting technique would only work with buildings with small setbacks whose lit façade is directly adjacent to the pedestrian walkway; buildings with larger setbacks would not be able to provide lighting for the adjacent walkways.

Planning/Policy Guidance

- Perform lighting study to conform to current lighting standards.
- Site bus stops and bus shelters to take advantage of overflow lighting from existing street lights (see graphic at right).
- Provide solar lighting in locations where connecting to power can be costly.
- Position backlit information kiosks to illuminate the interior of a bus shelter.
- Provide pedestrian level lighting either by retrofitting existing streetlight poles with a new lighting arm or by installing new/additional lighting.
- Consider low cost lighting solutions such as LED and other technologies.



Source: TCRP Report 19c - Guidelines for the Location and Design of Bus Stops

Cost

The table below lists the estimated unit construction costs for lighting features that may be included at transit stops. The potential application of each feature by prototype is highlighted.

Table 16: Cost of Lighting & Potential Prototype Application

Feature	Description	Unit	Unit Cost	Application for Prototypes				
				Urban Core	Urban Retail	Urban Res.	Sub. Retail	Sub. Res.
Security/ Lighting	Luminaire adjacent to shelter	Each	$10,000					
	Pedestrian lighting attached to existing street light pole	Each	$7,500					
	Pedestrian lighting along walkway; 80' spacing	Each	$5,500					
	Electrical circuit / wire	Foot	$2					
	CCTV camera (1)	Each	$5,000					

1. Cost for real-time traveler information and CCTV does not include any necessary communications backbone or central processing system.

Information Signage

Issue

To have an effective transit system, riders need to have easy, reliable, and up-to-date information regarding the transit service. Providing bus service information at bus stops is important to transit users and can be used effectively to increase ridership by retaining existing riders and encouraging the use of transit by new riders, infrequent riders, and disabled individuals.

Importance

During the field survey, transit riders were asked if an increase in schedule information would make them more likely to ride the bus more often; **64% of transit riders said they would ride the bus more often if adequate schedule information was provided.**

At most case study locations bus stops had little to no information signage. The existing signage offered at all bus stops includes a bus route number sign only. Several locations also included a sign providing the bus stop number and a phone number that transit riders can call to get additional information about the bus stop location and routes offered at that stop. Few locations offered a full transit system map. One location (90th and Shea) provided park-and-ride location information. None of the case study locations provided a bus schedule, route destinations, or real-time travel information.

Table 17: Information Signage Elements

Information Content	Station/stop, route, schedule, service alert, real-time location, destination, vehicle load factor.
Information Format	Map, table, website, trip planner, electronic message, phone text.
Information Delivery Media	Telephone, personal computer, mobile device, signage, kiosk.

Improvement Considerations

Information signage can be implemented in several formats and with various combinations of information. It is highly encouraged that transit stops include a full bundle of information for transit riders including: a bus stop number, route(s) number and destinations, transit system schedule, transit system map, transit system provider's contact information, and if applicable, the park-and-ride location. Furthermore, bus stops and routes with high ridership volumes can consider adding real-time travel information. The types of information signage shown below are but a few examples of the possible design and format to provide the information. Overall, transit system information signage should be as consistent as possible throughout the entire transit system.

Freestanding information kiosk with detailed route and schedule information.

Existing post-mounted bus stop sign with bus route number. Proposed post-mounted bus stop sign with bus route numbers and destinations.

Post-mounted information box with route map.

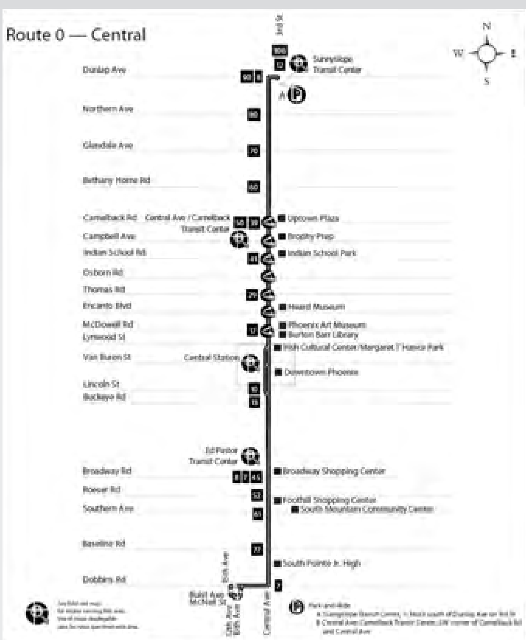
Bus Stop Sign with Route(s) Number and Destinations | As stated in the table above, the existing post-mounted bus stop sign includes the bus route number. These signs can be enhanced to include the route name and the primary destination along the route.

Information Kiosk | Each bus stop can include an information kiosk houses the transit system schedule and the system map. This may be another location to consider for the transit provider's contact information.

Contact Information Signage | Each bus stop can include the transit provider's contact information with the bus stop number. This sign provides another means for riders to get information regarding their bus route and bus stop. Many bus stops in the greater Phoenix area already include this sign. In addition to providing a phone number, these signs can be enhanced to include a QR code which would direct smart phone users to a website providing updated information on the bus route and bus stop.

Park-and-Ride Signage | Signage can be provided at bus stops directing transit riders to nearby park-and-ride facilities.

Real-time Travel Information | Bus routes and stops with high ridership volumes can be enhanced to include real-time travel information, further enhancing the customer service quality of the transit system. Vehicle tracking systems, such as Automatic Vehicle Location (AVL) systems, can also be used to process information and provide next bus arrival predictions.



The sample destination-based route map shown above could serve as an example for the MAG region.

Planning/Policy Guidance

- Consider incorporating transit-related information technologies (i.e. smart phone apps, phone text lines).
- In addition to improvements made at specific bus stop locations, a destination-based route map can be used throughout the transit system in the MAG region. The sample below shows an example of what that map may include.
- Install specific route information for transit users, particularly when low frequency service is provided. Install route information on separate signs if cost effective.

Cost

Of the improvement considerations listed above the freestanding kiosk has the highest capital cost. The post mounted signs provide the lowest cost option, but also the lowest level of information—typically a route number and final destination only. Adding information boxes with real time travel information through web-based (QR codes) or text messaging requires displaying printed schedule information and replacing schedule materials in the field whenever route schedules are modified. The table below lists the estimated unit construction costs for information signage that may be included at transit stops. The potential application of each feature by prototype is highlighted.

Table 18: Cost of Information Signage & Potential Prototype Application

Feature	Description	Unit	Unit Cost	Application for Prototypes				
				Urban Core	Urban Retail	Urban Res.	Sub. Retail	Sub. Res.
Information Signage	Real-time information display (1)	Each	$5,000					
	Static information display	Each	$500					

1. Cost for real-time traveler information and CCTV does not include any necessary communications backbone or central processing system.

Wayfinding

Issue

Wayfinding is an important component in guiding bicyclists, pedestrians and transit riders to nearby destinations. Wayfinding includes physical and visual elements that orient and aid people in reaching their destination including paths, landmarks, nodes, edges and districts. These physical and visual elements are further described in the FTA report titled *Traveler Information Systems and Wayfinding Technologies in Transit Systems* listed in *Appendix A: Reference Material.*

Importance

The field survey did not ask specific questions related to wayfinding. However, when asked if there were interesting things to see on their trip to the bus, only 19% indicated that there was something interesting to see along their route. None of the case study locations provided transit, bicycle or pedestrian wayfinding.

> *"...Wayfinding signage plays an important role in the overall success of a rail authority. Not only does effective signage help create an environment where passengers feel informed and secure, it also provides an unrestricted opportunity for the authority to create and/ or maintain a defining image with its riders and the surrounding community. Essentially, wayfinding signage is the most prominent and, therefore, the most vital communication tool of any public transit system..."*
>
> Source: "Design & Placement: The Defining Elements of Successful Wayfinding Signage" (Owens, Ron)

Improvement Considerations

Bicycle and pedestrian wayfinding signage near bus stops and along other pedestrian/bicycle friendly routes would not only direct the pedestrian or bicyclist towards nearby destinations but would indicate where nearby pedestrian/bicycle friendly routes are located, and would be used to direct potential riders to nearby bus stop locations. Where it is not possible to provide a bike path or lane, bicycle improvements can focus on wayfinding which would connect transit stops with off-street routes and nearby local or collector streets where traffic volumes and speeds are more conducive to bicycle travel.

Transit stop wayfinding can be provided as part of a larger community wayfinding signage program.

Source: MUTCD 2009, Ch. 2D

The MUTCD provides general information signs that may be used to identify transit stops/stations.

Source: MUTCD 2009, Ch. 2H

Bicycle wayfinding signs may also indicate the direction of transit station.

Source: City of Long Beach

Transit Stop Wayfinding | Transit, pedestrian and bicycle wayfinding can be created or can be added to an existing community wayfinding program.

Transit Stop Directional Signage | These general information signs can used to throughout a community to direct users to nearby transit stop locations.

Bicycle Wayfinding | Bicycle wayfinding can be used to direct bicyclist to nearby bicycle friendly routes, to destinations, and to transit stop locations.

Table 19: Example of Destination Classifications

Primary	Downtown and adjoining jurisdictions (signed at a distance up to five miles).
Secondary	Transit stations and districts (signed at a distance up to two miles).
Tertiary	Parks, landmarks, colleges, hospitals, and high schools (signed at a distance up to one mile).

Planning/Policy Guidance

- Consider incorporating a comprehensive, city-wide wayfinding signage program in the local community and consider transit riders, bicyclists, and pedestrians when designing the wayfinding system.
- Use an interdisciplinary team to design and develop wayfinding systems.
- Include an evaluation component into the implementation of wayfinding to understand how customers use them and assess effectiveness.
- Consider establishing a uniform set of regional transit wayfinding guidelines or standards.
- Establish a hierarchy that classifies destinations as primary, secondary and tertiary destinations.

Table 20: Wayfinding Strategies by Level of Technology

Uses	Basic	State-of-the-Practice	State-of-the-Art	Future
Signage	Signage – static fixed signage (ER, AS)	Signage – dynamic and mobile signage (ER, AS)	Remote Infrared Audible Signage (RIAS) (AS)	
Routes	Routes (ALL)	Route choices/Best Route (PT)	Real-time route info (ALL)	
Stations/Stops	Station/Stops (ALL)	Station Access (ALL)		
Fare	Schedules (ALL)	Travel mode & route fare/ cost options - Financial Comparisons (PT)	Financial Comparison (PT)	
Service Alerts	Elevator/excalator station access (ALL) signalge/oral instructions (AS)	Service alerts (ALL)	Customized service alerts (ALL)	
Real-Time Location		Self (ER, AS)	Transit Vehicles (ER, AS)	All Vehicles (ALL)
Destinations	Station/stop names (ALL)	Non-integrated (PT) Landmarks/Points of interests (PT)	Integrated (ALL)	
Vehicle Passenger Load	Seasonal surveys (PT)	Using APC for plannign (PT)		Vehicle passenger load available to passenger (ALL)

Trip Stages: Pre-Trip (PT), En Route (ER), At-station/Stop (AS), All Trip Stages (ALL)
Source: FTA, Traveler Information Systems and Wayfinding Technologies in Transit Systems, 2011

Cost

The table below lists the estimated unit construction costs for wayfinding features that may be included at transit stops. The potential application of each feature by prototype is highlighted.

