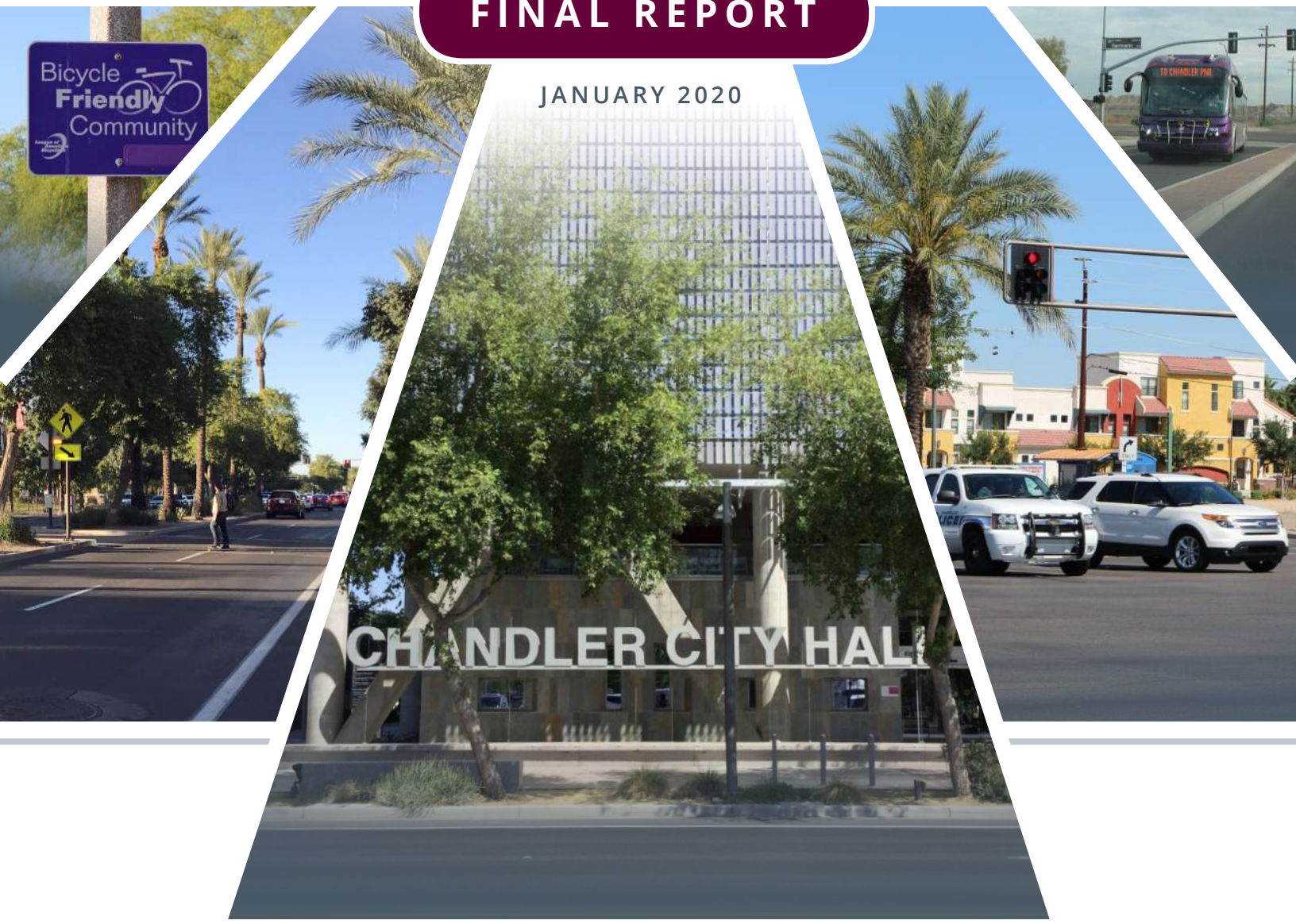
CHANDLER arizona

Transportation Master Plan 2019 Update

FINAL REPORT

JANUARY 2020



Kimley»Horn

CHANDLER arizona

City of Chandler Transportation Master Plan 2019 Update

FINAL REPORT

Prepared by:

Kimley»Horn

In Conjunction with:

AECOM LEE ENGINEERING MakPro

January 2020

RESOLUTION NO. 5341

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF CHANDLER, ARIZONA, APPROVING THE TRANSPORTATION MASTER PLAN 2019 UPDATE

WHEREAS, it is necessary to periodically update the Chandler Transportation Master Plan to reflect the City's growth and evolving transportation needs; and

WHEREAS, an update to the Transportation Master Plan is needed to plan for a transportation system that best leverages new and emerging transportation technologies; and

WHEREAS, an updated Transportation Master Plan will enable the City to compete for regional and federal funding opportunities for recommended transportation projects.

NOW, THEREFORE, BE IT RESOLVED that the City Council of the City of Chandler, Arizona, as follows:

Section 1. Approves the Transportation Master Plan 2019 Update.

PASSED AND ADOPTED by the Mayor and City Council of the City of Chandler, Arizona, this 13th day of February, 2020.

ATTEST:

CITY CLERK

MAYOR

CERTIFICATION

I HEREBY CERTIFY that the above and foregoing Resolution No. 5341 was duly passed and adopted by the City Council of the City of Chandler, Arizona, at a regular meeting held on the 13th day of February 2020, and that a quorum was present thereat.

CITY CLERK

APPROVED AS TO FORM:

CITY ATTORNEY

CITY OF CHANDLER CORPORATE SEAL ARIZONA

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EXECUTIVE SUMMARY

INTRODUCTION

This Transportation Master Plan 2019 Update is being prepared to reflect the anticipated growth, changing trends in transportation and technology, corresponding existing and future transportation needs, and recommended transportation improvements within the City of Chandler (City).

Study Area

This document looks at transportation conditions, needs, and recommended improvements within a study area that matches the Chandler Municipal Planning Area, the boundaries of which are essentially the corporate limits of the City and county islands located within the corporate limits. The study vicinity has the Gila River Indian Community to the south, the City of Phoenix to the west, the City of Tempe and City of Mesa to the north, and the Town of Gilbert to the east.

Planning Process

The process used in the preparation of the Transportation Master Plan 2019 Update included a combination of technical research and analysis, coordination with City staff, input from the Transportation Commission, and a series of public and stakeholder engagement activities.

The technical research included a review of existing plans, existing data collection, analysis of existing conditions, population projections, employment projections, traffic projections, analysis of future conditions, development of alternatives, evaluation of transportation system improvement alternatives, recommended improvements, and implementation recommendations.

The public and stakeholder engagement activities included stakeholder meetings, public open houses, a project webpage, and an online survey to solicit community input regarding needs, desires and recommendations for Chandler's transportation system.

The Transportation Commission provided input into the technical evaluations and conclusions of the Transportation Master Plan.

The Transportation Master Plan 2019 Update addresses the following three transportation modal elements:

- Roadway;
- Transit; and
- Bicycle/pedestrian.

The existing roadway and bicycle/pedestrian systems in Chandler are relatively well developed while the existing transit system is less developed. Transportation technology has advanced rapidly in recent years within all three of these modal elements and is anticipated to be an even more important component of all modes of transportation in the future. The Transportation Master Plan 2019 Update covers all three modal elements, with more detailed analysis on transit and future technology integration in multimodal transportation than prior transportation master plans had.

VISION, GOALS, AND OBJECTIVES

Vision Statement

The Transportation Master Plan 2019 Update vision statement acknowledges the connectivity required across modes and the need for movement toward a more sustainable transportation environment. Considering the influence of technology and innovation on current transportation options and the anticipated technological changes in the future, the vision for this Plan is:

> *Develop an environmentally-friendly, multimodal transportation system that leverages technology and provides choices to make Chandler known as the "Most Connected City".*

Goals and Objectives

Transportation goals and objectives provide a framework for implementing the vision statement. The Transportation Master Plan 2019 Update goals and objectives are consistent with the City's current 2016 General Plan, which includes a mix of policies related to transportation under the title of "Connecting People and Places Policies".

EXISTING AND FUTURE CONDITIONS

Population and Employment

The projected 2040 population for the study area is 328,000 based on data provided by the City and the Maricopa Association of Governments (MAG). This represents an increase of 18 percent compared to the 2018 study area population of 277,000.

The estimated number of employees in 2040 in the study area is approximately 194,000 based on data provided by the City and MAG. This represents an increase of 36 percent compared to the 2018 study area employment of 143,000.

By 2040, Chandler is expected to reach effective build-out, which means practically all undeveloped land is anticipated to have been developed by then.

Roadway

The City of Chandler's roadway system serves as the foundation of the City's multimodal transportation system and provides access and mobility within the City and regional connectivity. The Transportation Master Plan 2019 Update focuses on the arterial roadway system, which is shared by many road users, including automobiles, trucks, buses, bicyclists, and pedestrians.

The existing roadway system generally accommodates travel demand but there are a few corridors and intersections with traffic congestion and/or safety concerns. The City has several roadway segment and intersection projects programmed in the next five years that will address many of the identified areas of concern. Additional roadway segment and intersection improvements are needed to accommodate the anticipated future growth in traffic volumes.

Transit

Valley Metro provides fixed-route transit services in Chandler and throughout the Phoenix metropolitan area. Most of the existing transit services are in North, West, and Central Chandler. The existing fixed-route bus transit system in Chandler is comprised of approximately 50 miles of local and express services, all of which also provide service in at least one of Chandler's neighboring cities. Several Chandler bus routes make connections to the light rail in Mesa that provides train service to Tempe and Phoenix.

Additional existing and future transit demand has been identified, particularly in South and East Chandler where there are currently few transit services.

Bicycle/Pedestrian

Existing bicycle and pedestrian facilities in Chandler include bike lanes, designated bike routes, sidewalks, off-street shared use paths (both paved and unpaved), paved shoulders of roadways, bike lockers at major bus facilities, overpasses/underpasses at freeways and canals, and signalized crossings. Arterials in the developed parts of Chandler typically have sidewalks and bike lanes. The off-street shared-use path system is partially developed, with signalized crossings present at a handful of locations.

Bicycle and pedestrian facility safety, connectivity, and comfort have been identified as high priorities for bicyclists and pedestrians.

Leveraging Technology

Transportation technology is evolving rapidly and affecting all modes of travel – both transportation facilities themselves as well as how they are used. Recent technological advances have brought about autonomous and connected vehicles, private automobile ride-sharing, microtransit, electric bicycles and scooters, and advanced traffic signal and traveler information systems.

Technology is anticipated to continue to play a key role in the evolution of transportation modes, facilities, processes, and priorities.

RECOMMENDED IMPROVEMENTS AND COSTS

Roadway

Figure ES-1 shows the major roadway improvements that are programmed or recommended in the 2020 - 2040 timeframe to bring the projected 2040 horizon year operations to acceptable levels of service. Implementing these recommended improvements will create an arterial roadway system of primarily four-lane and six-lane roads. North of Loop 202 and east of Loop 10, several of the four-lane roads will have six lanes at critical intersections. The timeframes recommended for the major roadway improvements are summarized below.

<u>Near-Term (2020 - 2025) Roadway Recommendations:</u>

- Widen to four lanes:
    - Programmed projects on Chandler Heights Road, Ocotillo Road, Cooper Road, and Lindsay Road;

- Widen to six lanes:
    - Programmed projects on Alma School Road and Gilbert Road;
- Major arterial capacity improvement:
    - Dobson Road;
- Study potential for traffic calming features on Hunt Highway.

Mid-Term (2026 - 2030) Roadway Recommendations:

- Widen to six lanes:
    - Programmed projects on Alma School Road;
- Major arterial capacity improvement:
    - Elliot Road;
    - Warner Road;
    - Kyrene Road;
    - Alma School Road (segment not programmed); and
    - McQueen Road;
- Other improvements:
    - Pecos Road/Arizona Avenue intersection; and
    - Freeway to Chandler Park-and-Ride connector with direct high-occupancy vehicle ramps at Loop 202.

Long-Term (2031 - 2040) Roadway Recommendations:

- Minor arterial capacity improvement:
    - 56th Street;
- Major arterial capacity improvement:
    - Warner Road;
    - Ray Road;
    - Chandler Boulevard; and
    - Germann Road;
- Other improvements:
    - Germann Road/Price Road intersection;
    - Ocotillo Road/Alma School Road intersection;
    - Collector streets in the remaining larger undeveloped areas; and
    - Four potential arterial-to-freeway access enhancements along Loop 101 and Loop 202.

Other recommended roadway improvements include:

- Ongoing roadway operations and maintenance, which includes the pavement, landscaping, signing and striping, traffic signals, street lights, drainage features, and miscellaneous repairs.

Table ES-1 shows the capital, operations and maintenance, and total costs for the near-term, mid-term, and long-term roadway facility and technology recommendations. The total cost of all recommended roadway improvements in 2019 dollars for the 2020 - 2040 timeframe calculates to $617.75 million.

Table ES-1. Total Cost of Roadway Improvement Recommendations 2020 - 2040

Time Period	Capital Cost of Recommendations [1]	Operations and Maintenance Cost of Recommendations	Total 2019 Cost of Recommendations
2020 - 2025	$33,050,000	$75,100,000	$108,150,000
2026 - 2030	$148,050,000	$71,350,000	$220,100,000
2031 - 2040	$131,000,000 [2]	$158,500,000	$289,500,000
Total Costs	**$312,800,000**	**$304,950,000**	**$617,750,000**

Notes: (1) Programmed Projects Not Included. (2) Capital Costs Include ADOT Freeway Connections and Cooper Road Extension Collector Street.

Transit

Figure ES-2 shows the major transit improvements that are programmed or recommended in the 2020 - 2040 timeframe. Implementing these recommended improvements will create a transit system that provides flexible transit service coverage for most of Chandler, an interconnected hierarchy of high capacity transit, express bus, and local bus, and new or expanded transit centers and park-and-ride lots. The timeframes recommended for the transit improvements are summarized below.

Near-Term (2020 - 2025) Transit Recommendations:

- Local bus service refinements;
- New express bus route along Loop 202 and Loop 101 connecting the Chandler Park-and-Ride with downtown Tempe;
- Flexible transit services:
  - Pilot program along Price Road corridor; and
  - Study for North Chandler area;
- First-mile/last-mile subsidy program in South Chandler;
- Site selection studies for North Chandler Park-and-Ride and Downtown Chandler Transit Center; and
- High capacity transit studies for Arizona Avenue, Chandler Boulevard, and Rural Road.

Mid-Term (2026 - 2030) Transit Recommendations:

- Local bus service refinements;
- New regional route along Queen Creek Road that could potentially be deviated service;
- Flexible transit services implementation:
  - North Chandler area;
  - West Chandler area; and
  - East Chandler area;
- Construct North Chandler Park-and-Ride and Downtown Chandler Transit Center; and
- Continue to advance high capacity transit studies (if determined appropriate by near-term study) for Arizona Avenue, Chandler Boulevard, and Rural Road.

Long-Term (2031 - 2040) Transit Recommendations:

- Local bus service refinements;
- Flexible transit services implementation:

    - Ocotillo area;
    - Chandler Airpark area; and
    - South Chandler area;
- Expansion of existing Chandler Park-and-Ride; and
- Implement high capacity transit (if determined appropriate by near-term and mid-term studies) on Arizona Avenue, Chandler Boulevard, and Rural Road.

Other recommended transit improvements include:

- Establish planning guidelines, branding, and service standards for flexible transit services in Chandler;
- Implement a public education program on transit technology;
- Coordinate with Valley Metro regarding emerging transit technologies to leverage in Chandler; and
- Consider making investments in City-owned transit technology such as automated microtransit services, further rollout of transit signal prioritization, street-side infrastructure upgrades, electric vehicle charging stations, and hydrogen refueling locations.

Table ES-2 shows the capital, operations and maintenance, and total costs for the near-term, mid-term, and long-term transit improvement recommendations. The total cost of all recommended transit improvements in 2019 dollars for the 2020 - 2040 timeframe calculates to $192.94 million. Operations and maintenance costs for the proposed transit recommendations will likely continue beyond 2040, at an estimated annual cost of $11.7 million per year.

Table ES-2. Total Cost of Transit Improvement Recommendations 2020 - 2040

Time Period	Capital Cost of Recommendations	Operations and Maintenance Cost of Recommendations	Total 2019 Cost of Recommendations
2020 - 2025	$2,200,000	$15,546,000	$17,746,000
2026 -2030	$16,850,000 (1)	$35,015,000	$51,865,000
2031 - 2040	$12,400,000 (1)	$110,930,000	$123,330,000
Total Costs	**$31,450,000**	**$161,491,000**	**$192,941,000**

(1) Capital Costs for High Capacity Transit Not Included Because Costs Depend on Outcome of Studies.

Bicycle and Pedestrian

Figure ES-3 shows the major bicycle and pedestrian improvements that are programmed or recommended in the 2020 - 2040 timeframe. Implementing these recommended improvements will create a bicycle and pedestrian system that provides bike lanes on all arterials, an interconnected network of on-street and off-street paved facilities, and shared use path signalized crossings at all arterial roads (if warranted). The timeframes recommended for the bicycle and pedestrian improvements are summarized below.

Near-Term (2020 - 2025) Bicycle and Pedestrian Recommendations:

- Programmed bike lanes on Chandler Boulevard, Kyrene Road, and McClintock Drive;
- Bike lanes installed as part of programmed arterial roadway improvements;

- On-street separated/buffered bike lanes:
    - Frye Road; and
    - Hunt Highway;
- Paved shared use path:
    - Highline Canal; and
    - Ashley Trail (with signalized crossing).

Mid-Term (2026 - 2030) Bicycle and Pedestrian Recommendations:

- Bike lanes installed as part of programmed arterial roadway improvements;
- Paved shared use path:
    - Ocotillo Road;
    - Price Road;
    - Appleby Trail;
    - Eastern Canal;
    - Consolidated Canal; and
    - Kyrene Branch Canal;
- Signalized path crossings; and
- Two bridges over Eastern Canal.

Long-Term (2031 - 2040) Bicycle and Pedestrian Recommendations:

- Bike lanes installed as part of programmed arterial roadway improvements;
- Paved shared use path:
    - Loop 202 (in coordination with Arizona Department of Transportation);
    - Railroad spur (in coordination with Union Pacific Railroad);
    - Basha Road;
- Bicycle/pedestrian bridge over Loop 101 north of Ray Road;
- On-street separated/buffered bike lanes:
    - Chandler Boulevard (if high capacity transit advances);
    - Arizona Avenue (if high capacity transit advances).

Other recommended bicycle and pedestrian improvements include:

- Ongoing maintenance of bicycle and pedestrian facilities; and
- Develop City policies and guidelines to help promote safe and effective bicycle and pedestrian facilities.

Table ES-3 shows the capital, operations and maintenance, and total costs for the near-term, mid-term, and long-term bicycle and pedestrian improvement recommendations. The total cost of all recommended bicycle and pedestrian improvements in 2019 dollars for the 2020 - 2040 timeframe calculates to $183.49 million.

Table ES-3. Total Cost of Bicycle and Pedestrian Improvement Recommendations 2020 - 2040

Time Period	Capital Cost of Recommendations (1), (2)	Operations and Maintenance Cost of Recommendations	Total 2019 Cost of Recommendations
2020 - 2025	$10,090,000	$1,200,000	$11,290,000
2026 - 2030	$45,590,000	$1,250,000	$46,840,000
2031 - 2040	$122,360,000	$3,000,000	$125,360,000
Total Costs	**$178,040,000**	**$5,450,000**	**$183,490,000**

Notes: (1) Programmed Projects Not Included. (2) Capital Costs Include Preparation and Implementation of Policies and Guidelines.

Leveraging Technology

Figure ES-4 shows the physical and/or virtual mobility hubs that are recommended in the 2020 - 2040 timeframe. Implementing these recommended improvements will support emerging technologies and mode choice for travelers by creating hubs that provide traveler information, accommodation for all modes, and traveler amenities. Overarching strategies for technology include:

- Focus on moving people and data (instead of on moving vehicles);
- Develop flexible policies that accommodate ever-changing technologies; and
- Partner with the private sector to encourage technological advances and wide-scale implementation.

Recommended technology improvements and their associated timeframes are summarized below:

Near-Term (2020 - 2025) Technology Recommendations:

- Develop an Intelligent Transportation Systems (ITS) Strategic Plan that includes detailed implementation plans/projects, staffing resources, and ongoing costs, including refining the hub concept.

Mid-Term (2026 - 2030) Technology Recommendations:

- Develop and construct physical and virtual hubs – initial recommendation is two physical and two virtual hubs, but this will need to be refined in the ITS Strategic Plan.

Long-Term (2026 - 2030) Technology Recommendations:

- Develop and construct physical and virtual hubs – initial recommendation is two physical and eight virtual hubs, but this will need to be refined in the ITS Strategic Plan.

Other recommended technology improvements include:

- Fully fund the required maintenance for roadway signs and pavement marking assets and continue maintaining and upgrading the City's ITS devices and other technology infrastructure as well-maintained and well-instrumented transportation infrastructure improves autonomous vehicle and connected vehicle functionality;
- Ongoing operations and maintenance of technology elements associated with roadway, transit, and bicycle and pedestrian technology;

Making these technology investments will keep the City at the forefront of using transportation technology to improve the quality of life and the experience of travelers in Chandler.

Table ES-4 shows the capital, operations and maintenance, and total costs for the near-term, mid-term, and long-term leveraging technology improvement recommendations. The total cost of all recommended leveraging technology improvements in 2019 dollars for the 2020 - 2040 timeframe calculates to $18.10 million. These costs have already been incorporated into the aforementioned roadway and transit costs as technology is typically integrated with those improvements.

Table ES-4. Total Cost of Leveraging Technology Improvement Recommendations 2020 - 2040

Time Period	Capital Cost of Recommendations (1)	Operations and Maintenance Cost of Recommendations (1)	Total 2019 Cost of Recommendations
2020 - 2025	$750,000	$1,200,000	$1,950,000
2026 - 2030	$4,100,000	$1,250,000	$5,350,000
2031 - 2040	$7,800,000	$3,000,000	$10,800,000
Total Costs	**$12,650,000**	**$5,450,000**	**$18,100,000**

Note: (1) Technology capital and operations/maintenance costs have been separated and included in the Roadway and Transit Total Cost tables.

Total Costs for All Recommended Improvements

Table ES-5 shows the capital, maintenance, and total costs for the near-term, mid-term, and long-term improvement recommendations, combining the total costs of the roadway, transit, bicycle and pedestrian, and leveraging technology elements. The total cost of all recommended improvements in 2019 dollars for the 2020 - 2040 timeframe calculates to $994.18 million.

Table ES-5. Total Cost of All Improvement Recommendations 2020 - 2040

Time Period	TMP Element (3)	Capital Cost of Recommendations (4)	Operations and Maintenance Cost of Recommendations	Total 2019 Cost of Recommendations
2020 - 2040	Roadway	$312,800,000 (1)	$304,950,000	$617,750,000
	Transit	$31,450,000 (2)	$161,491,000	$192,941,000
	Bicycle and Pedestrian	$178,040,000	$5,450,000	$183,490,000
	Total	*$522,290,000*	*$471,891,000*	*$994,181,000*

Notes: (1) Capital Costs Include ADOT Freeway Connections and Cooper Road Extension Collector Street.
(2) Capital Costs for High Capacity Transit Not Included Because Costs Depend on Outcome of Studies.
(3) Technology Costs are Incorporated into the Roadway and Transit Costs. (4) Programmed Costs not Included.

COMMUNITY ENGAGEMENT

Community engagement was an important component of the development process for the Transportation Master Plan 2019 Update. To ensure that residents, businesses, and those that may travel for work or pleasure in Chandler had an opportunity to provide their input or thoughts related to the future of transportation in Chandler, the following opportunities for input were provided:

- Project hotline and website: KeepChandlerMoving.com;
- Transportation survey: 1,075 responses received;
- Interviews with technology experts: corresponded with 14 different experts;
- Public meetings: three meetings in the first round and one meeting in the second round;
- Stakeholder workshops: two meetings with select community leaders;
- Transportation Commission: three presentations; and
- City Council: interim updates.

