DESIGNING TRANSIT ACCESIBLE COMMUNITIES STUDY

DRAFT WORKING PAPER #4

Prototype Concepts & Implementation Strategies

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1.0 Purpose of Working Paper #4

Working Paper #4 describes the development of prototypical bus stop areas or Bus Stop Prototypes for the MAG region. 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.

Transit rider surveys collected as part of this planning process illustrate that pedestrian and cycling modes are critical for accessing the bus transit system in the MAG region. The survey showed, for example, that over 60% of transit riders access bus stops by foot, while 22% access bus stops by bicycle. Given these high rates of non-motorized access to the bus system, MAG recognizes the importance of supporting local agencies in their efforts to plan for environments that are safe, comfortable and inviting.

DTAC *Working Paper #2 Categorization of Bus Stops* described a process whereby the 5,800+ bus stops in the MAG region were grouped into distinct bus stop areas based on the demand for transit and built environment characteristics including population and employment density and availability of retail land use. Once the bus stop areas were categorized, the project team conducted detailed case studies at a sample of bus stops from each category, relying largely on field reviews, intercept surveys and analysis of GIS data. A key goal of the case study analysis was to support the development of generalized pedestrian and bicycle facility improvement recommendations that could serve as prototypical bus stop areas to guide local agencies' efforts to improve public right-of-way environments and land uses near bus stops in a manner that would maximize the safety and comfort of non-motorized travelers accessing the bus system.

This Working Paper is organized into the following sections:

- **Section 2 Developing Bus Stop Prototypes:** summarizes the process for developing Bus Stop Prototypes, including examination of the bus stop categories, review of survey data and incorporation of local and national best practices for bicycle and pedestrian improvement recommendations.
- **Section 3 Bus Stop Prototypes:** describes each of the five Bus Stop Prototypes in a brief graphical format, with linkages to *Section 4 Transit Accessibility Toolkit*, with the intention of facilitating the application of improvement concepts by local agencies in particular bus stop areas. This section also utilizes the results of the case study field review and provides key examples of optimal improvements at case study locations.
- **Section 4 Transit Accessibility Toolkit:** 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 the roadway and land use environments near bus stops. Additionally this section provides an implementation checklist.
- **Section 5 Implementation Checklist:** Includes a listing 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. The checklist includes core elements identified in the DTAC study that make an effective transit stop and the topics to be taken into consideration when planning for, locating, and building a bus transit stop.

2.0 Developing Bus Stop Prototypes

Bus Stop Prototypes were developed based upon the project team's examination of bus stop categories as shown in Working Papers # 2 and #3, evaluation of the results of the transit rider survey, and consideration of national and regional best practices related to bicycle and pedestrian improvement strategies. The subsections below describe the project team's approach to developing Bus Stop Prototypes.

2.1 Bus Stop Categorization

The bus stop categorization process included the following four general steps:

1. Developing a GIS database of variables describing bus stop areas (*potential demand and transit service quality*) within a one quarter-mile street network buffer area of all bus stops.
2. Performing a cluster analysis to identify natural groupings of bus stop areas based upon the demand and transit service quality variables.
3. Ground-truthing the cluster analysis results via aerial imagery and windshield surveys.
4. Proposing bus stop categories to describe the groupings found through the assessments listed above.

Table 2-1 describes the final bus stop categories developed during the DTAC planning process.

Table 2-1: **Bus Stop Categories**

Category Ranking	Category Name	Defining Characteristics	Bus Stop % (Number of Stops)
1	Urban Core	• Some Retail • Very High Employment Density • Average Population Density • Multiple High Frequency Transit Routes	15.4% (898)
2	Urban Retail	• Retail • High Employment Density • Average Population Density • High Frequency Only During Peak Period	14.9% (865)
3	Urban Residential	• No Retail • High Employment Density • Average Population Density • A Single High Frequency Transit Route	8.7% (460)
4	Suburban Retail	• Retail • High Employment Density • Average Population Density • Majority of Stops without High Frequency Transit Service	33.6% (1,955)
5	Suburban Residential	• No Retail • Low Employment Density • Low Population Density • No High Frequency Transit Service	28.3% (1,648)

Source: Chen Ryan Associates; January 2013.

A key conclusion from the categorization of the MAG region's bus stops is that they can be ordered along a spectrum from very urban to very suburban. The *Urban Core* category reflects the most urban areas of the MAG region where transit demand and service capacities are relatively high. The *Suburban Residential* category reflects those areas of the MAG region with relatively low transit demand and service capacity. The project team developed pedestrian and bicycle improvement recommendations, or *Bus Stop Prototypes*, to fit this varying context along the spectrum from urban to suburban environments.

As summarized in the following sections, the bus stop categories, transit rider surveys and best practice manuals were referenced to support development of *Bus Stop Prototypes*. Another important aspect of the Bus Stop Prototype development process included careful consideration of the end-users, as well as the ultimate application of these recommendations by local agencies.

The bus stop categories include more generalized characteristics describing each category, such as the level of accessibility, predominant street network type, and the predominant neighborhood type. This method of describing bus stop categories is intended to improve the application of *Bus Stop Prototypes* by local agencies and therefore bring about more positive change in the streetscape environments near bus stops.

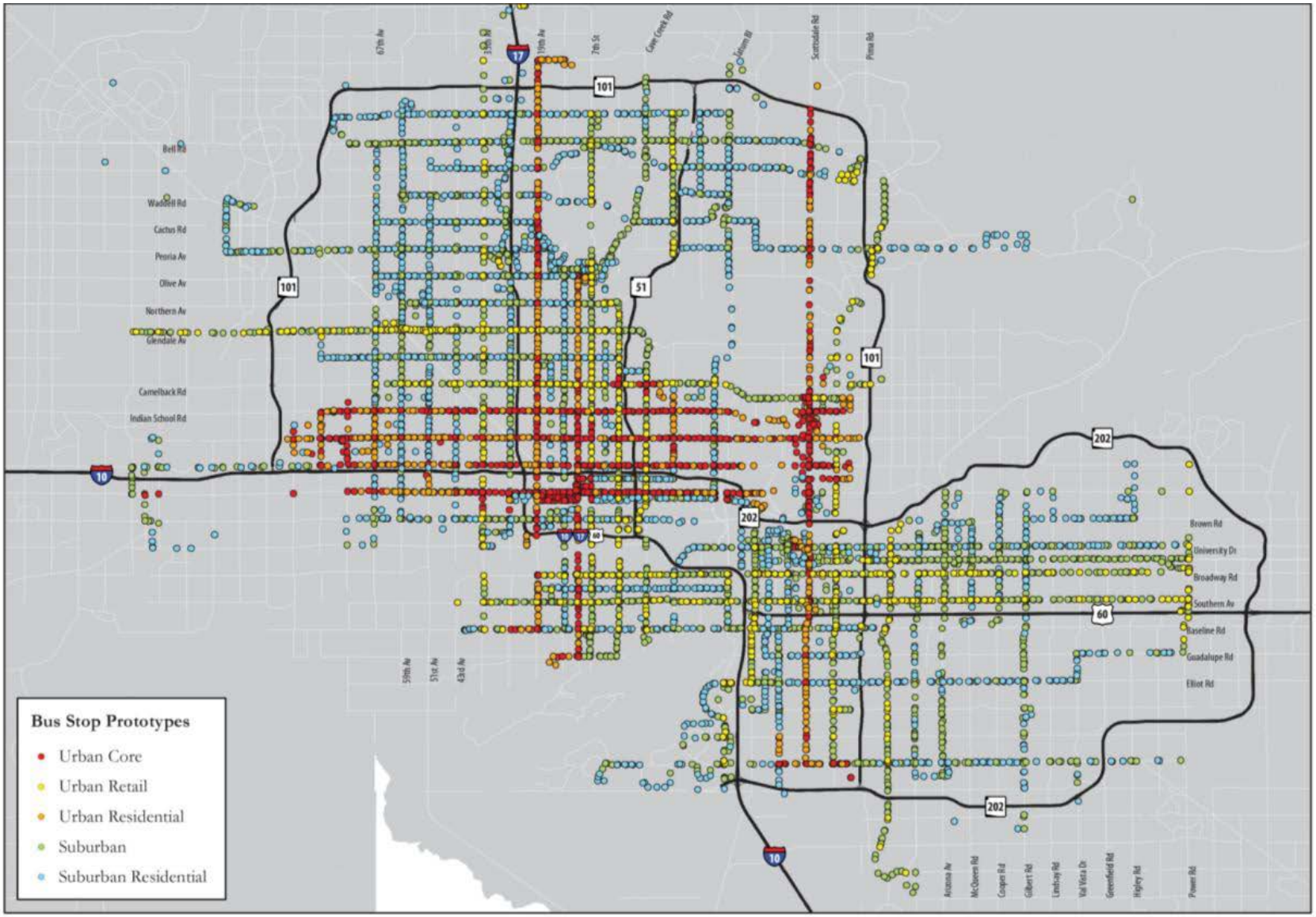
Table 2-3 displays the characterization of bus stop categories that ultimately supported the development of *Bus Stop Prototypes*. As shown, the naming strongly relates to where the bus stop category falls within the spectrum from urban to suburban. The *Urban Core Bus Stop Prototype* will generally suit the most urban environments in the MAG region with the highest level of transit service, while the *Suburban Residential Bus Stop Prototype* will generally suit the most suburban environments in the MAG region.

	Bus Stop Prototype	***Urban Core***	***Urban Retail***	***Urban Residential***	***Suburban***	***Suburban Residential***
Transit Supply Characteristics	**Level of Accessibility**	High	Medium	Medium	Low	Low
	High Frequency Transit Service	Predominantly high, but also includes low frequency service	Peak Hour Service	Only One All-Day High Frequency	None	Limited Stop / Express Service/ No Local Service
	Street Network Type	Traditional Street Network	Traditional Street Network	Traditional Street Network	Conventional Suburban Street Network	Conventional Suburban Street Network
	Percent of Total Bus Stops	15.4%	14.8%	7.8%	22.3%	39.5%
Transit Demand Characteristics	**Mean Daily Transit Boardings**	69 boardings	50 boardings	27 boardings	24 boardings	12 boardings
	Neighborhood Type	Core Metropolitan	Central Metropolitan	Central Metropolitan	Suburban	Suburban
	Presence of Retail	Both	Yes	No	Yes	No
	Employment Density	High	Medium	Medium	Low	Low
	Population Density	Mixed	Medium	Medium	Low	Low

Source: Chen Ryan Associates; October 2012

Figure 2-1 displays the distribution of bus stops across the MAG region, along with each bus stop's recommended *Bus Stop Prototype* designation. The following sections of this report provide more detail on specific recommendations associated with each of the *Bus Stop Prototypes*.

Figure 2-1: **Bus Stop Categorization**



2.2 Transit Rider Survey Results

A transit rider survey was administered in-person at 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 in the MAG region. 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

The survey was performed during the second and third week of April, 2012, using study team member staff and volunteer agency staff. A total of 221 surveys were collected, with 188 "Arriving To" surveys and 33 "Departing From" surveys.

Several interesting findings were obtained from the survey in relation to transit riders' perceptions of the quality of the environment near bus stops, and along the way to and from bus stops. This section provides specific results related to transit riders' opinions about the types of streetscape improvements that would "likely" encourage more frequent walking and cycling to transit stops. Responses to this question have direct implications for understanding potential effectiveness of a range of potential enhancements.

Table 2-2 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 2-2: **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%

Urban Core		Urban Residential		Urban Retail		Suburban Retail		Suburban Residential	
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.

As shown in Table 2-2, the most valued improvement type is *Shade Trees*, which garnered the highest level of agreement in terms of influencing the frequency of walking or cycling to bus stops. For three of five bus stop categories (Urban Core, Urban Retail, and Suburban Residential), *Shade Trees* ranked highest, with about 60%-90% of survey respondents saying that more shading would increase the likelihood of walking/cycling to bus stops more frequently.

The next most valued improvement type is *Bus Schedule Information*, which was the most valued for one bus stop category (Suburban Retail), and second most valued for three categories (Urban Core, Urban Residential, and Suburban Retail). About 40%-70% of survey respondents said that more bus schedule information would increase the likelihood of walking/cycling to bus stops more frequently.

The third most valued improvement type is *Streetlights*. This was ranked in the top three positions for four of five bus stop categories.

The overall ranking – without separating results by bus stop category – is provided in the list below:

1. Shade Trees (58%)
2. Bus Schedule Information (55%)
3. Streetlights (46%)
4. Bicycle Lanes (42%)
5. Bicycle Parking (38%)
6. Landscaping (38%)
7. Curb Extensions (35%)
8. Decorative Pavement (30%)
9. Art (27%)
10. Medians (26%)

The overall ranking also shows *Shade Trees*, *Bus Schedule Information* and *Streetlights* as being the most valued improvement types, followed by *Bicycle Lanes* and *Bicycle Parking*.

2.3 Best Practices for Transit-Related Bicycle & Pedestrian Improvements

In addition to the transit rider survey, 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*.

3.0 Proposed Bus Stop Prototypes

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.

The following subsections describe each of the bus stop categories and presents the related *Bus Stop Prototype* with pedestrian and bicycle access improvement considerations. Each improvement type is elaborated upon in the *Transit Accessibility Toolkit* shown in Section 4.

3.1 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 and high frequency 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. Figure 3-1 illustrates all bus stops with *Urban Core* characteristics. 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. Figures 3-2 to 3-7 illustrate the optimal improvements at the 16th and Thomas case study location given existing constraints.

3.1.1. Characteristics and Constraints

Each bus stop type has physical constraints that limit the ability to make all pedestrian and bicycle improvement typically recommended for the stop type. Typically, *Urban Core* bus stops have several constraints, primarily as a result of the dense, urban environment in which the stop is located. Below is a table that illustrates the physical characteristics and constraints of the 16th Street and Thomas Road case study location[1]. A complete assessment of the 16th and Thomas case study location can be found in *Working Paper #3*.

For the purpose of consistency throughout the document, the constraints and characteristics tables are organized into the following categories identified in Table 3-1.

[1] Each bus stop within this bus stop category will have slight variations from this specific case study location; however, the general character of the area should be consistent among all bus stops within the bus stop category.

Table 3-1: **Urban Core Characteristics and Constraints**

Category	Characteristic	Constraint	Improvement Considerations
Lighting	• Street "cobra" lights only. • Indirect lighting from some adjacent land uses.	• Cost.	• Meet or update current lighting standards to reduce occurrence of dark spots and improve pedestrian safety. • Examine opportunities for pedestrian level lighting.
Information	• General passenger and route number information only. • No bus schedule or route destination information.	• Transit system information signage must compete with advertising space.	• Display schedule, route information, and full system map inside the stop shelter. • Install pedestrian/bicycle friendly route wayfinding signage for stop locations.
Seating	• Provided at shelter. • Not enough seating to accommodate high ridership volumes	• Limited right-of-way (ROW) to accommodate additional seating.	• Develop process to request and evaluate additional stop seating.
Shelter	• Not enough shelter to accommodate high ridership volumes.	• Limited ROW to accommodate additional shelters.	• Install shelter adjacent to existing shelter as appropriate.
Shade	• Provided via shelters and few adjacent trees. • Little to no shade in catchment areas.	• Limited ROW to accommodate shade trees.	• Provide shade trees with grates to establish a larger sidewalk space for strollers and pedestrians. • Locate stops to take advantage of building structure or existing tree shade.
Adjacent Land Use	• Direct access. • Retail, service, and medium- to high-density residential nearby. • Parking conflicts with street and transit access. • Excessive litter.	• Limited access to adjacent land uses. • Limited cross access between adjacent land uses.	• Provide bicycle and pedestrian access to adjacent land uses and between adjacent land uses.
Bicycle Access	• No direct bicycle access to bus stop.	• Existing travel lanes are narrow. • High traffic volumes.	• Install wayfinding signage for stop locations.