Table 21: Cost of Wayfinding Signage & Potential Prototype Application

Feature	Description	Unit	Unit Cost	Application for Prototypes				
				Urban Core	Urban Retail	Urban Res.	Sub. Retail	Sub. Res.
Wayfinding	Wayfinding sign	Each	$250					

Seating

Issue

Seating is typically included in shelter design, but where installation of a shelter is not justified a bench with a shade tree provides comfort and convenience at bus stops. Factors used in determining installation and locations of bus stop seating include:

- Available space
- Stops with long headways
- Landowner/developer was denied permission to install a shelter
- Stops frequently used by elderly and the disabled
- Evidence of riders sitting on nearby land or structures

Importance

The field survey did not ask specific questions related to seating. In “Evaluating Transit Stops and Stations from the Perspective of Transit Users” 749 transit users were surveyed at 12 transit stops and stations around metropolitan Los Angeles; in terms of provided amenities, **respondents selected “enough places to sit” as fourth out of five in rank of importance** (Isekis, H., Taylor, B. D., 2010).

Most case study locations provided seating via a bus shelter. One location provided additional benches outside of the shelter. And one location provided no seating at the bus stop.

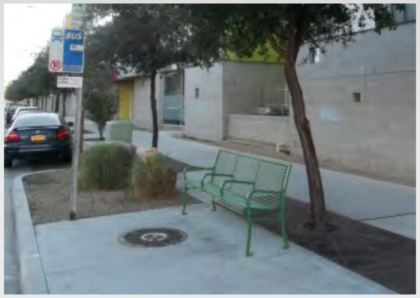
Improvement Considerations

Bus stop seating may be provided independent of bus shelters, offering comfort and convenience at bus stops. Seating at bus stops is often provided based on existing or projected ridership.

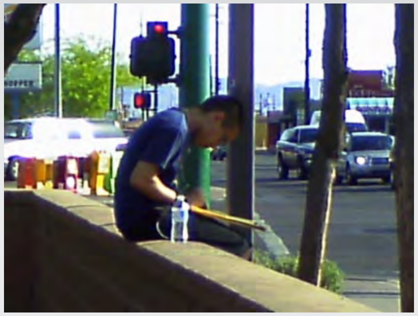
Bench | Seating provided independent of bus shelters would typically be provided where ridership is below those justifying a bus shelter. The quality, financing and siting of benches may vary according to the needs and resources of the responsible agency and local community. Locate benches near shade trees whenever possible to maximize shade or plant shade trees near the bench location. Coordinate bench locations with street lighting to increase visibility and enhance security. Do not locate benches in undeveloped areas of the right-of-way or near driveways to improve pedestrian safety and comfort. Locate benches on a non-slip, properly drained, concrete pad.

Seat Wall | Street walls can be designed at lower heights to serve as additional seating from transit patrons (aka Seat Walls). Seat walls can be integrated into pedestrian refuges. Shade trees should be planted near seat walls to provide the maximum amount of shade. Install skate stops or skate blocks along seat walls to avoid damage that may occur to wall.

Public Art/Gateway Monument | Seating can be incorporated as public art or as part of a gateway monument.



Bench with no advertising (shade from tree and building)

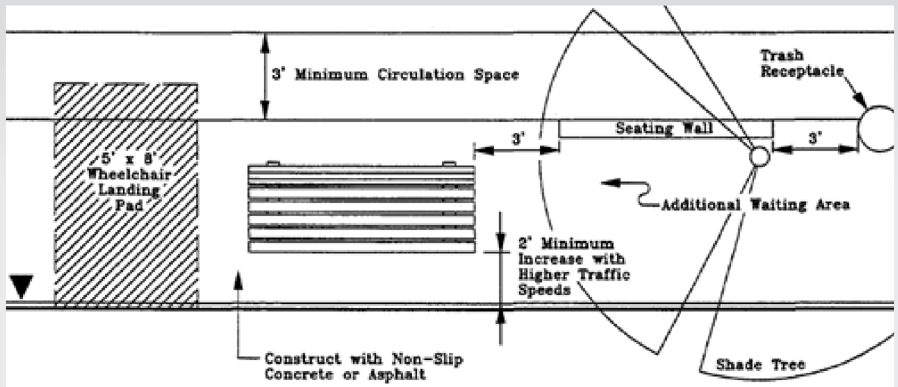


Seating provided on adjacent street wall, also known as a seat wall.

Seating provided on adjacent street wall, also known as a seat wall.

Planning/Policy Guidance

- TCRP Report 19c provides detailed guidance on the siting of bus benches. The siting of bus stop benches in the MAG region should consider:
  - distance from intersection,
  - distance from street light,
  - proximity to existing shade,
  - distance from driveways,
  - speed limit,
  - ADA mobility clearances, and
  - proximity and access to surrounding destinations.
- Seating may also be incorporated into the design of the adjacent development including designing street walls along the property line to be at a height that allows passengers to use the wall as seating.



Conceptual Bench and Waiting Pad Design
Source: TCRP Report 19c - Guidelines for the Location and Design of Bus Stops

Cost

The table below lists the estimated unit construction costs for seating that may be included at transit stops. The potential application of each feature by prototype is highlighted. Refer to the *RPTA Bus Stop Program and Standards*, 2008, for bus stop design information.

Table 22: Cost of Seating & Potential Prototype Application

Feature	Description	Unit	Unit Cost	Application for Prototypes				
				Urban Core	Urban Retail	Urban Res.	Sub. Retail	Sub. Res.
Seating	Standard shelter w/ seating, lighting, bicycle rack, concrete pad, trash receptacle	Each	$16,000					
	Enhanced shelter w/ seating, side screens, lighting, bicycle rack, concrete pad, trash receptacle	Each	$25,000					
	Custom shelter w/ seating, side screens, interior lighting, stop area lighting, bicycle rack, concrete pad, *trash receptacle*	Each	$35,000					
	Bench w/ concrete pad, shade	Each	$3,000					
	Bench w/ concrete pad, shade, lighting, trash receptacle	Each	$6,000					

Shelter

Issue

Bus shelters provide protection shade, seating, protection from the elements, and serve as a visual guide for transit stops. The Transportation Research Board published a report titled *Guidelines for the Location and Design of Bus Stops* which demonstrated the importance of shelter location, design, and pavement materials used. The report states that both **asphalt and concrete increase air temperature by several degrees because of the material's ability to retain and reflect heat. Temperatures at bus stops can often exceed actual air temperature by several degrees.** The report also states where shelters should be located based on accessibility factors such as bus stop transfer distances.

Within the MAG region, local jurisdictions determine bus shelter designs. There are a variety of designs that can accommodate different passenger volumes and various site demands. In the MAG region, sun protection is a key function of shelters. Depending on the orientation of the bus shelter (south facing, north facing, etc.), time of day and transit service time, a typical bus shelter may or may not provide relief from direct sunlight. In these circumstances other shading strategies such as locating the shelter near an existing tree can also be considered.

Importance

The field survey did not ask specific questions related to shelter. In *Evaluating Transit Stops and Stations from the Perspective of Transit Users* 749 transit users were surveyed at 12 transit stops and stations around metropolitan Los Angeles; **69% of respondents reported shelter to protect them from the sun or rain as being important, also, it was the highest ranking in terms of importance of all five amenities surveyed** (Isekis, H., Taylor, B. D., 2010).

Most case study locations provided bus shelters and bus stops. Some locations had bus shelters installed but bus service was not provided. At these locations bus transfer distances were long which resulted in riders missing transfers or cutting through developments to reach the next bus stop. One location had no shelter, only a bus sign and a shade tree. None of the case study locations included shelters designed for southern climates.

Improvement Considerations

Like bus benches, bus shelters may be supported by advertising or constructed using entirely public funds. Transparent screening is an important element of both of the examples below, as visibility is an important security feature and it also allows passengers to see approaching buses from behind the screen.

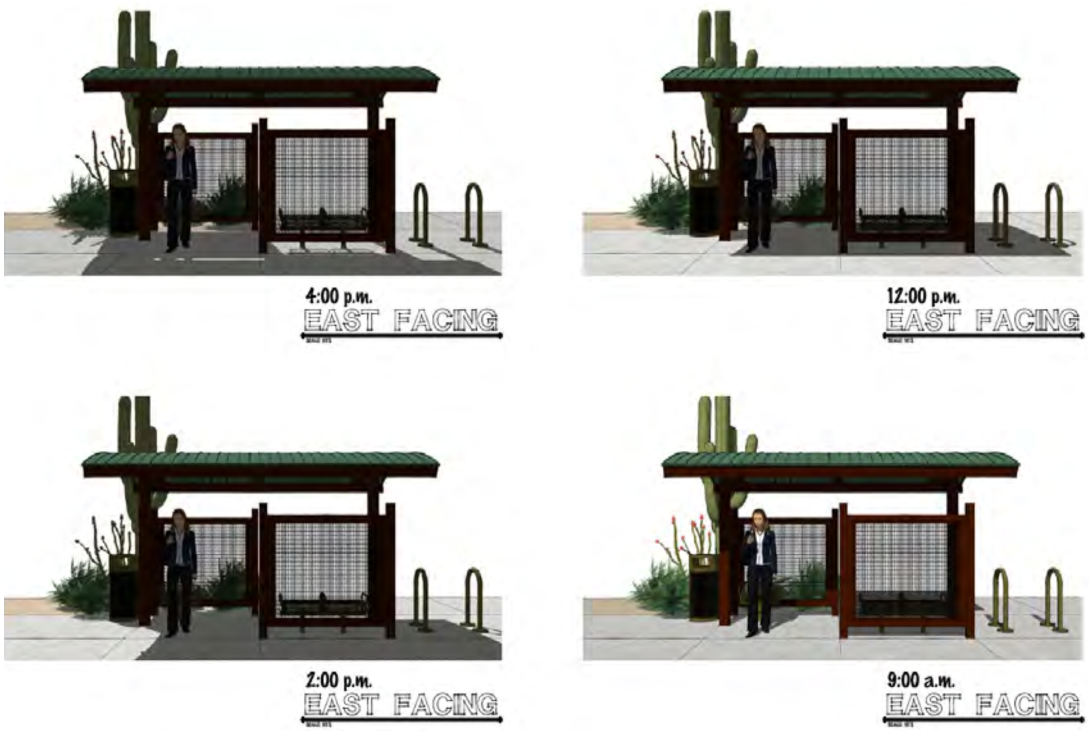
Furthermore, **shelters can be coordinated with landscaping to provide maximum protection from the elements** and to enhance the visual quality of the bus stop. Shade trees reduce heat at a site and provide additional shade for patrons waiting outside the shelter. To increase rider comfort consider using low heat gain materials and finishes.