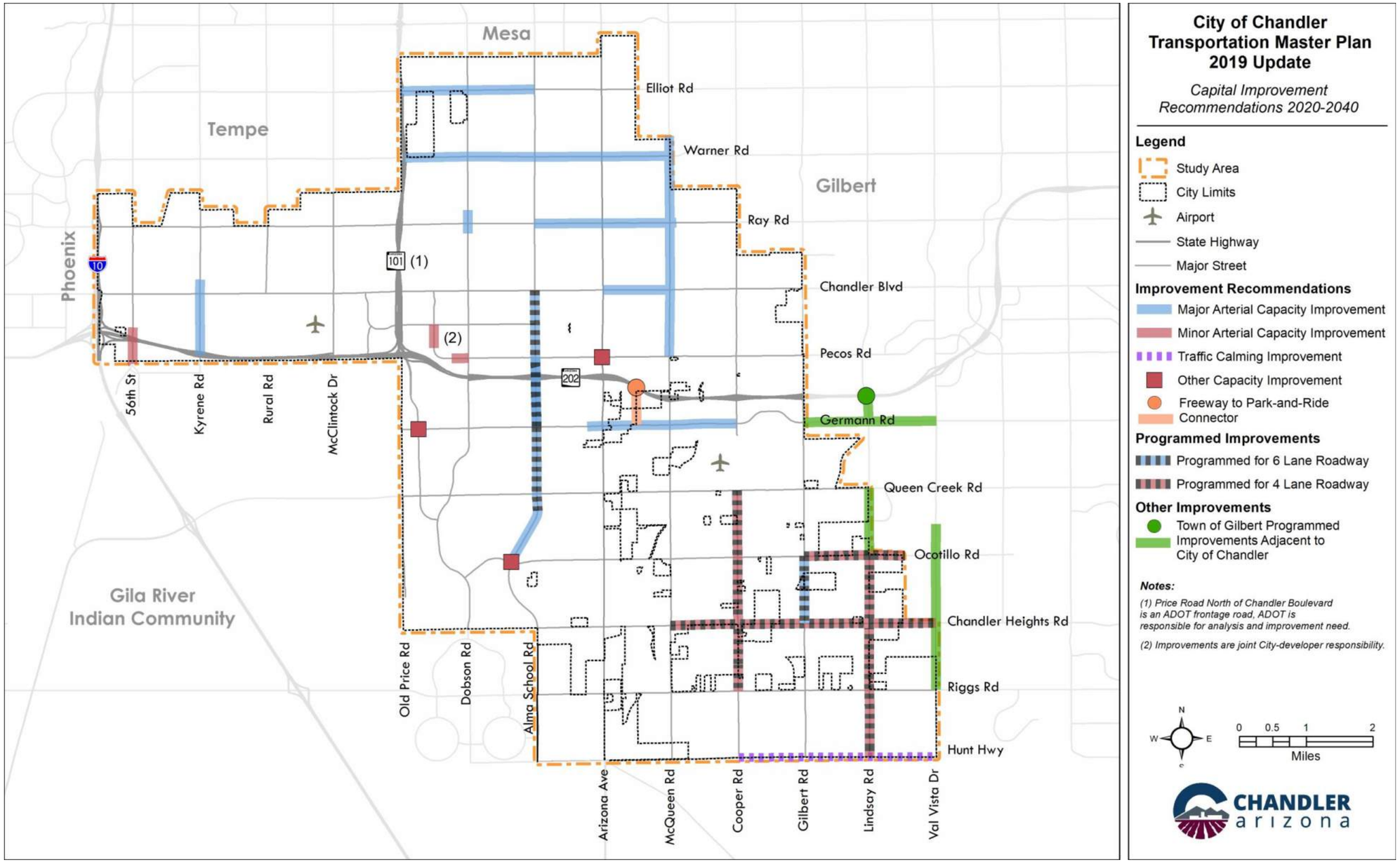


Figure ES-1. Capital Improvement Arterial Roadway Recommendations 2020 - 2040

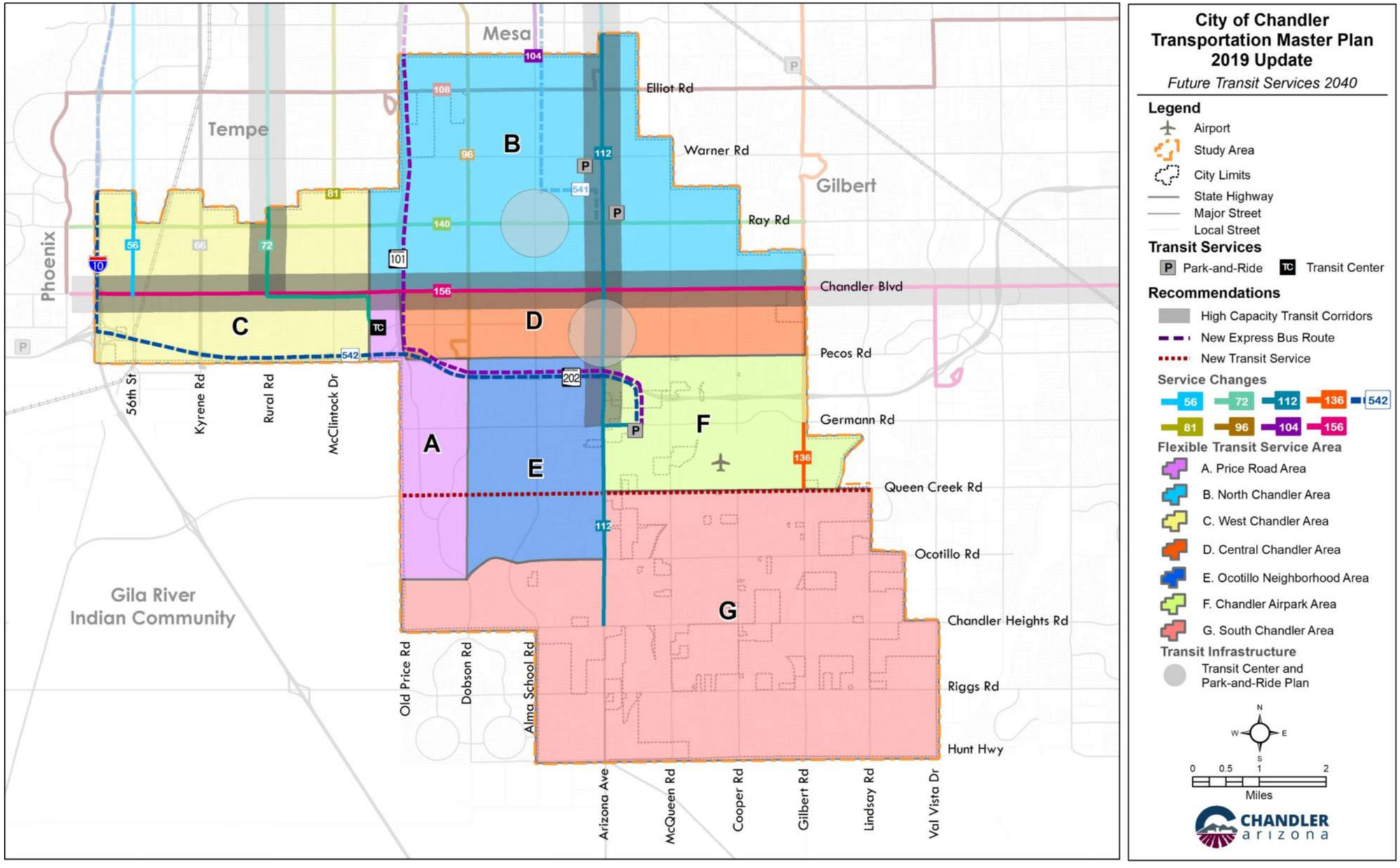


Figure ES-2. Future Transit Services by 2040

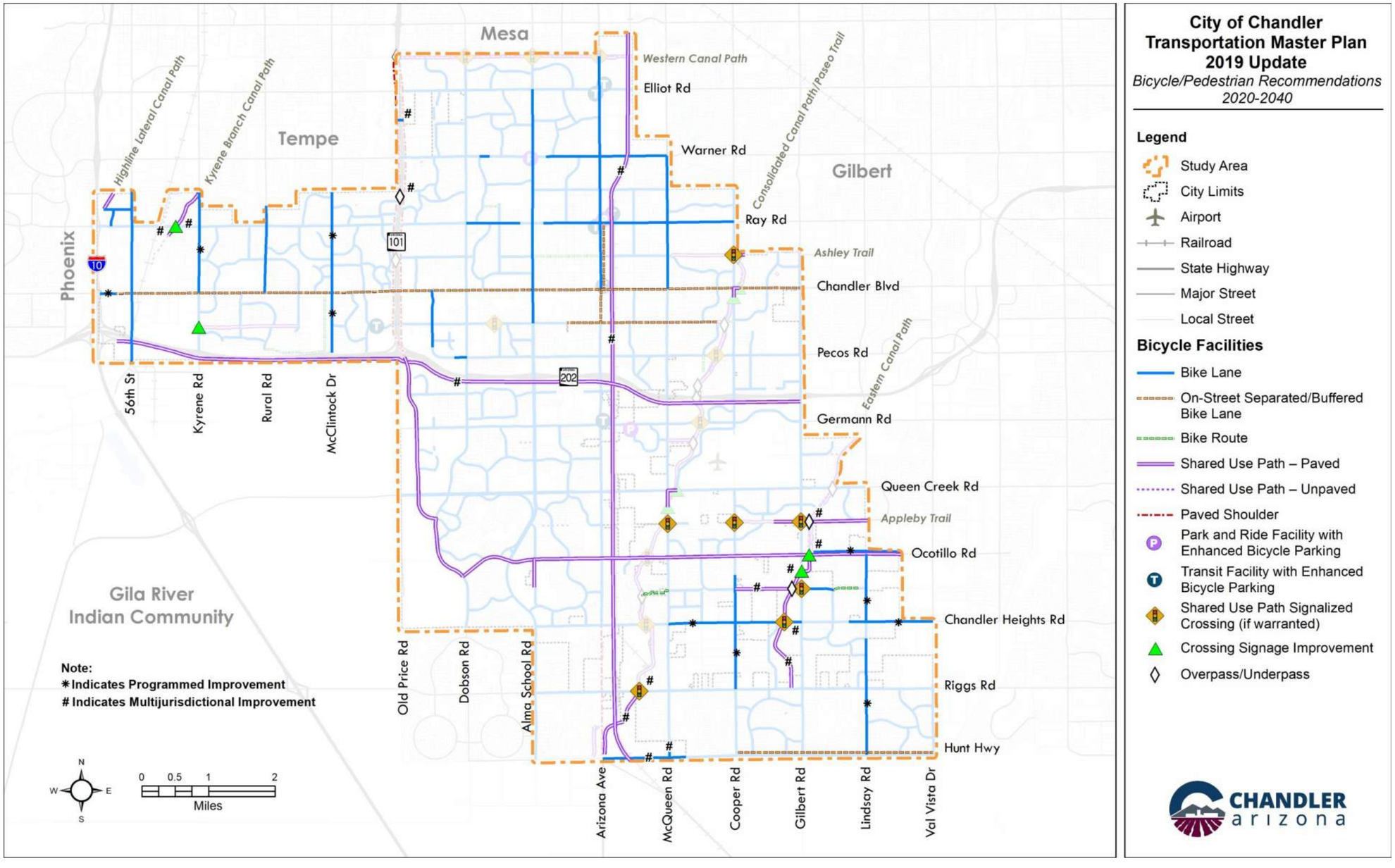


Figure ES-3. Bicycle and Pedestrian Recommendations 2020 - 2040

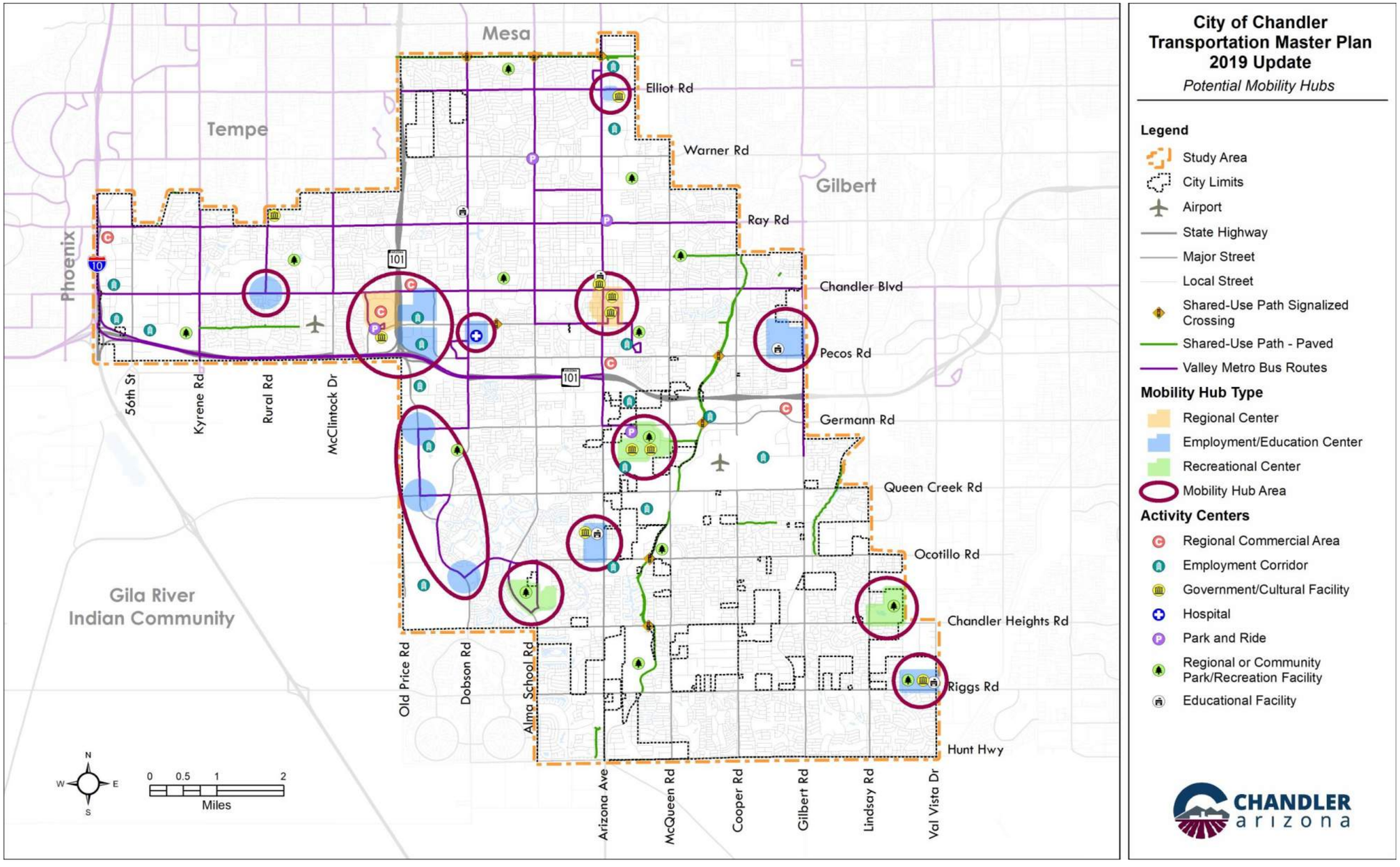


Figure ES-4. Potential Physical and Virtual Mobility Hubs

1.0 INTRODUCTION

This Transportation Master Plan 2019 Update is being prepared to reflect the City's growth, changing trends in transportation and technology, and the corresponding existing and future transportation needs in Chandler.

1.1 STUDY AREA

The 2019 Transportation Master Plan looks at the transportation conditions and needs within the study area. The study area is bounded by the Chandler Municipal Planning Area, which includes the corporate limits of the City and county islands located within the corporate limits, as shown in **Figure 1-1**. The study area is bounded by the Gila River Indian Community on the south, the City of Phoenix on the west, the City of Tempe and City of Mesa on the north, and the Town of Gilbert on the east.

1.2 PLANNING PROCESS

The process used in the preparation of the Transportation Master Plan included a combination of technical research and analysis, coordination with City staff, input from the Transportation Commission, and a series of public and stakeholder engagement activities.

The technical research included a review of existing plans, existing data collection, analysis of existing conditions, population projections, employment projections, traffic projections, analysis of future conditions, development of alternatives, evaluation of transportation system improvement alternatives, and implementation recommendations.

The public and stakeholder engagement activities included stakeholder meetings, public open houses, a project webpage, and an online survey to solicit community input regarding needs, desires and recommendations for Chandler's transportation system.

The Transportation Commission provided input into the technical evaluations and conclusions of the Transportation Master Plan.

The Transportation Master Plan addresses the following three transportation modal elements:

- Roadway;
- Transit; and
- Bicycle/pedestrian.

The Transportation Master Plan places an emphasis on transit and future technology integration in multimodal transportation, reflecting the relative maturity of Chandler's roadway, bicycle, and pedestrian networks.

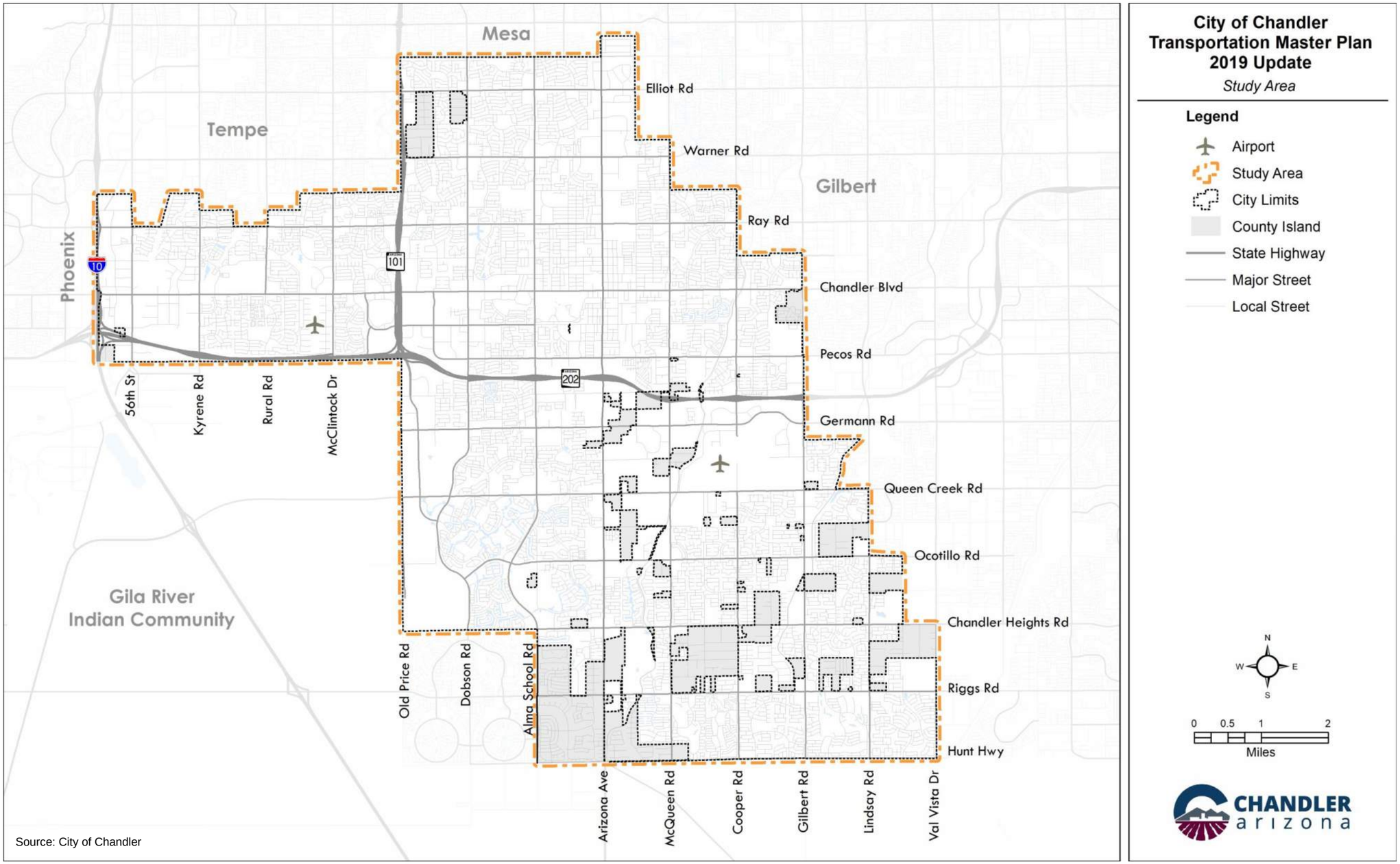


Figure 1-1. Study Area

2.0 VISION, GOALS, AND OBJECTIVES

2.1 VISION STATEMENT

The 2019 Transportation Master Plan vision statement acknowledges the connectivity required across modes and the need for movement toward a more sustainable transportation environment. Considering the influence of technology and innovation on current transportation options and the anticipated technological changes in the future, the vision for this Plan is:

Develop an environmentally-friendly, multimodal transportation system that leverages technology and provides choices to make Chandler known as the "Most Connected City".

2.2 GOALS AND OBJECTIVES

Transportation goals and objectives provide a framework for implementing the vision statement. The City's current 2016 General Plan includes a mix of policies related to transportation under the title of "Connecting People and Places Policies". These goals and objectives are shown in the subsequent sub-sections, organized by modal element, with refinements to better reflect the technological and modal shifts currently underway.

2.2.1 ROADWAY

a) Plan transportation improvements and capacities that support land uses and employment for both current and projected traffic volumes.

b) Provide a comprehensive street network that allows residents to get to the regional transportation facilities efficiently.

c) Emphasize transportation efficiency and safety.

d) Discourage through-traffic in neighborhoods.

e) Continue to develop an integrated multimodal transportation system.

f) Improve the operational efficiencies of the existing transportation infrastructure.

2.2.2 TRANSIT

a) Continue to study high-capacity transit corridors to support mobility, connectivity, and economic development.

b) Prioritize future transit enhancements and emerging transit technologies that serve or connect to high-capacity transit corridors (Rural Road, Chandler Boulevard, and Arizona Avenue).

c) Coordinate with adjacent communities to support regional transit services.

d) Ensure the transit system adequately serves areas with high-density land uses, employment areas, and transit-dependent populations.

e) Continuously monitor and adjust the transit system as needed to maintain an efficient transit system, including service areas and operating characteristics.

f) Leverage transit alternatives such as micro-transit, transportation networking companies (TNCs), and future autonomous vehicles to increase efficiency and to enhance ease of access to transit.

g) Continue providing paratransit services to meet the needs of our residents, comply with federal requirements, and manage increased demand and cost.

h) Encourage paratransit users to take advantage of lower cost transportation options such as fixed route transit and Ride Choice.

i) Comply with Title VI regulations by ensuring that transit services and outreach efforts do not discriminate on the basis of race, ethnicity, or disability status.

j) Support nearby commuter rail to improve mobility for Chandler residents.

2.2.3 BICYCLE/PEDESTRIAN

a) Provide bicycle and pedestrian facilities along arterial roadways to enhance the safety of bicycling and walking.

b) Encourage partnerships that expand and co-locate pedestrian and bicycle opportunities outside of public right of way.

c) Provide off-street bicycle paths to allow connectivity between neighborhoods, parks, and schools.

d) Provide on-street bicycle lanes on roadways for bicycle commuters and experienced cyclists.

e) Provide bicycle facilities at transit connections and population centers.

f) Continue efforts to provide pedestrian infrastructure that meet or exceed accessibility requirements.

2.2.4 GENERAL STRATEGIES

a) Accommodate all transportation modes in the approval of private developments.

b) Provide for efficiency, convenience, and reliability in the design and operation of the transportation system and the connections between modes.

c) Implement measures such as intelligent transportation system improvements, promotion of public transportation, bicycling and other non-single-occupancy vehicle travel, etc.

d) Support and promote the use of alternative mode choices such as shared transportation and electric vehicles.

e) Apply new and emerging technologies to improve traffic and transit operations.

f) Enhance the availability and access to real-time traveler information related to all modes of transportation.

g) Continue to implement state-of-the-art transportation related technology throughout the city.

2.3 LITERATURE REVIEW

Previous transportation plans, studies, and reports were reviewed to acknowledge recommendations and implemented plans that apply to the City of Chandler's existing roadway, transit, bicycle, and pedestrian network. A review of surrounding jurisdictions' previously completed studies and plans was completed to better understand the local, regional, and statewide network of transportation facilities that will directly or indirectly impact the City of Chandler's transportation system.

2.3.1 CHANDLER-SPECIFIC LITERATURE

Valley Metro Arizona Avenue Alternatives Analysis (currently under development)

This ongoing study is analyzing different high capacity transit types along the Arizona Avenue corridor with the goal of defining a locally preferred alternative that describes the recommended route, transit type, station locations, and street configuration.

Valley Metro Fiesta-Downtown Chandler Transit Corridor Study (2017)

Valley Metro, in partnership with Mesa, Chandler and Gilbert, initiated this study to identify the potential and requirements for short-, mid- and long-term transit investments within the Arizona Avenue/Country Club Drive corridor. Preferred routes and phasing approaches were recommended.

City of Chandler General Plan (2016)

The General Plan established a clear direction that spelled out public expectations and preferences to sustain a desirable community. Vision, guiding principles, and core values are provided in sections supporting the areas of strategic community building, focused stewardship, and strong community foundation. The plan provides the policy framework that balances competing objectives and points the City in the direction into the future of community development and a strategic path of growth.

City of Chandler ADA Self-Evaluation and Transition Plan (Phase 1 in 2015 and Phase II to be completed in 2020)

The City completed a Phase I self-evaluation of all City programs in 2015 to identify where the City's programs and facilities are not in compliance with federal Americans with Disabilities Act (ADA) requirements. The review identified and recommended corrections to programmatic, building, and infrastructure obstacles that prevent full access to City of Chandler programs and services. Phase II began in early 2018 and is scheduled to be completed in fall 2020. Phase II evaluates all City public facilities not included in the 2015 transition plan, all public rights-of-way north of Loop 202, and arterial and major collector street rights-of-way south of Loop 202.

Valley Metro Arizona Avenue High Capacity Transit Study (2012)

This study assessed the need for high capacity transit along Arizona Avenue. Key recommendations included a more detailed analysis of high capacity transit alternatives, expanding the local fixed bus network to increase access to high capacity transit, providing additional park-and-ride facilities, improving bicycle and pedestrian facilities, adopting plans and land development policies that support transit-oriented development, and exploring funding options.

City of Chandler Transportation Master Plan (2010)

The prior Transportation Master Plan outlined transportation goals and strategies, documented existing and future conditions, and developed recommendations. This document serves as the starting point for the current Transportation Master Plan update.