Bicycle Parking	• None provided.	• Concerns regarding safety and monitoring bicycle parking and issues with bicycle theft.	• Install bicycle parking facilities in visible areas.
Crossings	• Signalized • Crossing distance = 66' • Crosswalk striping is worn. • 6 travel lanes including center left-turn lane. • Roadway width = 66'. • Bus bay/pull-out/acceleration lane.	• Congested crossings. • Competition with turning vehicles. • No pedestrian refuge/median. • Constrained by adjacent development with small setbacks. • Wide cross-section. • No pedestrian refuge/median.	• Restripe pedestrian crossings. • Construct median for pedestrian refuge. • Examine opportunities for "all-pedestrian" traffic signal phase. • Construct median for pedestrian refuge.
Sidewalk	• 4-5' wide. • Pedestrian tripping hazards.	• Heavily utilized ROW by both pedestrians and bicyclists. • Limited ROW to accommodate a wider sidewalk.	• Maintain sidewalks. • Examine sidewalk widening opportunities between stop and crosswalks.

Figure 3-1: **Urban Core Bus Stop Locations**

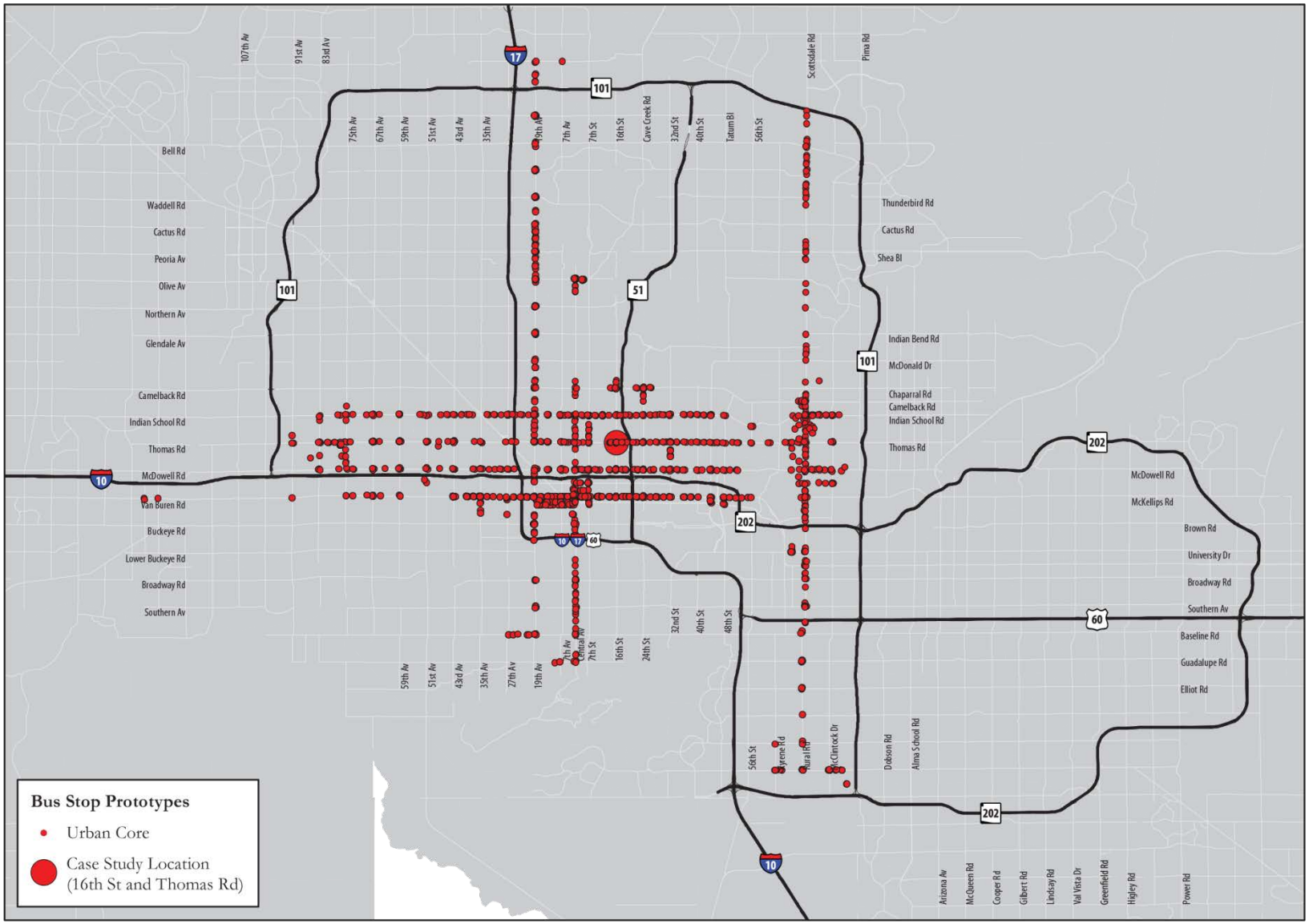
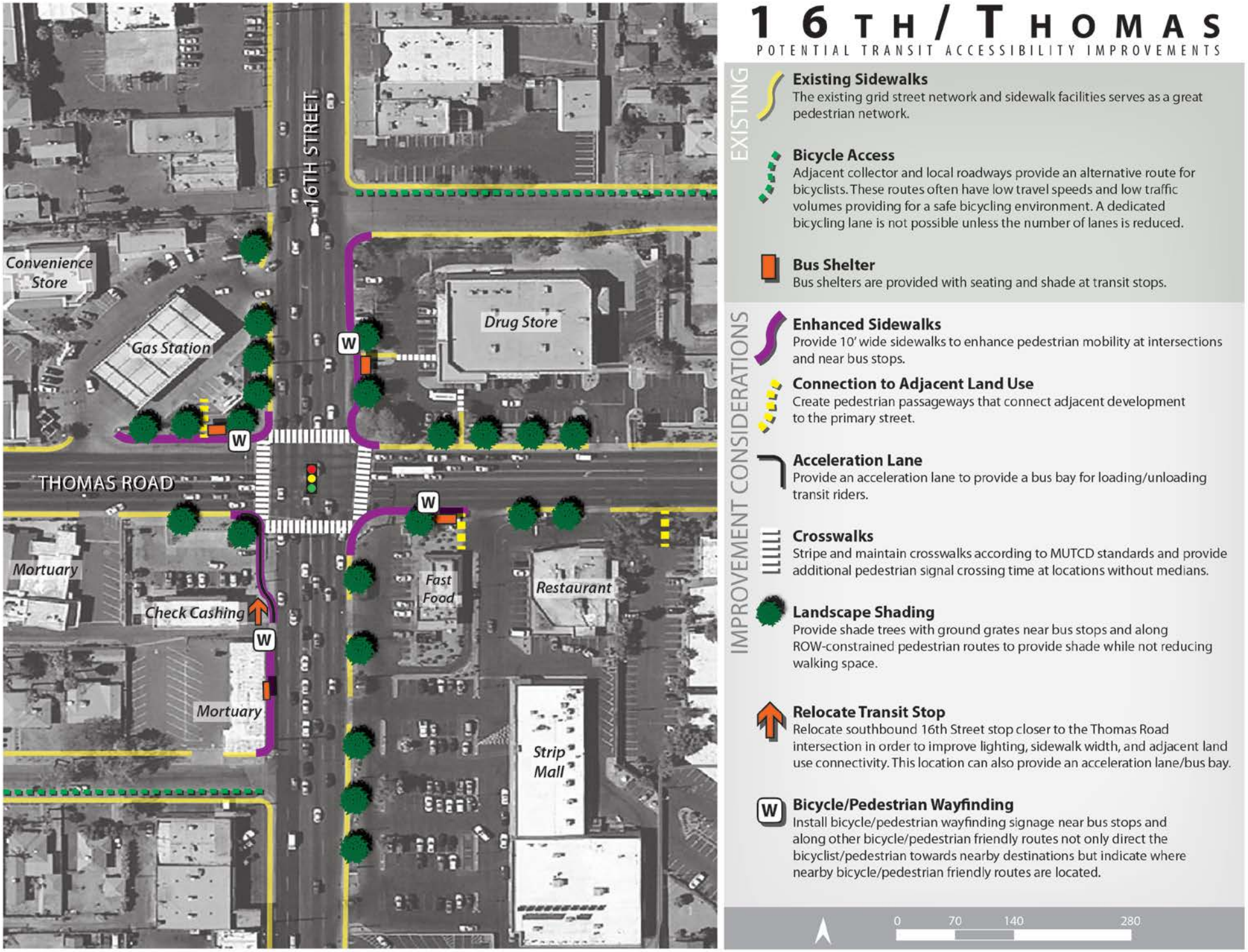


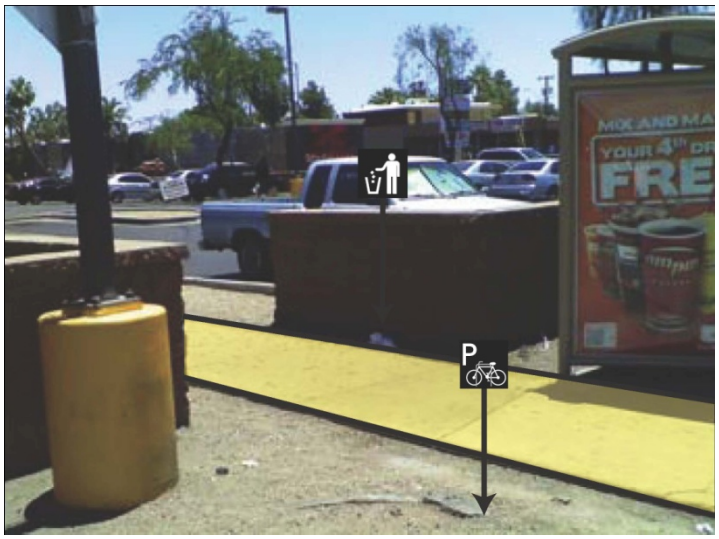
Figure 3-2: **16th and Thomas Optimal Improvements**



3.1.2. Improvement Considerations

	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.
	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. Reduce turning radius at intersection.
	Relocate Transit Stop	Relocate closer to Thomas Road to improve transit connections/ transfers and existing setback space.
	Seating	Seating under a nearby shade tree improves pedestrian comfort. Lower walls provide additional seating in high transit usage areas.
	Landscape Shading	Provide shade trees with grates to establish a larger sidewalk space for strollers and pedestrians.
	Bicycle Access	The addition of a bicycle lane would require further narrowing of travel lanes which is not feasible at this location. 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.
	Maintenance	Additional improvements and repairs.

Figure 3-3: **Northbound 16th Street Stop Improvement Considerations**



Connection to Adjacent Use

Maintenance

Bicycle Parking

Figure 3-4: **Northbound 16th Street Stop Improvement Considerations**

Enhanced Sidewalk

Landscape Shading

Information Signage

Seating

Bicycle/Pedestrian Wayfinding

Figure 3-5: **Southbound 16th Street Stop Improvement Considerations**

Enhanced Sidewalk

Information Signage

Relocate Transit Facility

Maintenance

Bicycle/Pedestrian Wayfinding

Figure 3-6: **16th Street and Thomas Road Improvement Considerations**

Enhanced Sidewalk

Crosswalk/Reduced Corner Radii

Landscape Shading

Bicycle Access

3.2 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. Figure 3-8 illustrates all bus stops with *Urban Retail* characteristics. 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 on medium-sized shopping centers and strip malls. The case study location for the *Urban Retail* bus stop is 90th Street and Shea Boulevard. Figures 3-9 to 3-15 illustrate the optimal improvements at the 90th and Shea Boulevard case study location given existing constraints.

3.2.1. Characteristics and Constraints

Each bus stop type has physical constraints that limit the ability to make all pedestrian and bicycle improvement typically recommended for the stop type. Typically, *Urban Retail* bus stops have several constraints, primarily as a result of the large scale adjacent land uses and the automobile-dominated environment in which the stop is located. Below is a table that illustrates the physical characteristics and constraints of the 90th Street and Shea Boulevard case study location[2]. A complete assessment of the 90th and Shea case study location can be found in *Working Paper #3*.

Table 3-2: **Urban Retail Characteristics and Constraints**

Category	Characteristic	Constraint	Improvement Considerations
Lighting	• Street "cobra" lights only. • Land uses setback too far to use as indirect lighting.	• Cost.	• Meet or update current lighting standards to reduce occurrence of dark spots and improve safety. • Examine opportunities for pedestrian level lighting.
Information	• General passenger, park and ride, and route number information only. • No bus schedule or route destination information.	• Transit system information signage must compete with advertising space.	• Display schedule, route information, and full system map inside the stop shelter. • Install pedestrian/bicycle friendly route wayfinding signage for stop locations.
Seating	• Provided at shelter. • Not enough seating to accommodate high ridership volumes.	• None	• Develop process to request and evaluate additional stop seating.
Shelter	• Not enough seating in shelter to accommodate high ridership volumes. Does not provide shade at all times of day. • Underutilized shelters.	• None	• Examine shelter type/design to maximize shade opportunities. • Correlate shelter use to ridership and provide a program to move shelter locations to higher volume stops (including unused shelters).

[2] Each bus stop within this bus stop category will have slight variations from this specific case study location; however, the general character of the area should be consistent among all bus stops within the bus stop category.

Category	Characteristic	Constraint	Improvement Considerations
Shade	• Partial shade provided via shelter. • Little to no adjacent shade trees. • Not located to accommodate catchment areas.	• Catchment area and transfer distances are far apart which could mean planting many shade trees along the pedestrian route. • Landscaping and buildings associated with adjacent development are set back far from the street.	• Provide shade trees with grates to establish a larger sidewalk space for strollers and pedestrians.
Adjacent Land Use	• Access to adjacent developments blocked by landscaping and large parking lots. • Far setbacks.	• Development pattern is less conducive to pedestrian and bicycle mobility.	• Encourage pad sites close to right-of-way to provide closer store access. • Provide several "landscape breaks" and install sidewalks to enhance connectivity between stops and storefronts.
Bicycle Access	• No on-street facilities. • Multi-use trail in close proximity.	• Difficult to connect from trail to transit stop.	• Install wayfinding signage.
Bicycle Parking	• Not provided at stop location. • Provided at some adjacent developments.	• Far walk between bus stop and development to park bicycle.	• Provide one bicycle rack per intersection to be shared between stops at all four quadrants.
Crossings	• Signalized at intersections • Long crossing distance: 60-80' • Poor mid-block crossings make pedestrian crossings less visible. • 7 travel lanes with center left-turn lane and right-turn lane. • Bus bay/pull-out.	• Competition with vehicles. • Refuge areas / medians are not present. • Long bus transfer walk distances. • Wide pavement section.	• Construct median for pedestrian refuge area. • Examine opportunities for "all pedestrian" traffic signal phase. • Construct median for pedestrian refuge.
Sidewalk	• 5-8' wide. • Lack of shade. • Detached from travel lanes in some locations.	•	• Construct / integrate sidewalk in landscaped area.