Standard Bus Shelter | Transit agency requirements for bus shelters may include:

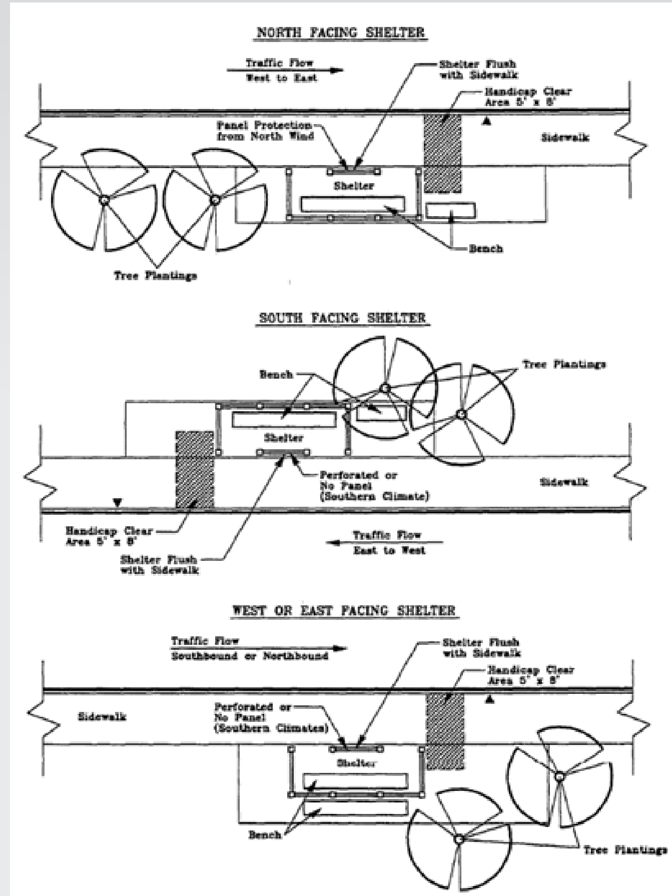
- Shelter location,
- Pedestrian access (i.e., direct sidewalk to the shelter),
- Visibility for vehicles and waiting passengers,
- ADA accessibility, and
- Signage.

Development-funded Bus Shelter | Local jurisdictions may require developers to install bus shelters. Additionally, ownership and maintenance of the shelter may be handled by the local jurisdiction or the developer. The designs of such shelters can vary from the typical bus shelter type to coordinate the design with major design features of the building or development.

Southern Climate Shelters | Shelters designed for southern climates are designed with the goal of alleviating uncomfortable conditions caused by heat and sun exposure. Shelters can be configured with a screen placed between the street and bench to protect waiting passengers from direct sunlight; this configuration would be most applicable for east or west facing stops and where there are few trees or buildings to block the sun. Prefabricated trellis panels may be used in the construction of transit shelters which offer both aesthetic and thermal benefits. Vertical panels and seating areas can be staggered to maximize shade opportunities throughout the day.



The City of Scottsdale conducted a sun exposure study as part of the conceptual design for standard bus shelters in the city. The resulting design is similar to concept designs included in TCRP Report 19c (referenced above).



Conceptual Shelter Design for Southern Climates
Source: TCRP Report 19c - Guidelines for the Location and Design of Bus Stops

Planning/Policy Guidance

- Consider requiring private developers to install and/or maintain bus shelters.
- Consider establishing a southern climate shelter standard for bus stops and create a program to convert local shelters to shelters with enhanced protection from the sun.
- Consider the local transit agency's criteria to determine if a shelter should be provided at a bus stop and consider steps to be made to prove the need for a shelter at a stop location. Common factors in determining shelter need include:
  - Number of passenger boardings
  - Transit service type and frequency
  - Number of transfers
  - Available space
  - Number physically challenged individuals in the area
  - Adjacent land use compatibility
  - Shelters exclusively served by peak period express transit services will have different shade requirements than shelters utilized by all day services.

Coated Pavement | *Emerald Cities*, a Scottsdale-based environmental company, has created a pastel-hued coating that is sprayed over asphalt and lasts for five to eight years. The lighter color attracts and reflects less heat. The company measured the temperature of the surface of asphalt and compared it to their pastel-coated surface and saw an 80 degree difference in surface temperature.

Other Shade Structures | At locations with high pedestrian activity additional shade structures can be installed which may or may not act as a transit shelter.

Coated, light color pavement attracts and retains less heat.
Source: http://emeraldcoolpavements.com/

Prefabricated trellis panels may be used in the construction of transit shelters, offering aesthetic and thermal benefits.
Source: greenscreen.com

Cost

The table below lists the estimated unit construction costs for shelter that may be included at transit stops. The potential application of each feature by prototype is highlighted.

Table 23: Cost of Shelter & Potential Prototype Application

Feature	Description	Unit	Unit Cost	Application for Prototypes				
				Urban Core	Urban Retail	Urban Res.	Sub. Retail	Sub. Res.
Shelter	Standard shelter w/ seating, lighting, bicycle rack, concrete pad, trash receptacle	Each	$16,000					
	Enhanced shelter w/ seating, side screens, lighting, bicycle rack, concrete pad, trash receptacle	Each	$25,000					
	Custom shelter w/ seating, side screens, interior lighting, stop area lighting, bicycle rack, concrete pad, trash receptacle	Each	$35,000					
	Sidewalk, concrete	Sq. Ft.	$4.00					
	Coated Pavement	Sq. Ft.	$1.50					
	Concrete pavers	Sq. Ft.	$7.00					

Shading

Issue

Adequate shading can improve uncomfortable environmental conditions like heat and sun. In the MAG region, sun protection is a key function of shelters. Depending on the orientation of the bus shelter (south facing, north facing, etc.), time of day, and transit service time, a typical bus shelter may or may not provide relief from direct sunlight. In these circumstances other shading strategies such as locating the bus stop near an existing tree can be considered. *TCRP Report 19c* provides detailed guidance on the shade of bus stop areas.

It is important to recognize that the movement of the sun will impact the effectiveness of the shade improvement. Before selecting a treatment visit the site during the period(s) of peak activity. Stop level transit ridership data and pedestrian counts will be useful in determining the periods of peak activity.

Importance

During the field survey, transit riders were asked if an increase in shade trees would make them more likely to ride the bus more often; **68% of transit riders said they would ride the bus more often if additional shade was provided.** Only 21% of riders thought there were a lot of trees and plants.

At all case study locations only partial shade was provided during certain periods of the day but not during all hours of daylight. At most case study locations at least partial shade was provided from the bus shelter; at bus stops where a shelter was not provided a nearby shade tree provided partial shade. None of the case studies had adequate shade pedestrian or bicycle routes in the catchment area.

Improvement Considerations

Various strategies for providing shade at transit stops have been discussed in previous sections including the siting of benches to take advantage of existing shade and the design and orientation of shelters. In addition to shade at the bus stop location, consideration should be given to providing adequate shade on bicycle and pedestrian routes that connect to bus stops.

Street Trees with Grates | Shade trees planted in tree wells are common in urban areas where on-street parking may be directly adjacent to the planting area. Shade trees with grates can be installed which maintain a larger sidewalk space for pedestrian, strollers and handicapped individuals.

Tree wells are typically used in urban areas or areas with high turnover of street parking.

A landscaped strip between the curb and sidewalk is more common in suburban settings.

Landscape Strip | Streets with a landscape strip can be enhanced by planting street trees in the space between the sidewalk and curb. This location can provide shade both to the sidewalk and to on-street bicycle lanes (if applicable). When sidewalks are detached, shade trees can be planted on both sides of the sidewalk to provide shade throughout the day.
Landscape strips that will be planted with shade trees need to be at least 3' wide to allow for a minimum 2'6" clearance radius around the base of the tree. Evaluate tree litter, fruit characteristics, smell, growth rate, proximity to building structures and utilities, root spread, and seasonal growth when determining tree species. Certain species can have major impacts on building foundations, sidewalks, cars, pedestrians, and utilities.

Shade Trees | Whenever possible, landscape transit, pedestrian and bicycle areas with shade trees rather than palm trees. Palm trees provide little to no shade.

Sidewalk-oriented Buildings | The design and orientation of buildings, particularly with regard to setback and height, can have a significant impact on the level of shade provided at transit stop and along sidewalks in the transit stop catchment area. Structures may also be built over sidewalks for short stretches to provide pockets of relief from direct sun exposure. Depending upon the orientation of the building (i.e. north, south, east, west) and the location of the sun, buildings with a zero setback line or small setback line can provide shade for the sidewalk. A two-story building has a comparable height to a mature shade tree.

Canopies | Canopies are typically used on private property. They may be erected to provide shade between the building entrance and the public sidewalk. Canopies have also been used on roadways in some urban settings.

Planning/Policy Guidance

- Install trees to maximize shade opportunities while considering the natural and built environmental impacts.
- Some cost effective strategies for planting street trees include:
  - Locating bus stops in locations where they will benefit from existing shade trees.
  - Prioritizing the planting of street trees that will serve existing bus shelters and sidewalks.
- Wide and/or detached sidewalks allow for a buffer zone that can include tree wells in urban areas or a continuous landscaped strip in more suburban settings.
- Shade can be a consideration during private development design and review and the implementation of public improvements within the public right-of-way. Identifying the appropriate strategy requires consideration of capital cost, maintenance and contextual factors such as aesthetics and the number of pedestrians and transit users who will actually benefit from the investment.
- Provide appropriate landscaping that does not interfere with pedestrian and bicycle accessibility.

The combination of tree wells and sidewalk-oriented buildings provides consistent shade throughout most of the day.

Sidewalk oriented development provides shaded connection between bus stops and building entrances.
Source: City of Chandler, Green Building Program

Canopies provide shade from the public sidewalk to the building entrance.

Cost

The table below lists the estimated unit construction costs for shade that may be included at transit stops. The potential application of each feature by prototype is highlighted.

Table 24: Cost of Shade & Potential Prototype Application

Feature	Description	Unit	Unit Cost	Application for Prototypes				
				Urban Core	Urban Retail	Urban Res.	Sub. Retail	Sub. Res.
Shading	Standard shelter w/ seating, lighting, bicycle rack, concrete pad, trash receptacle	Each	$16,000					
	Enhanced shelter w/ seating, side screens, lighting, bicycle rack, concrete pad, trash receptacle	Each	$25,000					
	Custom shelter w/ seating, side screens, interior lighting, stop area lighting, bicycle rack, concrete pad, trash receptacle	Each	$35,000					
	Shade tree (irrigated)	Each	$750					
	Landscape buffer w/ shade tree (irrigated)	Sq. Ft.	$3.00					
	Tree well with cover	Each	$250					
	Custom shade structure	Each	$5,000					

Adjacent Land Use

Issue

Adjacent land use is an important element to consider when creating or improving a pedestrian environment. Developments with large setbacks, retaining walls, or gated communities all act as barriers separating pedestrians and bicyclists from the development.

Importance

During the field survey, transit riders were asked if the bus stop was close to home, work, or shopping; 34% of riders thought the bus stop was close to their origin or destination point.