City of Chandler South Arizona Avenue Design Guidelines (2010)

The South Arizona Avenue Design Guidelines established a vision for the corridor between downtown Chandler and the Santan Freeway (Loop 202), located ¾ mile to the south. The City has plans to develop

this corridor with high-density residential and commercial mixed uses to create a dynamic new "front door" for Chandler. The design guidelines encourage well-designed and maintained pedestrian infrastructure on Arizona Avenue. The guidelines specify that pedestrian infrastructure should provide access to transit stops to facilitate first mile/last mile trips.

2.3.2 NEIGHBORING AGENCY LITERATURE

Maricopa County Department of Transportation Active Transportation Plan (2018)

This plan was developed by the Maricopa County Department of Transportation with the purpose of preparing a blueprint for a complete and accessible active transportation network that encourages activity, emphasizes local and regional connectivity, is equitable, and provides all persons with transportation choices. The goal of the plan is to increase active transportation county-wide. The plan identifies a vision, needs, and next steps for all users, including bicyclists and pedestrians.

Neighboring Agency Transportation Master Plans (Gilbert 2014, Mesa 2014, Tempe 2015, Phoenix 2016)

The goal of these plans is to provide a multimodal transportation guide that includes both short-term (2020) and long-term (2040) recommendations to improve the transportation network. These plans include a list of possible projects as funding becomes available to help each agency reach its goals and policies.

2.3.3 REGIONAL AND STATEWIDE LITERATURE

ADOT Statewide Bicycle and Pedestrian Program

The Arizona Department of Transportation (ADOT) supports a bicycle and pedestrian program (http://www.azbikeped.org/) with many resources and tools about biking and walking including safety tips, laws and policies, maps, and organizations/groups to reach out to or join. The ADOT *Statewide Bicycle and Pedestrian Plan Update* (2013) addresses the State's most critical bicycle and pedestrian transportation planning needs on the State Highway System. The recently completed statewide *Bicyclist Safety Action Plan* (2018) and *Pedestrian Safety Action Plan* (2017) both promote safety and identify potential future projects to help improve safety throughout the multimodal transportation network statewide.

MAG Bicycle and Pedestrian Program

The Maricopa Association of Governments (MAG) *Bicycle and Pedestrian Pathway/Railroad Crossing Recommendations* (2014) report establishes regional recommendations that can be applied to both existing and future pedestrian/bicycle shared use path crossings of active railroad lines, specifically those not located on public streets or intersections. The MAG *Bicycles Count: Report and Implementation Plan* (2014) plan developed a regional bicycle counting strategy. On-going counting helps build the region's understanding of bicycle trends and patterns. The MAG *Bikeways Map* (2015) shows all routes included in the regional bicycle and pedestrian network including bike lanes, paths, canal trails, etc. MAG also developed the *Valley Path Brand and Wayfinding Signage Guidelines* (2015) that serve as a resource to implement signage and a brand for a bicycle network in the region.

MAG Regional Transit Framework Study (2019 and 2010)

The 2010 Regional Transit Framework Study identified current and future transit deficiencies to define a long-range regional approach for addressing transit needs. MAG developed three transit scenarios as alternative long-range approaches. The 2019 study updated the horizon year to 2040 and accounted for changes in market conditions, development patterns, and rapid advancements in transportation technology and innovation. In the 2010 study, key 2030 transit needs identified within Chandler included headway improvements and new local services in areas with infrequent headways and minimal service coverage.

MAG Active Transportation Plan (2019)

The MAG Active Transportation Plan serves as a guide for improving, expanding, and connecting the region's bicycle and pedestrian network. The Active Transportation Plan gathered public comments on where network users can provide feedback and ideas regarding the network. Potential SuperGrid and Activity Centers were identified along with a toolbox of design element options that can be implemented.

MAG Systems Management and Operations Plan (2018)

The MAG *Systems Management and Operations (SMO) Plan* is a coordinated approach to cost-effectively manage the transportation network. This plan factors in current investments and programmed projects through the end of Proposition 400, new priorities that have been identified through the freeway funding rebalancing, and important changes that will influence mobility in the MAG region. The MAG *I-10 Integrated Corridor Management Concept of Operations and System Requirements* (2018) looks at a freeway corridor as a network that includes the freeway, arterials and transit and encourages coordination to optimize the use of existing infrastructure assets and improve operational efficiency of the corridor.

Valley Metro Regional ADA Paratransit and Dial-A-Ride Service Plan (2016)

The 2016 plan assessed all paratransit programs with a focus on regional Dial-A-Ride (DAR) services. Emphasis on the differences between DAR days and hours of service and policy differences in each service area were examined to identify deficits of the current independent systems. Stakeholders from the separate DAR agencies and current riders identified DAR operational deficiencies and associated costs. Fourteen recommendations were suggested to improve operation, user experience, ADA compliance, and lower cost.

Valley Metro Regional Transit Standards and Performance Measures (2016)

This 2016 report established standards and performance measures for regionally funded transit operations and capital for bus and light rail service throughout the region. Performance thresholds outlined in the report are applicable to identifying underperforming lines along transit routes. Additionally, the report establishes transit prioritization standards that can be applied in the Transportation Master Plan.

MAG Southeast Valley Transit System Study (2015)

The purpose of this study was to identify short-, mid-, and long-term recommendations that will advance the transit system throughout the study area. The study evaluated existing transit conditions followed by an analysis of the transit needs for the area. This MAG study documented transit performance of the existing transit network. It recommended extending service routes, starting new service routes, and adjusting service headways to a maximum of 30 minutes for local bus service throughout Chandler.

MAG Sustainable Transportation & Land Use Integration Study (2013)

The purpose of this study (known as ST-LUIS) was to highlight the potential for (and to encourage) the Phoenix metropolitan region moving towards greater use of sustainable transportation modes including transit, walking and biking. The study examined previously recommended transit investments and services that support walkable and transit-oriented communities and outlined recommendations for optimizing transit.

MAG Designing Transit Accessible Communities Study (2013)

This study focused on the challenges experienced by transit users as they access transit stops. Through public input, strategies were developed to remove barriers between stops and users. The Transit Accessibility Toolkit was created to aid in this endeavor. The principles from the Transit Accessibility Toolkit can be incorporated into the Transportation Master Plan to improve transit stops.

MAG Complete Streets Guide (2011)

MAG published a Complete Streets Guide that serves as a resource to ensure that bicycle, pedestrian, and transit facilities are integral for design and functioning streets. The guide includes goals, strategies, and a planning process that helps the region create a safe and useful transportation network by integrating the complete street concept where possible.

Valley Metro Comprehensive Arterial Bus Rapid Transit Planning Study (2009)

This 2009 study identified the demand for bus rapid transit (BRT) service and defined operational characteristics, capital infrastructure needs, and fleet requirements for arterial BRT corridors throughout the region. The study considered how operational characteristics and corridor needs may change as the regional transit network develops. This study described the vision for the BRT system and each of the corridors planned for future implementation, including BRT services for the Arizona Avenue LINK.

MAG High-Capacity Transit Study (2003)

The High-Capacity Transit Study presented a network of new transit services designed to meet growing travel demand in the MAG region. The study focused on the three most prevalent existing and emerging forms of high capacity transit in North America: commuter rail, light rail transit, and bus rapid transit. This long-range study considered projected travel demand in the MAG region with a forecast horizon year of 2040. The findings and recommendations from the study were considered in the development of the Regional Transportation Plan.

3.0 SOCIOECONOMIC CONDITIONS

3.1 EXISTING SOCIOECONOMIC CONDITIONS

Population and employment data form the basis for the assessment of future transportation needs. The Arizona Office of Economic Opportunity prepares the state and county population projections. The Maricopa Association of Governments (MAG) is the designated Metropolitan Planning Organization for regional transportation planning in the Phoenix metropolitan area. MAG prepares projections below the county level that are consistent with the county totals generated by the Arizona Office of Economic Opportunity. These socioeconomic projections are used in computer models to forecast future travel conditions and needs.

Existing socioeconomic data are used to develop a simulation of existing travel demand. The existing year model provides a baseline for verifying that the model correctly simulates existing conditions and therefore provides a basis for analyzing future conditions. This section presents a summary of existing population and employment.

3.1.1 POPULATION

3.1.1.1 Existing Population

The estimated 2018 population for the study area is 277,000 based on data provided by MAG. Per the Arizona Office of Economic Opportunity, the 2018 population for the City of Chandler is approximately 262,000, which means approximately 15,000 residents within the study area currently live in unincorporated areas. **Figure 3-1** shows the distribution of the study area population based on data provided by MAG.

3.1.1.2 Title VI and Environmental Justice Populations

Title VI of the Civil Rights Act of 1964 provides that individuals may not be excluded from participation in, denied the benefit of, or subjected to discrimination on the basis of race, color, national origin, religion, age, gender, or disability. Executive Order 12898, entitled Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, was issued in February 1994. This executive order requires federal agencies to identify and avoid “disproportionately high and adverse effects of its programs, policies, and activities on minority populations and low-income populations”. Recipients of federal assistance for transportation-related projects must be in compliance with the requirements of Title VI and the Environmental Justice Executive Order.

The demographic characteristics considered in the evaluation of disproportionate adverse effects are:

- Race (% minority (i.e., non-white)) or ethnicity (% Hispanic);
- Age (% 65 and older);
- Low-Income (defined by federal poverty guidelines);
- Mobility Disability (prevalence of persons with mobility or self-care limitations); and
- Female Head of Household (% single female parent).

The locations of these environmental justice populations in Chandler are shown in **Figure 3-2** through **Figure 3-7**.