Figure 3-7: **Urban Retail Bus Stop Locations**

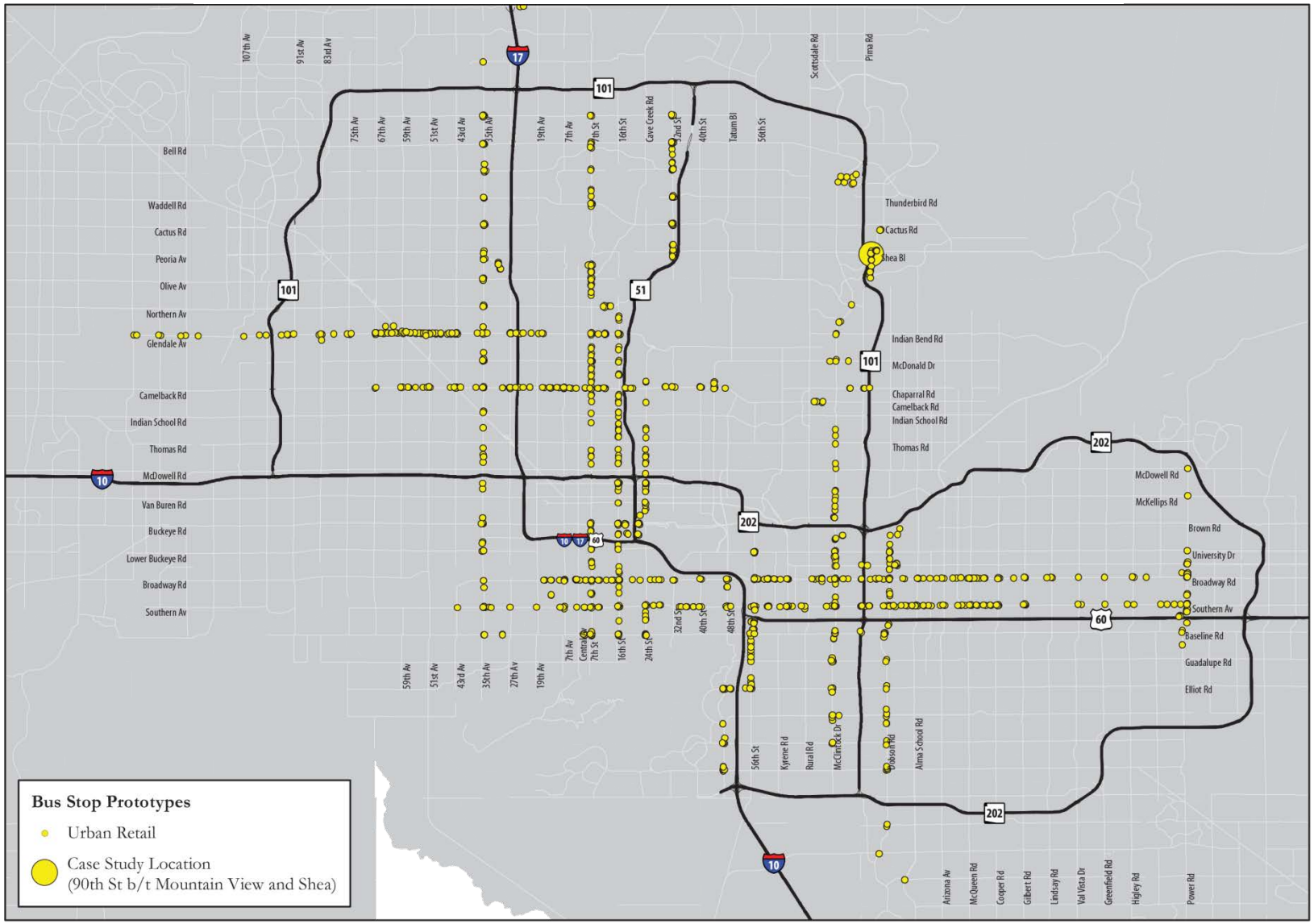
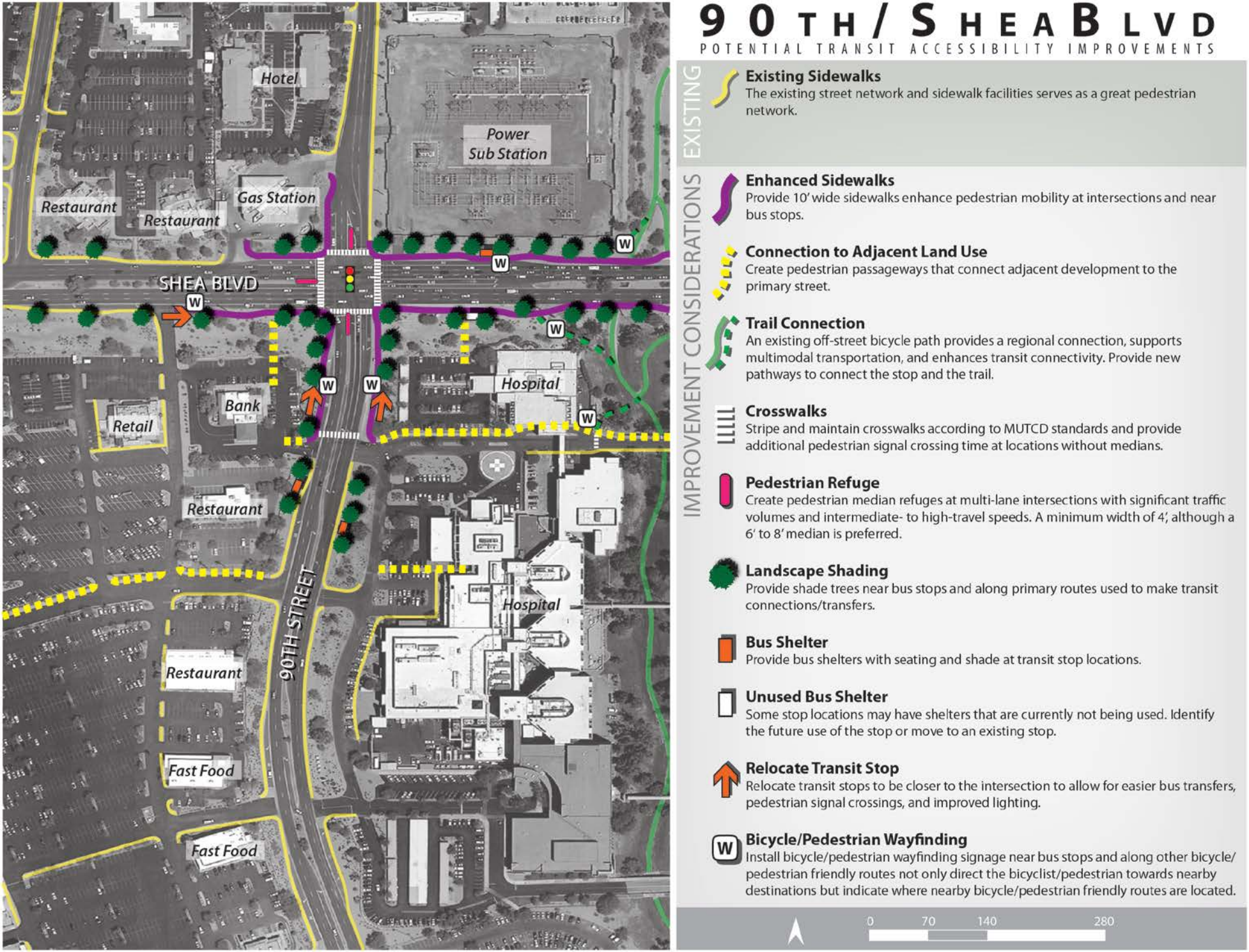


Figure 3-8: **90th and Shea Optimal Improvements**



3.2.2. Improvement Considerations

	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.
	Crosswalk/Pedestrian Refuge	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. Pedestrian refuges are encouraged on multi-lane roadways with significant traffic volumes and intermediate- to high-travel speeds.
	ADA/Bicycle Access	ADA and bicycle access to be provided along all off-street and on-street routes.
	Lighting	Provide pedestrian-scale lighting near transit facility to improve safety. Pedestrian-scale lighting along off-street pedestrian and bicycle routes improve safety.
	Landscape Shading	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	The addition of a bicycle lane would require further narrowing of travel lanes which is not feasible at this location. Wayfinding directs cyclists to low traffic volume roadways/ collector streets.
W	**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. Locate surface parking to the side or back of building, not adjacent to the street.

Figure 3-9: **South of Shea Boulevard, Bicycle Path Improvement Considerations**

ADA/Bicycle Access

Lighting

Landscape Shading

Bicycle/Pedestrian Wayfinding

Figure 3-10: **90th Street at Scottsdale Healthcare Improvement Considerations**

Connection to Adjacent Use

Reduced Building Setback

Figure 3-11: **90th Street Improvement Considerations**

Enhanced Sidewalk

Crosswalk/Pedestrian Refuge

Landscape Shading

Lighting

Figure 3-12: **Southbound 90th Street Stop Improvement Considerations**

Enhanced Sidewalk

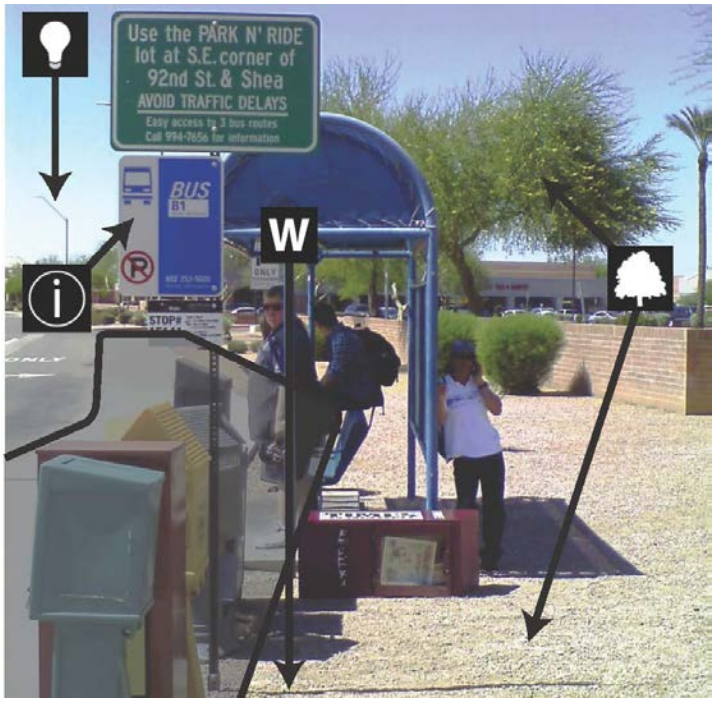
Crosswalk/Pedestrian Refuge

Landscape Shading

Information Signage

Lighting

Figure 3-13: **Southbound 90th Street Stop Improvement Considerations**



Enhanced Sidewalk

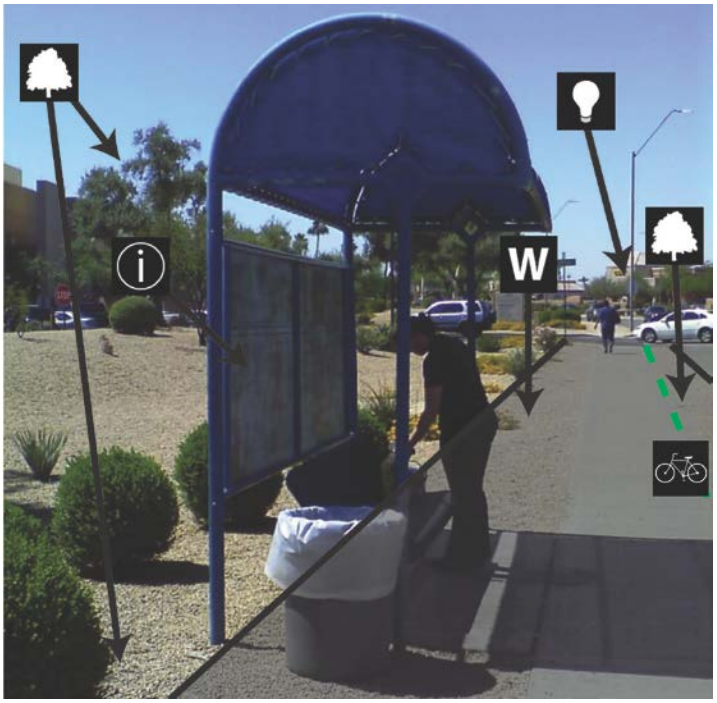
Landscape Shading

Information Signage

Lighting

Bicycle/Pedestrian Wayfinding

Figure 3-14: **Northbound 90th Street Stop Improvement Considerations**



Enhanced Sidewalk

Landscape Shading

Information Signage

Lighting

Bicycle/Pedestrian Wayfinding

Bicycle Access

3.3 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. Figure 3-16 illustrates all bus stops with *Urban Residential* characteristics. 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 3-17 to 3-23 illustrate the optimal improvements at the 19th and Southern case study location given existing constraints.

3.3.1. Characteristics and Constraints

Each bus stop type has physical constraints that limit the ability to make all pedestrian and bicycle improvement typically recommended for the stop type. Typically, *Urban Residential* bus stops have several constraints, primarily as a result of the dense, automobile-dominated environment in which the stop is located. Below is a table that illustrates the physical characteristics and constraints of the 19th Avenue and Southern Avenue case study location[3]. A complete assessment of the 19th and Southern case study location can be found in *Working Paper #3*.

Table 3-3: **Urban Residential Characteristics and Constraints**

Category	Characteristic	Constraint	Improvement Considerations
Lighting	• Street "cobra" lights only. • Land uses setback too far to use as indirect lighting.	• Cost.	• Meet or update current lighting standards to reduce occurrence of dark spots and improve safety. • Examine opportunities for pedestrian level lighting. • Encourage side-of-building lighting.
Information	• General passenger and route number information only. • No bus schedule or route destination information.		• Display schedule, route information and full system map inside stop shelter. • Install pedestrian/bicycle friendly route wayfinding signage for stop locations.
Seating	• Provided at shelter. • Some bus stop locations have an additional bench.	• None	•
Shelter	• Provided at all bus stops.	• None	
Shade	• Partial shade provided via shelter. • Little to no adjacent shade trees or in catchment area.	• Landscaping and buildings associated with adjacent development are set back far from the street. • Underground utilities.	• Require new developments to provide shade trees along sidewalk and adjacent to stop locations. • Provide shade trees with grates to establish a larger sidewalk space for strollers and pedestrians.

[3] Each bus stop within this bus stop category will have slight variations from this specific case study location; however, the general character of the area should be consistent among all bus stops within the bus stop category.