Of the case study locations, only the Urban Core stop provided direct access to adjacent land uses. The Urban Residential stop provided direct access to some adjacent uses but no direct access to the surrounding residential areas. All other case study locations had no direct access to adjacent land uses. The Suburban Residential stop had walled subdivisions with access only at subdivision roads that were far from the bus stops.

Recent research has concluded that land use and development patterns have a significant impact on transit systems and stops:

"The results of this research suggest there are three primary means available to planners to enhance transit ridership through land use planning: increase residential density in the areas near transit corridors, concentrate mixed-use development within an eighth mile of the transit corridors, and channel a greater proportion of the retail development within a quarter mile of transit lines. In fact, this analysis suggests that transit planners would increase ridership to a greater degree through catalyzing retail, mixed-use and multifamily development than increasing transit service."

- Bus Transit and Land Use: Illuminating the Interaction

Improvement Considerations

Urban planners and transit planners should consider locating bus stops adjacent to land uses that generate the most activity or "eyes on the street" to enhance personal safety of transit users. Transit-stop-adjacent land uses can be compatible with high levels of pedestrian activity and provide services that may be useful to transit users, which also provide an economic development return on the transit investment.

Sidewalk-oriented Development | The design and orientation of buildings, particularly with regard to setback and height, can have a significant impact on the comfort of the pedestrian environment. Buildings with minimal or zero-setback lines create an ideal pedestrian environment and shorten the connecting distance for pedestrians from the street to the development. Many developments in the MAG region include a setback with surface parking between the building and the street; these developments can be improved by designing the site so that parking is provided on the side or rear of the building.

Sidewalk-oriented development provides shade and direct access to building entrances.

Where parking is located along the side or rear of a building, locate at least one building entrance at or near the street side of the building to allow for ease of pedestrian access.

Sidewalk/Pedestrian Paths | Should buildings have a setback, sidewalks or pedestrian paths can be installed which direct pedestrians to the easiest route to the building or development.

Street Walls | Street walls are a common urban design tool used to improve a development with a setback; however, these street walls can also disconnect street activity from the development. It is important that these street walls be designed with openings at key locations that provide easy access for pedestrians and bicyclists to access the development. Many subdivisions in the MAG region are walled, these walls can be designed with openings at strategic locations that provide easy access for pedestrians and bicyclists to both enter and exit the subdivision.

In Metro core locations, a minimal setback is encouraged, such as this example in Tempe.

The City of Tempe has several means by which to encourage pedestrian- and transit- friendly development. The *City of Tempe Transportation Master Plan* includes design criteria for new development (excerpt at right). Additionally, the City's Public Works Department enforces the City's *Engineering Design Criteria* which includes right-of-way dedication/improvement requirements (excerpt below).

Pedestrian-friendly Design Criteria for New Development

The City of Tempe Transportation Master Plan (pp. 2-2 & 2-3) includes design criteria for new development promoting pedestrian-friendly design:

- Encourage pedestrian and transit-user access to buildings by locating buildings at the minimum setback for arterial and arterial to collector intersections. The distance between bus stops and building entrances shall be minimized by using minimum setback requirements for locations of buildings on the site.
- Encourage pedestrian and bicycle access to the main building entrances from all sides of the site by providing more links to street frontages.
- Encourage buildings to locate closer to street intersections by minimizing the amount of parking allowed at street frontages, or by locating all parking behind or to the side of buildings.
- Encourage mixed-use development, allowing people to work where they live.
- New and existing cul-de-sacs and dead-end streets can be enhanced by providing connecting pedestrian and bicycle paths to the major streets.

Table 25: Cost of Wayfinding Signage & Potential Prototype Application

Right-Of-Way (ROW) Dedication/Improvement		Manufacturing/Industrial			Commercial/Retail			Residential		
		Large 70,000+ SF	Medium 18,000-70,000 SF	Small 0-18,000 SF	Large 45,000+ SF	Medium 8,000-45,000 SF	Small 0-8,000 SF	Large 75+ Units	Medium 25-75 Units	Small 0-25 Units
1. Public Health and Safety Requirements or Requests	1a. ROW/Install turning lane	R	R	R	R	R	N	R	R	N
	1b. Install looped water system where pressure/supply problems would otherwise exist.	R	R	R	R	R	R	R	R	R
2. Trip Generation Rate Requirements or Requests	2a. ROW for arterial street.	R	R	N	R	R	N	R	R	N
	2b. Full arterial half-street improvements (see 1b & 1e)	R	R	N	R	R	N	R	R	N
3. Individualized Determination or Requests	3a. Bus pad dedications for bench	R	R	N	R	R	N	R	R	N
	3b. Bus pad installation for bench	R	N	N	R	N	N	R	N	N
	3c. Bus shelter dedication	R	R	N	R	R	N	R	R	N
	3d. Bus shelter installation	R	N	N	R	N	N	R	N	N
	3e. Bus bay dedication (Arterial/Aterial, Arterial/Collector)	R	R	R	R	R	R	R	R	R
	3f. Bus bay installation (Arterial/Aterial, Arterial/Collector)	R	N	N	R	N	N	R	N	N
	3g. Multi-use path easement	R	N	N	R	N	N	R	N	N
	3h. Multi-use path construction (including lighting)	N	N	N	R	N	N	R	N	N
	3i. Construction of looped water main where existing pressure/supply is inadequate to service subject property.	N	N	N	N	N	N	N	N	N

Where setbacks are used, a clear path from the sidewalk to the building entrance is to be provided.

Pedestrian connection through a parking lot provides a solution for large setbacks and parking lots.
Source: City of Chandler, Green Building Program

Partial street closures act as "dead ends" for vehicles while allowing bicyclists and pedestrians to continue along the roadway. This is a good solution for subdivisions with cul-de-sac, hammerheads, and dead end streets.

Planning/Policy Guidance

- Consideration should be given to locating bus stops opposite convenience stores wherever practical as these stores provide a quick stop for transit riders.
- The best way to ensure adjacent land uses are compatible with transit stops is through the regulation of design or form of development. Two key urban design issues include:
  - Orientation of buildings relative to the sidewalk
  - Orientation of building entrances relative to sidewalk
  - Establishment of direct connections between the sidewalk and building entrances.
- Surface parking between the sidewalk and building entrances can be minimized or eliminated by locating surface parking lots at the rear or side of the building.
- Develop land use ordinances to better accommodate transit/ pedestrians through reducing parking requirements, reducing minimum setback, increasing the percentage of permitted lot coverage, and create more flexible ordinance that encourages innovation in design and greater density.

Cost

The table below lists the estimated unit construction costs for adjacent land use access improvements that may be included at transit stops. The potential application of each feature by prototype is highlighted.

Table 26: Cost of Adjacent Land Use & Potential Prototype Application

Feature	Description	Unit	Unit Cost	Application for Prototypes				
				Urban Core	Urban Retail	Urban Res.	Sub. Retail	Sub. Res.
Adjacent Land Use	Provide opening in street wall	Each	$1,000					
	Sidewalk (concrete)	Sq. Ft.	$4.00					
	Path (asphalt)	Sq. Ft.	$2.00					

Bicycle Access

Issue

Bicycle access is important in any city and within the MAG region. Access is an important extension of any transit system as it improves mobility, extends and enhances transit service quality, and reduces reliance on automobiles. Some of the common challenges to providing good bicycle access include street crossings, lack of bicycle lanes or paths, perceived dangerous roadways, constrained right-of-way, station characteristics, network connectivity, transit agency policies, and surrounding land uses.

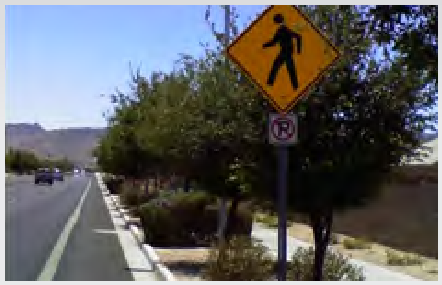
Importance

When asked if certain improvements would increase their use of transit, **52% of riders indicated adding a bicycle lane would increase their use of the transit system.**

Of the case study locations only the Urban Residential and Suburban Residential stops provided direct access for bicyclists to the bus stops via on-street bicycle lanes. The Suburban Retail stop had an off-street bicycle trail but no means of connecting from the trail to the bus stop. In addition to on-street and off-street facilities, bicyclists can often safely ride along local and collector streets that have lower traffic volumes and lower traffic speeds; however, none of the case study bus locations provided bicycle access from collector and local streets to the bus stop.

Improvement Considerations

Bicycle access improvements may include on-street or off-street bicycle facilities and can be focused on gaps or weak links in the bikeway network, particularly those situated between a transit stop and a major activity center. Existing or proposed bicycle paths can provide wayfinding signage to nearby transit stops and include marked and/or signalized crossings of major roadways to facilitate the use of bicycle paths to access transit.



Bicycle lanes on Southern Avenue in addition to vehicular travel lanes. Bicycle lanes can be installed by reducing the number of vehicular lanes from four to three or reducing vehicle travel lane widths.

Interim FHWA approved green paint denotes the "conflict zone" where buses and motorists will cross the bicycle lanes in order to pick up passengers or make right turns.

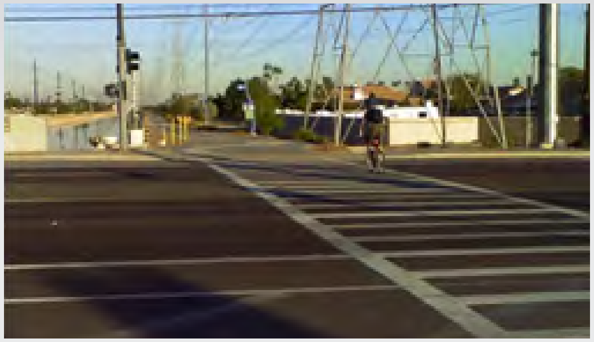
Buffered or protected bicycle lanes create greater separation between bicyclists and adjacent vehicular traffic and have been shown to attract new riders.

Bicycle Lanes | Bicycle lanes may be provided along major arterials and other roadways if there is sufficient roadway width. Because bicyclists in bicycle lanes often cross paths with buses and turning motorists near intersections, treatments such as interim FHWA approved green paint are being used increasingly at these locations to highlight the conflict zone. Designated bicycle routes or shared roadways may include a variety of treatments including signage, pavement markings, and traffic calming treatments.

Bike Lanes and On-Street Parking | A major component of bicycle access is on-street parking. On-street parking creates many hazards to cyclists when bike lanes are located behind parked cars. Where ROW permits, buffer space should be considered between parking and bike lanes.

Bicycle Paths | Bicycle paths are off-street routes that provide additional comfort and safety for the bicyclist. These facilities should be well lit with landscaping whenever possible.

Crossings | Street crossing locations are one of the major safety issues for bicyclists. Well lit and signalized bicycle crossings can improve safety. Crossings that occur at street intersections can be coordinated with pedestrian crossing signals. Local regulations determine allowable bicycle travel and crossing treatments, increased signage and standards can improve cyclist's awareness. Where bicycles cross at mid-block locations, HAWK signals, Rapid rectangular flashing beacons, and in-road flashing beacons can provide additional safety. To increase driver awareness incorporate lighted bike zone signs at intersections with high volumes of traffic. See the Crossings section of this toolkit for additional details.