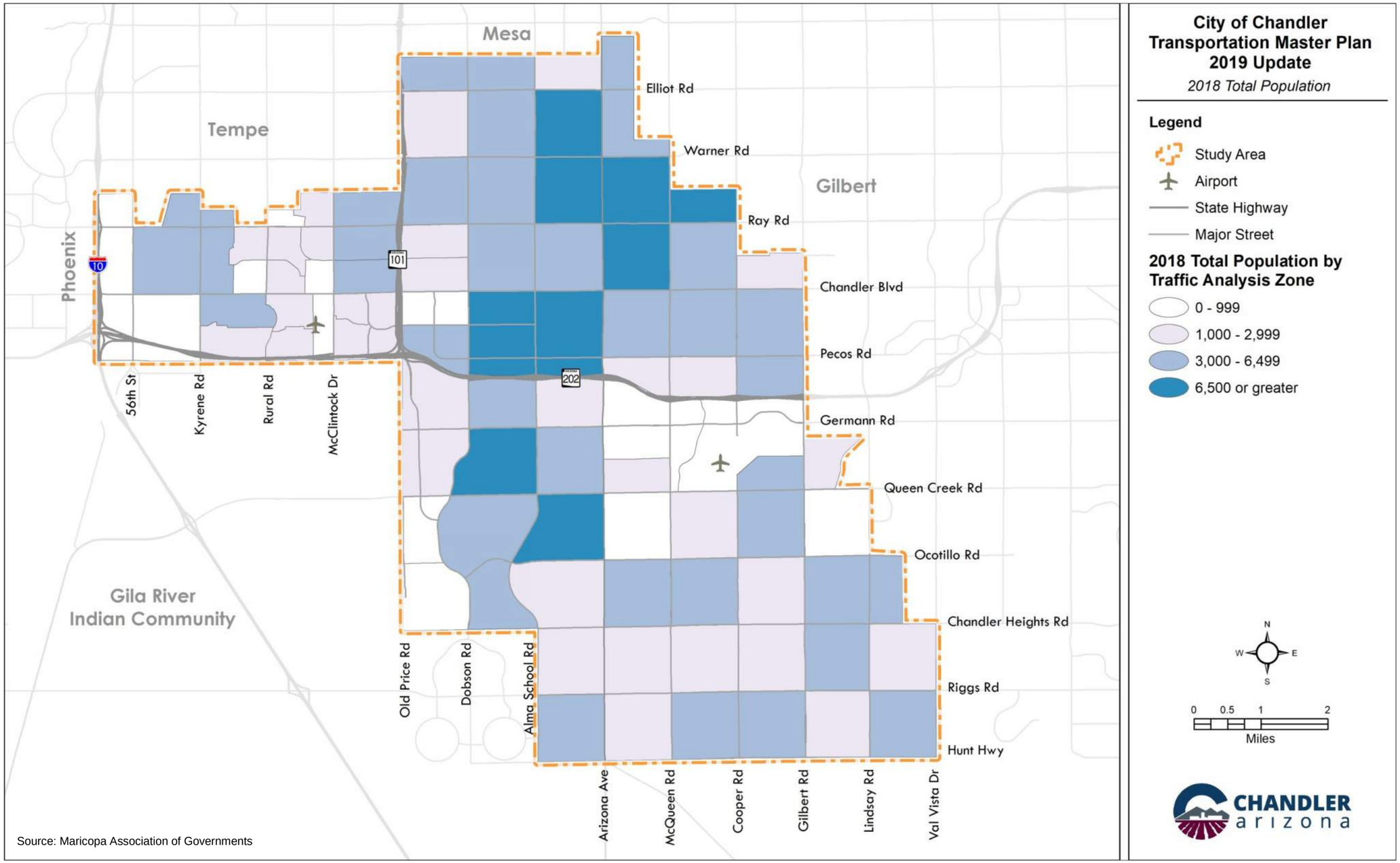


Figure 3-1. 2018 Study Area Population Distribution

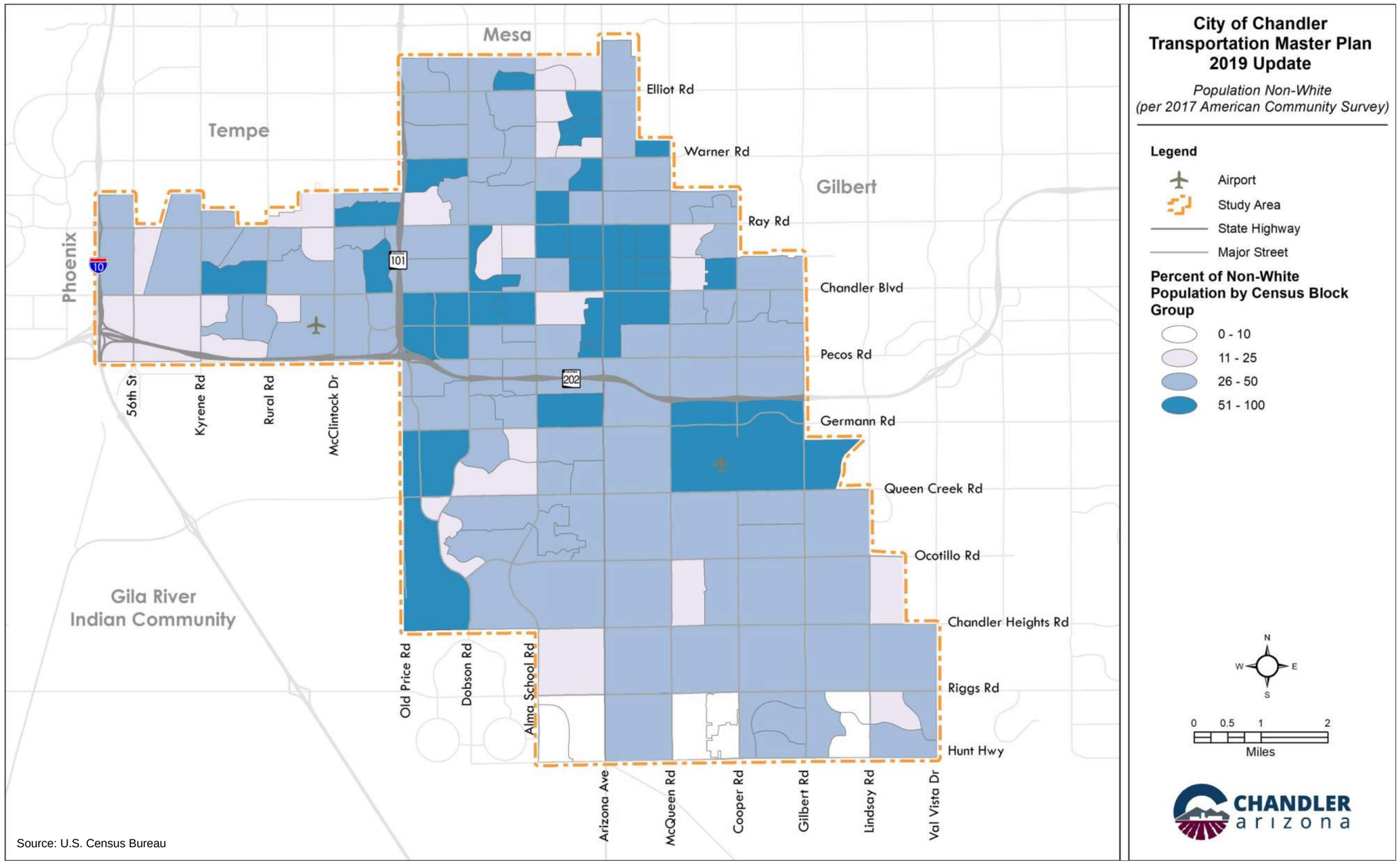


Figure 3-2. 2017 Minority (Non-White) Population

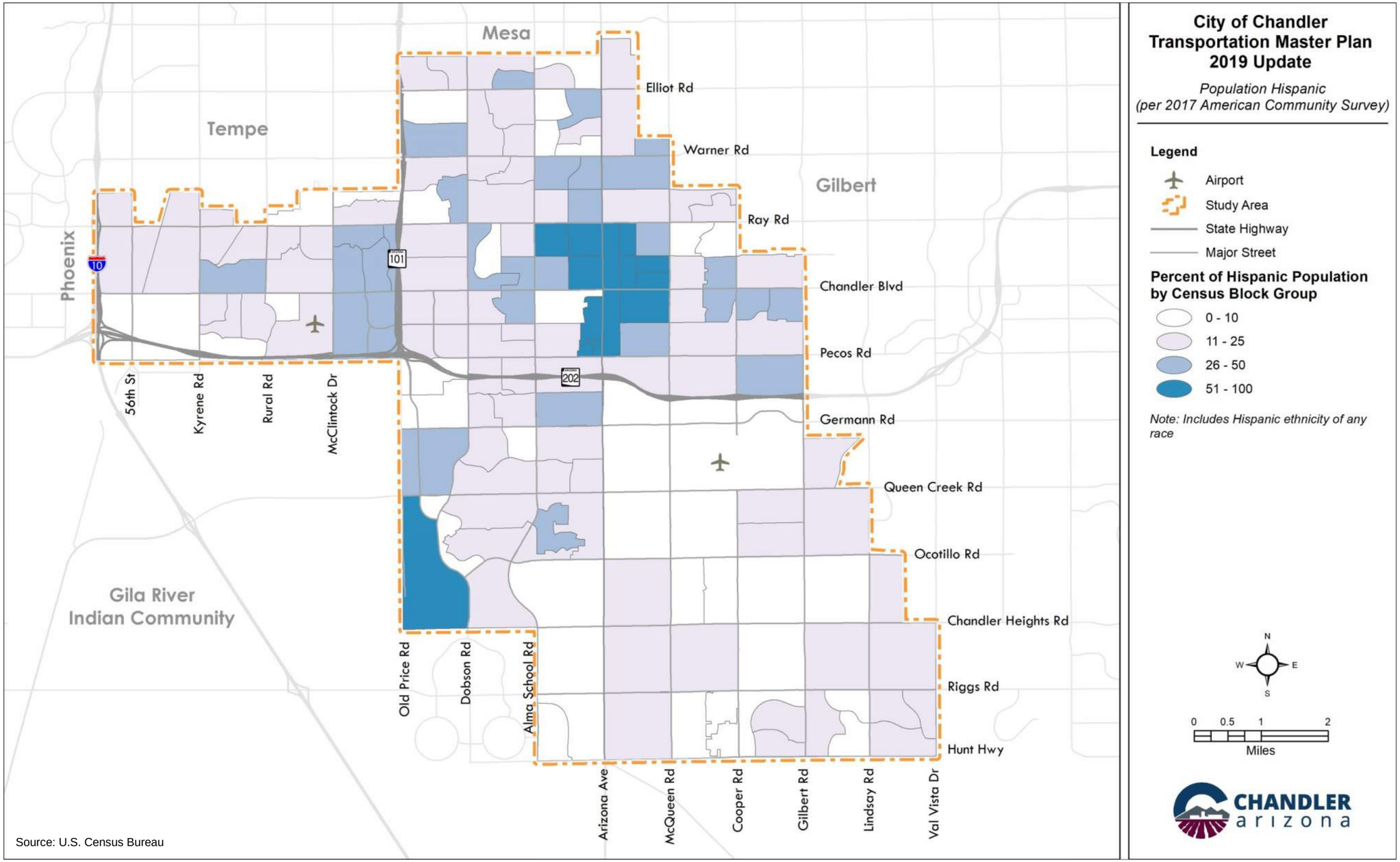


Figure 3-3. 2017 Hispanic Population

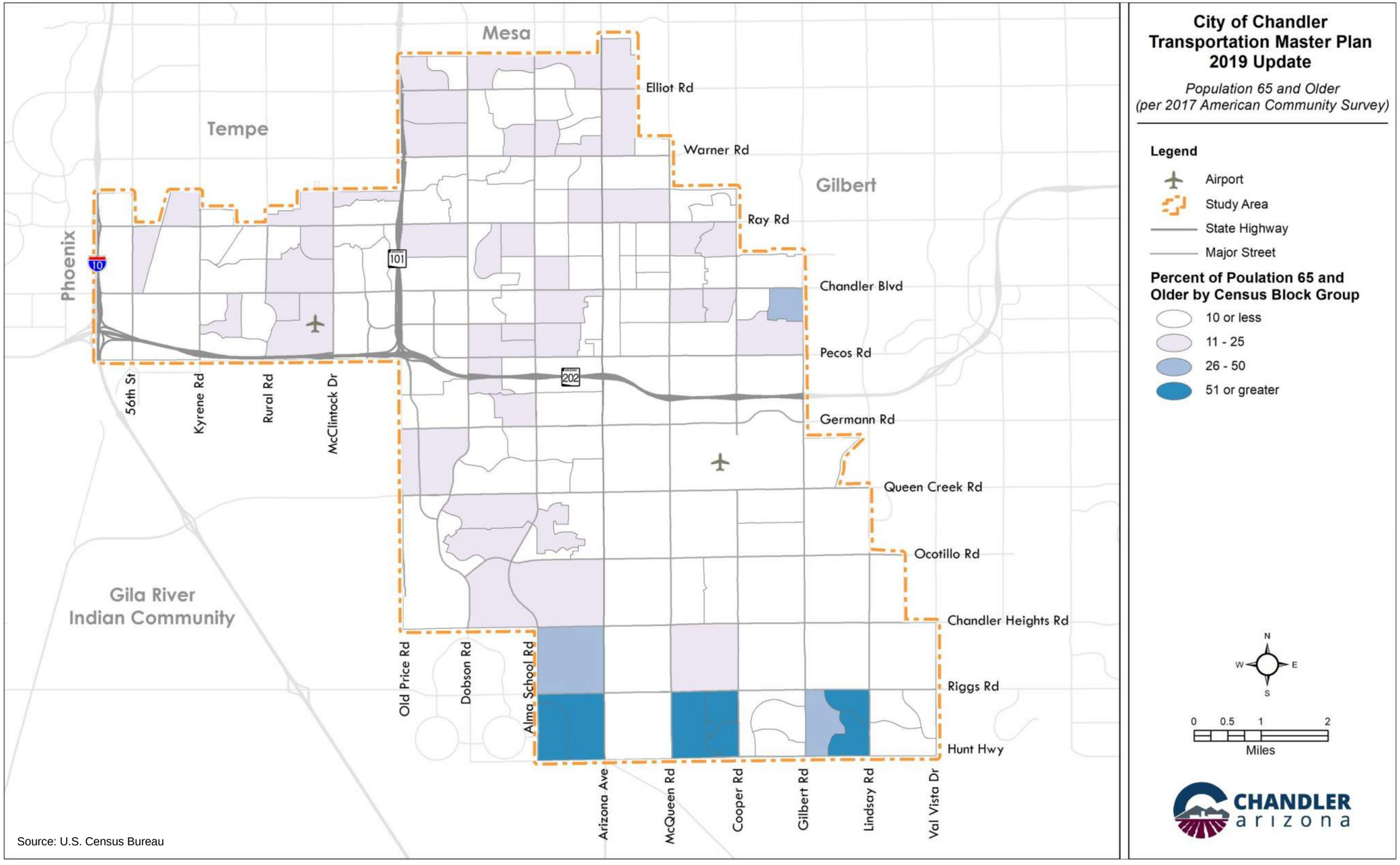


Figure 3-4. 2017 Population 65 and Older

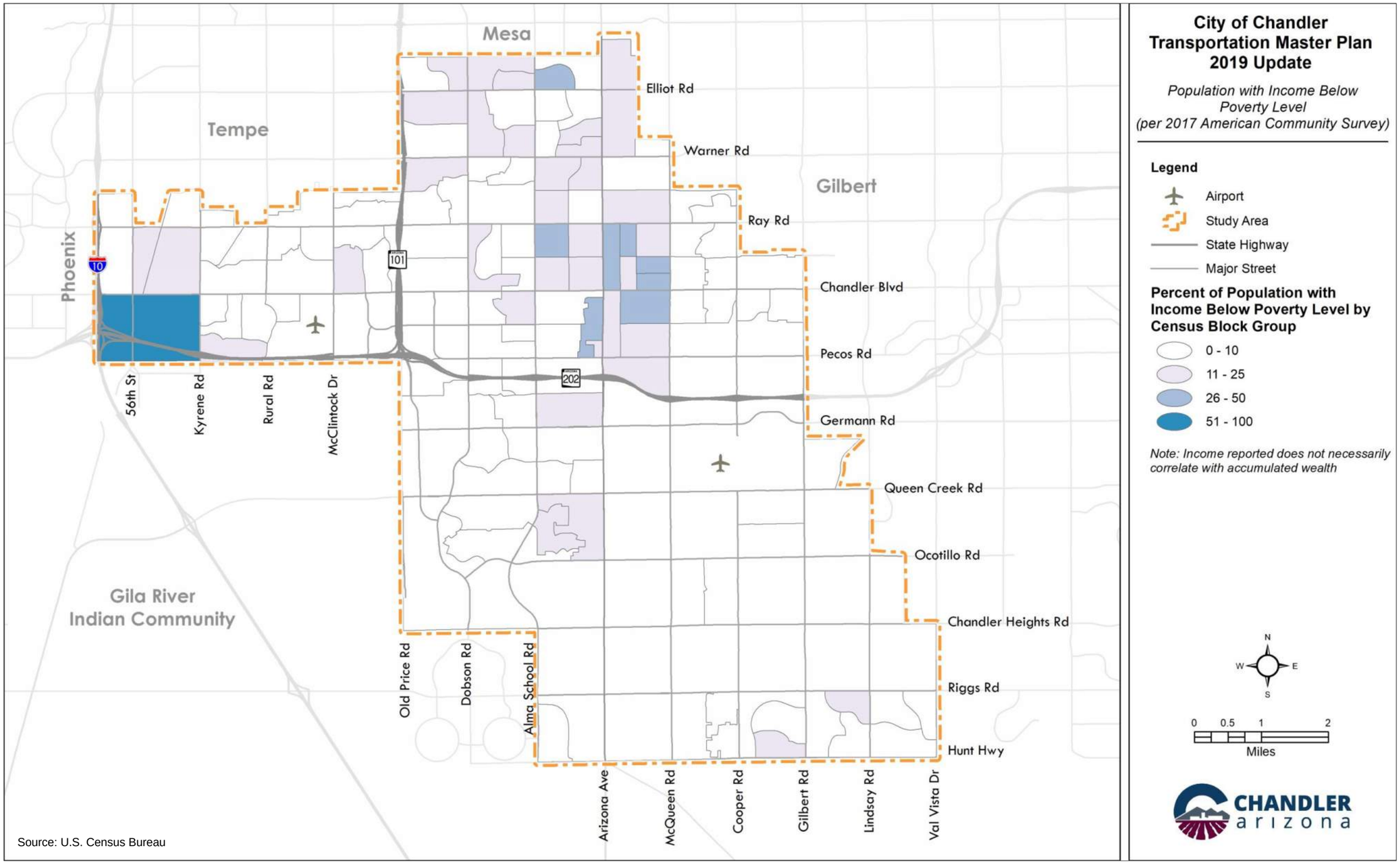


Figure 3-5. 2017 Population in Poverty

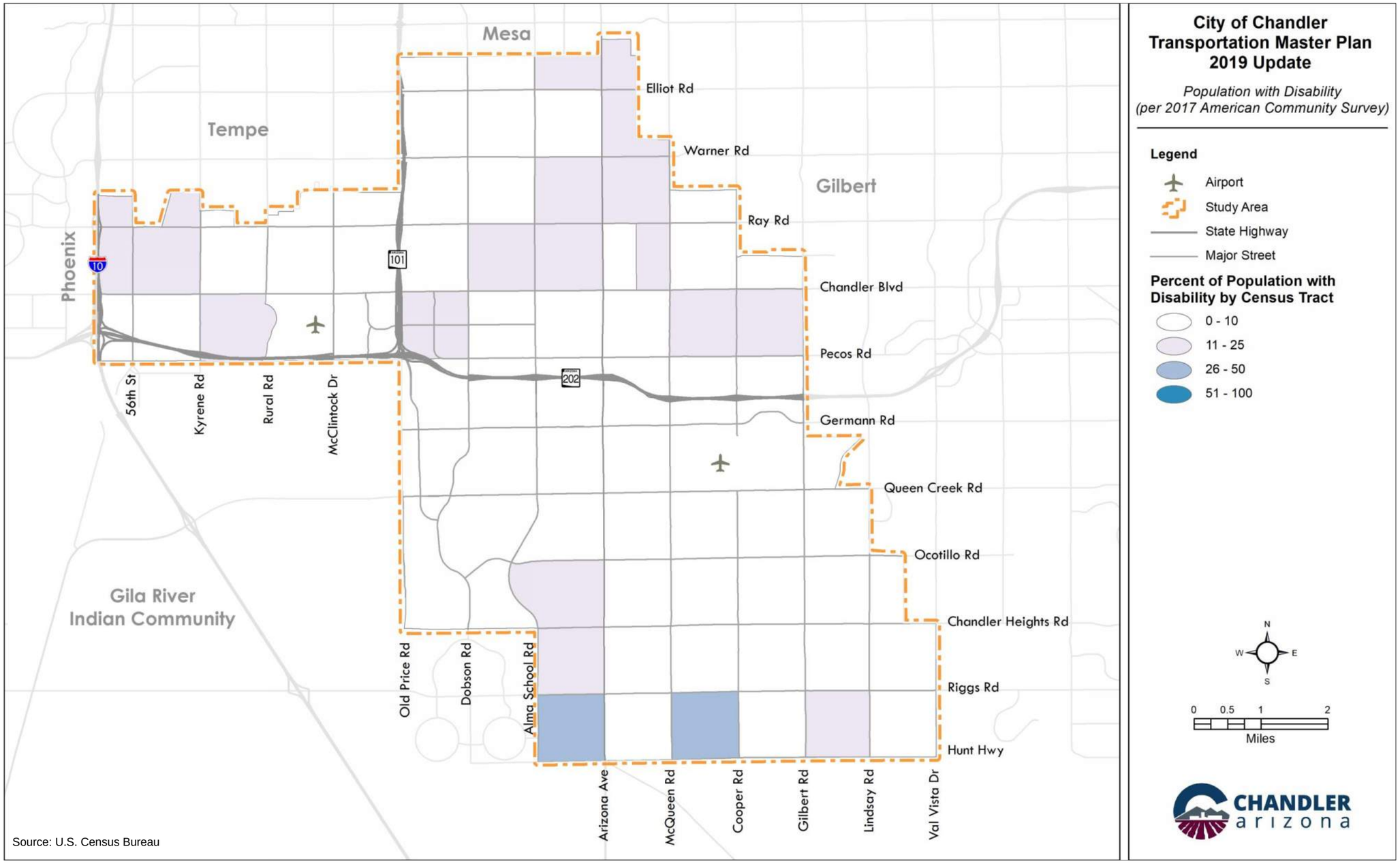


Figure 3-6. 2017 Mobility Disability Population

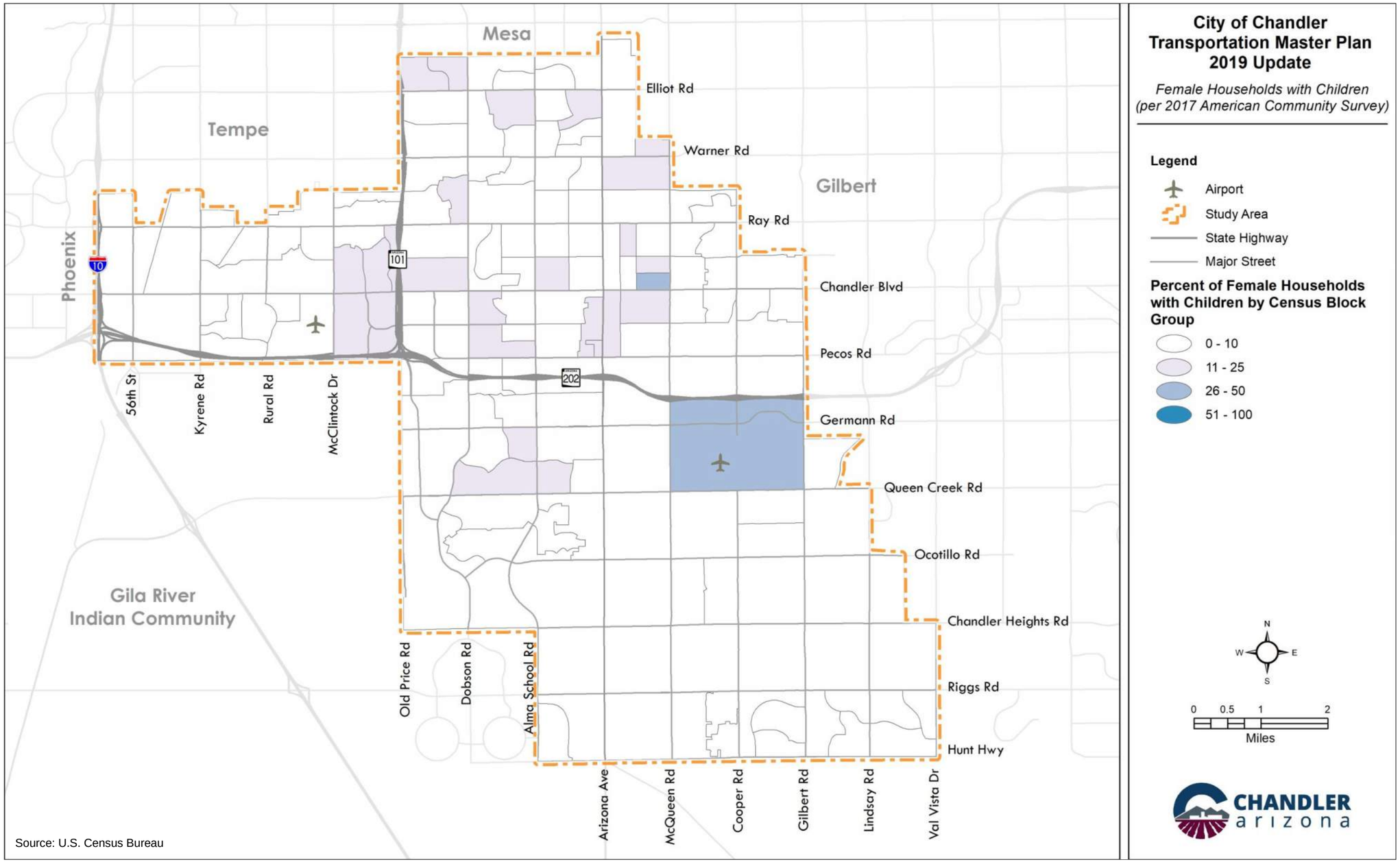


Figure 3-7. 2017 Female Households with Children

Table 3-1 provides a comparative summary of the City of Chandler's environmental justice characteristics mapped on the preceding pages for those characteristics with readily available corresponding county and state demographic characteristics.

Table 3-1. Summary of Select Environmental Justice Population Characteristics

Census Data Category	State of Arizona		Maricopa County		City of Chandler	
	2010 Census	2015 American Community Survey	2010 Census	2015 American Community Survey	2010 Census	2015 American Community Survey
Total Population	6,392,017	6,641,928	3,817,117	4,018,143	236,326	250,202
% Non-White	27.0	21.6	27.0	20.4	26.7	22.6
% Over 65	7.5	15.4	12.1	13.4	7.8	9.2
% Below Poverty Level	15.3	18.2	13.9	17.0	7.3	10.0

Source: U.S. Census Bureau

3.1.2 EMPLOYMENT

The estimated number of persons employed in 2018 in the study area is approximately 143,000 based on data provided by MAG. **Figure 3-8** shows the distribution of the study area employment based on data provided by MAG.

3.1.3 MAJOR ACTIVITY CENTERS AND LAND USES

The locations of select major activity centers in Chandler are shown in **Figure 3-9**. These activity centers have the propensity to attract or produce trips on the City's transportation system via a range of travel modes (e.g., automobile, transit, bicycle, or walking).

The transportation system should serve and promote multimodal travel to and from the existing and future land uses identified in the City's General Plan.

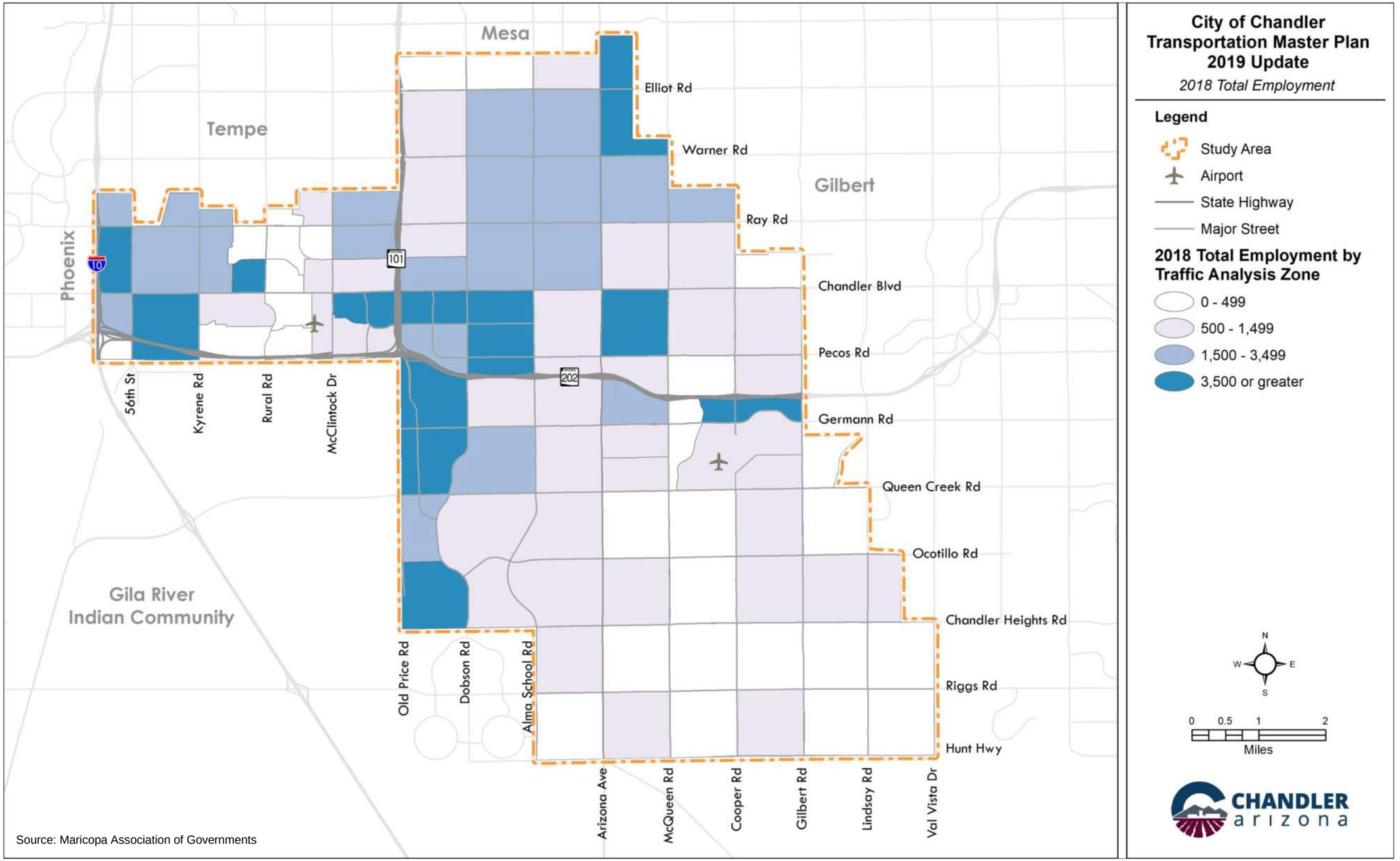
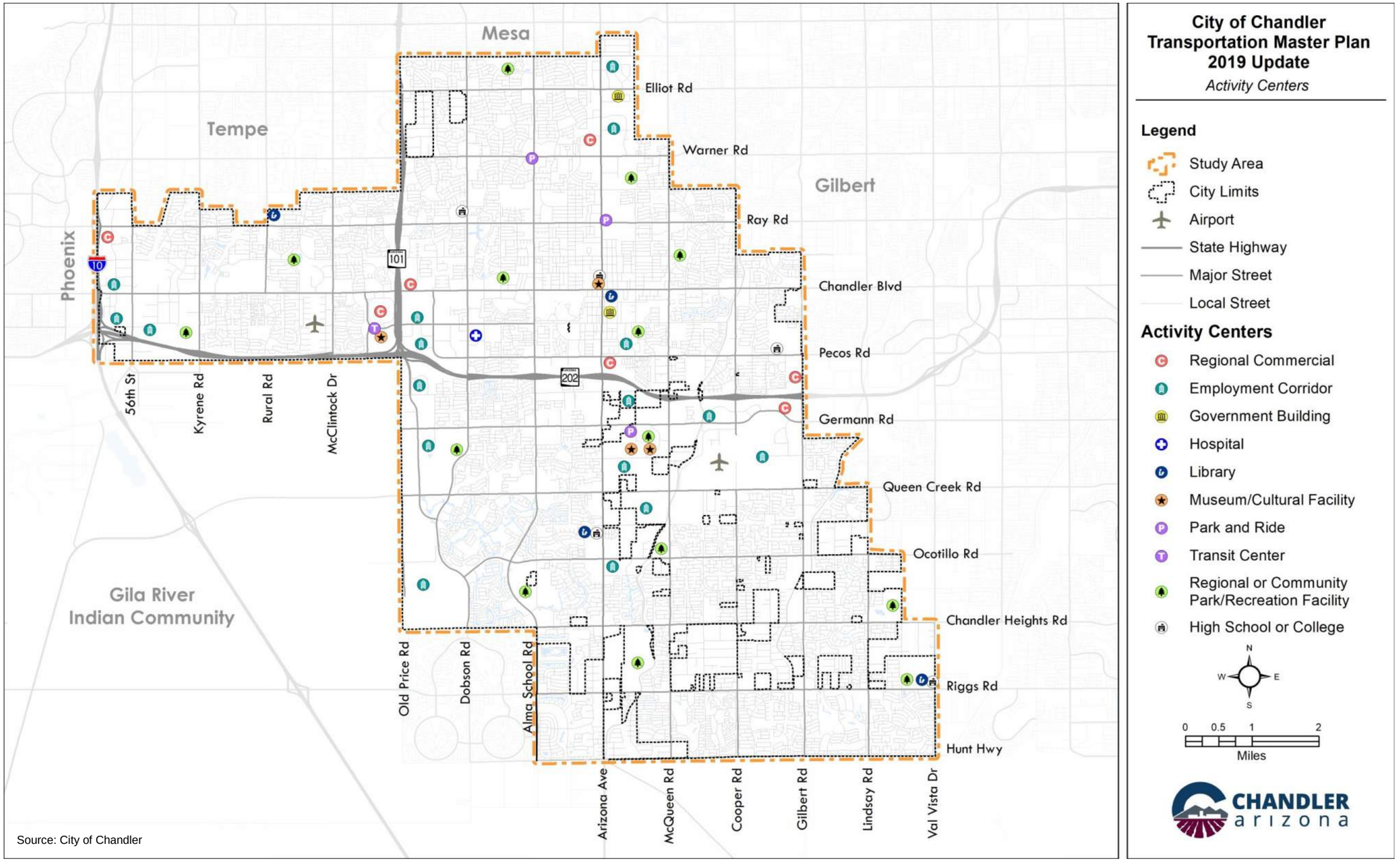


Figure 3-8. 2018 Study Area Employment Distribution



Source: City of Chandler

Figure 3-9. Major Activity Centers

3.2 FUTURE SOCIOECONOMIC CONDITIONS

Population and employment data form the basis for the assessment of future transportation needs. The Arizona Office of Economic Opportunity prepares the state and county population projections. The Maricopa Association of Governments (MAG) is the designated Metropolitan Planning Organization (MPO) for regional transportation planning in the Phoenix metropolitan area. MAG prepares projections at the county level that are consistent with the statewide county totals generated by the Arizona Office of Economic Opportunity. These socioeconomic projections are used in computer models to forecast future travel conditions and needs.

3.2.1 FUTURE 2040 POPULATION

The projected 2040 population for the study area is 328,000 based on data provided by the City and MAG. This represents an increase of 18 percent compared to the 2018 study area population of 277,000. The 2040 population for the City of Chandler is projected to be approximately 310,000, which means approximately 18,000 residents within the study area are projected to live in unincorporated areas in 2040. **Figure 3-10** shows the projected distribution of the study area 2040 population based on data provided by MAG. Most of the future high population density areas are located in the area bounded by Dobson Road, Elliot Road, McQueen Road, and Ocotillo Road.

3.2.2 FUTURE 2040 EMPLOYMENT

The estimated number of employees in 2040 in the study area is approximately 194,000 based on data provided by the City and MAG. This represents an increase of 36 percent compared to the 2018 study area employment of 143,000. **Figure 3-11** shows the projected distribution of the study area employment.

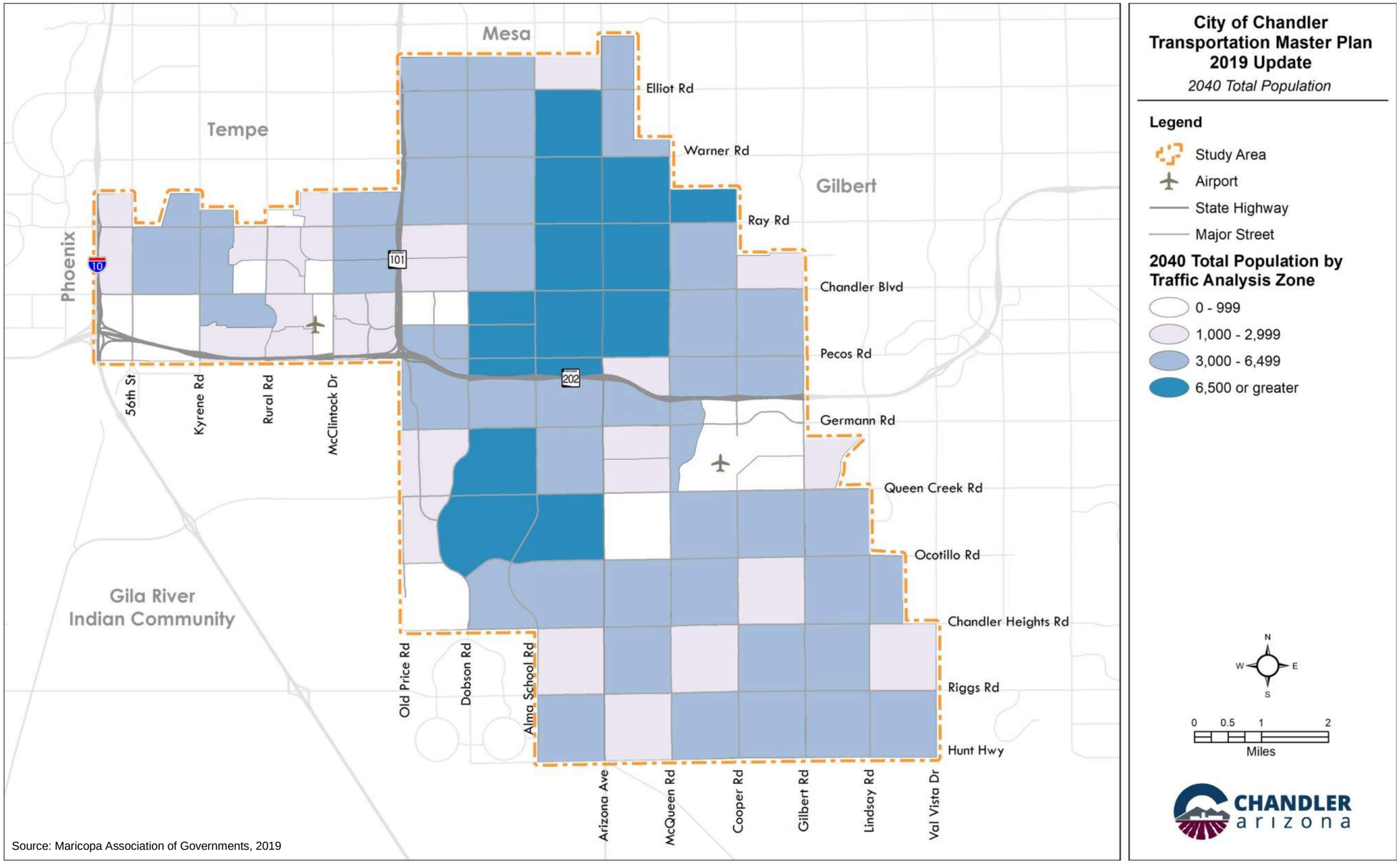
High employment density is projected along the Price Road Corridor and in the Medical/Regional Retail Growth Area (in the vicinity of Dobson Road/Chandler Boulevard). Some of the other areas with high employment density are West Chandler (between I-10 and Kyrene Road) and the Chandler Airpark Area.

The Arizona COG/MPO Employer Database has provided employee percentages for five prominent employment centers within Chandler (based on 2017 data) as shown in **Table 3-2**. The majority of employment comes from the Price Corridor and West Chandler employment centers, with 34 percent and 24 percent of total employees, respectively. These employment centers are expected to continue to be the predominant employment centers in 2040.