Category	Characteristic	Constraint	Improvement Considerations
Adjacent Land Use	• Direct access to some adjacent retail developments. • No direct access to adjacent residential neighborhoods. • High activity retail, service, and high-density residential uses nearby. • Undeveloped lots in catchment area.	• Development pattern is less conducive to pedestrian and bicycle activity, including walled subdivisions.	• Create corner-lot paths similar to northeast quadrant. • Locate future buildings closer to ROW.
Bicycle Access	• On-street bicycle lanes provided.	• No bicycle lane striping prior to intersection stop bar.	• Install wayfinding Signage.
Bicycle Parking	• None provided.	• Safety/theft.	• Provide one bicycle rack per intersection to be shared between stops at all four quadrants.
Crossings	• Signalized at intersections • Mid-block crossings are difficult to see. • Crossing distance: 60' • 5-6 travel lanes w/ center left turn lane • Bus bay/pull out.	• Competition with vehicles.	• Consider "HAWK" signal where warranted and/or flashing beacons. • Maintain crosswalk stripes.
Sidewalk	• 5' wide. • Lack of shade. • Detached from travel lanes in some locations.	• Available right-of-way/easement	• Construct/integrate sidewalk in landscape area.

Figure 3-15: **Urban Residential Bus Stop Locations**

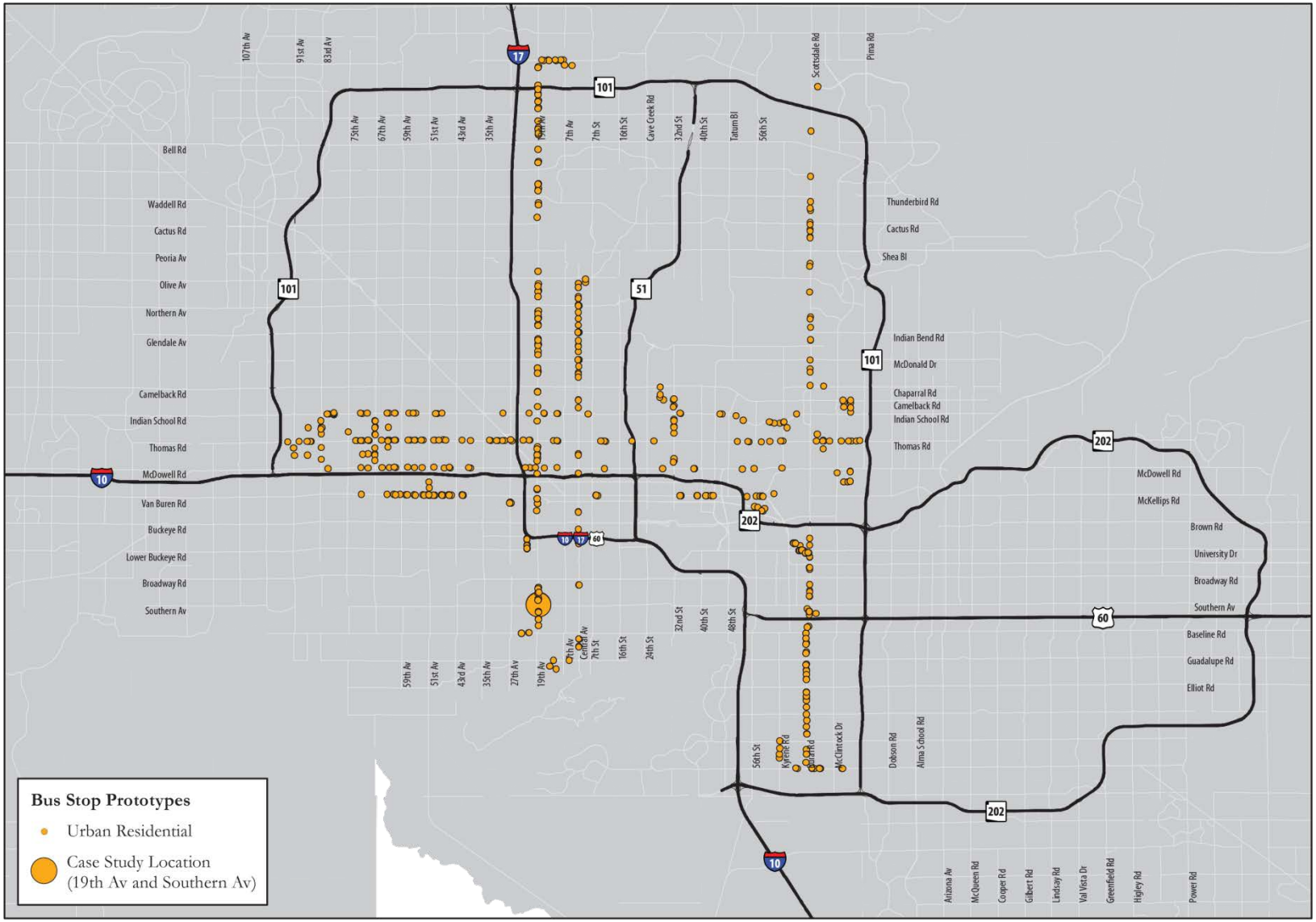
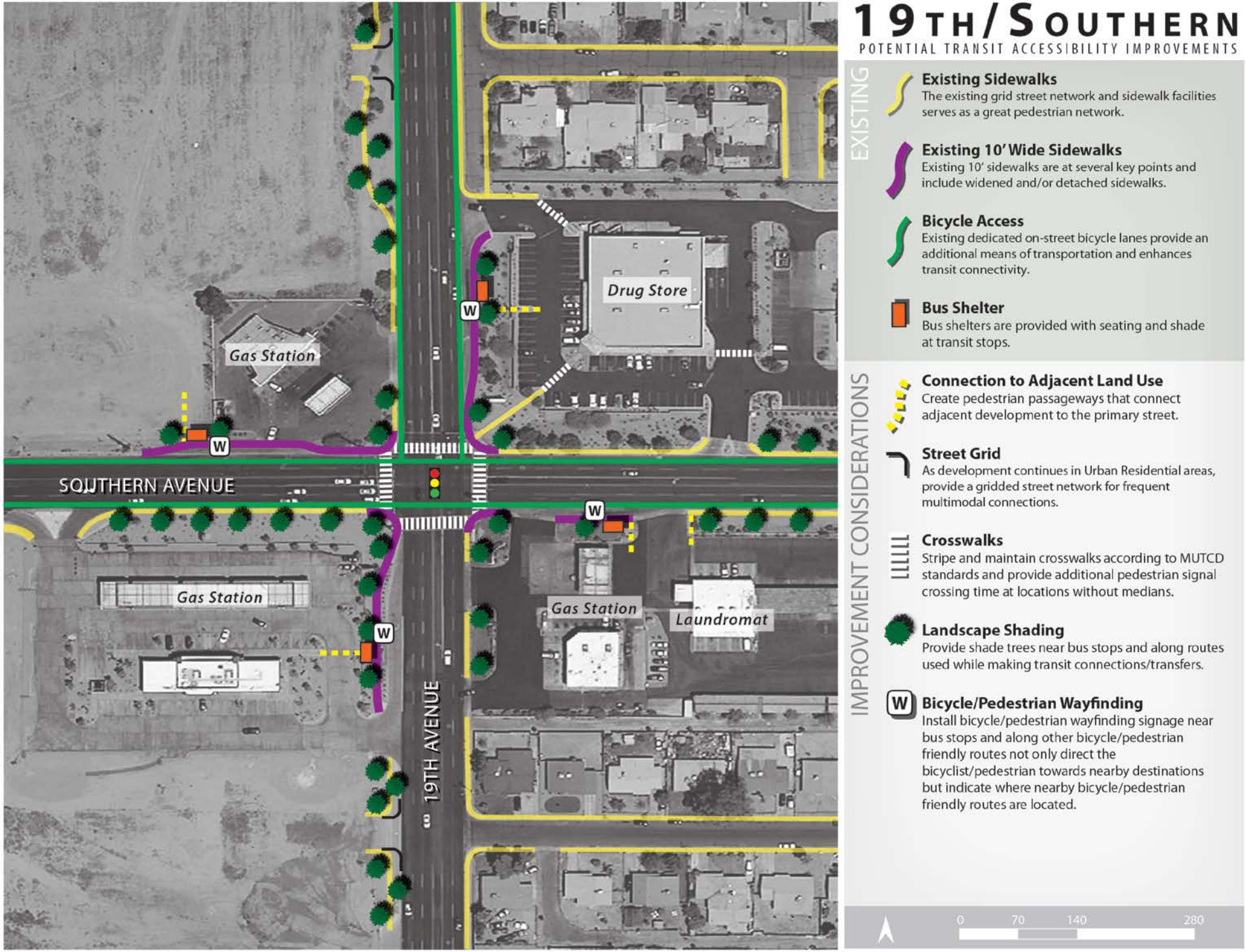


Figure 3-16: **19th and Southern Optimal Improvements**



3.3.2. Improvement Considerations

	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.
	Lighting	Provide pedestrian-scale lighting near transit facility to improve safety. Pedestrian-scale lighting along off-street pedestrian and bicycle routes improve safety.
	Landscape Shading	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 bicyclist in a safe environment.
	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.
	Maintenance	Additional improvements and repairs.

Figure 3-17: **Northbound 19th Street Stop Improvement Considerations**

Connection to Adjacent Use

Landscape Shading

Information Signage

Lighting

Bicycle/Pedestrian Wayfinding

Bicycle Parking

Figure 3-18: **Southern Avenue Bicycle Access Improvement Considerations**

Lighting

Bicycle Access

Figure 3-19: **Eastbound Southern Avenue Stop Improvement Considerations**

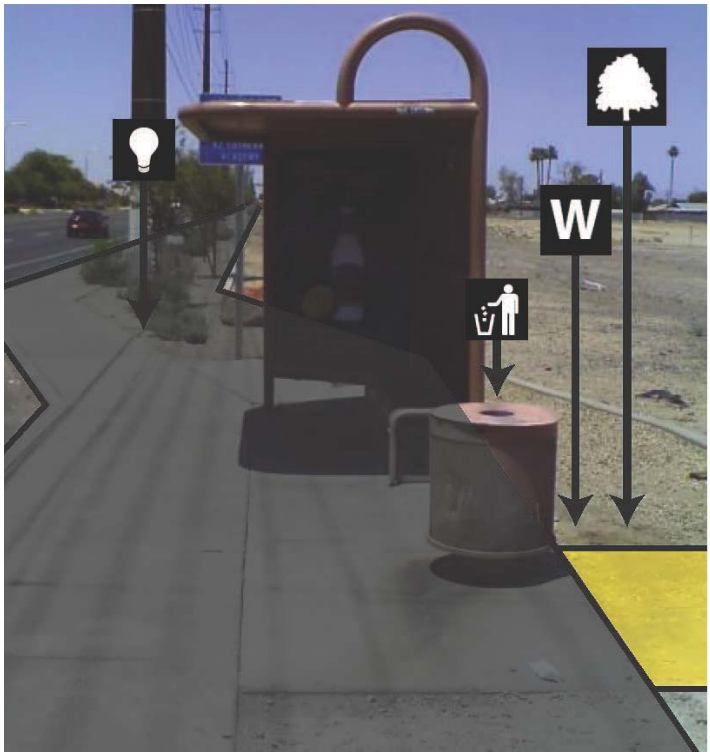
Landscape Shading

Information Signage

Maintenance

Bicycle/Pedestrian Wayfinding

Figure 3-20: **Westbound Stop Improvement Considerations**



Connection to Adjacent Use

Enhanced Sidewalk

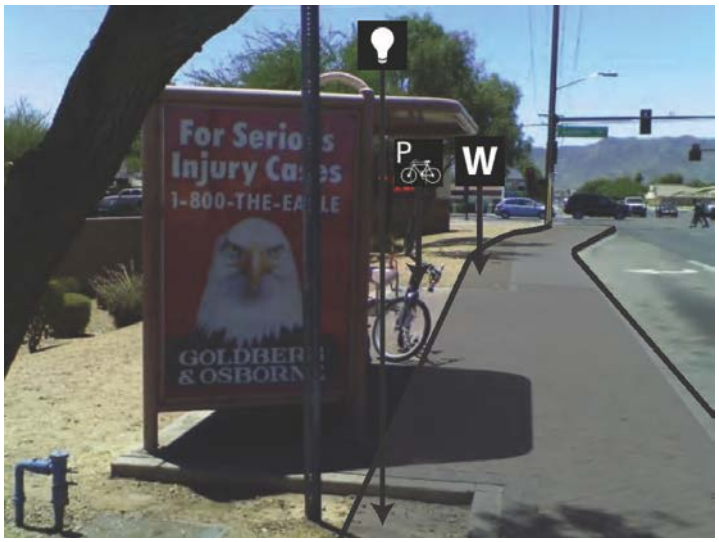
Landscape Shading

Lighting

Bicycle/Pedestrian Wayfinding

Maintenance

Figure 3-21: **Northbound Stop Improvement Considerations**



Enhanced Sidewalk

Lighting

Bicycle Parking

Bicycle/Pedestrian Wayfinding

3.4 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. Figure 3-24 illustrates all bus stops with *Suburban Retail* characteristics. 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 3-25 to 3-32 illustrate the optimal improvements at the 75th and Bell case study location given existing constraints.

3.4.1. Characteristics and Constraints

Each bus stop type has physical constraints that limit the ability to make all pedestrian and bicycle improvement typically recommended for the stop type. Typically, *Suburban Retail* bus stops have several constraints, primarily as a result of the automobile-dominated environment in which the stop is located. Below is a table that illustrates the physical characteristics and constraints of the 75th Avenue and Bell Road case study location[4]. A complete assessment of the 75th and Bell case study location can be found in *Working Paper #3*.

[4] Each bus stop within this bus stop category will have slight variations from this specific case study location; however, the general character of the area should be consistent among all bus stops within the bus stop category.

Table 3-4: **Suburban Retail Characteristics and Constraints**

Category	Characteristic	Constraint	Improvement Considerations
Lighting	• Street "cobra" lights only. • Land uses setback too far to use as indirect lighting.	• Cost.	• Meet or update current lighting standards to reduce occurrence of dark spots and improve pedestrian safety. • Examine opportunities for pedestrian level lighting. • Encourage side-of-building lighting.
Information	• General passenger and route number information only. • No bus schedule or route destination information.	• At stops with no bus shelter there are limited opportunities to place information signage.	• Display schedule, route information and full system map on route sign pole. • Install pedestrian/bicycle friendly route wayfinding signage for stop locations.
Seating	• When a bus shelter is provided.	•	• Develop process to request and evaluate additional stop seating.
Shelter	• Provided at some bus stops. Other stop locations have a tree and the bus stop sign only.	• None.	• Provide shelters at arterial/arterial intersections.
Shade	• Partial shade provided via shelter (when provided). • Adjacent shade trees.	• Landscaping and buildings associated with adjacent development is often set back far from the street.	• Require new developments to provide shade trees along sidewalk and adjacent to stop locations.
Adjacent Land Use	• Few opportunities to directly access adjacent developments (large setbacks/parking lots). • High activity retail and commercial uses nearby.	• Development pattern is less conducive to pedestrian and bicycle activity.	• Create corner-lot paths. • Enhance connectivity to the buildings situated close to the ROW.
Bicycle Access	• None provided. • Off-street trail located a short distance from transit facilities.	• High traffic speeds and volumes.	• Install wayfinding signage.
Bicycle Parking	• Provided at adjacent developments.	• Businesses want bicycle parking for their patrons.	• Provide one bicycle rack per intersection to be shared between stops at all four quadrants. This would supplement parking at adjacent businesses.
Crossings	• Signalized at intersections. • Long crossing distance: 105-130' • Narrow pedestrian refuge. • Not all pedestrian crossings are well marked.	• 8' to 10' travel lanes. • High travel speeds and volumes.	• Widen median for better pedestrian refuge area and install median pedestrian push button. • Restripe pedestrian crossings.
Sidewalk	• 4-6' wide. • Detached from travel lanes in some locations.	• Available right-of-way.	• Provide a 10' wide sidewalk (min.) to at least the first driveway in each quadrant of the intersection.