Bicycle paths such as the Sun Circle Trail may facilitate access to transit if connections are made between the path and nearby transit stops. This bicycle and pedestrian crossing is signalized via a HAWK signal.

Bicycle paths will include lighting and landscaping wherever possible and have clearly marked and/or signalized crossings at major roadways.

Bike Sharing is a service where bicycles are made available for use for individuals who do not own them.

Bike Share | Bike sharing provides users point-to-point transportation for distances typically ranging between 1/2 and 3 miles. Bike Sharing can be provided and organized by a local community group or non-profit organization (Community Bike Program) or it can be provided and organized by government agencies, often through public-private partnerships (Smart Bike Program). Users have the ability to pick up a bicycle and return it to any self-serve bicycle station in the network. Common components and terminology of a bike share network include:

- Bike Sharing Stations;
- Docks;
- Customer Kiosks;
- 'Last Mile' Trips;
- Members;
- Membership Dues;
- Ridership/Usage Fees;
- Service Areas; and
- Rebalancing/Redistribution.

Bike Sharing in the United States: State of the Practice and Guide to Implementation further elaborates on planning, implementation, and evaluation of a bike share system.

Transit Connections | Off-street paths that are located at mid-block locations may have difficulty connecting to transit stations that are often located near street intersections. Whenever possible, improve bicycle access that connects off-street bicycle paths to the transit stops or to bike lanes that connect to transit centers/destinations.

Pavement Markings | Properly mark on-street bicycle pathways including dedicated bicycle lanes, bicycle boulevards and shared lanes to most recent MUTCD standards. The AASHTO Guide for the Development of Bicycle Facilities includes illustrations for correct bicycle lane markings at intersections that help minimize conflicts between cyclists and vehicles in right turn lanes, bus lanes, and trap lanes.

Bicycle Boulevards | Bicycle Boulevards are streets with low automobile traffic volumes and speeds. Many local streets offer these basic components and can be easily enhanced to create a bicycle boulevard. Bicycle Boulevards are commonly designed to give bicycles the highest priority by using the following measures:

- Route Planning;
- Signs and Pavement Markings;
- Speed Management;
- Volume Management;
- Minor and Major Street Crossings;
- Offset Crossings; and
- Green Infrastructure.

The NACTO Urban Bikeway Design Guide further elaborates on these recommended measures for Bicycle Boulevards.

Constrained Right-of-way | Adding bicycle lanes to existing roadways requires further narrowing of travel lanes which may not be feasible on all roadways. In such circumstances there may be few solutions including bicycle wayfinding that would direct bicyclists to nearby local and collector streets or off-street paths. For signage and wayfinding, see the Information Signage

Recent research on the safety of 10-foot versus 12-foot travel lanes has concluded that:

> *"...there is no indication that crash frequencies increase as lane width decreases for arterial roadway segments or arterial intersection approaches. These findings suggest that the AASHTO Green Book is correct in providing substantial flexibility for use of lane widths narrower than 3.6 m (12 ft) on urban and suburban arterials. Use of narrower lanes in appropriate locations can provide other benefits to users and the surrounding community including shorter pedestrian crossing distances and space for additional through lanes, auxiliary and turning lanes, bicycle lanes, buffer areas between travel lanes and sidewalks, and placement of roadside hardware. Interpretation of design policies as rigidly requiring the use of 3.6 m (12 ft) lanes on urban and suburban arterials may miss the opportunity for these other benefits without any documentable gain in safety."*
>
> *- Relationship of Lane Width to Safety for Urban and Suburban Arterials*, TRB2007 Annual Meeting

sections later in the toolkit. The examples in this section intend to increase bicyclist comfort by slowing traffic and/or reducing traffic volumes on local streets.

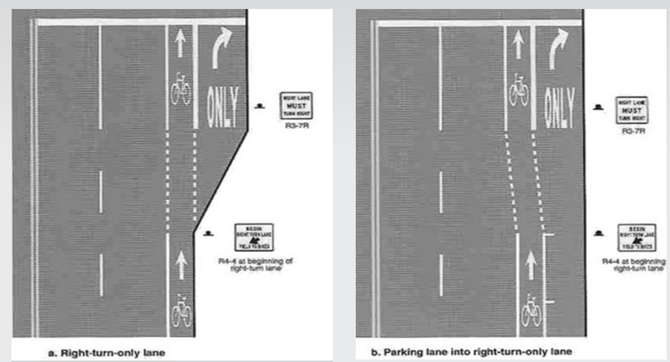
Lane Narrowing and Lane Removal | Bicycle lanes or cycle tracks can be considered on arterial or urban roadways. The installation of bicycle lanes may be achieved most cost effectively through lane narrowing or lane removal. On roadways with multiple 12-foot travel lanes, the narrowing of lanes to as narrow as 10 feet may provide sufficient width to stripe 5 to 6 foot bicycle lanes.

Traffic Calming and Diversion | Traffic calming devices can be used on local and collector streets to reduce both traffic volumes and travel speeds. Such treatments can greatly improve perceived and real pedestrian and bicycle safety.

City of Scottsdale Restriping Program

As an example, the City of Scottsdale has been actively restriping major streets with maintenance overlays to add bicycle lanes where feasible.

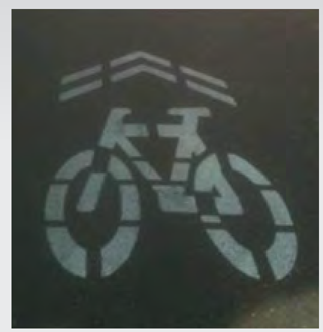
> *"They generally allow 11 foot wide through lanes and 10 foot wide turn lanes to accomplish this. In some cases the City of Scottsdale will accept 10 foot wide through lanes, but only on streets with lower speed limits and limited truck traffic."* *-Street Engineer*



Source: AASHTO Guide for the Development of Bicycle Facilities, 4th Ed., 2012

Speed bumps may be designed with a spacing that allows wide axle emergency vehicles to straddle the humps. Bicyclists may also ride through the gaps to avoid being impacted.

Mini traffic circles can be used to replace all-way stops, allowing cyclists to legally maintain momentum through minor low volume intersections.

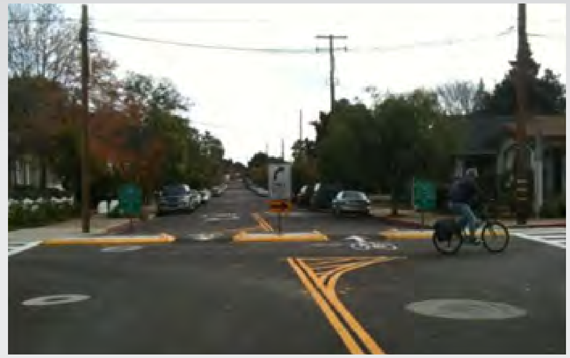


Shared lane markings have been approved by FHWA and are included in the 2009 MUTCD.

Large custom bicycle boulevard pavement marking are used in some jurisdictions.

Planning/Policy Guidance

- Bicycle lanes or cycle tracks can be considered on arterial or urban roadways. The installation of bicycle lanes may be achieved most cost effectively through lane narrowing or lane removal. Lane removal can be considered in cases where a roadway is determined to have excess capacity.
- Bicycle lanes or shared lane markings can be considered on all collector or local streets that connect neighborhoods and commercial areas to major transit corridors, particularly in cases where parallel arterial roadways cannot accommodate bicycle lanes. Shared lane markings do not require the narrowing or removal of travel lanes and are generally suitable for roadways with speed limits of 35 miles per hour or less.
- Traffic calming measures can be implemented in a way that discourages "cut-through" traffic by motorists, but facilitates bicycle through traffic. This strategy of implementing traffic calming improvements combined with bicycle-oriented improvements such as signage and pavement markings on local streets is often referred to as the development of "bicycle boulevards" or "neighborhood greenways."



Traffic diverters reduce through traffic by forcing vehicles to turn at some intersections, while allowing bicyclist through movements.
Sources: pedbikeimages.org

Partial street closures act as "dead ends" for vehicles while allowing bicyclists and pedestrians to continue along the roadway.

Cost

The table below lists the estimated unit construction costs for bicycle access improvements that may be included at transit stops. The potential application of each feature by prototype is highlighted.

Table 27: Cost of Bicycle Access & Potential Prototype Application

Feature	Description	Unit	Unit Cost	Application for Prototypes				
				Urban Core	Urban Retail	Urban Res.	Sub. Retail	Sub. Res.
Bicycle Access	Add bicycle lane by restriping travel lanes	Mile	$15,000	(highlighted)	(highlighted)	(highlighted)	(highlighted)	(highlighted)
	Bicycle path (asphalt)	Sq. Ft.	$2.00	(highlighted)	(highlighted)	(highlighted)	(highlighted)	(highlighted)
	Mid-block crossing	Each	$10,000			(highlighted)	(highlighted)	(highlighted)
	Mid-block crossing w/ flashing beacon	Each	$50,000			(highlighted)	(highlighted)	(highlighted)
	Mid-block crossing signal (HAWK)	Each	$100,000	(highlighted)	(highlighted)	(highlighted)		
	Pavement markings (sharrow, Bicycle Blvd, etc)	Each	$300	(highlighted)	(highlighted)	(highlighted)	(highlighted)	(highlighted)
	Bicycle wayfinding sign	Each	$500	(highlighted)	(highlighted)	(highlighted)	(highlighted)	(highlighted)

Bicycle Parking

Issue

Bicycle access can also address the need for bicycle parking and on-board accommodations (exterior and interior). Allowing bicycles on buses and providing bicycle accommodations at bus stops can greatly expand the service area of a transit system. Throughout the MAG region there is a lack of safe and secure bicycle parking facilities. Currently, buses in the MAG region provide exterior bicycle racks on most of their bus fleet. However, additional consideration should be given to routes and stops with high bicycle activity and when the exterior bicycle racks are at capacity.

Importance

When asked if certain improvements would increase their use of transit, **51% of riders indicated that adding bicycle parking would increase their use of the transit system.**

Of the case study locations, few bus stops provided bicycle racks or other bicycle parking facilities. Occasionally adjacent private developments would provide a bicycle rack. Exterior bicycle racks on buses were often at or near capacity and the transit agency does not accommodate interior bicycle storage. Additional bicycle racks may be needed, particularly at locations with low frequency transit service.

Improvement Considerations

Information signage can be implemented in several formats and with various combinations of information. It is highly encouraged that transit stops include a full bundle of information for transit riders including: a bus stop number, route(s) number and destinations, transit system schedule, transit system map, transit system provider's contact information, and if applicable, the park-and-ride location. Furthermore, bus stops and routes with high ridership volumes can consider adding real-time travel information. The types of information signage shown below are but a few examples of the possible design and format to provide the information. Overall, transit system information signage should be as consistent as possible throughout the entire transit system.