Table 3-2. Chandler Employee Percentages by Employment Center

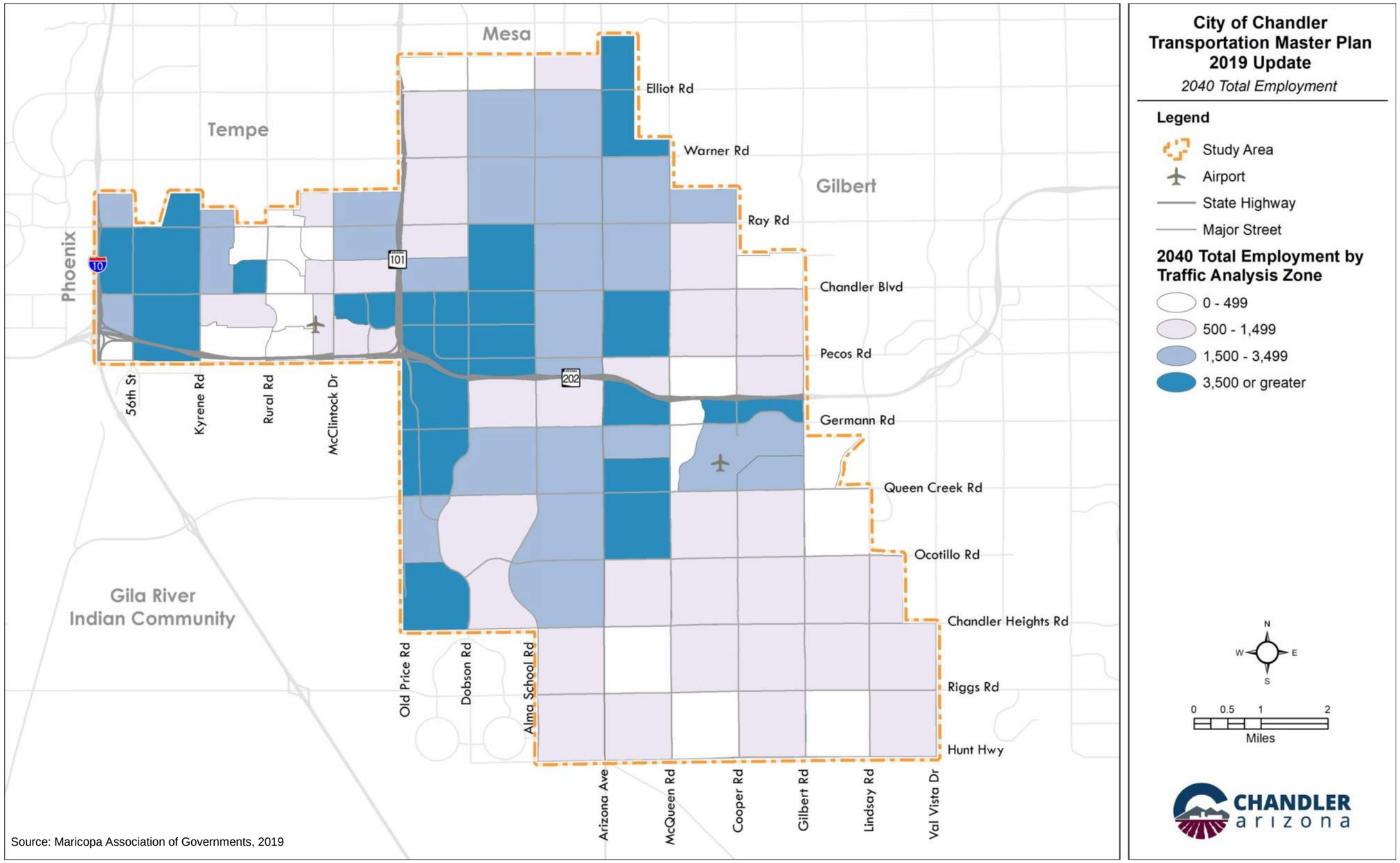
Chandler		Airpark Area	Downtown Chandler	North Chandler	Price Corridor	West Chandler
Employment Type	Total Existing Employees	% of Total Employees	% of Total Employees	% of Total Employees	% of Total Employees	% of Total Employees
Total	114,380	7%	2%	10%	34%	24%

Source: Arizona COG/MPO Employer Database, employers with 5 or more employees, 2017 data.



Source: Maricopa Association of Governments, 2019

Figure 3-10. 2040 Study Area Population Distribution



Source: Maricopa Association of Governments, 2019

Figure 3-11. 2040 Study Area Employment Distribution

4.0 ROADWAY ELEMENT

4.1 ROADWAY EXISTING CONDITIONS

The City of Chandler's roadway system serves as the foundation that provides access and mobility within the City and provides access to regional connections. The arterial roadway system is an integral component of the City's multimodal transportation system that is shared by many road users, including automobiles, trucks, buses, bicyclists, and pedestrians. Improvements to the existing roadway system should consider and balance the needs of all road users. The roadway system connects activity centers, supports new development, and provides a space for recreational use.

Existing roadway conditions have been reviewed to identify roadway system needs and concerns. The regional roadway facilities, arterial street system, traffic volumes, traffic signal equipment, traffic operation, and City-wide crash history have been analyzed and documented.

4.1.1 REGIONAL FACILITIES

4.1.1.1 Freeway System and State Highways

The City of Chandler is served by several regional freeways that pass through the City and along its boundaries. These freeways provide connections to the greater metropolitan area and access to interstate corridors. These facilities are essential for many users, including daily commuters, freight vehicles, and recreational travelers. The freeways that serve the City are described below.

Interstate 10 (Maricopa Freeway) – Interstate 10 (I-10) is an east-west interstate freeway that passes along Chandler's western boundary. In the vicinity of Chandler, I-10 exists in a north-south orientation. I-10 provides a connection to Phoenix and Tucson and is a major freight corridor that spans the southern United States from the western coast of California to the eastern coast of Florida. The I-10 interchanges that serve the City of Chandler include Ray Road, Chandler Boulevard, Queen Creek Road, and Riggs Road. Freeway-to-freeway system interchanges exist at US 60 (Superstition Freeway) and Loop 202 (Santan Freeway). Near the City of Chandler, I-10 has a cross-section that varies between eight and twelve lanes. The posted speed limit is 65 miles per hour (mph).

Loop 101 (Price Freeway) – Loop 101 is a regional freeway that runs north-south through Chandler. The freeway provides a loop connection to much of the Phoenix metropolitan area. The Loop 101 interchanges that serve the City of Chandler include Elliot Road, Warner Road, Ray Road, Chandler Boulevard, and Price Road (south of Loop 202). Freeway-to-freeway interchanges exist at US 60 and at Loop 202. Loop 101 has an eight-lane cross-section and has a posted speed limit of 65 mph.

Loop 202 (Santan Freeway) – Loop 202 is a regional freeway that runs east-west through Chandler. The Loop 202 interchanges that serve the City of Chandler include Kyrene Road, McClintock Drive, Price Road, Dobson Road, Alma School Road, Arizona Avenue, McQueen Road, Cooper Road, and Gilbert Road. The freeway-to-freeway system interchanges connect Loop 202 with I-10 and Loop 101. Loop 202 varies between an eight-lane and twelve-lane cross-section and has a posted speed limit of 65 mph.

State Route 87 (Arizona Avenue) – SR 87 is a regional at-grade arterial highway that runs north-south through the City of Chandler. SR 87 provides a regional connection to US 60 and Loop 202. SR 87 is

known as Arizona Avenue within the Chandler city limits, from north of the Western Canal to Hunt Highway. SR 87 varies between a four-lane and six-lane cross-section and has a posted speed limit between 30 mph (downtown area) and 45 mph.

US 60 (Superstition Freeway) – US 60 is an east-west freeway located north of the City of Chandler, but it provides regional connectivity for the northern portion of the City. The highway extends from I-10 in the west into Pinal County in the east. The US 60 interchanges that serve the City of Chandler include Rural Road, McClintock Drive, Dobson Road, Alma School Road, Arizona Avenue (Country Club Drive), McQueen Road (Mesa Drive), Cooper Road (Stapley Drive), and Gilbert Road. Freeway-to-freeway system interchanges exist at I-10 and Loop 101 (Price Freeway). US 60 has a twelve-lane cross-section and has a posted speed limit of 65 mph.

4.1.1.2 National Highway System Facilities

National Highway System (NHS) facilities are roadways considered important to the nation's economy, defense, and mobility. NHS facilities are subject to federal restrictions and requirements but also are eligible for National Highway Performance Program and other federal funding programs. They include freeways and federally classified principal arterials designated as being regionally important. In 2014, the Maricopa Association of Governments (MAG), in conjunction with the Arizona Department of Transportation (ADOT) and the Federal Highway Administration, updated the region's designated NHS principal arterial facilities. The study area roadways designated as NHS facilities are:

- Freeways: I-10, Loop 101, and Loop 202; and
- Principal Arterials: Arizona Avenue/SR 87 and Elliot Road (west of Arizona Avenue only).

The NHS facilities are shown in **Figure 4-1**.

4.1.2 ARTERIAL STREET SYSTEM

4.1.2.1 Existing Roadway System

The arterial roadway system in Chandler is generally a grid network, with arterial roadways typically spaced at one-mile increments. The City of Chandler has functionally classified its arterials as either major or minor arterials, as shown in **Figure 4-2**. The functional classification of study area segments in unincorporated areas is not shown in the figure but is assumed to match the functional classification of adjacent City segments. Major arterials usually carry higher traffic volumes and have, or are planned to ultimately have, a larger cross-section than minor arterials. The Transportation Master Plan focuses primarily on major arterials.

The arterial roadway system includes roadways of varying cross-sections. The roadways vary in terms of number of lanes, presence and type of median, bicycle facilities, and lane configuration at intersections. **Figure 4-3** illustrates the existing number of through lanes on arterial roadways in 2018. Most arterials within the City are four-lane or six-lane arterials, but many of the roadways in the less-developed southeastern portion of the city are two-lane arterials.

There are currently 222 signalized intersections within the City of Chandler, as shown in **Figure 4-4**. The locations of the signalized intersections follow the development of the City; there are fewer signals in the southeastern portion of the City.

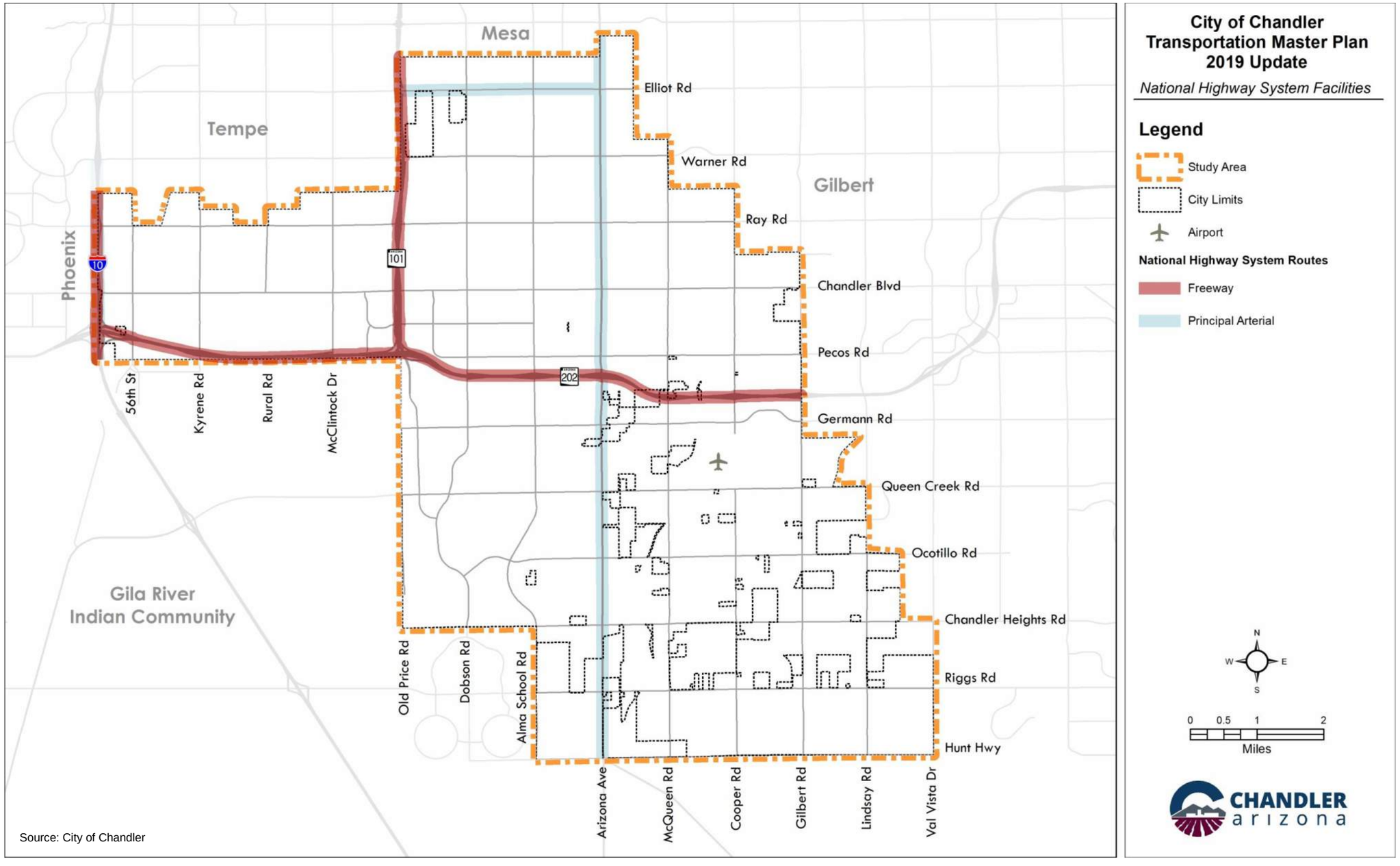
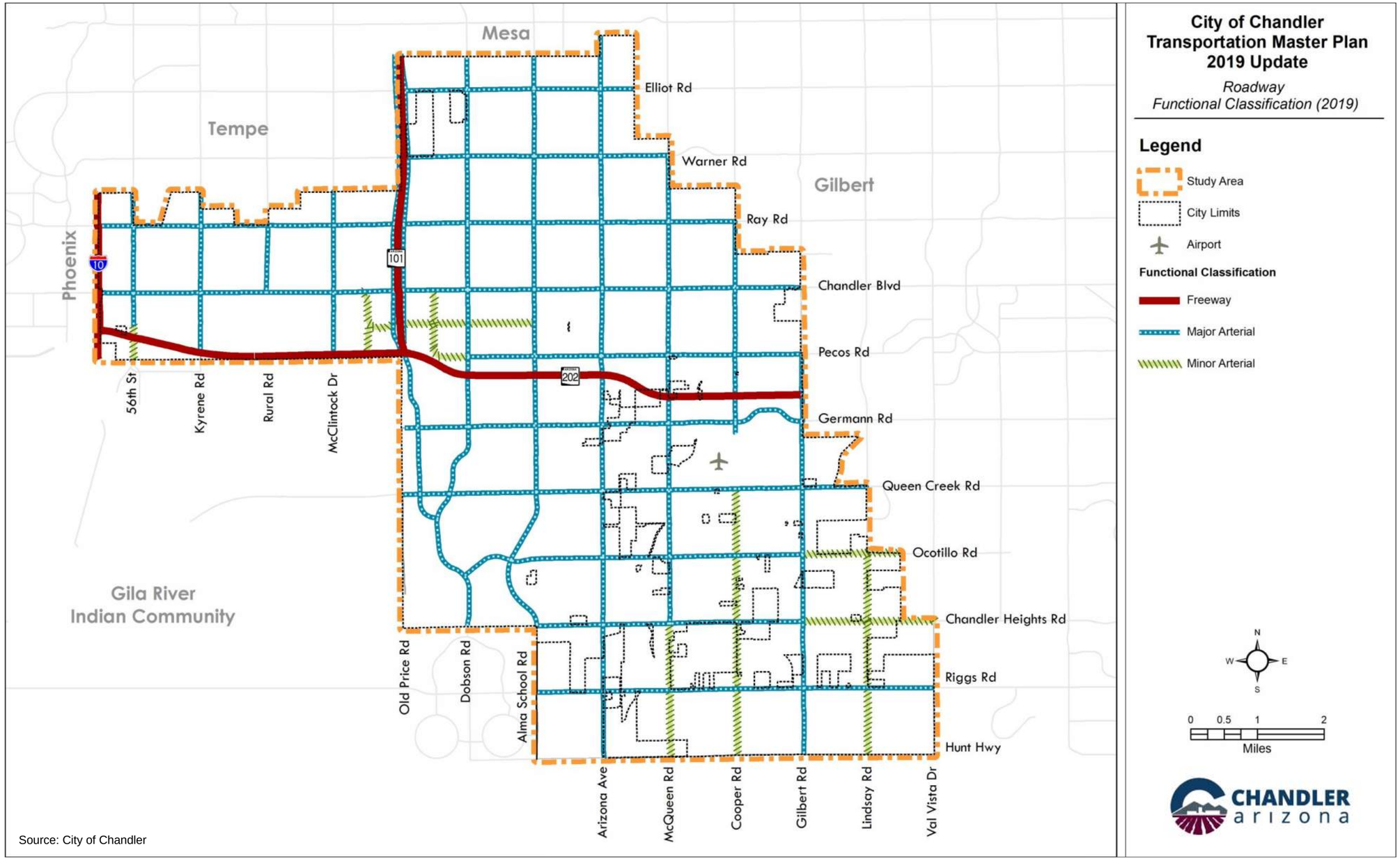


Figure 4-1. National Highway System Facilities



Source: City of Chandler

Figure 4-2. City of Chandler Roadway Functional Classification

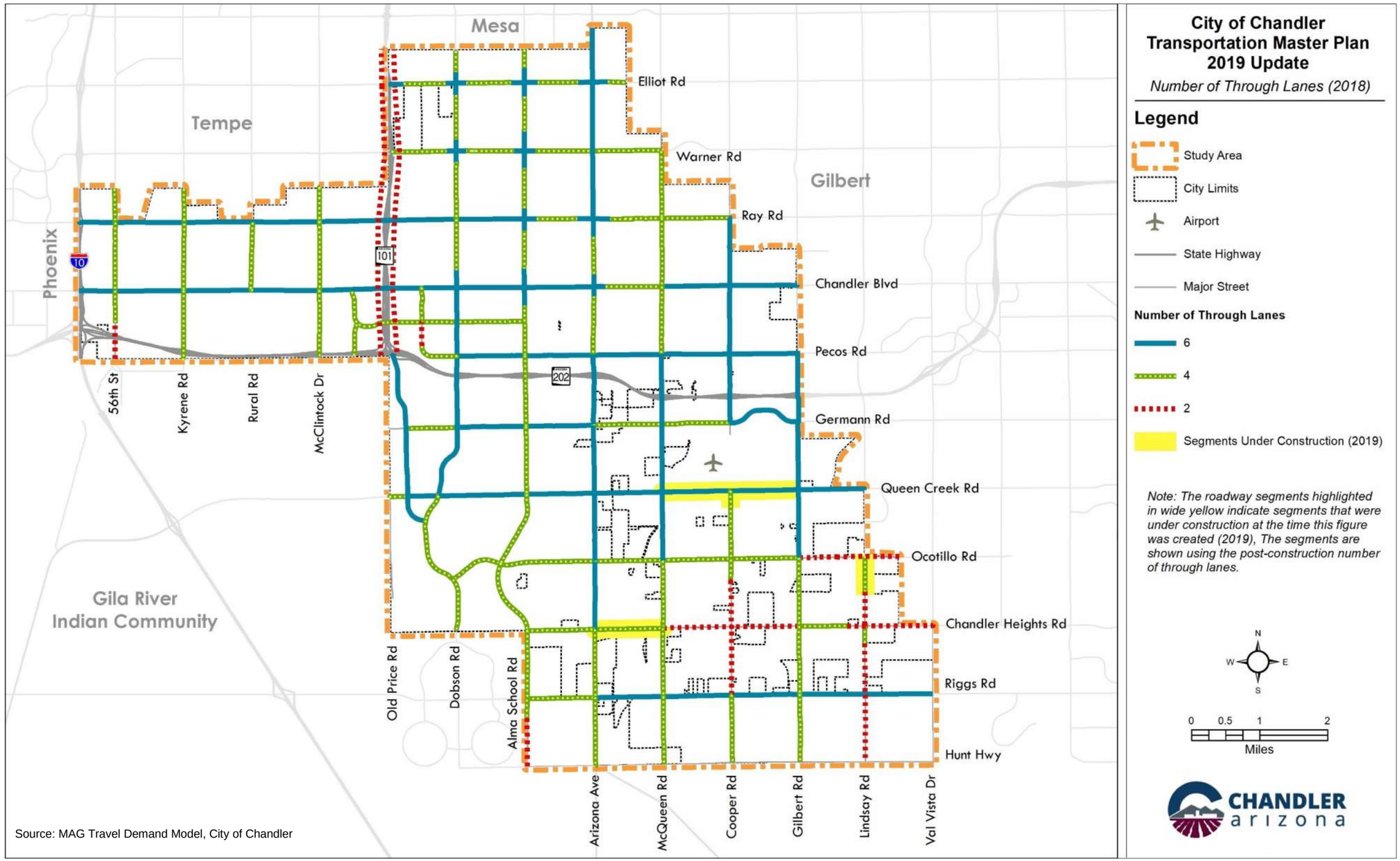


Figure 4-3. Number of Through Lanes (2018)

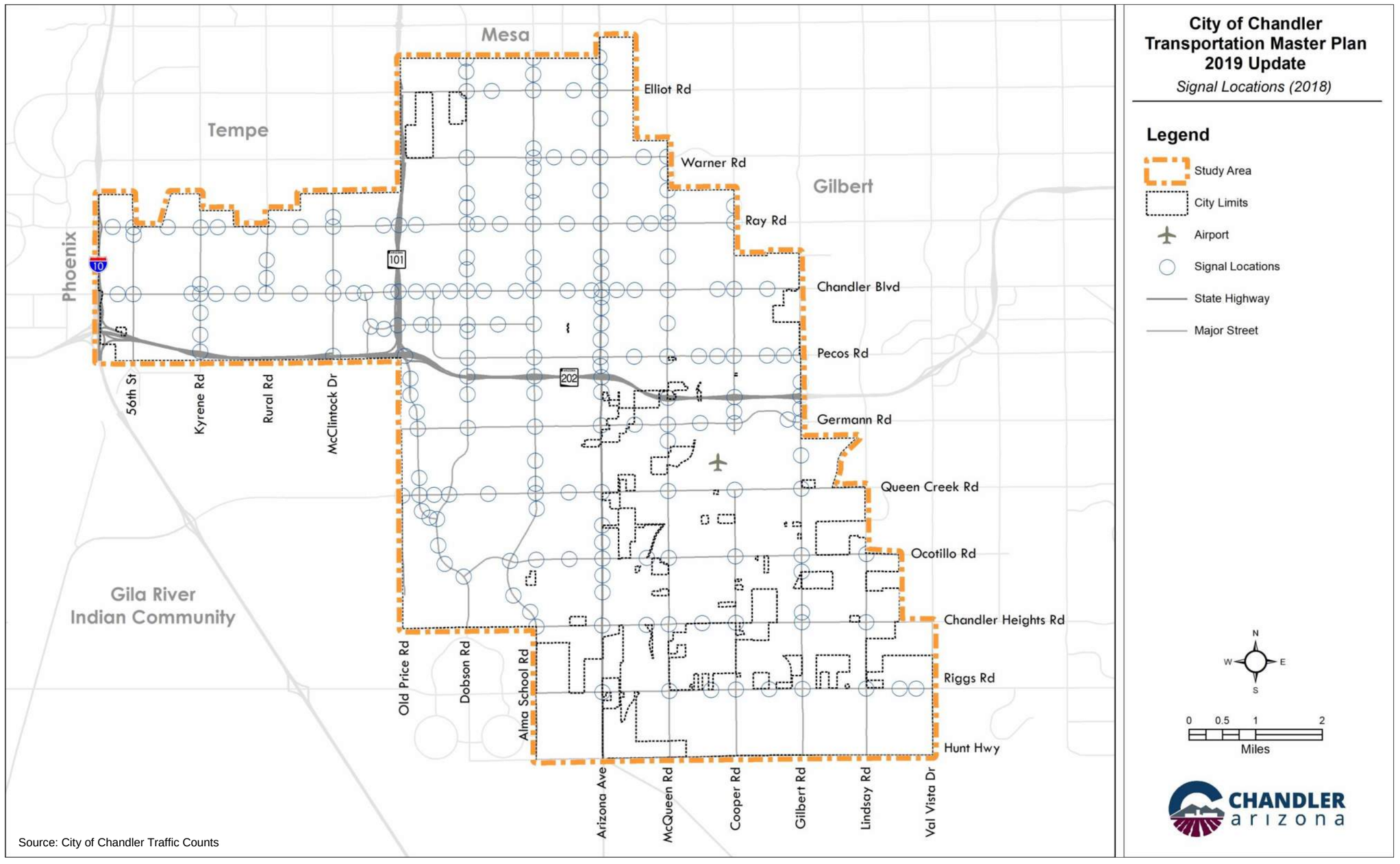


Figure 4-4. Signalized Intersections (2018)

4.1.2.2 Existing Travel Characteristics

Traffic counts are collected on all major arterials an annual basis by the City of Chandler. The traffic counts are collected at intersections and at mid-block locations. All counts are collected for a duration of 24-hours. The traffic counts are summarized annually and reported in terms of segment and intersection Average Daily Traffic (ADT) volumes.

Roadway segments with the highest ADT volumes recorded in 2018 are shown in **Table 4-1**. The highest segment volumes are primarily on Chandler Boulevard, Price Road, Arizona Avenue, and Ray Road. The roadway segment traffic volume map is shown in **Figure 4-5**.