Figure 3-22: **Suburban Retail Bus Stop Locations**

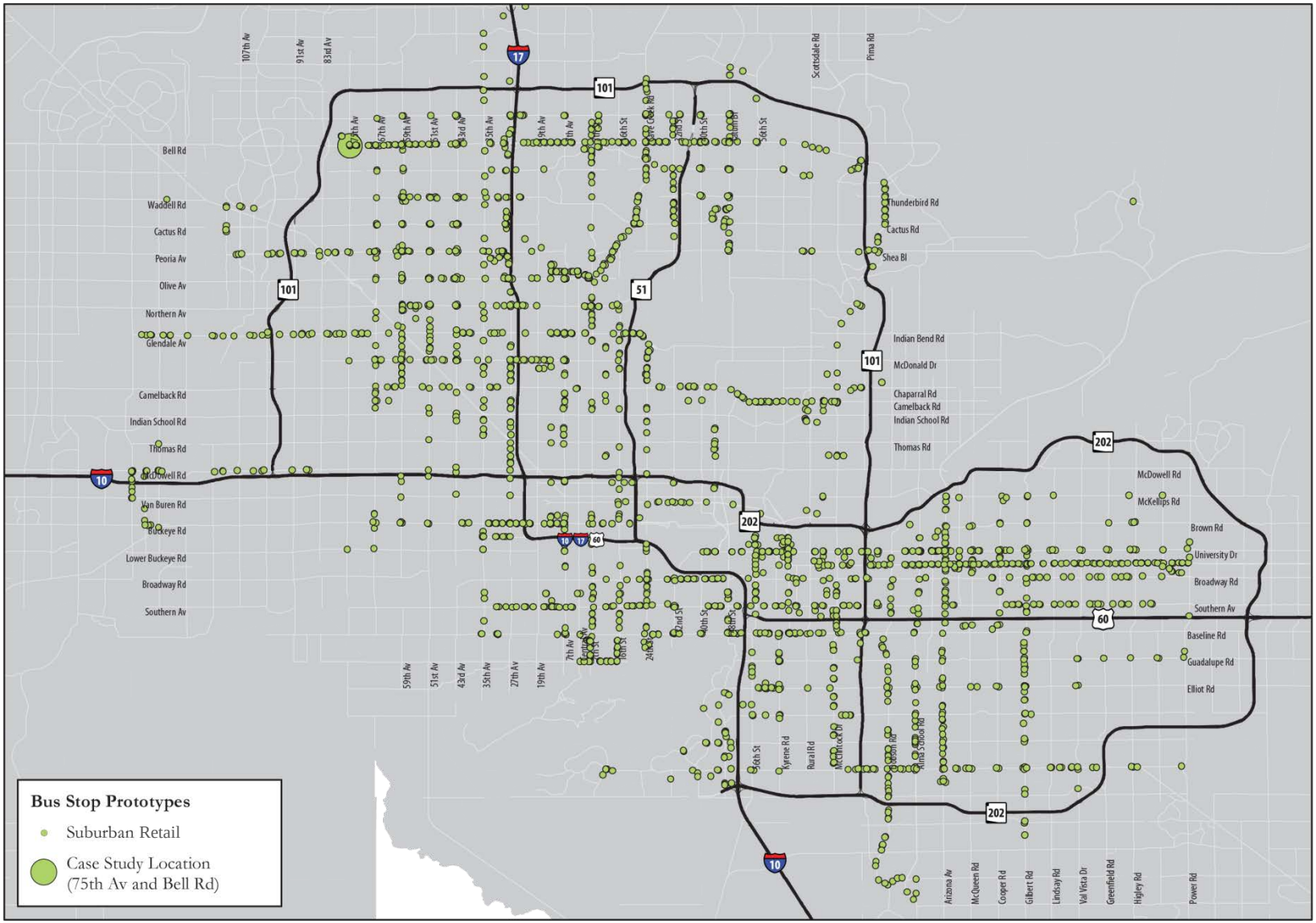
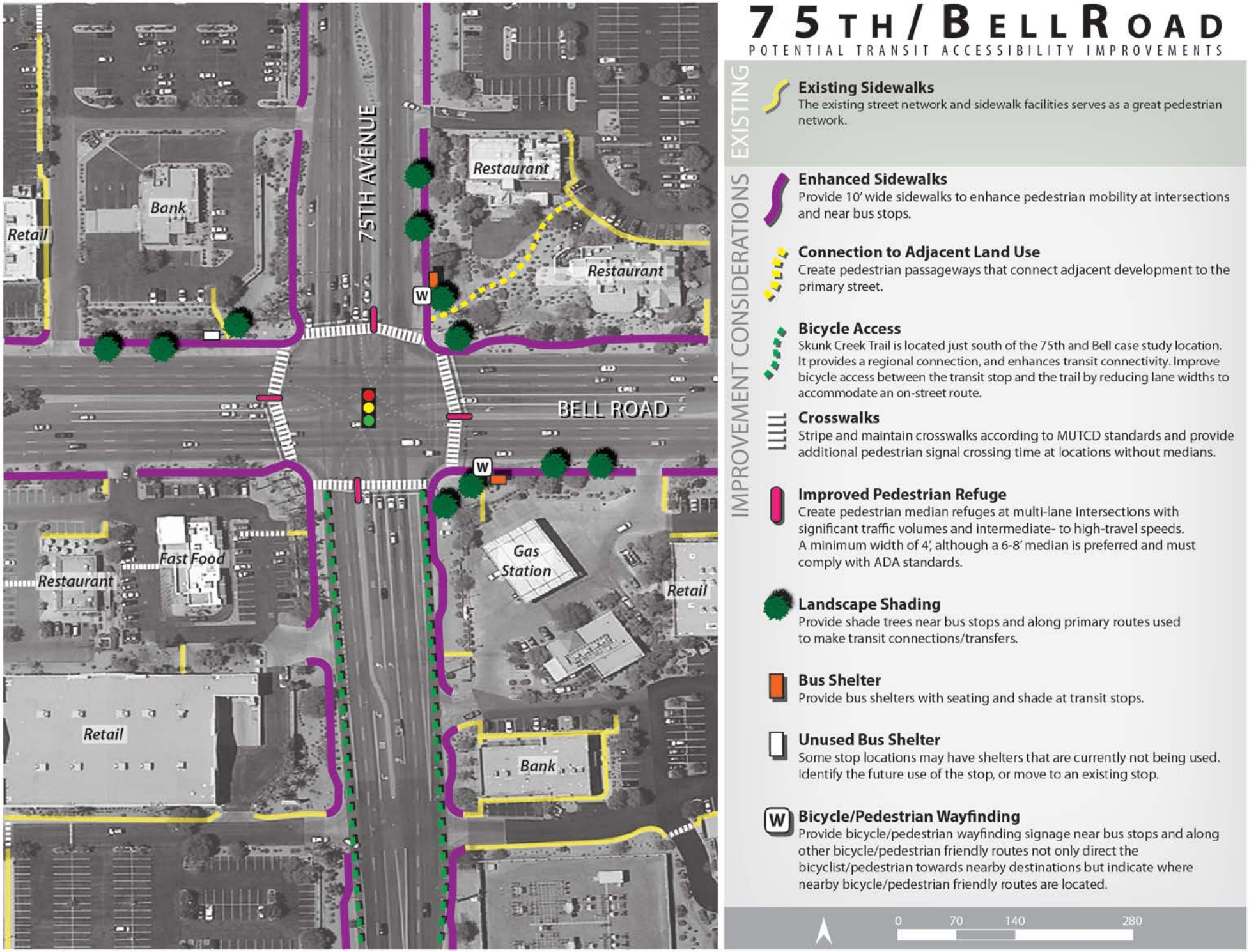


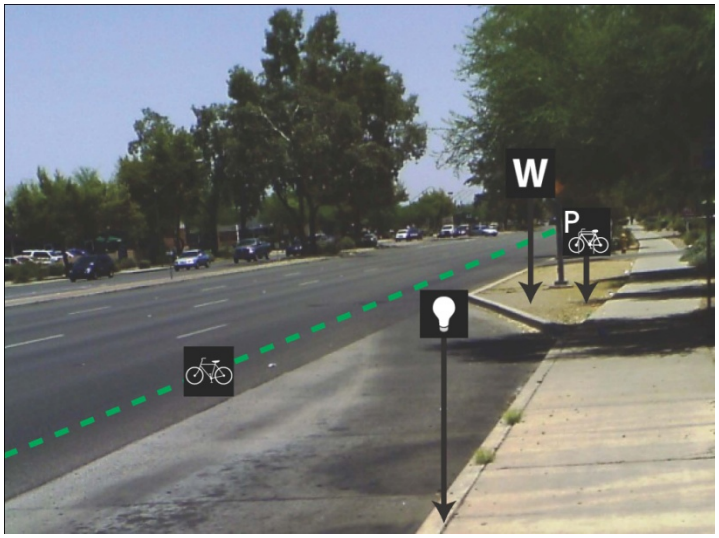
Figure 3-23: **75th and Bell Optimal Improvements**



3.4.2. Improvement Considerations

	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.
	Crosswalk/Pedestrian Refuge	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. Pedestrian refuges are encouraged on multi-lane roadways with significant traffic volumes and intermediate- to high-travel speeds.
	Lighting	Provide pedestrian-scale lighting near transit facility to improve safety.
	Landscape Shading	Provide shade trees to maximize shade along pedestrian/bicycle routes.
	Seating/Shelter	Seating under a nearby shade tree improves pedestrian comfort. Lower walls provide additional seating in high transit usage areas.
	Unused Transit Facility	Existing unused transit facilities exist at both a westbound and southbound stop location near 75th Avenue and Bell Road. Should the transit system be expanded to include a west and/or south route, these existing facilities are ideal locations.
	Bicycle Access	The addition of a bicycle lane would require further narrowing of travel lanes which is not feasible at this location. Wayfinding directs cyclists to low traffic volume roadways/ collector streets.
	Bicycle Parking	Bicycle racks or other parking facilities to be provided 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.
	Maintenance	Additional improvements and repairs.

Figure 3-24: **Eastbound Bell Road Stop Improvement Considerations**



Lighting

Bicycle Access

Bicycle Parking

Bicycle/Pedestrian Wayfinding

Figure 3-25: **Eastbound Bell Road Stop Improvement Considerations**

Lighting

Information Signage

Bicycle Parking

Bicycle/Pedestrian Wayfinding

Maintenance

Figure 3-26: **Bell Road Crossing Improvement Considerations**

Crosswalk/Pedestrian Refuge

Landscape Shading

Figure 3-27: **Future Westbound Bell Road Stop Improvement Considerations**

Lighting

Landscape Shading

Unused Transit Facility

Bicycle Parking

Bicycle/Pedestrian Wayfinding

Figure 3-28: **Future Southbound 75th Avenue Stop Improvement Considerations**

Enhanced Sidewalk

Lighting

Unused Transit Facility

Bicycle/Pedestrian Wayfinding

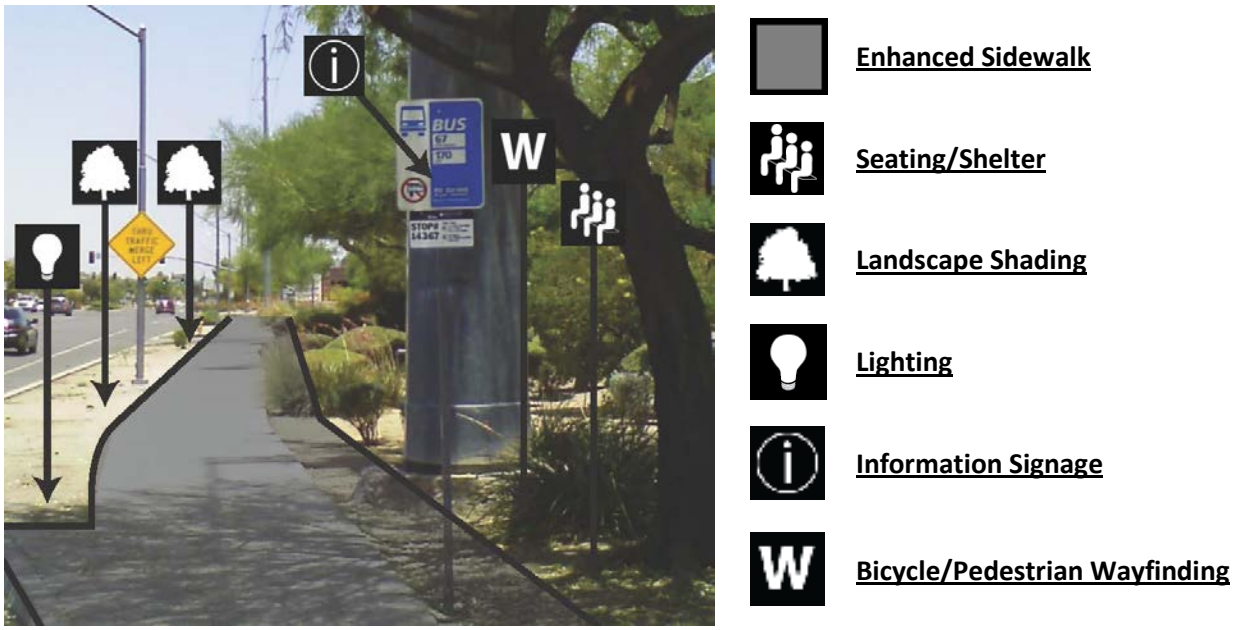
Figure 3-29: **Southwest Corner Pedestrian Access Improvement Considerations**

Connection to Adjacent Use

Landscape Shading

Lighting

Figure 3-30: **Northbound 75th Avenue Stop Improvement Considerations**



3.5 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. Figure 3-33 illustrates all bus stops with *Suburban Residential* characteristics. 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 3-34 to 3-41 illustrate the optimal improvements at the Elliot and Lakeview case study location given existing constraints.

3.5.1. Characteristics and Constraints

Each bus stop type has physical constraints that limit the ability to make all pedestrian and bicycle improvement typically recommended for the stop type. Typically, *Suburban Residential* bus stops have several constraints, primarily as a result of the highly residential and automobile-dominated environment in which the stop is located. Below is a table that illustrates the physical characteristics and constraints of the Lakeview Drive and Elliot Road case study location[5]. A complete assessment of the Elliot and Lakeview case study location can be found in *Working Paper #3*.