Bicycle Racks | Bicycle racks that fit universal bicycle design standards can be installed in the landscape or furniture zone of the sidewalk so that they do not obstruct the path of pedestrians.

Bicycle Corrals | Bicycle corrals are typically installed in an on-street parking space. This option is attractive to some business owners who see the conversion of a single car parking space into 8-12 bicycle parking spaces as an opportunity.

Bicycle Cellar/Transportation Station | Bicycle stations are major investments that are typically incorporated into larger transportation facilities. They can include a variety of bicycle parking options such as racks, lockers, and bike sharing facilities as well as personal lockers, showers, bicycle repair, rentals, and accessories, as well as other pedestrian amenities. The Bicycle Cellar at Tempe Transportation Station is an example of this type of facility.

Bicycle Lids and Lockers | A bicycle lid or locker is a secured box that stores a single bicycle which can be locked to prevent theft and vandalism and protect the bicycle from environmental conditions. This improvement is commonly considered one of the highest standards of bicycle safety and can be placed at locations where numerous cyclists are parking and storing their bicycles for extended periods of time.

Sidewalk bicycle racks.

Bicycle corrals.

Tempe Transportation Station

Planning/Policy Guidance

- Consider implementing a bikes-on-board program for interior, on-board bicycle storage for transit routes that have high volumes of bicyclists and when exterior bicycle storage is at or near capacity. Such bus vehicle improvements would need to be properly marked and have fixtures used to secure bicycles when the bus is in motion. The determination of if a bicycle can be properly stored on-board a bus is at the discretion of the bus driver.
- Universal design of bicycle parking on private property can be required by ordinance with clear guidance on design and siting. Design guidelines can promote use of racks similar to those used in the public right-of-way as this will facilitate standardization and ease of use. Locating guidelines can focus on visibility and the location of racks relative to main building entrances.
  - Bicycle parking should be clearly visible from the bus stop or building entrance.
  - The bicycle parking area should be located within 50 feet of the bus stop or building entrance it is intended to serve and no further than the closest (non-disabled) automobile parking space.
  - Under no circumstances should walls, fencing or landscaping be used to “screen” bicycle parking from view, as that will create an environment that facilitates bicycle theft.
  - Consider Bicycle Lids for highest frequency access stops (and LRT stations). Bicycle Lids provide more secure parking that discourages theft. Bicycle Lids securely protect the whole bicycle while costing less than actual bicycle lockers.
  - Consider ordinances that require locating bicycle parking facilities in highly visible locations along establishments located on arterial streets.

Bicycle Lockers and Bicycle Lids provide additional storage and protection for bicycles.

Cost

The table below lists the estimated unit construction costs for bicycle parking/storage that may be included at transit stops. The potential application of each feature by prototype is highlighted.

Table 28: Cost of Bicycle Parking & Potential Prototype Application

Feature	Description	Unit	Unit Cost	Application for Prototypes				
				Urban Core	Urban Retail	Urban Res.	Sub. Retail	Sub. Res.
Bicycle Parking	Bicycle rack	Each	$400					
	Bicycle lockers	Each	$2,500					
	Bicycle shelter	Each	$5,000					
	Bicycle lid	Each	$1,500					

Pedestrian Crossing

Issue

Pedestrian and cyclists are most vulnerable at pedestrian crossings. Typical crossings include crossing at street intersections or at mid-block locations. Particular attention should be paid to locations with high vehicle-pedestrian conflicts and accidents.

Importance

During the field survey, transit riders were asked how they arrived to the bus stop; 61% of riders said they arrived by foot which is slightly higher than the national figure of less than 59%. **When asked if curb extensions would increase their use of transit, 50% of riders indicated adding these improvements would increase their use of the transit system. And when asked if installation of medians would increase their use of transit, 43% of riders indicated adding these improvements would increase their use of the transit system.**

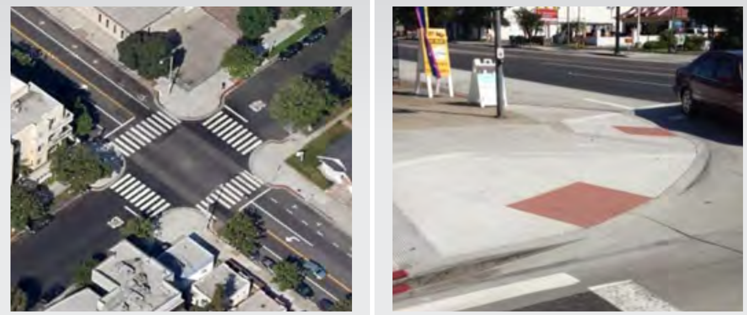
None of the case study locations included curb extensions and just one location (the Suburban Retail case study) had pedestrian refuges although they were too narrow to accommodate a waiting pedestrian with stroller or a wheelchair. None of the case study locations included formal mid-block crossings; however, several locations experience a high amount of illegal mid-block crossings.

Improvement Considerations

When planning for access to transit stops, desired crossing locations can be identified and enhanced to support safe and comfortable crossing of roadways by transit users. Such improvements can include marked crosswalks, traffic signals, pedestrian refuges, and curb extensions. Pedestrian crossings should be as short as possible, reducing the time exposure of pedestrians to cross traffic.

Reduced Curb Radii | Shortened crossing distances through reduced curb radii or curb extensions are encouraged where such improvements would meet minimum design standards.

Curb Extensions | Curb extensions shorten crossing distances and can be installed on streets where on-street parking is allowed. Curb extensions also create additional space at street corners that can facilitate the installation of dual curb ramps. This provides the mobility impaired and pedestrians with strollers and other wheeled devices a shorter crossing distance. Neither curb extensions nor the adjacent gutter pan can extend into the bicycle lane at intersections. Drainage must be considered when designing curb extensions.



Curb extensions shorten crossing distances for pedestrians and can create additional space at street corners that can facilitate the installation of dual curb ramps.

Mid-block Crossings | Mid-block crossings are discouraged, but when necessary can be enhanced to improve pedestrian safety. Whenever possible, locate bus stops near intersections where crossings already exist and not at mid-block locations. When bus stops are located mid-block, a pedestrian crossing can be added to facilitate safe and legal crossings. Unsignalized mid-block crossings can use high visibility crosswalk markings and include median refuge islands wherever possible. The path through the median refuge should be angled to turn pedestrian to the right to face traffic before making the second stage of the crossing. The desired minimum width for a median refuge is six feet as that

This mid-block crossing includes a raised median refuge, high contrast crosswalk, and in-pavement flashers.
Source: pedbikeimages.org

Raised crosswalks may be appropriate at some locations where reducing traffic speed is desirable. The impact on drainage must be considered.
Source: pedbikeimages.org

Rapid rectangular flashing beacons.
Source: pedbikeimages.org

Scottsdale HAWK signal.

In-road flashing beacons. *Source: crosswalks.com*

provides sufficient space for most bicyclists, pedestrians pushing strollers, and wheelchairs. Raised crosswalks can also be considered and are intended to slow vehicle traffic at the crossing locations while providing pedestrians, bicyclists and wheelchair users with a level crossing path.

Traffic Signals and Flashing Beacons | Flashing beacons can be considered at locations with sight distance issues and with nighttime crossing activity. Such improvements are based on the local jurisdiction's preference. Along high-volume arterials, either a traffic signal or HAWK signal (see above) may be required. HAWK signals are activated by crossing pedestrians; motorists may proceed during the flashing red phase after pedestrians clear the crosswalk. User activated rectangular rapid flashing beacons (RRFBs) may be considered at mid-block crossing to alert approaching motorists in advance. In-road flashing beacons alert drivers of crossing pedestrians and enhance the pedestrian crosswalk by improving visibility in the evening hours.

Planning/Policy Guidance

- Pedestrian safety cannot be compromised to accommodate greater auto volumes. Traffic engineering techniques such as double right-turn lanes and free right-turn lanes are discouraged along primary pedestrian routes and near bus stops.
- Bus stops at mid-block can be located based on an evaluation of ridership and crossing opportunities and should not be determined by the ¼ mile spacing distance as it is currently. Through collaboration with the community the local jurisdiction may be able to determine alternative options for bus stop placement or they may determine that the identified location is a critical need location.
- Establish policies that prioritize improvements in locations that do not meet ADA standards.

Cost

The table below lists the estimated unit construction costs for pedestrian crossings that may be included at transit stops. The potential application of each feature by prototype is highlighted.

Table 29: Cost of Pedestrian Crossings & Potential Prototype Application

Feature	Description	Unit	Unit Cost	Application for Prototypes				
				Urban Core	Urban Retail	Urban Res.	Sub. Retail	Sub. Res.
Pedestrian Crossing	Mid-block crosswalk w/ pedestrian refuge	Each	$10,000					
	Mid-block crosswalk w/ flashers	Each	$50,000					
	Mid-block pedestrian signal	Each	$100,000					
	Sidewalk, concrete	Sq. Ft.	$4.00					
	Concrete pavers	Sq. Ft.	$7.00					
	Curb extension	Each	$5,000					

Sidewalk

Issue

Sidewalks are the means by which pedestrians access transit stops. Creating a comfortable pedestrian environment is important to a transit system's success. Unsafe and unfriendly pedestrian environments such as narrow or damaged sidewalks, poor landscaping, and poor lighting deter walking activity.

Design sidewalk ramps to continue in a straight or direct line across intersections. Currently, many sidewalks force pedestrians (and bicyclists) to walk out of their way to cross the street. This reduces visibility of the pedestrian for drivers and makes the pedestrian circulation less efficient by putting more distance between destinations.

Importance

During the field survey, transit riders were asked how they arrived to the bus stop; 61% of riders said they arrived by foot which is slightly higher than the national figure of less than 59%. When asked if there were good or bad sidewalks and walkways; **just 38% of riders classified the sidewalks and walkways as good.**

All of the case study locations included 4-to-5-foot wide sidewalks along arterial roads which provide a network for pedestrian connectivity. The Urban Retail case study location included enhanced sidewalks along several segments of roadway including near the arterial street intersection and adjacent to bus stops. These enhanced sidewalks were 10 feet wide and detached from the street curb providing a landscape strip for shade trees.

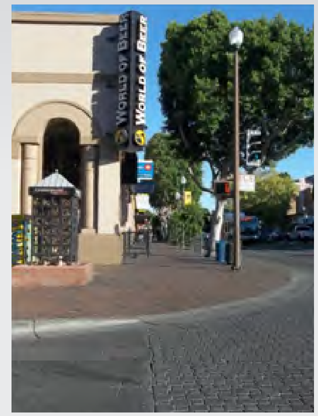
Improvement Considerations

Widening and detaching the sidewalk accommodates a heavier flow of traffic and provides a buffer which improves real and perceived pedestrian safety. Additionally, wide sidewalks with "buffer zones" make additional pedestrian improvements possible. The buffer zone may take very different forms in urban and suburban contexts.