Table 4-1. Roadway Segments with the Highest Existing ADT Volumes in 2018

Roadway Segment	From	To	Average Traffic Volume (vehicles/day)
Chandler Blvd.	Price Rd.	Dobson Rd.	41,700
Price Rd.	Loop 202	Germann Rd.	41,700
Arizona Ave.	Loop 202	Germann Rd.	40,600
Price Rd.	Chandler Blvd.	Frye Rd.	40,100
Ray Rd.	Price Rd.	Dobson Rd.	39,600
Ray Rd.	McClintock Dr.	Price Rd.	39,500
Warner Rd.	Dobson Rd.	Alma School Rd.	39,400
Chandler Blvd.	McClintock Dr.	Price Rd.	38,400
Arizona Ave.	Germann Rd.	Queen Creek Rd.	38,400
Price Rd.	Ray Rd.	Chandler Blvd.	37,600

Source: City of Chandler

The intersection traffic counts are reported in terms of the number of vehicles entering the intersection each day. The intersections with the highest traffic volumes exist within a six square-mile area within the northern portion of the City. The ten highest-volume intersections are located between Warner Road and Chandler Boulevard and between Price Road and Arizona Avenue. The intersections with the greatest 2018 ADT volumes are shown in **Table 4-2.** The intersection traffic volume map is shown in **Figure 4-6**.

Table 4-2. Intersections with the Highest Existing ADT Volumes in 2018

Intersection		Average Traffic Volume (entering vehicles per day)
East-West Street	North-South Street	
Chandler Blvd.	Price Rd.	79,400
Ray Rd.	Price Rd.	74,100
Chandler Blvd.	Dobson Rd.	70,300
Ray Rd.	Dobson Rd.	69,300
Chandler Blvd.	Alma School Rd.	68,100
Warner Rd.	Alma School Rd.	67,700
Ray Rd.	Alma School Rd.	66,400
Warner Rd.	Dobson Rd.	66,400
Ray Rd.	Arizona Ave.	65,400
Warner Rd.	Arizona Ave.	64,800

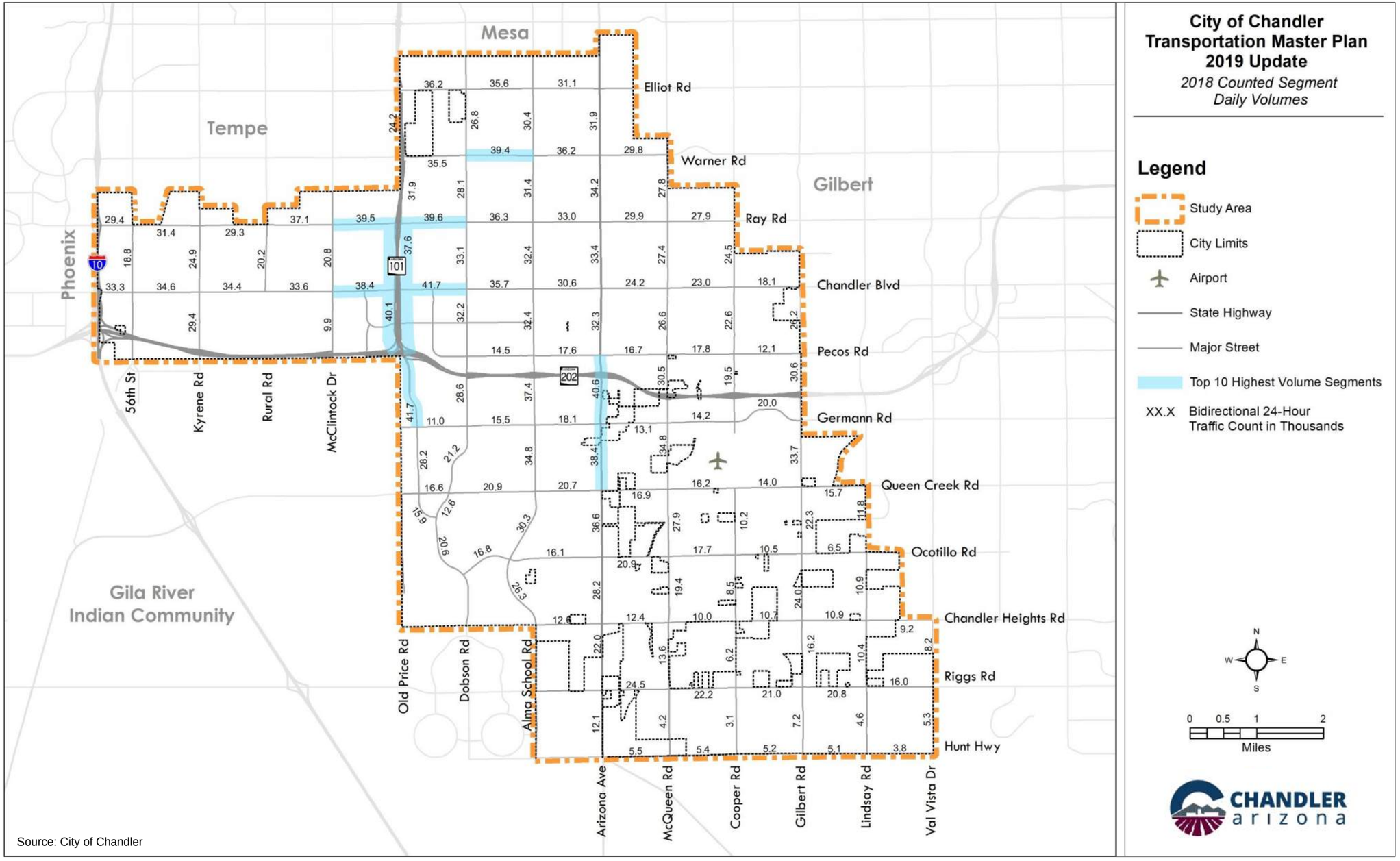


Figure 4-5. Existing Roadway Segment Traffic Volumes (2018)

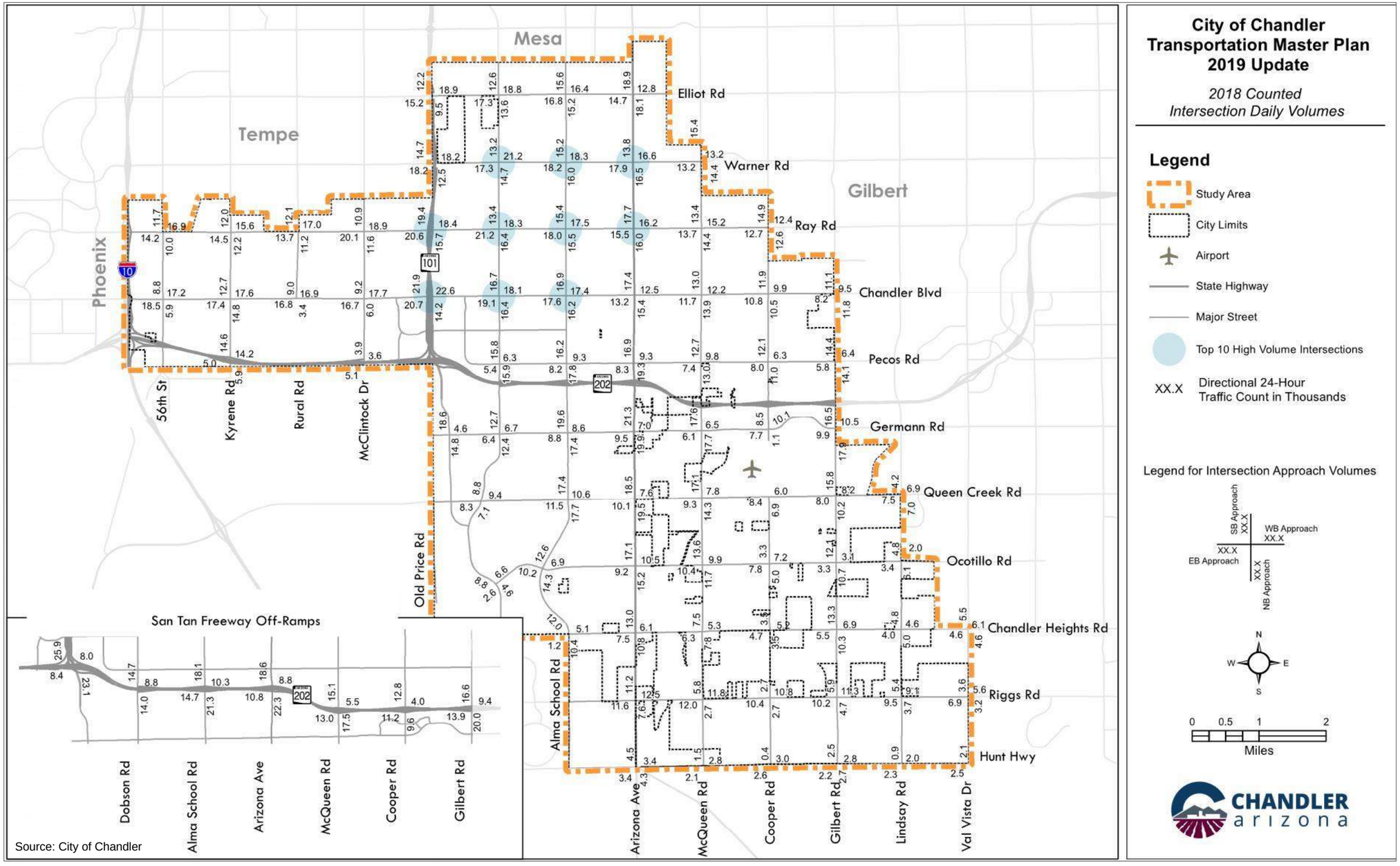


Figure 4-6. Existing Intersection Approach Traffic Volumes (2018)

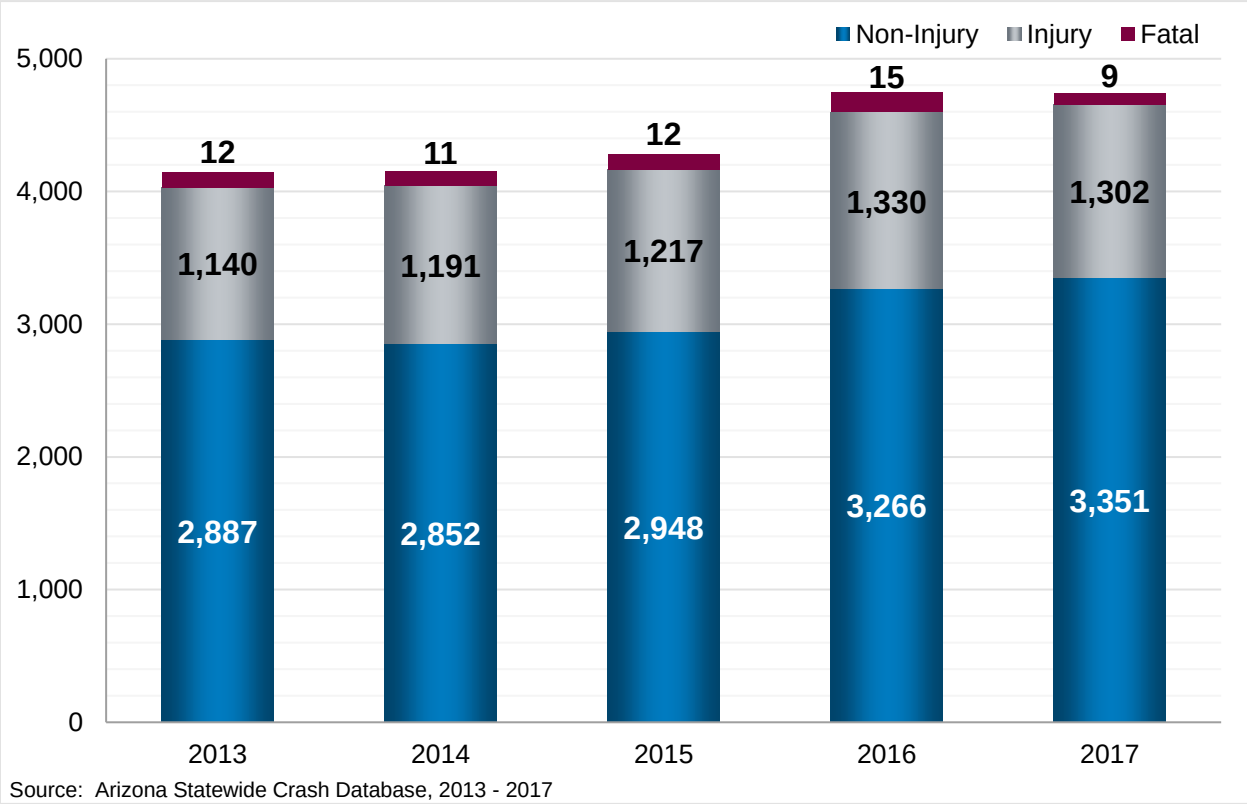
4.1.3 CRASH HISTORY

Historical crash data was obtained from the Arizona Statewide Crash Database (ADOT Safety DataMart) for the five most recent years. Data was queried to filter all crashes coded within the City of Chandler. In the five-year period from 2013 through 2017, there were a total of 21,543 reported crashes within the City of Chandler. Of these, 15,304 (71%) were non-injury crashes, 3,596 (17%) were possible injury crashes, 2,094 (10%) were minor injury crashes, 490 (2%) were serious injury crashes, and 59 crashes (<1%) resulted in fatalities. A summary of the historical crash data is shown in **Table 4-3** and **Figure 4-7**.

Table 4-3. Crash Summary, 2013-2017

Year	Fatal	Serious Injury	Minor Injury	Possible Injury	Non-Injury	Total
2013	12	103	348	689	2,887	**4,039**
2014	11	83	370	738	2,852	**4,054**
2015	12	102	396	719	2,948	**4,177**
2016	15	106	495	729	3,266	**4,611**
2017	9	96	485	721	3,351	**4,662**
Total	**59**	**490**	**2,094**	**3,596**	**15,304**	**21,543**

Source: Arizona Statewide Crash Database, 2013 - 2017



Source: Arizona Statewide Crash Database, 2013 - 2017

Figure 4-7. Crash Summary, 2013-2017

The City of Chandler summarizes crash data annually and reports a variety of crash statistics for the city. The crash information is used to:

- Identify crash patterns and potential countermeasures to improve safety;
- Assess before and after data related to safety improvements;
- Provide information for Capital Improvement Projects; and
- Respond to crash data requests from community members, consultants, and stakeholders.

In addition, the historical crash data is also used to calculate crash rates. Crash rates incorporate vehicle exposure, or the amount of traffic at a particular location. Crash rates are calculated to more fairly compare various locations. Crash rates are expressed in "Crashes per Million Entering Vehicles" (MEV) at intersections.

Using historical crash data from 2013 through 2017, the 10 intersections that have the highest collision rates are shown in **Table 4-4**. These locations are also shown in **Figure 4-8**. The high crash rate intersections exist primarily in the northern and central portions of the City and are within the same area as the high-volume intersections.

Table 4-4. Intersections with High Crash Rates, 2013-2017

Rank	Intersection		5-Year Crash Total	Average Crashes per Year	Daily Intersection Entering Volume	Crash Rate (crashes per MEV)
	East-West Street	North-South Street				
1	Chandler Blvd.	Alma School Rd.	255	51.0	62,820	2.22*
2	Warner Rd	Arizona Ave.	237	47.4	61,620	2.11
3	Ray Rd.	Arizona Ave.	205	41.0	58,660	1.91
4	Ray Rd.	Dobson Rd.	227	45.4	66,900	1.86
5	Ray Rd.	54th St.	150	30.0	47,920	1.72
6	Chandler Blvd.	Kyrene Rd.	182	36.4	58,160	1.71
7	Warner Rd.	Alma School Rd.	190	38.0	61,500	1.69
8	Pecos Rd.	Arizona Ave.	148	29.6	50,360	1.61
9	Germann Rd.	Alma School Rd.	157	31.4	55,060	1.56
10	Queen Creek Rd.	Alma School Rd.	155	31.0	56,120	1.51

Source: Arizona Statewide Crash Database, 2013 - 2017, City of Chandler

** Note: The crash data used (2013-2017) reflects conditions before the intersection of Alma School Road and Chandler Boulevard was reconstructed in 2018.*

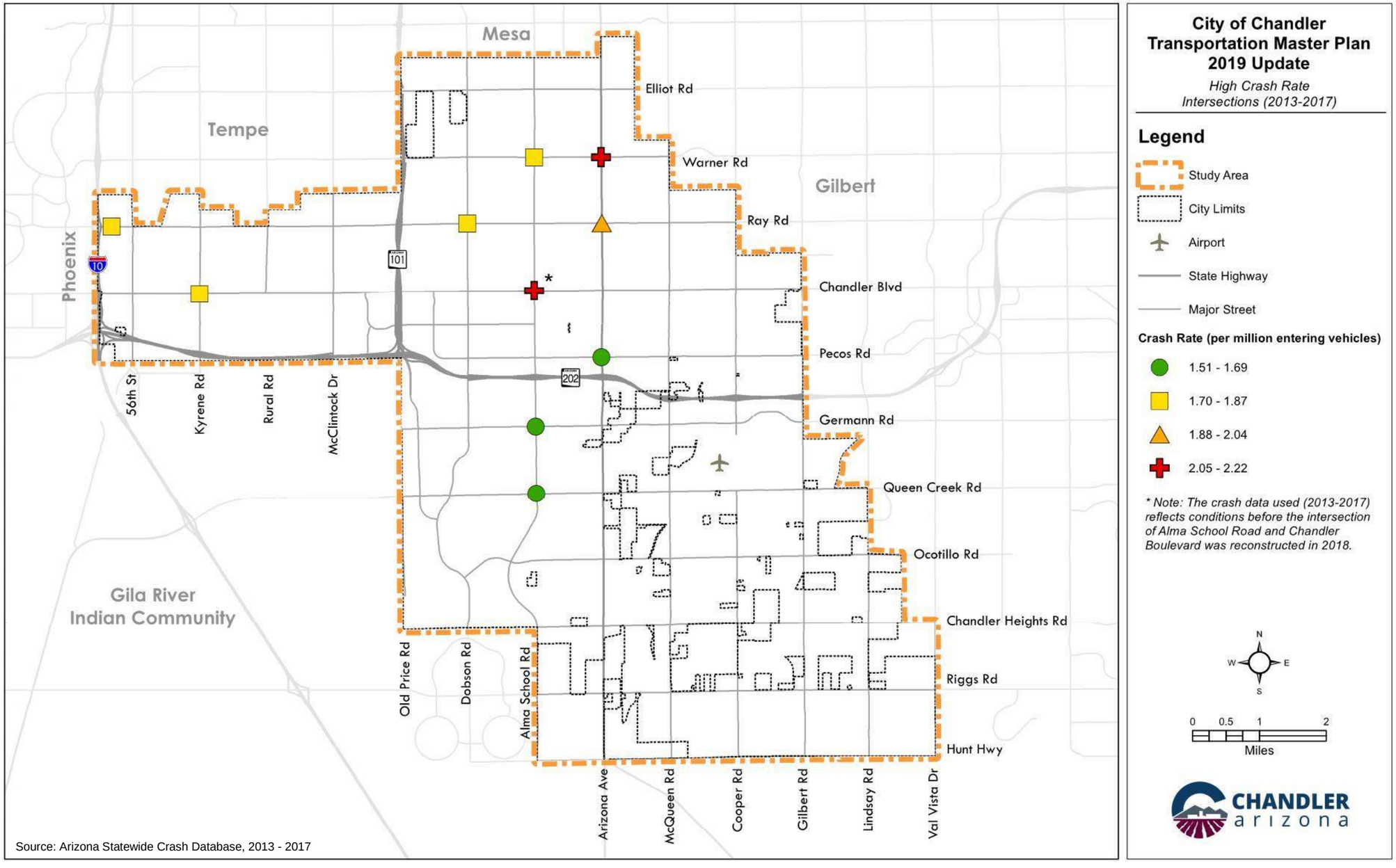


Figure 4-8. High Crash Rate Intersections, 2013 - 2017

MAG conducts a network crash review within the MAG Region periodically. The purpose of this process is to identify specific intersections for roadway improvements by ranking intersections in terms of crash risk. The methodology considers three attributes: Crash Frequency (CF), Crash Severity (CS), and Crash Type (CT).

- **The CF Score** is the ratio of crash frequency of a particular intersection to the highest intersection crash frequency for the MAG region.
- The **CS Score** is calculated using the KABCO crash severity scale based on the highest resulting injury from the crash. The CS Score for an intersection is the ratio between the CS value for the intersection to the maximum CS value for the MAG region.
- The **CT Score** considers the number of vehicles, injury severity, and manner of collision for each reported crash. These factors are used to approximate an associated crash cost. The CT Score for a particular intersection is the ratio of Crash Type Cost at that intersection to the maximum Crash Type Cost for any intersection in the MAG region.

The Final Score combines the three attributes using the following weighting:

Final Score (ISS) = 25% Crash Frequency Score + 50% Crash Severity Score + 25% Crash Type Score

The most recent MAG Top 100 Intersection Crash Risk list was published in January 2019 and uses five years of crash data, from 2013 through 2017. The three intersections within Chandler included in the MAG list are provided in **Table 4-5**.

Table 4-5. Chandler Intersections on MAG Top 100 Intersection Crash Risk List

Rank	Intersection	Crashes	CF Score	CS Score	CT Score	Final Score
45	Arizona Avenue / Loop 202 (Santan Freeway)	126	0.606	0.585	0.636	0.603
63	Ray Road / Dobson Road	152	0.731	0.403	0.701	0.559
97	Ray Road / McClintock Drive	121	0.582	0.351	0.685	0.492

Source: Maricopa Association of Governments

The list of intersections with the highest crash rates developed for the Chandler Transportation Master Plan (**Table 4-4** and **Figure 4-8**) varies from the MAG Top 100 Intersection Crash Risk list due to the methodology used. **Table 4-4** and **Figure 4-8** were determined using solely crash frequency, while the MAG methodology uses crash frequency, crash severity, and crash type to determine rankings.

4.1.4 INTERSECTION AND ROADWAY LEVEL OF SERVICE

The efficiency of a roadwork network can be described by Level of Service (LOS), a measurement of travel time delay and traffic congestion. LOS can be measured for various components of a roadway system, including segments, signalized intersections, and unsignalized intersections. In the Highway Capacity Manual, the capacity of a particular facility is defined as “the maximum number of vehicles that can pass a given point during a specified period under prevailing roadway, traffic, and control conditions.” For each roadway segment or intersection, the capacity for that facility is assumed to remain constant under standard operating conditions.

The LOS represents a range of operating conditions on a particular facility and describes the level of congestion. The Highway Capacity Manual defines six levels of service, ranging from A to F. LOS A represents the best operating conditions (free flow conditions, little to no delay) and LOS F represents the worst conditions (heavy congestion and delays). LOS D is often considered the acceptable level threshold for urban intersections and roadway segments.

The level of service for signalized intersections is determined by the level of average delay experienced by a vehicle as it passes through the intersection. **Table 4-6** shows the capacity criteria for signalized intersections in terms of average vehicle delay.

Table 4-6. Capacity Criteria for Signalized Intersections

Level of Service	Definition	Average Vehicle Delay (seconds/ vehicle)
A	Primarily free-flow operation with no delay	≤ 10
B	Reasonably unimpeded operation with minimal delay	> 10 - 20
C	Stable operation with some delay	> 20 - 35
D	Somewhat stable operation with moderate delay; approaching capacity	> 35 - 55
E	Unstable operation with significant delay; at or almost at capacity	> 55 - 80
F	Severe congestion and delay; over capacity	> 80

Source: Highway Capacity Manual

For roadway segments, the capacity and LOS can be estimated using the maximum hourly service flow rates for multi-lane roadways presented in the Highway Capacity Manual. The service volume thresholds were determined for each LOS for a roadway with a given number of through lanes using the 2018 Chandler segment traffic volumes.

For a given roadway segment cross-section and known daily traffic volumes, the LOS may be estimated using the Highway Capacity Manual criteria shown in **Table 4-7**. This table includes LOS estimates for two-lane, four-lane, and six-lane arterial roadways.

Table 4-7. Average Daily Traffic Volume Thresholds for Estimating Level of Service

Functional Classification	Number of Through Lanes	Average Daily Traffic Volume Thresholds		
		LOS D	LOS E	LOS F
Arterial	2	12,200 - 15,300	15,301 - 16,100	> 16,100
	4	27,500 - 32,200	32,201 - 33,900	> 33,900
	4 with 6 at intersection	35,100 - 37,100	37,100 - 42,900	> 42,900
	6	42,200 - 48,500	48,501 - 50,900	> 50,900

Source: Highway Capacity Manual

The roadway segment LOS for the existing traffic volumes based on **Table 4-7** is shown in **Figure 4-9.** For roads currently under construction, the anticipated post-construction LOS is shown. Most of the roadway network is operating under good conditions (LOS A - LOS D); however, several roadway segments are operating at or near capacity. These roadway segments are concentrated in the north and central regions of the City.