Table 3-5: **Suburban Residential Characteristics and Constraints**

Category	Characteristic	Constraint	Improvement Considerations
Lighting	• Street "cobra" lights only. • Land uses setback too far to use as indirect lighting.	• Cost. • Street lighting spacing too far apart leaving gaps of dark spaces.	• Meet or update current lighting standards to reduce occurrence of dark spots and improve pedestrian safety. • Examine opportunities for pedestrian level lighting. • Encourage side-of-building lighting.
Information	• Little to no signage. • When provided, signage includes general passenger and route number information only. • No bus schedule or route destination information.	• At stops with no bus shelter there are limited opportunities to place information signage.	• Display schedule, route information and full system map on route sign pole. • Install pedestrian/bicycle friendly route wayfinding signage for stop locations.
Shade	• Shelter provides shade but not at all times. • Shade trees provided but not continuous. • Little to no shade in catchment area.	• Landscaping and buildings associated with adjacent development is often set back far from the street to take advantage of shade facilities. • Large catchment area means a larger area to shade.	• Integrate sidewalk into landscaped areas.

[5] Each bus stop within this bus stop category will have slight variations from this specific case study location; however, the general character of the area should be consistent among all bus stops within the bus stop category.

Category	Characteristic	Constraint	Improvement Considerations
Seating	• Provided at shelter.	• None	•
Shelter	• Shelters provided at all stops.	• None	•
Adjacent Land Use	• Walled subdivisions. • School, park, and low-density residential uses nearby. • Developments have large setbacks and do not face the street. • Parking lots facing streets.	• Development pattern is less conducive to pedestrian and bicycle activity.	• Provide landscape/wall "breaks" and install sidewalks to enhance connectivity between stops and residential areas/ storefronts.
Bicycle Access	• Bicycle lanes provided.		• Provide wayfinding signage.
Bicycle Parking	• None provided.	• • Most stops are low visibility areas increasing opportunity for theft.	• Adjacent developments are far from transit stops limiting the opportunity to park bicycles near developments.
Crossings	• Roadway width: 75' • 3-5 travel lanes w/ center left turn lane. • Signalized at intersections. • Some crosswalks include brick paver materials.	• Competition with vehicles.	•
Sidewalk	• 5-8' wide. • Detached from travel lanes in some locations.	• None.	• Provide 8' wide sidewalks to at least the first driveway.

Figure 3-31: **Suburban Residential Bus Stop Locations**

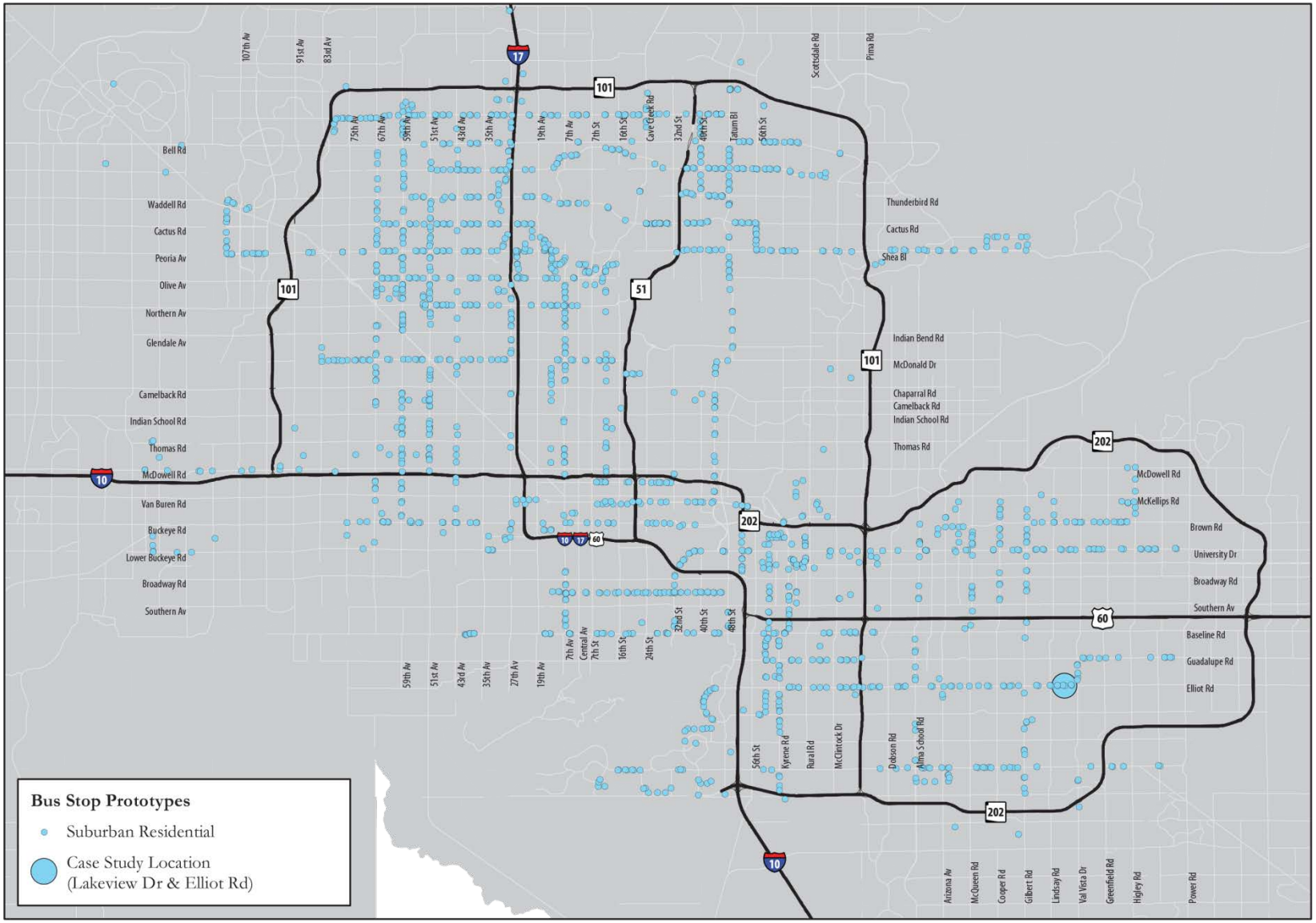
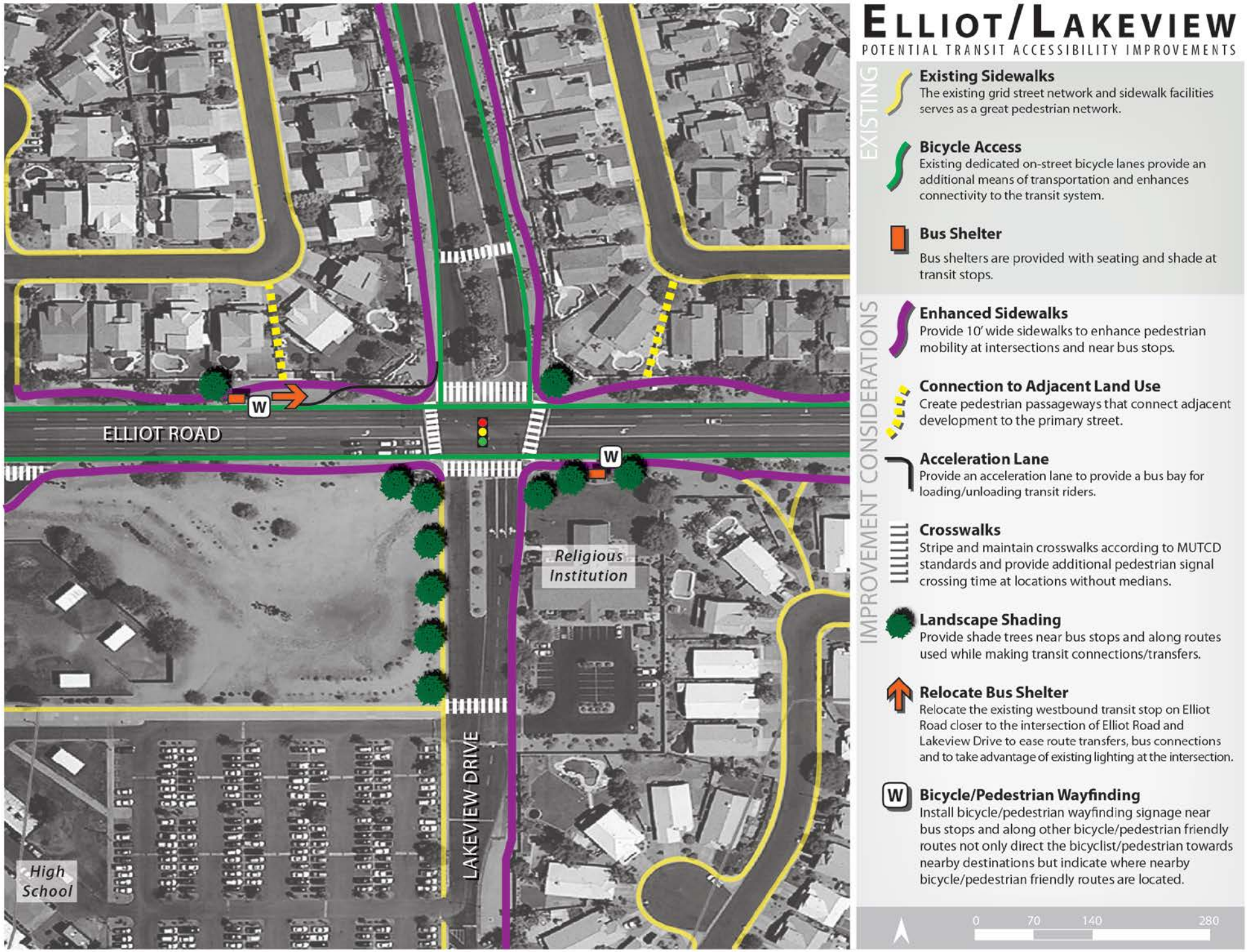


Figure 3-32: **Elliot and Lakeview Optimal Improvements**



3.5.2. Improvement Considerations

	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.
	Acceleration Lane/ Bus Bay	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. Pedestrian refuges are encouraged on multi-lane roadways with significant traffic volumes and intermediate- to high-travel speeds.
	Lighting	Provide pedestrian-scale lighting near transit facility to improve safety.
	Landscape Shading	Provide shade trees to maximize shade along pedestrian/bicycle routes.
	Seating/Shelter	Seating under a nearby shade tree improves pedestrian comfort. Lower walls provide additional seating in high transit usage areas.
	Relocate Transit Facility	Relocate bus stop to the intersection to ease route transfers and connections and to take advantage of existing lighting at the intersection.
	Bicycle Access	Bicycle lanes serve as an additional route of travel for bicyclist in a safe environment.
	Bicycle Parking	Bicycle racks or other parking facilities to be provided 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.

Figure 3-33: **Eastbound Elliot Road Stop Improvement Considerations**

Landscape Shading

Lighting

Bicycle Parking

Bicycle/Pedestrian Wayfinding

Figure 3-1: **Pedestrian Access to Park Improvement Considerations**

Landscape Shading

Lighting

Bicycle Access

Bicycle/Pedestrian Wayfinding

Figure 3-2: **Elliot Road Sidewalk Improvement Considerations**

Enhanced Sidewalk

Lighting

Bicycle/Pedestrian Wayfinding

Figure 3-3: **Elliot Road and Lakeview Drive Improvement Considerations**

Connection to Adjacent Use

Acceleration Lane/Bus Bay

Landscape Shading

Lighting

Relocate Transit Facility

Figure 3-4: **Elliot Road and Lakeview Drive Intersection Improvement Considerations**

Connection to Adjacent Use

Acceleration Lane/Bus Bay

Landscape Shading

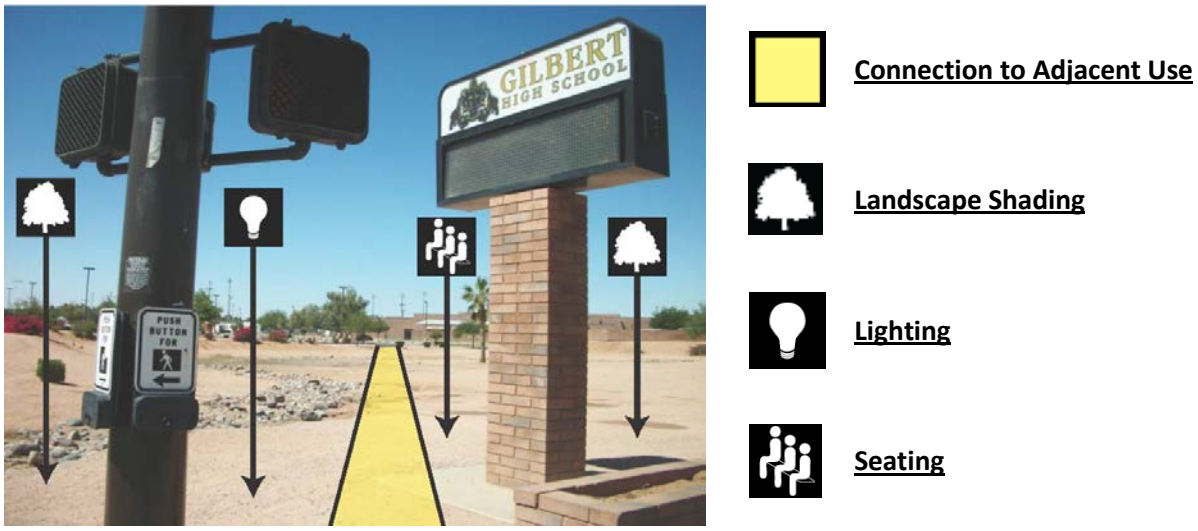
Lighting

Figure 3-5: **Elliot Road Improvement Considerations**

Lighting

Landscape Shading

Figure 3-6: **Southwest Corner Pedestrian Improvement Considerations**



4.0 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. 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
- Shade
- Adjacent Land Use
- Bicycle Access
- Bicycle Parking
- Crossings
- Sidewalk

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

4.1 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.

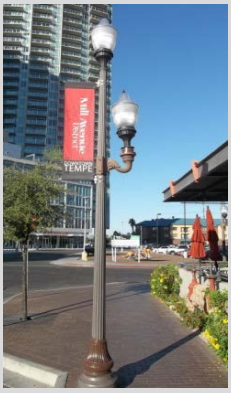
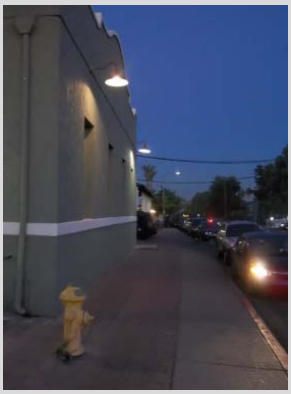
Importance

A field survey was conducted of transit users at each case study location. Numerous questions were asked of transit riders including "How likely is it that you would walk or ride a bicycle to this bus stop more frequently if there were more street lights?" Of the respondents, 60% 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'.

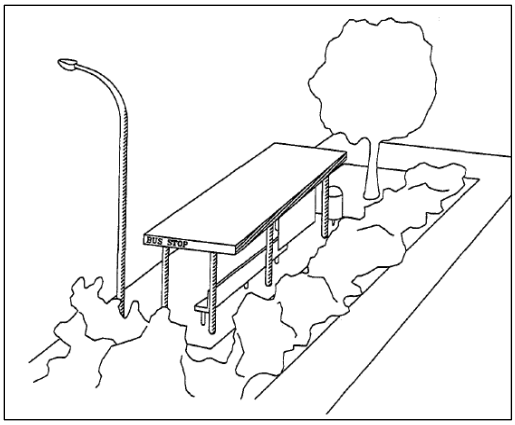
Pedestrian Light Mounted to Street Light. A pedestrian lighting arm may be attached an existing street light pole using a special SS band designed for this purpose. In addition to mounting to existing street lights additional pedestrian lighting may be necessary. Pedestrian lights must be located within 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.