Urban Sidewalk | In urban areas, sidewalk buffer zones are used for the placement of trees, bicycle parking, street furniture, signage, lighting and other elements while maintaining a clear path for pedestrians. Trees planted in tree wells with grates provide shade while increasing surface area for pedestrians, wheelchairs, and strollers. On-street parking increases pedestrian comfort by creating an additional buffer between pedestrians and traffic. The clear zone for pedestrians can be a minimum of ten feet in urban areas.

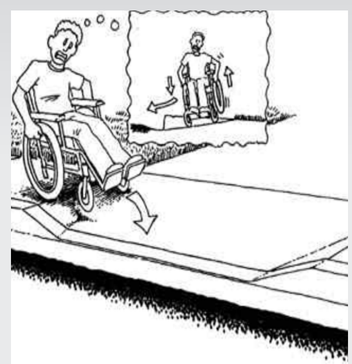
Suburban Sidewalk | In suburban areas the buffer zone typically takes the form of a landscape strip between the street and sidewalk, providing space for trees and other landscaping, fire hydrants, mailboxes, and utility poles. The clear zone for pedestrians can be a minimum of five feet in suburban areas.

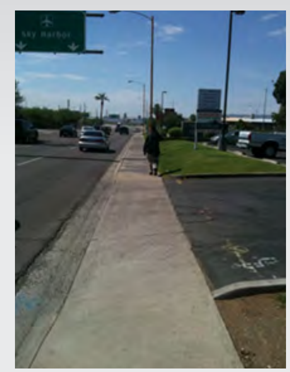
Driveway Ramps | Driveway ramps on narrow attached sidewalks are of particular concern because the resulting cross slope can be steep and turns wheelchair users toward the roadway and moving traffic. The issue of cross slope can be addressed in all new developments either through the installation of detached sidewalks with buffer zone or by designing a route around the driveway ramp providing wheelchair users with a flat surface when crossing driveways.



Urban area with sidewalk buffer zone.

Suburban area with landscape strip buffer zone.





When cross-slopes change rapidly over a short distance, wheelchair use becomes extremely unstable.

Planning/Policy Guidance

- Consider 10-foot wide paved pedestrian surfaces when bus stops are present between the intersection/pedestrian crossing and the first driveway or bus stop, whichever is furthest from the intersection.
- Sidewalks can always be included in road construction projects. Stand-alone projects cost more than the same work performed as part of a larger project. Sidewalks can be piggybacked to projects such as surface preservation, water or sewer lines, or placing utilities underground. Besides the monetary savings, the political fallout is reduced, since the public doesn't perceive an agency as being inefficient. It is typically very noticeable if an agency works on a road, then comes back to do more work later. The reduced impacts on traffic are an additional bonus to integration.
- A cost-savings can be achieved by combining several small sidewalk projects into one big one. This can occur even if the sidewalks are under different jurisdictions, or even if different localities, if they are close to each other. The basic principle is that bid prices drop as quantities increase.
- Establish policies that prioritize improvements in locations that do not meet ADA standards.

Cost

The table below lists the estimated unit construction costs for sidewalk improvements that may be included at transit stops. The potential application of each feature by prototype is highlighted.

Table 30: Cost of Enhanced Sidewalk & Potential Prototype Application

Feature	Description	Unit	Unit Cost	Application for Prototypes				
				Urban Core	Urban Retail	Urban Res.	Sub. Retail	Sub. Res.
Enhanced Sidewalk	Sidewalk (concrete)	Sq. Ft.	$4.00	●	●	●	●	●
	Concrete pavers	Sq. Ft.	$7.00	●	●	●	●	
	Shade tree (irrigated)	Each	$750	●	●	●	●	●
	Landscape buffer w/ shade tree	Sq. Ft.	$3.00			●	●	●
	Tree well cover	Each	$250	●	●	●		
	Trash receptacle	Each	$500	●	●	●	●	●
	Bench w/ concrete pad, shade	Each	$3,000	●	●	●	●	●
	Bench w/ concrete pad, shade, lighting, trash receptacle	Each	$6,000	●	●	●	●	●

Prototype Costs

Other Cost Considerations

The cost to implement improved transit access, regardless of area type, can vary substantially depending upon the types of features desired, the potential need for additional right-of-way, physical site improvements (i.e. grading, retaining wall, etc) that may be required, proximity to electric service, utility impacts, the amount of sidewalk required to provide connectivity, as well as other factors specific to a particular site. The following points address strategies for minimizing implementation costs, as well as other cost considerations.

Right-of-way | The need for additional right-of-way to implement a given prototype can be minimized or eliminated through design. However, in addition to meeting ADA requirements, location and design of transit stops and connecting pedestrian/bicycle facilities must not compromise safety and should provide sufficient capacity (i.e. seating, shade area) to comfortably accommodate the expected demand and allow ample room for passengers, particularly wheelchairs, to board and alight from transit vehicles. Limited right-of-way is more often an issue in urban areas as opposed to suburban. Strategies for minimizing potential right-of-way costs include obtaining needed right-of-way as adjacent properties develop or as part of other roadway improvement projects, such as roadway widening or intersection reconstruction.

Utilities | Since utility relocation within the public right-of-way is typically the responsibility of each utility, unless a utility has prior rights, the cost impact is expected to be minimal. It is usually possible to design the transit stop and access improvements

Unit Construction Costs

Table 31 lists the estimated unit construction costs for various features that may be included at transit stops. The potential application of each feature by prototype is highlighted. For example, a standard shelter would be appropriate at any of the prototypes, while a custom shelter might only be appropriate at high visibility and/or high activity stops within the urban core, urban retail, and suburban retail prototypes. Note that all shelters are assumed to include a concrete pad, side screens to provide shade, and a trash receptacle. Similarly, implementation of bike storage facilities, including a bike rack or bike lockers, are most appropriate at urban residential and suburban retail and residential prototype stops, where commuters might wish to leave their bicycles.

Table 31: Cost of Transit Stop Features and Potential Prototype Application

Feature	Description	Unit	Unit Cost	Application for Prototypes				
				Urban Core	Urban Retail	Urban Res.	Sub. Retail	Sub. Res.
Security/ Lighting	Luminaire adjacent to shelter	Each	$10,000	■	■	■	■	■
	Pedestrian lighting attached to existing street light pole	Each	$750	■	■	■	■	■
	Pedestrian lighting along walkway; 80' spacing	Each	$2,500	■	■	■	■	■
	CCTV camera (1)	Each	$5,000	■	■			
Information Signage	Real-time information display (1)	Each	$5,000	■	■			
	Static information display	Each	$500	■	■	■	■	■
Seating/ Shelter	Standard shelter w/seating ; concrete pad, lighting, bicycle rack, trash receptacle	Each	$16,000	■	■	■	■	■
	Enhanced shelter w/seating and side screens, concrete pad, lighting, bicycle rack, trash receptacle	Each	$25,000	■	■	■	■	
	Custom shelter w/ seating, side screens, concrete pad, lighting, bicycle rack, trash receptacle	Each	$35,000	■	■		■	
	Bench w/ concrete pad, shade	Each	$3,000	■	■	■	■	■
	Bench w/ concrete pad, shade, lighting, trash receptacle	Each	$6,000	■	■	■	■	■
Landscape/ Shade	Shade tree (irrigated)	Each	$750	■	■	■	■	■
	Landscape buffer w/shade trees (irrigated)	Sq. Ft.	$3.00			■	■	■
	Tree well cover	Each	$250	■	■	■		
	Custom shade structure	Each	$5,000	■	■			
Adjacent Land Use	Provide opening in street wall	Each	$1,000	■	■	■	■	■
	Sidewalk (concrete)	Sq. Ft.	$4.00	■	■	■	■	■
	Path (asphalt)	Sq. Ft.	$2.00	■	■	■	■	■

to avoid costly utility relocations (i.e. electric service cabinets or power poles), however if the relocation of a utility is needed, additional right-of-way may be required for the utility to move into. The costs for minor adjustments to manholes, water valve boxes, and electric/communication pull boxes are typically borne by the improvement project.

Electric Service | The cost to provide electric service for security and pedestrian walkway lighting, as well as transit stop amenities (lighting, real-time information display, CCTV camera) can be significant depending upon the location an appropriate service hook-up. At signalized intersections, it is often possible to obtain power from the signal electric service cabinet. At mid-block locations, it may be possible to tie into an existing street lighting system. Solar power systems can be a cost effective alternative for transit shelter lighting, pedestrian flashers, HAWK signals, and pedestrian lighting.

Component Costs | Standardizing transit stop components, including shelters, trash receptacles, bicycle racks, etc., can substantially reduce costs by allowing multiple vendors to provide bids and allowing for bulk purchasing. While one size/type may not be feasible across all jurisdictions in the Phoenix metro area, establishing 3-4 standard transit shelter configurations is reasonable.

Maintenance | Proper and frequent maintenance of transit stops and shelters is a valued service to existing transit users and an important consideration for potential transit users. Weekly trash pick-up and scheduled cleaning (power washing), graffiti abatement, and landscape maintenance can be included in the transit system program.

Feature	Description	Unit	Unit Cost	Application for Prototypes				
				Urban Core	Urban Retail	Urban Res.	Sub. Retail	Sub. Res.
Bicycle Access	Add bicycle lane by restriping travel lanes	Mile	$15,000					
	Bicycle path (asphalt)	Sq. Ft.	$2.00					
	Mid-block crossing	Each	$10,000					
	Mid-block crossing w/ flashing beacon	Each	$50,000					
	Mid-block crossing signal (HAWK)	Each	$100,000					
	Pavement markings (sharrow, Bicycle Blvd, etc)	Each	$300					
	Bicycle wayfinding sign	Each	$500					
Bicycle Parking	Bicycle rack	Each	$400					
	Bicycle locker	Each	$2,500					
	Bicycle shelter	Each	$5,000					
	Bicycle lid	Each	$1,500					
Sidewalk & Crossings	Sidewalk, concrete	Sq. Ft.	$4.00					
	Coated Pavement	Sq. Ft.	$1.50					
	Concrete pavers	Sq. Ft.	$7.00					
	Wayfinding sign	Each	$250					
	Curb extension	Each	$5,000					
	Mid-block crosswalk w/pedestrian refuge	Each	$10,000					
	Mid-block crosswalk w/ flashing beacon	Each	$50,000					
	Mid-block pedestrian signal	Each	$100,000					
Miscellaneous	Trash receptacle	Each	$500					

1. Costs for real-time traveler information and CCTV does not include any necessary communications backbone or central processing system.

Planning Level Prototype Costs

Planning level implementation costs for each prototype are provided in Table 32. Low, mid, and high cost levels are provided based on assumed features. These costs include construction, design, and administration. Design and administration costs are assumed to be 20% of construction cost. Additional costs that may be required for right-of-way, potential utility relocation, and ancillary site improvements are not included.

Reference Materials

Local, state and national best practices documents were referenced to develop the Bus Stop Prototypes and Transit Accessibility Toolkit. These references are further described in *Appendix A: Reference Materials*. The Reference Materials Appendix also provides a listing of reference materials by toolkit element.