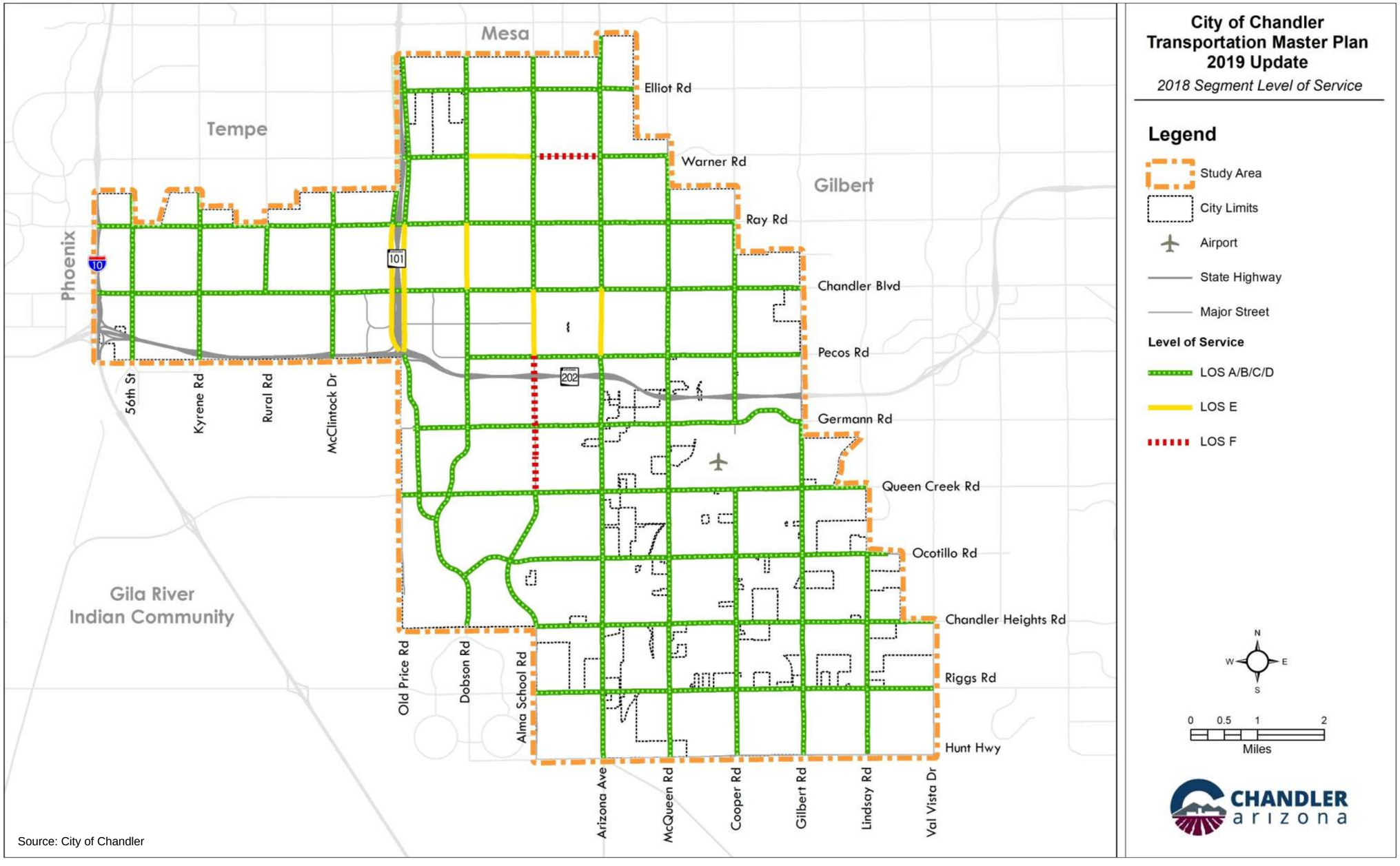


Figure 4-9. 2018 Roadway Segment Level of Service

4.1.5 INTELLIGENT TRANSPORTATION SYSTEMS

4.1.5.1 Intelligent Transportation System Infrastructure

The City has a combination fiber-optic and twisted pair copper communication network serving most of the traffic signals that are connected to the City's Traffic Management Center (TMC), from which the traffic signals are monitored for operations and signal coordination. The City's communication network is shown in **Figure 4-10**. The existing conduit available to serve the communication network is shown in **Figure 4-11**. There are some wireless radio connections to traffic signals, although those are currently being upgraded to fiber connections. The City is also connected to the Regional Community Network which provides a connection between jurisdictions to be able to share camera feeds and other essential traffic signal information in a secured and closed environment for traffic management purposes.

The Chandler TMC utilizes a traffic signal software system, called TransSuite, that allows for the remote operation of intelligent infrastructure for traffic management and mobility purposes from a central location. Under a formal agreement with the state, the City operates all signals at freeway traffic interchanges along Loop 101 Price, Loop 202 Santan, but not along I-10. The TMC is staffed Monday through Friday from 6:00 AM to 6:00 PM and operations staff are on-call after hours and on weekends to respond as needed using remote access into their software system. Maintenance and technician staff have access to the TMC software to be able to access the current traffic signal timing and phasing information for intersections of interest. There is also a new Emergency Operations Center being built at the City that will have a connection to the TMC software system to have remote TMC functionality from the new center.

The majority of the 220 signalized intersections have fixed cameras for vehicle detection at the stop bar. No advance detection is in place currently. These locations are shown in **Figure 4-12.** Signalized intersections without camera detection typically have inductive loops within the pavement to provide vehicle detection. The City of Chandler is installing traffic signal detection cameras that can also detect bicyclists at 40 locations in 2019, with plans for additional cameras in future years.

All signals have preemption devices, which are used only by fire vehicles to preempt the green lights in route toward an incident. Police and emergency medical vehicles do not have signal preemption devices.

Approximately 35 signals are also equipped with Pan-Tilt-Zoom (PTZ) Closed-Circuit Television (CCTV) cameras, which allow operators at the TMC to have full visual coverage of the intersection. The PTZ camera views are shared with the police department and the Emergency Operations Center. The locations with CCTV cameras are shown in **Figure 4-13.** Camera images are viewed only by traffic management and are not stored nor shared with the traveling public.

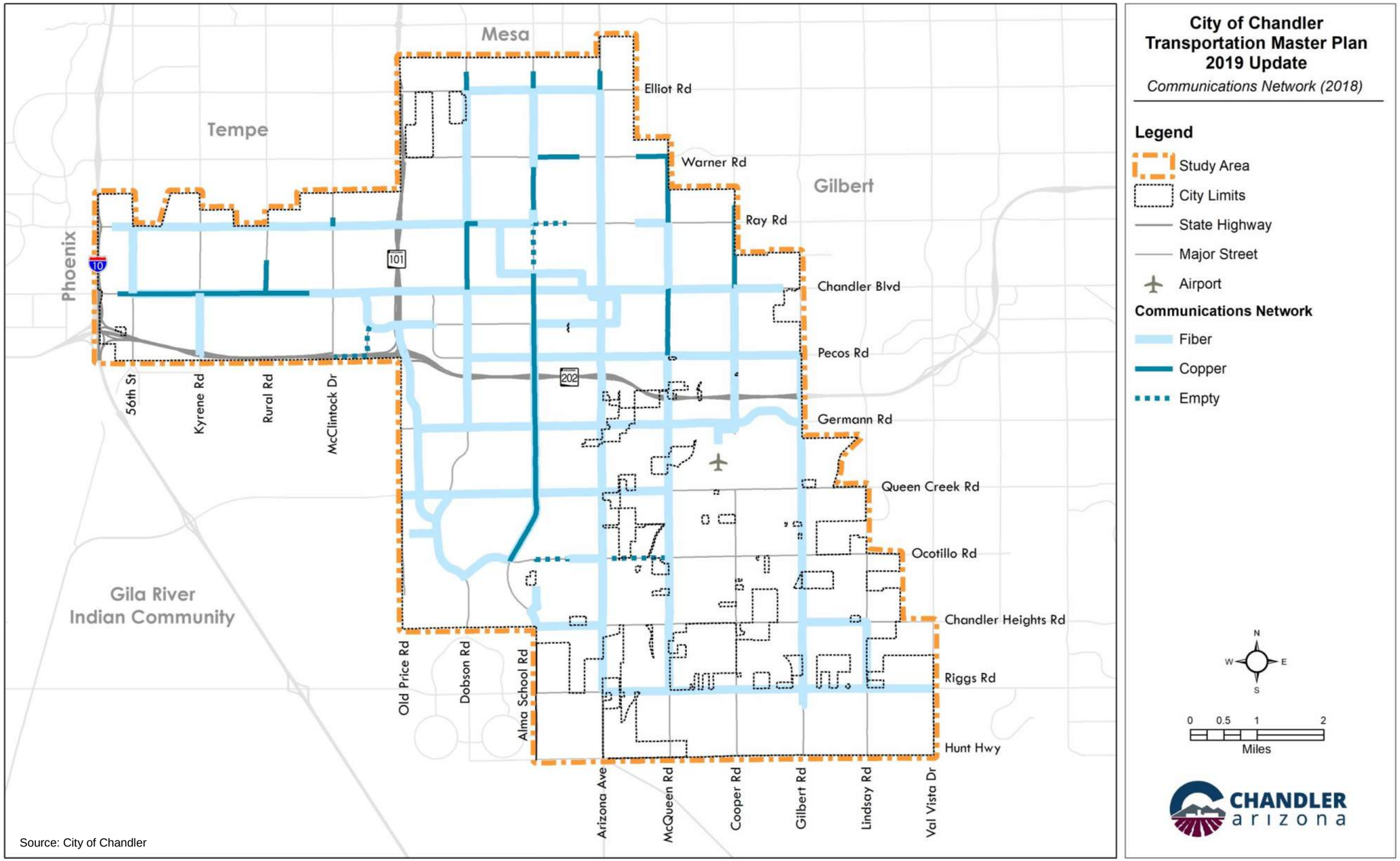


Figure 4-10. Existing Communications Network

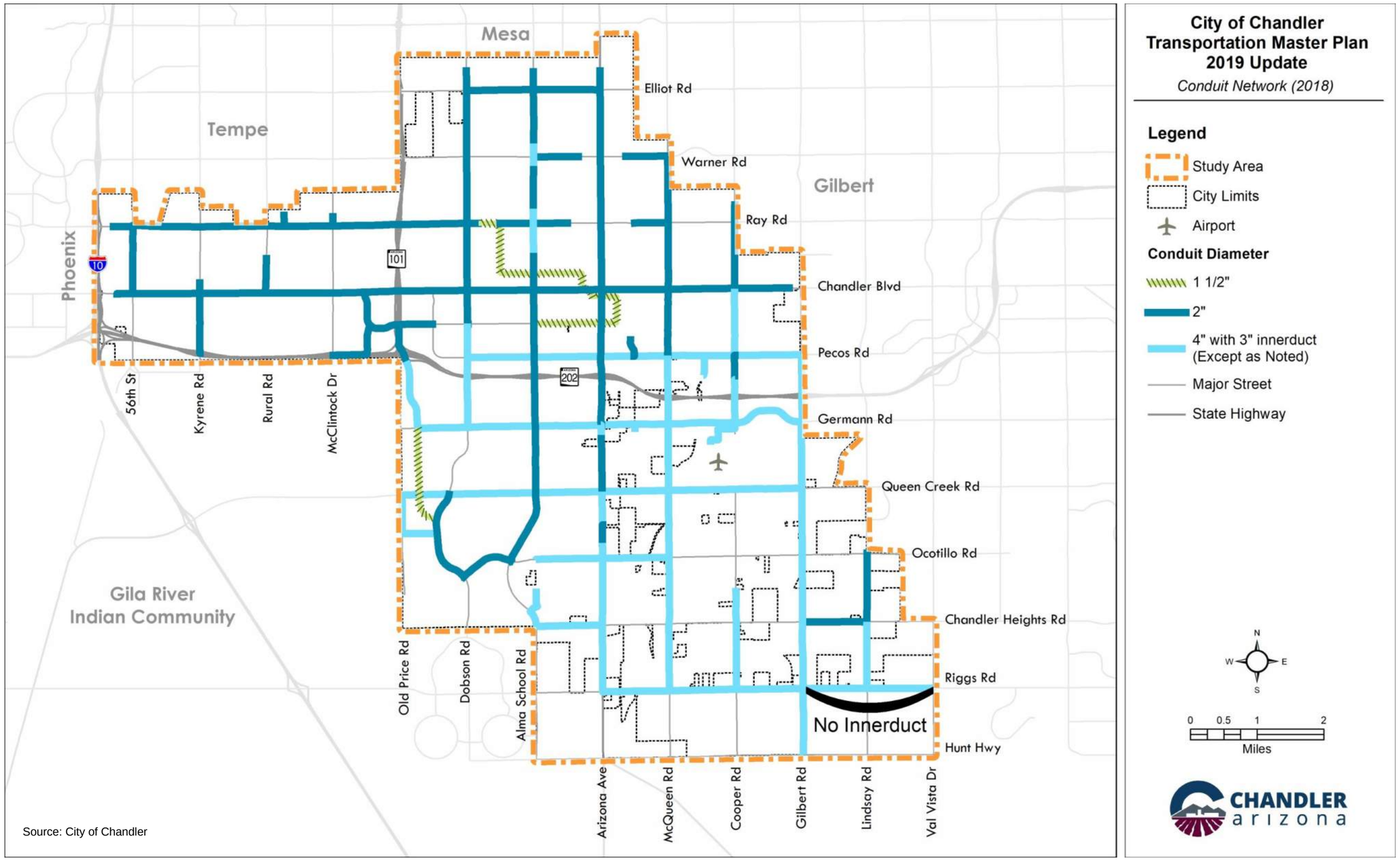


Figure 4-11. Existing Conduit Network

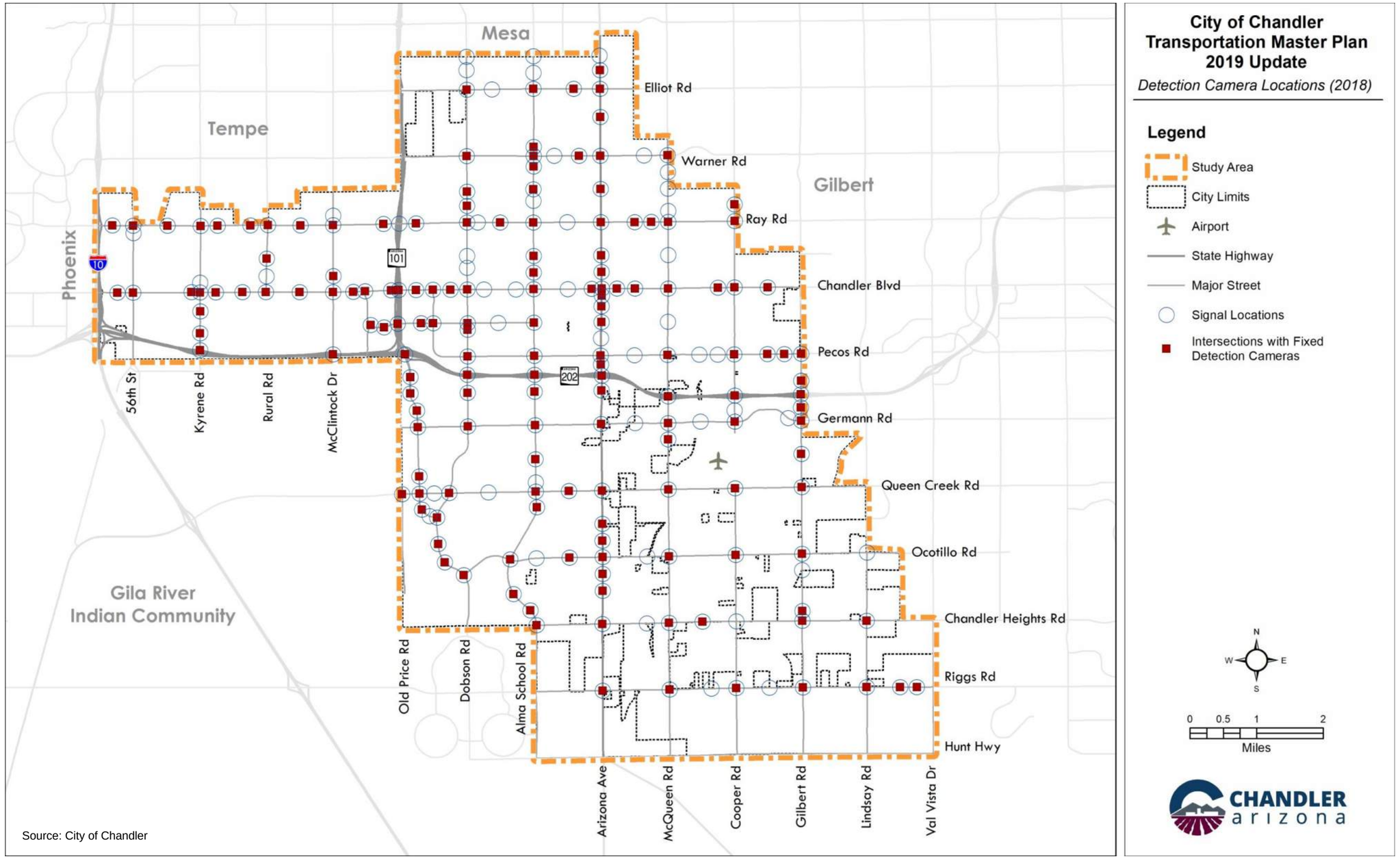


Figure 4-12. Intersections with Fixed Detection Cameras

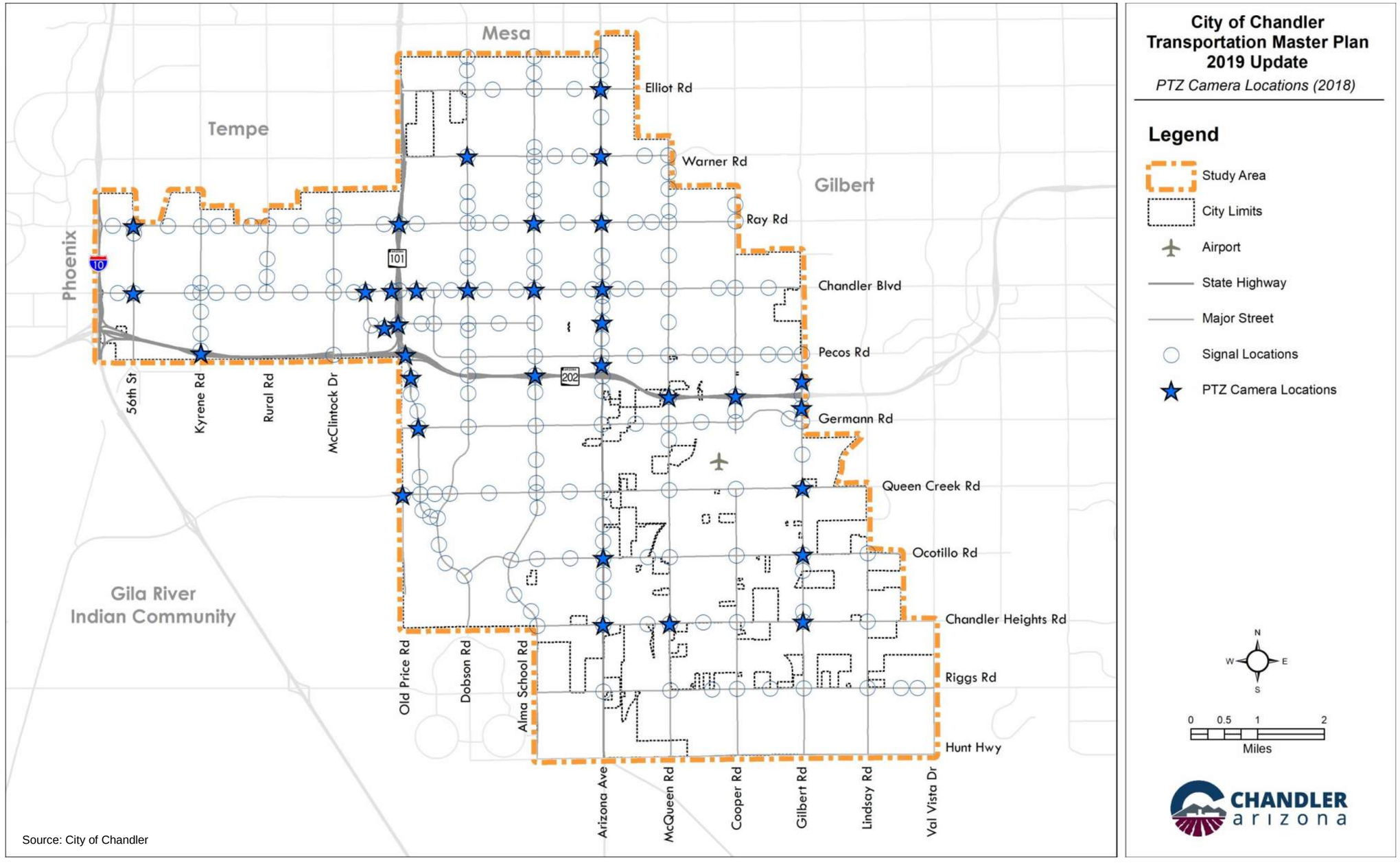


Figure 4-13. Intersections with Pan-Tilt-Zoom CCTV Cameras

There are three permanent arterial dynamic message signs (DMS) installed within the City of Chandler that communicate messages to the travelling public regarding construction activities, lane closures, or delays. The City views DMS as helpful if there are travel route choices to be made that real-time information would help educate the traveling public to determine the best route for their needs. The DMS are installed at the following locations:

- Chandler Boulevard, east of Kyrene Road;
- Price Road, north of Germann Road; and
- Arizona Avenue, north of Germann Road.

Two Rectangular Rapid-Flash Beacons (RRFB) exist in the City, which provide additional motorist warning for pedestrian crossing locations. One of the RRFBs is located within the Downtown Chandler area and the other RRFB is located near Chandler Mall. The RRFB devices are installed at the following locations:

- Arizona Avenue, 400 feet south of Buffalo Street (south of Chandler Boulevard); and
- Chandler Village Drive, 600 feet south of Chandler Boulevard.

The City has explored the use of travel time devices at some intersections along Arizona Avenue and Price Road that supports DMS south of the freeway to provide travel times to destinations along the freeway.

4.1.5.2 Flashing Yellow Arrow signals

Flashing yellow arrows (FYA) have also been deployed more in the City in recent years but are only used during certain times of the day. The FYA provides a flashing yellow arrow indication in addition to the standard red, yellow, and green arrow indications. FYA signals indicate a yield condition and have been shown to improve safety, reduce delay, and allow greater flexibility to handle variable traffic patterns.

4.1.5.3 Asset Management Program

The City has an initial asset management and replacement program in place for signal maintenance and has not undertaken lifecycle analysis or replacement needs related to other intelligent infrastructure. The City has a work order tracking system, Lucity, which tracks maintenance activities related to the intelligent infrastructure.

4.1.5.4 Annual Traffic Counts

Traffic counts are collected at a third of all signalized intersections each year in order to collect traffic counts at all signals once every three years in line with the TMC updating signal timing and the City's Synchro signal timing model every three years.

4.1.5.5 Transportation Management Center Operation

The TMC is able to monitor roadway conditions during incidents and roadway closures and generally is actively involved during longer term closures such as a freeway being closed or a fatality on a local road. The City uses portable message signs during events or long-term closures. There is a formal event

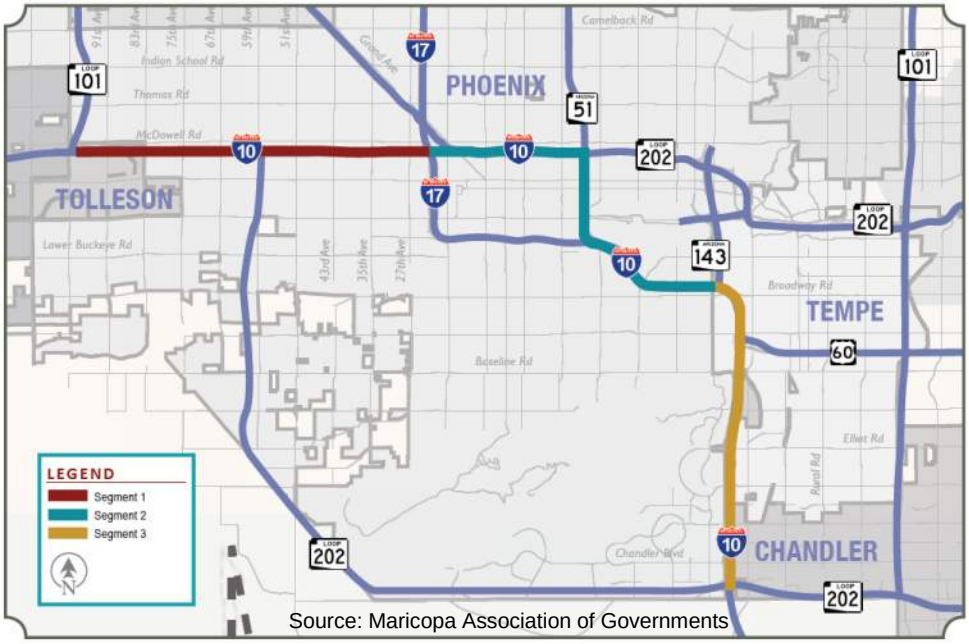
management plan in place for the Ostrich Festival and Light Parade and the TMC is actively involved in event plan review and changes each year to support ingress, parking, and egress to events.

The City has allowed for the capability to broadcast traffic signal phase and timing information to drivers through a partnership with TransSuite and Audi called GreenDriver. This GreenDriver application, while not currently active, would allow for transmission from the City's signal software system the City's signal phase and timing information to the GreenDriver application and out to participating vehicles manufacturers such as Audi.