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 4-1: **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.

4.2 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.

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.

Related 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.

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.

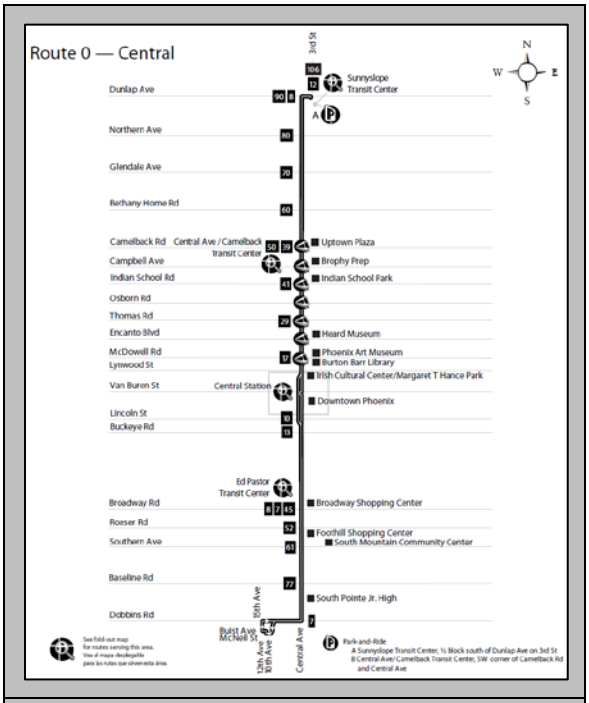
Contact Information Signage. Each bus stop can include the transit provider's contact information with the bus stop number. This sign provides another means for riders to get information regarding their bus route and bus stop. Many bus stops in the greater Phoenix area already include this sign. In addition 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.

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.



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

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 4-2: **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.

4.3 W 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.

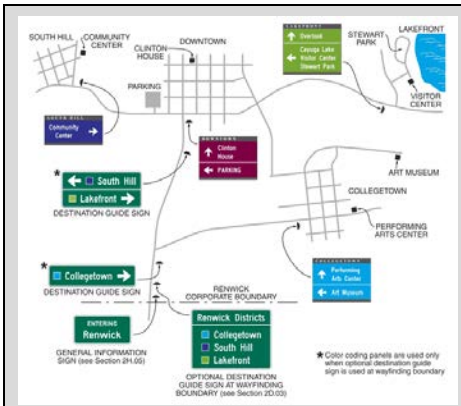
None of the case study locations provided transit, bicycle or pedestrian wayfinding.

In "Design & Placement: The Defining Elements of Successful Wayfinding Signage" (Owens, Ron) the paper describes how:

> *"…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…"*

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.

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	Stations/stops **(ALL)**	Station access **(ALL)**		
Fare	Schedules **(ALL)**	Travel mode & route fare/cost options – Financial Comparisons **(PT)**	Financial Comparisons **(PT)**	
Service Alerts	Elevator/escalator station access **(ALL)** Signage/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 planning (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

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 regional transit wayfinding guidelines and standards.
- Establish a hierarchy that classifies destinations as primary, secondary and tertiary destinations.

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).

Cost

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

Table 4-3: **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					

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

4.4 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

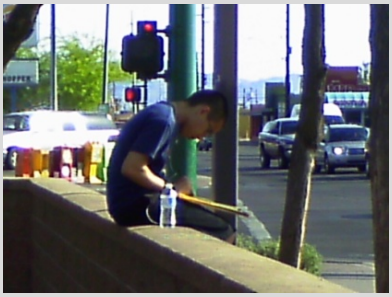
Importance

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 with no advertising (shade from tree and building)	Seating provided on adjacent street wall, also known as a seat wall.	Bench located under adjacent shade trees.

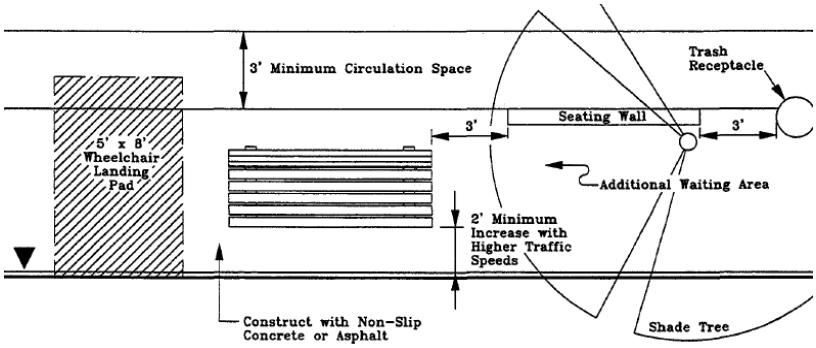
Bench. Seating provided independent of bus shelters would typically be provided where ridership is below those justifying a bus shelter. The quality, financing and siting of benches may vary according to the needs and resources of the responsible agency and local community. Locate benches near shade 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.

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

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,
  - ADA mobility clearances, and
  - proximity and access to surrounding destinations.



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

- 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.

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 4-4: **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					

4.5 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 sites 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 sites 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

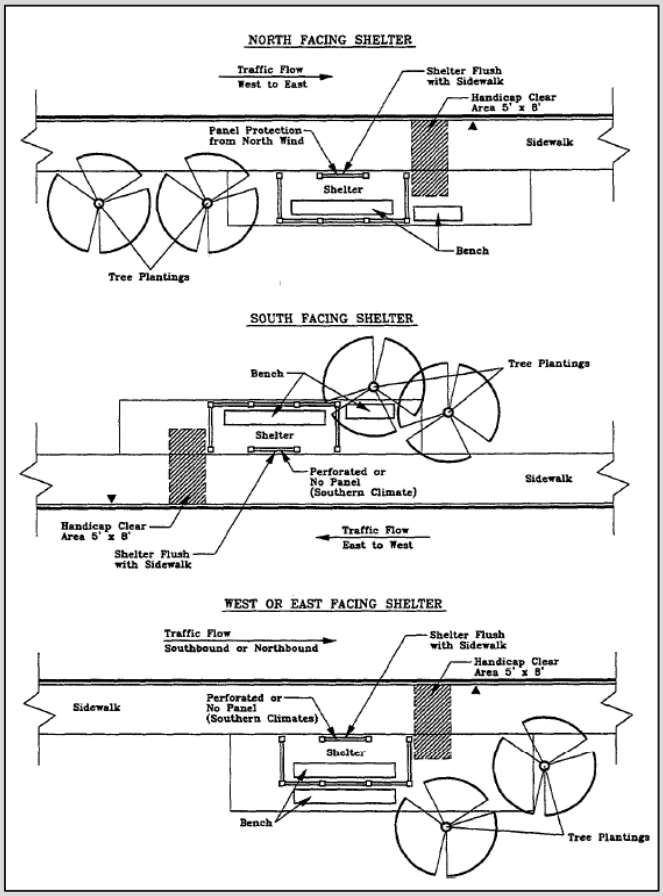
The field survey did not ask specific questions related to shelter. In "Evaluating Transit Stops and Stations from the Perspective of Transit Users" 749 transit users were surveyed at 12 transit stops and stations around metropolitan Los Angeles; 69% of respondents reported shelter to protect them from 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

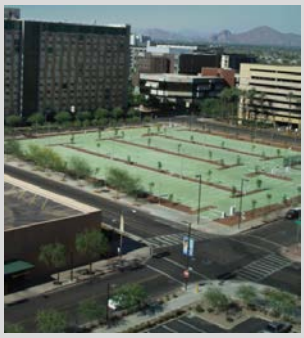
Like bus benches, bus shelters may be supported by advertising or constructed using entirely public funds. Transparent screening is an important element of both of the examples below, as visibility is an important security feature and it also allows passengers to see approaching buses from behind the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

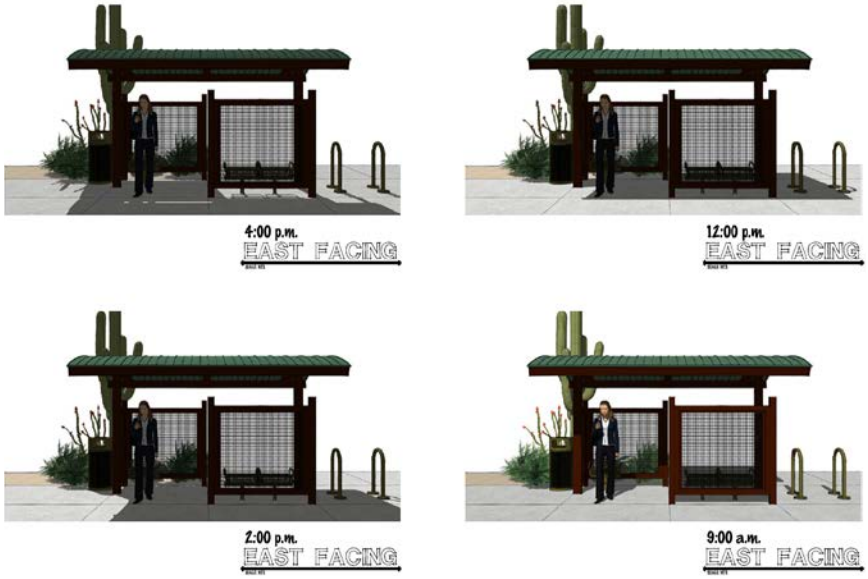
Furthermore, shelters can be coordinated with landscaping to provide maximum protection from the elements and to enhance the visual quality of the bus stop. Shade trees reduce heat at a site and provide additional shade for patrons waiting outside the shelter.



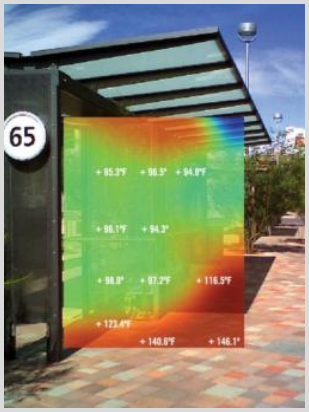
Conceptual Shelter Design for Southern Climates

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

		
Bus shelters can provide sufficient shade at all times of day to encourage their use. Shelters that do not provide sufficient shade may have a negative impact on transit ridership. Source: MAG	Public or development-funded bus shelters may be designed to satisfy more rigorous aesthetic or functional requirements. ***However, the provision of shade, during all times of day, always takes precedence over purely aesthetic design considerations.*** Source: South Mountain Studios	Coated, light color pavement attracts and retains less heat. Source: http://emeraldcoolpavements.com/



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).



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

Source: greenscreen.com

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.

Standard Bus Shelter. A standard bus shelter must meet transit agency requirements including:

- 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.

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.

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.

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

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 4-5: **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					

4.6 Shade

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.

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.

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.

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.

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

The combination of tree wells and sidewalk-oriented buildings provides consistent shade throughout most of the day.	Canopies are typically used on private property. They may be erected to provide shade between the building entrance and the public sidewalk.	Shade at building entrance. Source: City of Chandler, Green Building Program

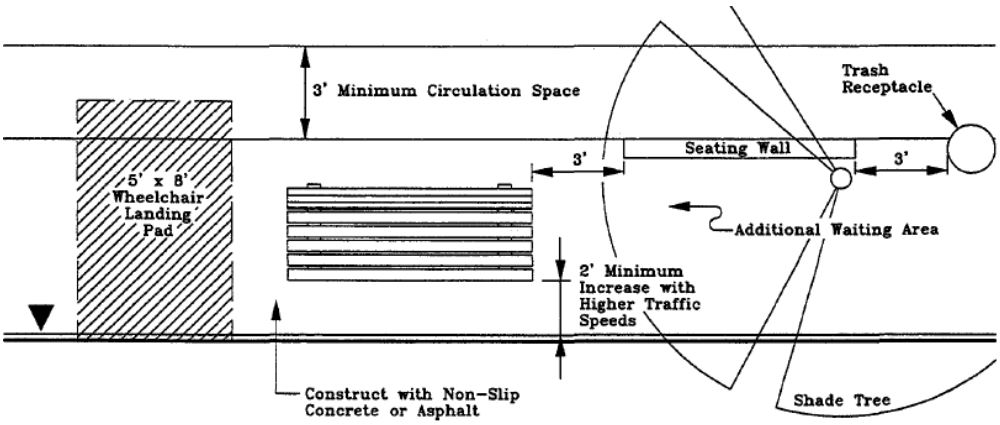
Sidewalk-oriented Buildings. The design and orientation of buildings, particularly with regard to setback and height, can have a significant impact on the level of shade provided at transit stop and along sidewalks in the transit stop catchment area. Structures may also be built over sidewalks for short 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.

Planning/Policy Guidance

- Some cost effective strategies for planting street trees include:
  - Siting bus stops in locations where they will benefit from existing shade trees; and
  - Prioritizing the planting of street trees that will serve existing bus shelters.
- 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.



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 landscape/shade that may be included at transit stops. The potential application of each feature by prototype is highlighted.

Table 4-6: **Cost of Landscape/Shade & Potential Prototype Application**

Feature	Description	Unit	Unit Cost	Application for Prototypes				
				Urban Core	Urban Retail	Urban Res.	Sub. Retail	Sub. Res.
Landscape/ Shade	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					

4.7 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.

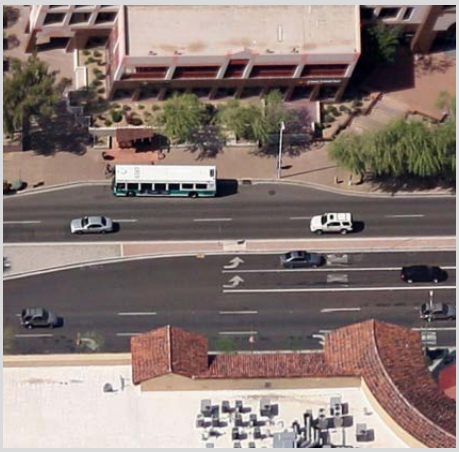
Of the case study locations, only the Urban Core stop provided direct access to adjacent land uses. The Urban Residential stop provided direct access to some adjacent uses but no direct access to the surrounding residential areas. All other case study locations had no direct access to adjacent land uses,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

In "Bus Transit and Land Use: Illuminating the Interaction" the author discusses the importance land use and development patterns have 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."*

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 provides shade and direct access to building entrances.	In Metro core locations, a minimal setback is be encouraged, such as this example in Tempe.

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.

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.

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 laying out the site so the parking is provided on the side or rear of the building.

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 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.

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 to grab a drink, snacks, or the newspaper.
- 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, and
  - 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.

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 4-7: **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					
1. Costs for real-time traveler information and CCTV does not include any necessary communications backbone or central processing system.								

4.8 Bicycle Access

Issue

Bicycle access is important in any city including the MAG region and is an important extension of any transit system as it improves mobility and 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

During the field survey, transit riders were asked how they arrived to the bus stop; 22% of riders said they arrived by bicycle which is considerably higher than the national figure of less than 2%. 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 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 (see Section 4.2) 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.	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 the catchments are where there is sufficient roadway width. Because bicyclists in bicycle lanes often cross paths with buses and turning motorists near intersections, treatments such as 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.