Table 32: Planning Level Costs for each Prototype

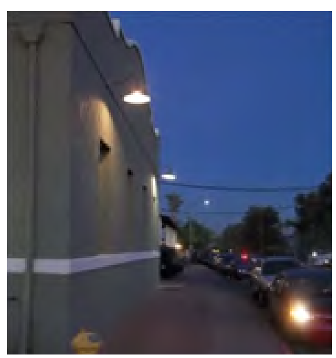
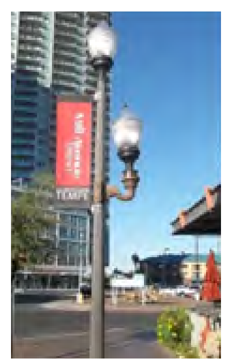
Prototype	Lower Cost	Moderate Cost	Higher Cost
Urban Core	Shelter: standard Information Signage: static display Bicycle Parking: bicycle rack Sidewalk: no additional sidewalk Lighting: none added Shade Tree: none added Cost: $19,800	Shelter: enhanced Information Signage: static display Bicycle Parking: bicycle rack Sidewalk: add sidewalk (500') Lighting: adjacent luminaire Shade Tree: shade trees Cost: $60,600	Shelter: custom Information Signage: real-time display Bicycle Parking: bicycle rack Sidewalk: add sidewalk (500'); Lighting: adjacent luminaire, CCTV camera Shade Tree: shade trees Cost: $89,400
Urban Retail	Shelter: standard Information Signage: static display Bicycle Parking: bicycle rack Sidewalk: no additional sidewalk Lighting: none added Shade Tree: none added Cost: $19,800	Shelter: enhanced Information Signage: static display Bicycle Parking: bicycle rack Sidewalk: add sidewalk (500') Lighting: adjacent luminaire Shade Tree: shade trees Cost: $60,600	Shelter: custom Information Signage: real-time display Bicycle Parking: bicycle rack Sidewalk: add sidewalk (500'); way finding signage Lighting: adjacent luminaire, CCTV camera Shade Tree: shade trees Cost: $94,800
Urban Residential	Shelter: standard Information Signage: static display Bicycle Parking: bicycle rack Sidewalk: no additional sidewalk Lighting: none added Shade Tree: none added Cost: $19,800	Shelter: standard Information Signage: static display Bicycle Parking: bicycle rack Sidewalk: added sidewalk (500'); mid-block cross walk Lighting: adjacent luminaire Shade Tree: shade trees Cost: $61,800	Shelter: enhanced Information Signage: static display Bicycle Parking: bicycle rack Sidewalk: added sidewalk (500'); Lighting: pedestrian walkway lighting (500') Shade Tree: buffer (5000 sq ft) Cost: $81,000
Suburban Retail	Shelter: standard Information Signage: static display Bicycle Parking: bicycle rack Sidewalk: no additional sidewalk Lighting: none added Shade Tree: none added Cost: $19,800	Shelter: standard Information Signage: static display Bicycle Parking: bicycle rack Sidewalk: added sidewalk (500'); Lighting: adjacent luminaire Shade Tree: shade trees Cost: $49,800	Shelter: enhanced Information Signage: real time display Bicycle Parking: bicycle lockers Sidewalk: added sidewalk (500'); wayfinding signage, mid-block cross walk Lighting: adjacent luminaire Shade Tree: buffer (5000 sq ft) Cost: $95,000
Suburban Residential	Shelter: standard Information Signage: static display Bicycle Parking: bicycle rack Sidewalk: no additional sidewalk Lighting: none added Shade Tree: none added Cost: $19,800	Shelter: standard Information Signage: static display Bicycle Parking: bicycle rack Sidewalk: added sidewalk (500'); Lighting: adjacent luminaire Shade Tree: shade trees Cost: $49,800	Shelter: enhanced Information Signage: static display Bicycle Parking: bicycle lockers Sidewalk: added sidewalk (500'); mid-block crosswalk Lighting: pedestrian walkway lighting (500') Shade Tree: buffer (5000 sq ft) Cost: $96,000

6.1 Implementation Checklist

Included in the following pages is a checklist of topics that have been recommended when considering the placement, replacement or upgrade of bus transit stops. The checklist is for all stakeholders in the design, development, installation, and maintenance of bus transit stops, including: planners, transit providers, city design review staff, and private developers. Below is a checklist illustrating all topics to be taken into consideration when planning for, locating, and building a bus transit stop. The checklist includes core elements identified in the DTAC study that make an effective transit stop.

Topics for Consideration	Check All That Apply
Have you **coordinated** with member agency staff?	☐ Transit operations staff
	☐ Facilities staff
	☐ Street planner/engineer
	☐ Development review/services
	☐ Safety/Safe Routes to School
	☐ Bicycle/Pedestrian
	☐ Other/parks and recreation/maintenance, etc
Did you consider **location**?	☐ At intersection (bus bay/acceleration lane).
	☐ Mid-block (with pedestrian crossing).
	☐ Close to targeted development.
	☐ Ease of transit transfer.
	☐ Potential conflict with pedestrian/bicyclists/auto users
Did you consider **lighting**?	☐ Reviewed applicable lighting standards.
	☐ Freestanding street light located near bus stop.
	☐ Freestanding pedestrian light.
	☐ Pedestrian light attached to street light pole.
	☐ Pedestrian light attached to building.

Lighting Examples

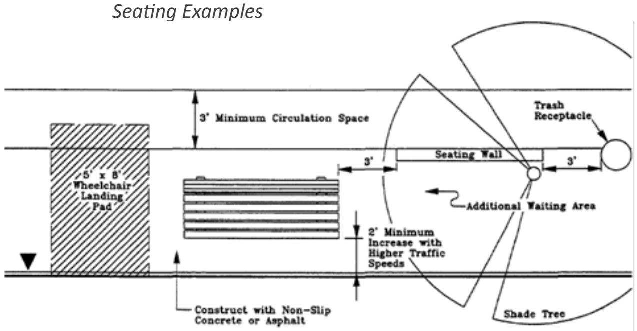



Did you consider information signage?	□ Freestanding information kiosk with detailed route and schedule information.
	□ Pole-mounted bus stop sign with associated bus route number(s)/ destinations and NextRide information.
	□ Pole-mounted information box with route map.
	□ Wayfinding signage to local attractions, libraries, schools, public spaces, transit centers, light rail.
	□ Bicycle wayfinding signage to iconic routes (major crossings, off street paths, canals, etc).

Information Signage Examples

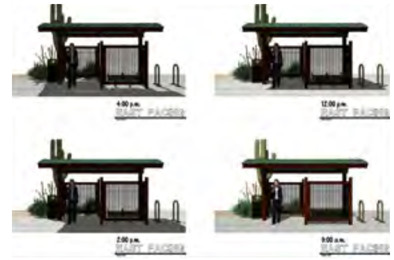
Did you consider seating?	□ Bench under tree.
	□ Bench in shelter.
	□ Seating wall.

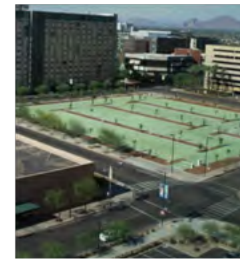
Seating Examples



Did you consider shelter?	□ Shelter designed for southern climates.
	□ Enhanced paving/surface coating.

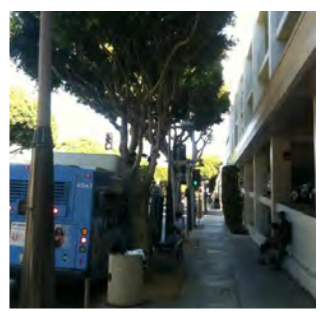
Shelter Examples

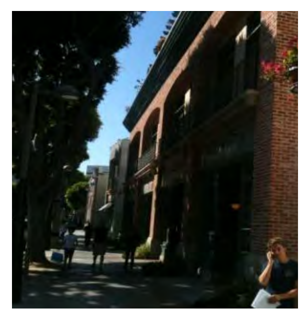




Did you consider shade?	□ Street trees that also create a buffer.
	□ Adjacent building structure.
	□ Other shade structure.
	□ Transit shelter that is appropriately oriented for southern climates.
	□ Shade/landscaping that minimizes interference to pedestrian and bike access.
	□ Interference to built/natural environment.

Shade Examples





Did you consider adjacent development (retail/ commercial)?	□ Sidewalk-oriented development.
	□ Pedestrian-oriented building entrance.
	□ Minimal setback with direct path.
	□ Path to building entrance.
	□ Shade at building entrance.
	□ Safe and shaded pedestrian pathway through parking lot.
	□ Awning or shade structure that shades the public ROW (TOD structures).
	□ Pedestrian and bicycle circulation between parcels.
	□ Multi use path or sidewalk easement (8-10' preferred).
	□ Safe pedestrian path from transit stop location to building access points.

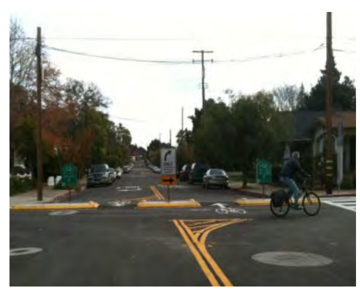
Adjacent Development (Retail/Commercial) Examples

Did you consider adjacent development (residential)?	□ Pedestrian and bicycle access from walled residential communities to the transit system.
	□ Pedestrian and bicycle infrastructure within the community and to transit access point.

Adjacent Development (Residential) Examples

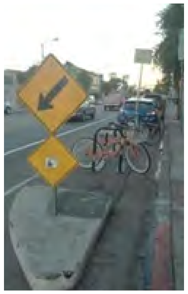
Did you consider bicycle access routes and multi-use paths?	□ On-street bicycle lane.
	□ Off-street bicycle path connected by wayfinding in catchment area.
	□ Local or collector road connected by wayfinding in catchment area.
	□ Bicycle crossings.
	□ Bicycle/pedestrian lighting.
	□ "Conflict zone" lane painting.
	□ Bicycle lane buffer.
	□ Pavement markings.
	□ Traffic calming and diversion.

Bicycle Access Examples



Did you consider bicycle parking?	◻ Sidewalk bicycle rack.
	◻ Bicycle corral.
	◻ Bicycle rack at development entrance.
	◻ Other bicycle parking (e.g. lockers).
	◻ Transit frequency and use.
	◻ Bike visibility and site location access.
	◻ Shade for bicycles.

Bicycle Parking Examples


Did you consider enhanced sidewalk?	◻ Urban buffer zone with tree wells.
	◻ Suburban buffer zone with landscape strip (Only in suburban/ collector streets. Not preferred in locations limited R.O.W.)
	◻ ADA accessibility.
	◻ Maximize sidewalk width (8-10”).

Enhanced Sidewalk Examples


Did you consider pedestrian crossings?	◻ Provide safe connects between pedestrian desire lines.
	◻ Curb extensions.
	◻ Median refuge.
	◻ Raised crosswalk.
	◻ Rapid rectangular flashing beacons.
	◻ HAWK signal at mid-block crossing.
	◻ In-road flashing beacons.
	◻ Transit stop placement proximity to safe street crossing.
	◻ Diagonal/direct pedestrian crossing.

Pedestrian Crossing Examples