Lane Narrowing. 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 5-6 foot bicycle lanes.

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*

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.

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

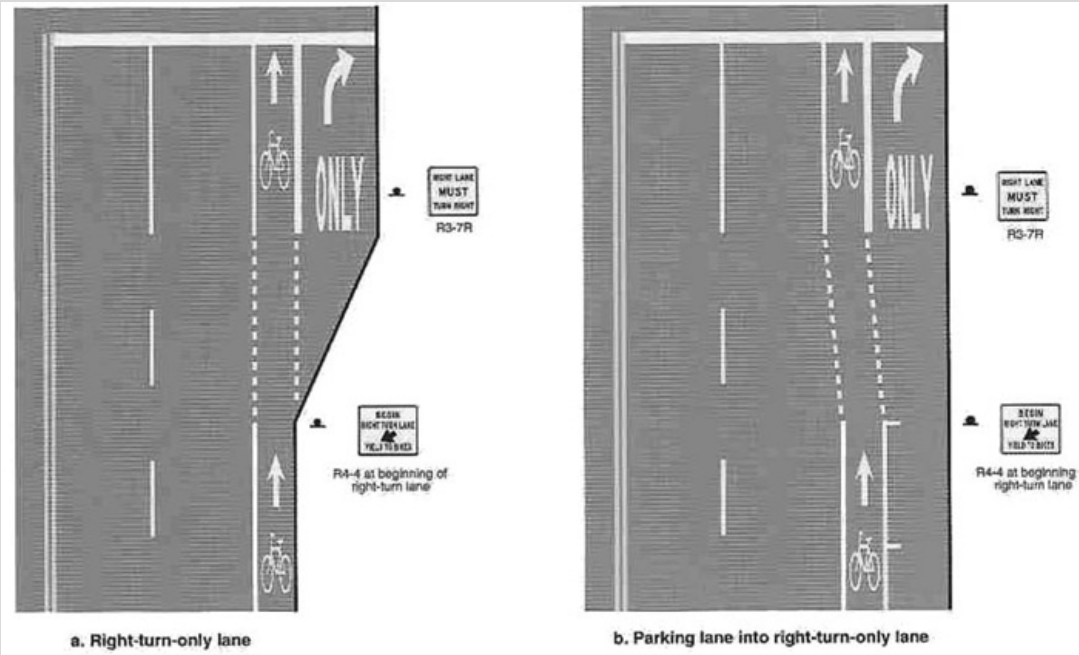
Crossings. Street crossing locations are one of the major safety issues for bicyclists. Well lit and signalized bicycle crossings can improve safety. Crossings that occur at street intersections can be coordinated with

pedestrian crossing signals. Where bicycles cross at mid-block locations, HAWK signals, Rapid rectangular flashing beacons, and in-road flashing beacons can provide additional safety. See section 1.10 for additional details on these road crossings.

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.

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.

Pavement Markings. Properly mark **o**n-street bicycle access including dedicated bicycle lanes, bicycle boulevards and shared lanes to MUTCD standards. The AASHTO Guide for the Development of Bicycle Facilities includes illustrations for correct bicycle lane markings at intersections.



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

Speed lumps 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 intersections.
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.

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 Section 4.3. Above are examples of measures to increase bicyclist comfort by slowing traffic and/or reducing traffic volumes on local streets.

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.

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 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."

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 4-8: **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					
	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					

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

4.9 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 great expand the service area of a transit system. 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

During the field survey, transit riders were asked how they arrived to the bus stop; 22% of riders said they arrived by bicycle which is considerably higher than the national figure of less than 2%. When asked if certain improvements would increase their use of transit, 51% of riders indicated 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.

Improvement Considerations

Bicycle parking can be provided at or near the transit stop and at key destinations in the catchment area of each transit stop. A variety of options exist for the design and installation of bicycle parking. Bicycle racks can support the frame of the bicycle and allow for locking the frame and both wheels directly to the rack. The "inverted-U" bicycle rack is the most commonly used rack that meets these requirements. Bicycle rack in the public right-of-way may be installed on sidewalks or in on-street parking spaces.

Sidewalk bicycle racks.

Bicycle corrals.

Sidewalk bicycle racks. Sidewalk bicycle racks 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.

Planning/Policy Guidance

- Interior, on-board bicycle storage can be considered by the transit agency for 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 which the bus is in motion.
- 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. Siting 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.

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 4-9: **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/ Storage	Bicycle rack	Each	$400					
	Bicycle lockers	Each	$2,500					
	Bicycle shelter	Each	$5,000					

4.10 Pedestrian Crossings

Issue

Pedestrian and cyclists are most vulnerable at pedestrian crossings. Typical crossings include crossing at street intersections or at midblock 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

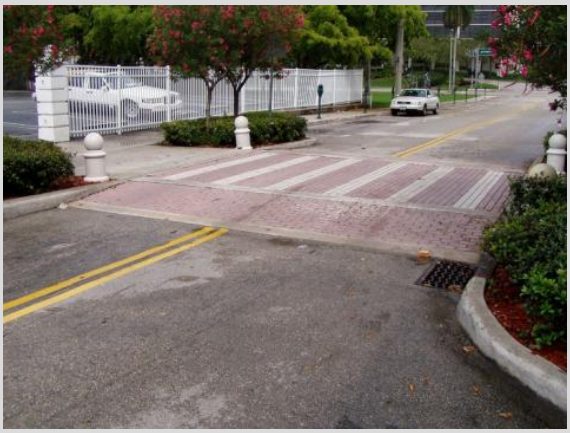
When planning for access to transit stops, desired crossing locations can be identified and enhanced to support safe and comfortable crossing of roadways by transit users. Such improvements can include marked crosswalks, traffic signals, pedestrian refuges, and curb extensions. Pedestrian crossings should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

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

Reduced Curb Radii. Shortened crossing distances through reduced curb radii or curb extensions are encouraged where such improvements would not negatively impact truck traffic.

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.

	
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

Midblock Crossings. Midblock 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 midblock 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 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.

Rapid rectangular flashing beacons. Source: pedbikeimages.org	Scottsdale HAWK signal.	In-road flashing beacons. Source: crosswalks.com

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.

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 4-10: **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					

4.11 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.

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

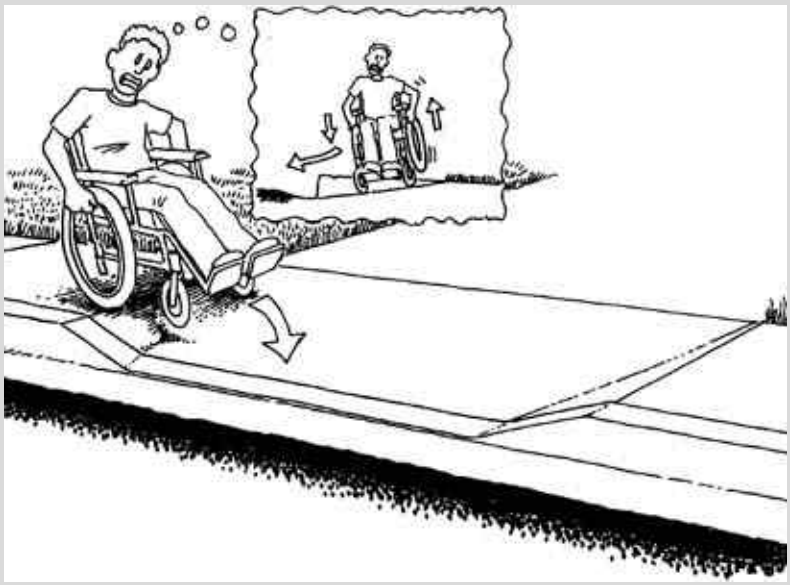
Widening and detaching the sidewalk accommodates a heavier flow of traffic and provides a buffer which improves real and perceived pedestrian safety. Additionally, wide sidewalks with "buffer zones" make additional pedestrian improvements possible. The buffer zone may take very different forms in urban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

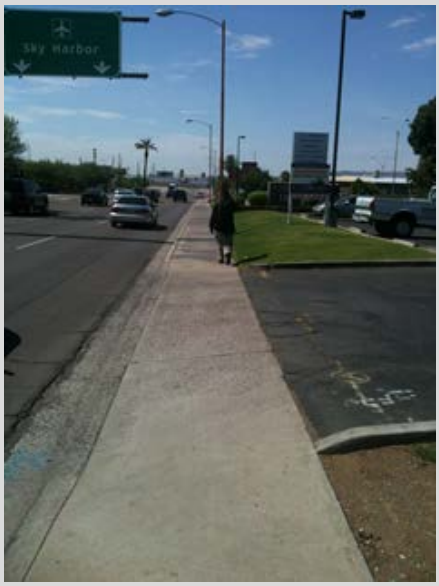
Urban area with sidewalk buffer zone.	Suburban area with landscape strip buffer zone.

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.





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

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.

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.

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.

Table 4-11: **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					

4.12 Prototype Costs

4.12.1. Transit Stop Costs

Table 1 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 4-12: **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					
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					

Feature	Description	Unit	Unit Cost	Application for Prototypes				
				Urban Core	Urban Retail	Urban Res.	Sub. Retail	Sub. Res.
	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					
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.

4.12.2. Planning Level Prototype Costs

Planning level implementation costs for each prototype are provided in Table 2. 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.

Table 4-13: **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**: static 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: $90,000**
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**

4.12.3. 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.

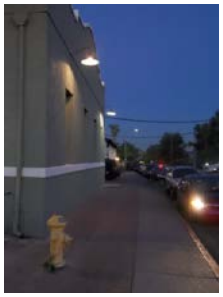
- **Right-of-way.** The need for additional right-of-way to implement a given prototype can be minimized or eliminated through design. However, in addition to meeting ADA requirements, location and design of transit stops and connecting pedestrian/bicycle facilities must not compromise safety and should 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 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.

4.13 Reference Material

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.

5.0 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.

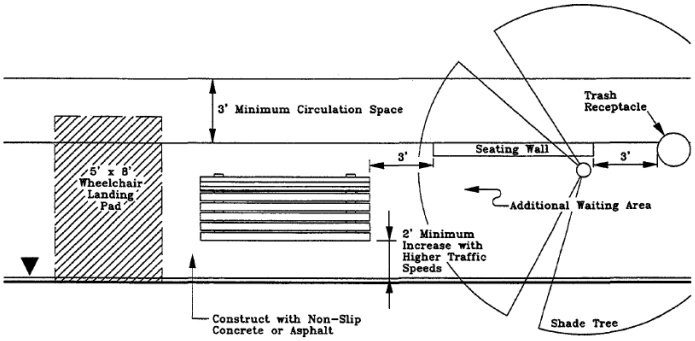
Topics for consideration	*Check all that apply.*
Did you consider **location**?	☐ At intersection (bus bay/acceleration lane). ☐ Mid-block (with pedestrian crossing). ☐ Close to targeted development. ☐ Ease of transit transfer.
Did you consider **lighting**?	☐ Conducted lighting study. ☐ Freestanding street light located near bus stop. ☐ Freestanding pedestrian light. ☐ Pedestrian light attached to street light pole. ☐ Pedestrian light attached to building.
Pedestrian 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. ☐ Transit stop wayfinding signage. ☐ Bicycle wayfinding signage.

Topics for consideration	*Check all that apply.*

Information Signage Examples

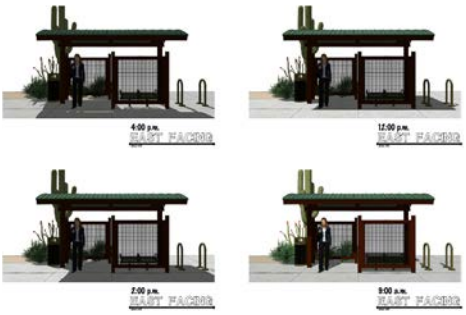
Did you consider **seating**?	☐ Bench under tree. ☐ Bench in shelter. ☐ Seating wall.

Seating Examples



Did you consider **shelter**?	☐ RPTA standard shelter. ☐ Shelter designed for southern climates. ☐ Enhanced paving/surface coating.

Shelter Examples

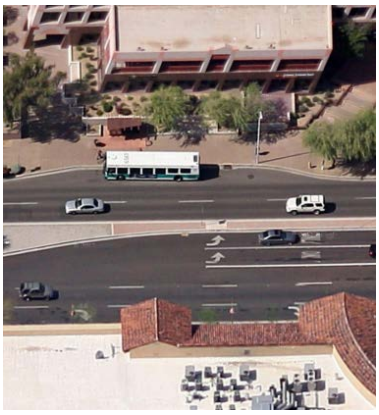
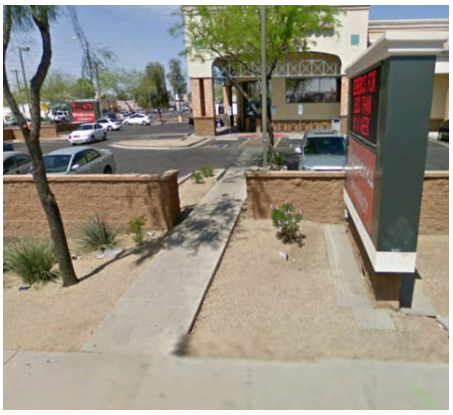


Topics for consideration	*Check all that apply.*
Did you consider **shade**?	☐ Street trees. ☐ Adjacent development. ☐ Other shade structure. ☐ Provided via transit shelter.

Shade Examples

Did you consider the **adjacent development**?	☐ Sidewalk-oriented development. ☐ Minimal setback with direct path. ☐ Path to building entrance. ☐ Shade at building entrance. ☐ Pedestrian path through parking lot. ☐ Pedestrian and bicycle access to walled residential communities.

Adjacent Development Examples

Topics for consideration	*Check all that apply.*
Did you consider **bicycle access and route**?	☐ 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.

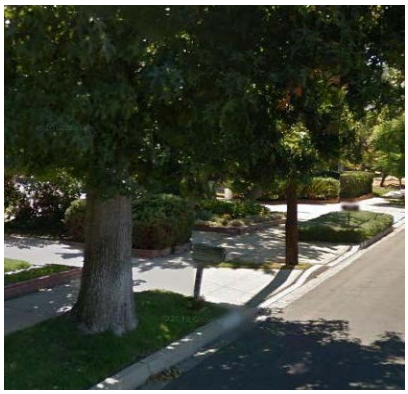
Bicycle Access and Route Examples

Did you consider **bicycle parking**?	☐ Sidewalk bicycle rack. ☐ Bicycle corral. ☐ Bicycle rack at development entrance. ☐ Other bicycle parking (e.g. lockers).

Bicycle Parking Examples

Topics for consideration	*Check all that apply.*
Did you consider **pedestrian crossings**?	☐ Curb extensions. ☐ Median refuge. ☐ Raised crosswalk. ☐ Rapid rectangular flashing beacons. ☐ HAWK signal at mid-block crossing. ☐ In-road flashing beacons. ☐ Transit stop placement proximity.

Pedestrian Crossing Examples

Did you consider as **enhanced sidewalk**?	☐ Urban buffer zone with amenities. ☐ Suburban buffer zone with landscape strip. ☐ ADA accessibility.

Enhanced Sidewalk Examples