4.1.5.6 Regional Technology Initiatives

I-10 Integrated Corridor Management (ICM) System Planning and Implementation

ICM is a combination of operational strategies and partnerships to improve throughput, reduce congestion, and coordinate traffic operations across modes. ICM looks at a freeway corridor as a network that includes the freeway, arterials and transit. ICM encourages coordination among each of these facilities to optimize the use of existing infrastructure assets and improve operational efficiency of the corridor. As part of a federal ICM Deployment Planning grant, MAG conducted an ICM project on I-10 between Loop 101 (Price Freeway) and Loop 202 (Santan Freeway), as shown in **Figure 4-14**. Segment 3 of this corridor, which goes from SR 143 to Loop 202, includes the portion of I-10 along the western edge of Chandler.



Source: Maricopa Association of Governments

Figure 4-14. I-10 Integrated Corridor Management Study Area

MAG Systems Management and Operations Plan

Systems Management and Operations (SMO) is a coordinated approach to cost-effectively manage the transportation network. SMO goes beyond a single strategy, and represents a holistic approach to planning, operating, and sustaining a suite of operational capabilities.

In 2016, MAG initiated the SMO Plan for the region. The SMO Plan has provisions to allocate funds to corridors identified in the MAG SMO Plan as ICM Corridors and Regional Priority Corridors. ICM Corridors identified through the City of Chandler are Loop 101 (Price Freeway), Loop 202 (Santan Freeway), and I-10. These ICM Corridors include the freeways and the arterial roadways within one mile on both sides of the freeways. Regional Priority Corridors (ranked from 1 to 100) identified through the City of Chandler are Alma School Road, Dobson Road, Gilbert Road, Ray Road, and Chandler Boulevard, as shown in **Figure 4-15**.

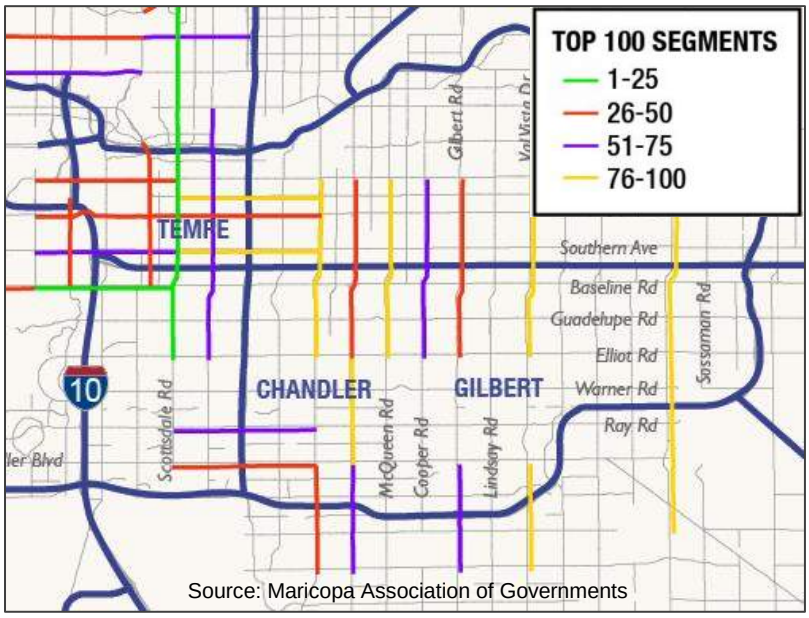


Figure 4-15. Top 100 Scoring Regional Priority Corridors

4.1.6 FUNDING OVERVIEW

Funding sources for roadway improvements are typically a combination of local general funds, regional arterial life cycle revenue funds, the state Highway User Revenue Fund, impact fees, bonds, grants, and federal programs such as Congestion Mitigation and Air Quality (CMAQ) and Highway Safety Improvement Program (HSIP).

4.2 ROADWAY FUTURE CONDITIONS

4.2.1 ANALYSIS PROCESS

The following sections describe the future roadway network and traffic operations for the forecast year 2040. Projected traffic volumes were analyzed to understand future operating conditions, identify roadway capacity and infrastructure needs, and to prioritize recommended future potential roadway capital improvement projects. These recommendations account for known regional and local programmed projects.

4.2.2 PROGRAMMED PROJECTS

Programmed Chandler roadway projects were identified in various fiscal years (FY) in the Chandler FY 2020-2029 Capital Improvement Program (CIP). The City of Chandler annually prepares a CIP, which programs capital improvement projects for the next ten years.

Programmed regional projects are identified in the MAG 2040 Regional Transportation Plan (RTP). The MAG RTP is a comprehensive, multimodal, and regionally coordinated transportation improvement plan. Projects were identified within the MAG 2040 RTP that are within or directly adjacent to the City, although it is recognized other improvements throughout the region may also impact City travel patterns.

The following relevant projects were identified in the FY 2020-2029 CIP and the MAG 2040 RTP. Note that all references to Loop 202 throughout this entire document refer to the Loop 202 – Santan Freeway.

Freeway Improvements:

- Interstate 10: Loop 202 to Riggs Road – Construction of high-occupancy vehicle (HOV) lane and general-purpose lanes;
- Interstate 10: I-17 to Loop 202 – Corridor capacity / interchange improvements;
- Interstate 10 at Chandler Heights Road – Construction of a new traffic interchange;
- Loop 101: Baseline Road to Loop 202 – Construction of general-purpose lanes;
- Loop 202 at Lindsay Road – Construction of a new traffic interchange; and
- Loop 202: I-10 to Val Vista Drive – Construction of general-purpose lanes.

Roadway Improvements:

- Alma School Road: Pecos Road to Germann Road (FY 2021);
- Gilbert Road: Ocotillo Road to Chandler Heights Road (FY 2021);
- Ocotillo Road: Gilbert Road to 148th Street (FY 2021);
- Chandler Heights Road: McQueen Road to Gilbert Road (FY 2021);
- Cooper Road: Alamosa Drive to Riggs Road (FY 2021);
- Chandler Heights Road: Gilbert Road to Val Vista Road (FY 2024);
- Lindsay Road: Ocotillo Road to Hunt Highway (FY 2024);
- Alma School Road: Germann Road to Queen Creek Road (FY 2026);
- Alma School Road: Chandler Boulevard to Pecos Road (FY 2027);
- Kyrene Road: Chandler Boulevard to Loop 202 (FY 2029 – design and right-of-way only);
- Traffic Signal Additions and Repairs (annual funding);
- Landscape Repairs (annual funding);
- Americans with Disabilities Act (ADA) Upgrades (annual funding);
- LED (light-emitting diode) Street Light Upgrades (annual funding); and
- Street Repaving (annual funding).

4.2.3 2040 PROJECTIONS

4.2.3.1 2040 Traffic Projections

Traffic projections were developed using the MAG Regional Travel Demand Model. Travel demand modeling is performed to assess the travel demand characteristics on the regional and arterial roadway network. The MAG Travel Demand Model forecasts daily, peak, and off-peak period vehicular traffic and transit ridership within the MAG region.

The input to the MAG Travel Demand Model incorporates the land use elements of comprehensive general plans adopted by cities and towns within the metropolitan planning area as the basis for its traffic forecasts. Various geographic areas were used to locate the incremental population and employment growth within the Phoenix Metropolitan Area. These areas included Municipal Planning Areas (MPAs), which typically correspond with the incorporated boundaries of cities and towns; Regional Analysis Zones (RAZs), which are geographical subsets of the MPAs; and Traffic Analysis Zones (TAZs), which can be as small as one square mile. The MAG Travel Demand Model input includes socioeconomic data, including population, employment, residential density, race, income, and other factors as well as the roadway system anticipated to be in place for the designated time period.

MAG provided the 2018 and 2040 Average Daily Traffic (ADT) projected volumes from the Travel Demand Model. The difference in the models' volumes indicates the anticipated traffic growth within the City of Chandler between these two years. Recognizing small changes to model elements may create large impacts to a localized area, a more generalized approach to segment growth was used. Analysis indicated varying patterns of growth by geographical area within the City. Growth percentages were developed for each area based on the 2018 and 2040 MAG Travel Demand Model volumes and applied to 2018 counted volumes to develop 2040 daily traffic projections for each roadway segment. The roadway segments with daily traffic volumes greater than 40,000 vehicles are listed in **Table 4-8.** The projected 2040 volumes for the entire roadway network are shown in **Figure 4-16**.

4.2.3.2 2040 Level of Service Projections

The 2040 roadway segment level of service (LOS) was determined using the MAG planned 2040 regional roadway network, which incorporates the freeway improvements and City of Chandler CIP programmed improvements identified previously, along with the 2040 traffic volume projections. **Figure 4-17** shows the roadway segments expected to operate at or near capacity (LOS E and LOS F) under the projected 2040 traffic volumes, assuming no further roadway improvement projects are implemented. The LOS E and LOS F roadway segments are concentrated near the northern and central parts of the City, with several north-south corridors significantly affected. The same methodology used previously for determining existing conditions LOS was used to determine the 2040 LOS. The daily volume ranges corresponding to the various LOS values are shown in **Table 4-9**.

Table 4-8. Roadway Segments with 2040 Daily Volumes of 40,000 Vehicles or Higher

Roadway Segment	From	To	2040 Traffic Volume (vehicles/day)
Arizona Ave	Pecos Rd	Germann Rd	50,800
Price Rd	Pecos Rd	Germann Rd	50,000
Chandler Blvd	Price Rd	Dobson Rd	48,000
Arizona Ave	Germann Rd	Queen Creek Rd	48,000
Alma School Rd	Pecos Rd	Germann Rd	46,800
NB/SB Price Frontage Rd	Chandler Blvd	Pecos Rd	46,100
Ray Rd	Price Rd	Dobson Rd	45,500
McQueen Rd	Queen Creek Rd	Ocotillo Rd	45,500
Warner Rd	Dobson Rd	Alma School Rd	45,300
Arizona Ave	Queen Creek Rd	Ocotillo Rd	43,900
Alma School Rd	Germann Rd	Queen Creek Rd	43,500
McQueen Rd	Germann Rd	Queen Creek Rd	43,500
NB/SB Price Frontage Rd	Ray Rd	Chandler Blvd	43,200
Ray Rd	Dobson Rd	Alma School Rd	41,700
Elliot Rd	Price Rd	Dobson Rd	41,600
Warner Rd	Alma School Rd	Arizona Ave	41,600
Ray Rd	McClintock Dr	Price Rd	41,500
Chandler Blvd	Dobson Rd	Alma School Rd	41,100
Elliot Rd	Dobson Rd	Alma School Rd	40,900
Warner Rd	Price Rd	Dobson Rd	40,800
Chandler Blvd	McClintock Dr	Price Rd	40,300

Table 4-9. Average Daily Traffic Volume Thresholds for Estimating Level of Service

Functional Classification	Number of Through Lanes	Average Daily Traffic Volume Thresholds		
		LOS D	LOS E	LOS F
Arterial	2	12,200 - 15,300	15,301 - 16,100	> 16,100
	4	27,500 - 32,200	32,201 - 33,900	> 33,900
	4 with 6 at intersection	35,100 - 37,100	37,100 - 42,900	> 42,900
	6	42,200 - 48,500	48,501 - 50,900	> 50,900

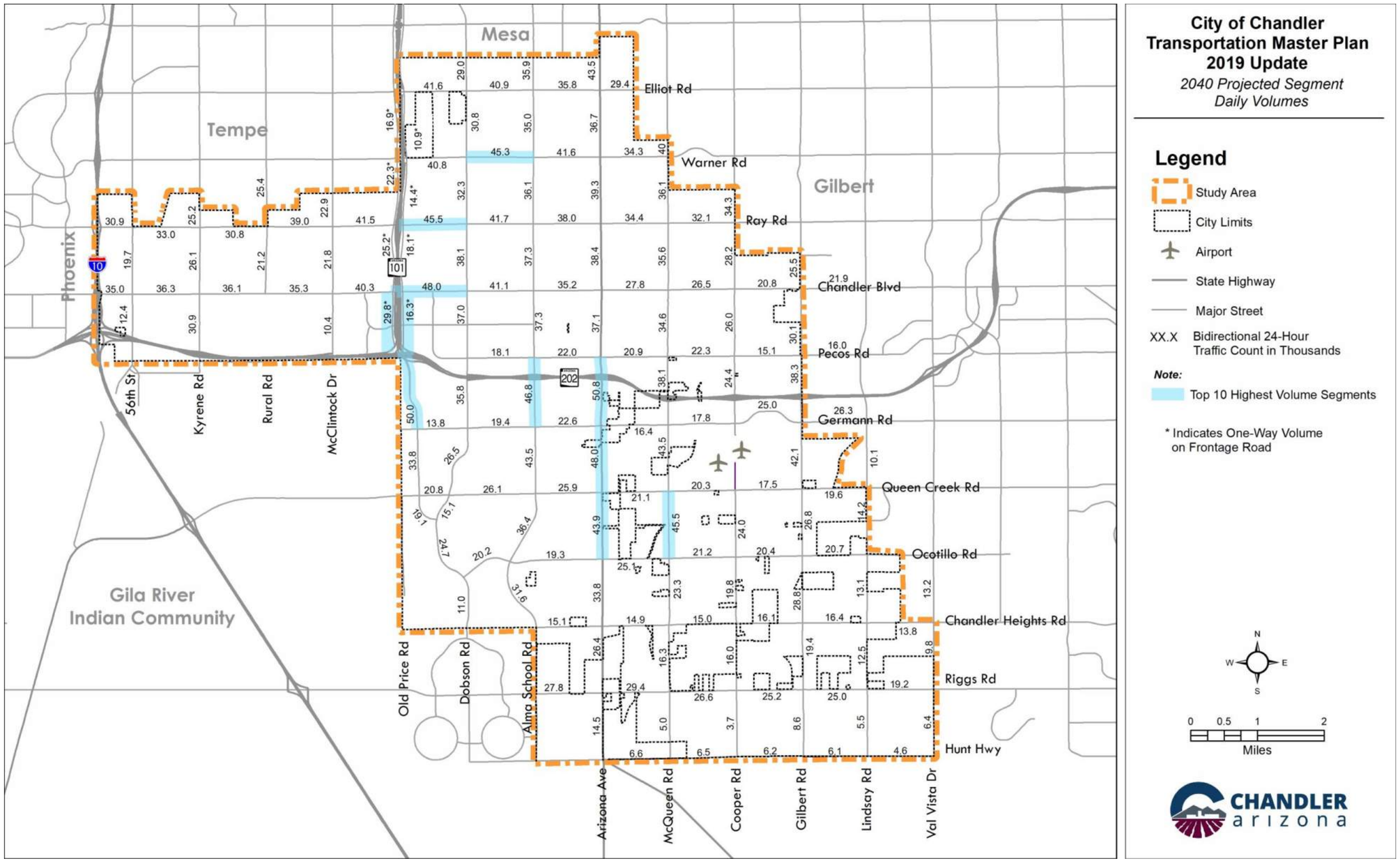


Figure 4-16. 2040 Average Daily Traffic Volume Projections

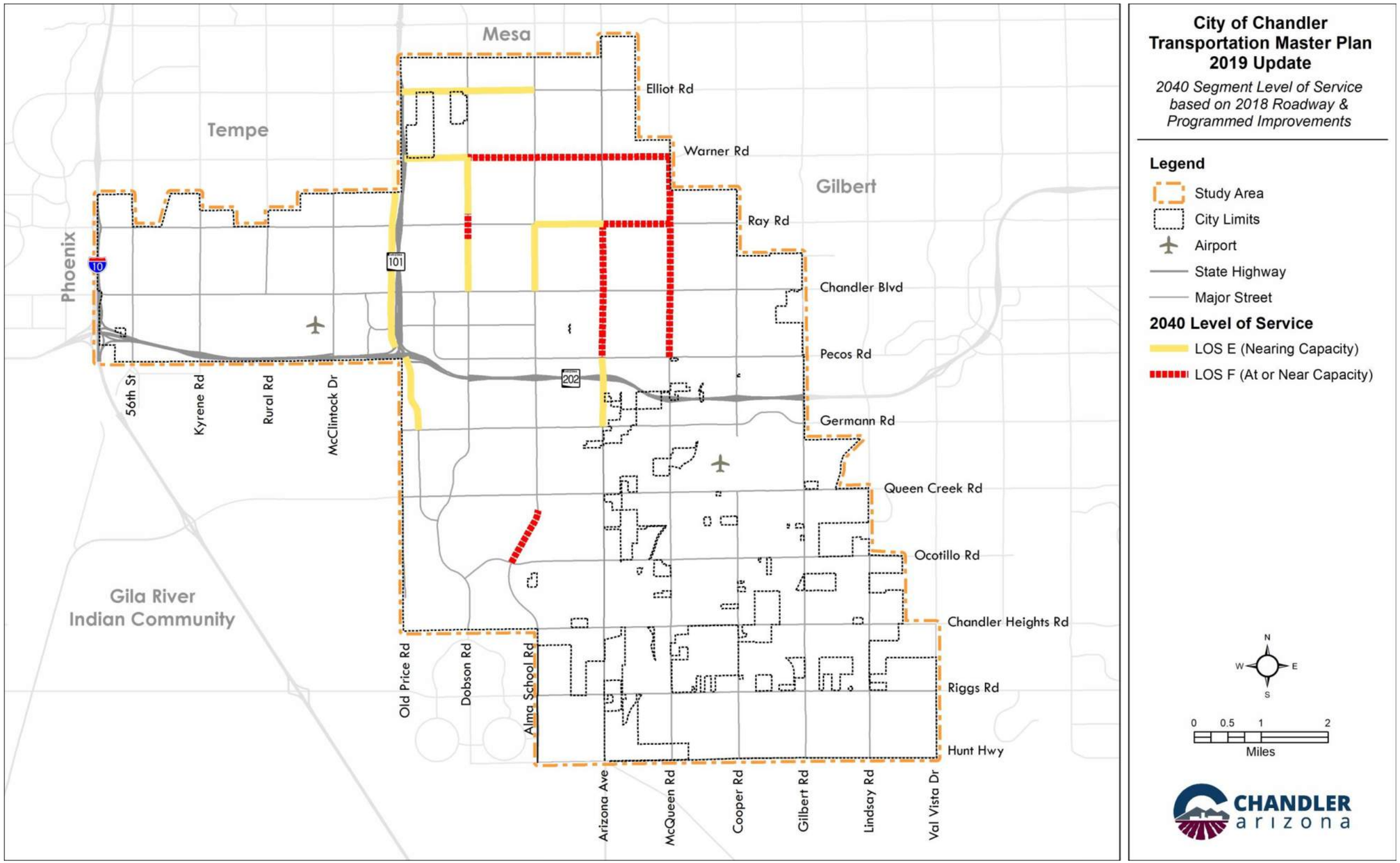


Figure 4-17. 2040 Level of Service Accounting for Programmed Projects and Planned MAG Roadway Network

4.2.4 ROADWAY RECOMMENDATIONS

A well-managed roadway system includes capital construction, maintenance, and operation of the roadway system. The capital component is the construction or improvement of a roadway and includes associated elements such as landscaping, lighting, traffic signals, and other enhancements. Operation and maintenance of a roadway system includes pavement preservation and rehabilitation, traffic operations, traffic safety, and other routine roadway upgrades.

The following sections identify the recommended roadway improvements and a draft implementation plan through the year 2040. The actual implementation of these improvements will depend on several factors, including available funding and development patterns.

4.2.4.1 Basis of Arterial Roadway Improvements

Recommended arterial roadway improvements are primarily based on the identified 2040 LOS but can also be based on impending development or the need to provide continuity in the roadway network. The City has a desire to generally maintain a minimum LOS D, with LOS E or LOS F acceptable at select locations due to the high cost of purchasing the right-of-way (ROW) necessary to widen the road, known difficulty of obtaining the ROW, or where other considerations have been identified. The locations where LOS E or LOS F are considered acceptable include:

- Arizona Avenue in the Downtown Area between Ray Road and Pecos Road (LOS F);
- Alma School Road, from Chandler Boulevard north to the City limits (LOS E); and
- Dobson Road, from Chandler Boulevard north to the City limits (LOS E).

Some locations within the City, such as the one-way Price Frontage Roads north of Chandler Boulevard, are not under the ownership of the City but rather are owned by the Arizona Department of Transportation (ADOT). Improvements to these segments and intersections leading to and from any other ADOT facility have not been identified for improvement by the City.

4.2.4.2 Definition of Arterial Roadway Improvement Options

Analyses were conducted to recommend the minimum capacity improvement needed to accommodate the estimated 2040 future traffic projections at LOS D or better operation (with a few exceptions where LOS E or LOS F is acceptable, as discussed earlier). Detailed investigation was not conducted on an individual link or intersection basis to determine if constraints exist that would make the improvement cost-prohibitive. Additional more detailed study will be needed in the future to confirm needed capacity improvements before design of improvements commences.

The following four arterial roadway capacity improvement options were considered:

- Widen minor arterial roadways to provide four continuous travel lanes;
- Widen major arterial four-lane arterials at major intersections to provide six travel lanes through the intersection;
- Widen major arterial roadways to provide six continuous travel lanes; and
- Make other capacity improvements at intersections.

The minimum improvement to achieve acceptable LOS operation under the projected 2040 daily volume scenario was recommended.

Widen Two-Lane Sections to Four Lanes

Existing two-lane arterials do not meet the City's design standards for major or minor arterial street cross-sections and are inadequate to meet the future needs of vehicles, pedestrians, and bicyclists. The two-lane arterial roadways require complete reconstruction to add travel lanes, bike lanes, and sidewalk on each approach. Currently, the City has a number of two-lane arterial segments that are in design, or that are programmed, for widening to four lanes. It is recommended that all remaining City-owned two-lane minor arterials be widened to provide a minimum of four lanes, based on designated roadway classifications, with the ability to accommodate multimodal operation that includes pedestrians, bicyclists, and transit.

Widen Four-Lane Sections to Six Lanes at Arterial Intersections

The City's design recommendations follow the Highway Capacity Manual where signalized intersections constrain capacity along an urban corridor. To increase the capacity of a four-lane major arterial roadway without widening the segment to six continuous lanes, intersection approach and departure areas can be upgraded to provide three directional travel lanes through the major intersections. This allows the narrower roadway segment between major intersections to remain four lanes instead of requiring six travel lanes along the entire length of the roadway segment.

Per the aforementioned LOS methodology, a four-lane roadway with six travel lanes through major intersections can accommodate 4,900 additional daily vehicles at LOS D when compared to intersections without intersection widening. This incremental capacity improvement may accommodate the daily projected volumes, extending the ability of a four-lane roadway to accommodate the projected demand. To increase the capacity of a four-lane roadway prior to its need for six lanes, a review of the adjacent arterial intersections was conducted. If the 2040 volume projection for a roadway segment can be accommodated at LOS D by increasing the adjacent arterial-arterial intersection through lanes from four to six, the four-lane cross-section along the corridor should be maintained and only intersection improvements to widen to six through lanes are needed.

Widen Four-Lane Sections with Improved Intersections to Six Lanes

If a major arterial roadway segment's projected 2040 daily volume is above the threshold value for LOS D for a four-lane roadway segment with six lanes at intersections, then a six-lane arterial is recommended. If the roadway segment's ADT is projected to be greater than the six-lane threshold volume for LOS D, then additional intersection widening, if not already in place (dual left-turn lanes and exclusive right-turn lanes) would be recommended or other capacity enhancements (transit, access management, signal timing improvements) should be considered.

It is recommended that the City not widen a roadway cross-section beyond six through travel lanes, as going to more than six through travel lanes would result in significant impacts to adjacent properties.

Make Other Capacity Improvements at Intersections

There are some intersections where the number of through travel lanes is adequate, but additional turn lanes are needed to increase the capacity of the intersections.

Improvement Methodology

A stepwise methodology was used to determine the improvement required to maintain LOS D or better on a given roadway segment. The following approach was used to determine the level of improvement based on the daily volume projections of the 2040 roadway network:

- If a two-lane facility operated at LOS E or LOS F, the segment was analyzed to determine if a four-lane segment was adequate;
- If a four-lane section did not provide the required capacity, then a four-lane section with six through lanes at the adjacent arterial-arterial intersections was considered;
- If a four-lane arterial with improved intersections did not provide sufficient capacity, a six-lane arterial was proposed; and
- If a six-lane arterial operated at LOS E or LOS F under 2040 projected volumes, then no further roadway widening was considered. The LOS would remain as-is and/or other trip reduction measures in the corridor would be considered.

4.2.4.3 Future Arterial Roadway Plan

Based on the LOS analysis results and input from the City on known operational issues, roadway improvements beyond what is already programmed are recommended on one or more segments of the following arterial roadways:

East/West Roadways:

- Elliot Road;
- Warner Road with intersection improvements at Arizona Avenue and McQueen Road;
- Ray Road with intersection improvements at McQueen Road;
- Chandler Boulevard;
- Pecos Road; and
- Germann Road with intersection improvements at Arizona Avenue.

North/South Roadways:

- 56th Street;
- Kyrene Road with intersection improvements at Chandler Boulevard;
- Ellis Road;
- Dobson Road with intersection improvements at Ray Road;
- Alma School Road; and
- McQueen Road with intersection improvements at Ray Road, Warner Road, and Chandler Boulevard.

No improvements are recommended for the following roadway segments where the City has determined LOS E or LOS F is considered acceptable due to ROW constraints and other factors:

- Arizona Avenue in the Downtown Area between Ray Road and Pecos Road;
- Alma School Road between Ray Road and Chandler Boulevard; and
- Dobson Road between Warner Road and Chandler Boulevard.

Intersections recommended for capacity improvements are:

- Pecos Road/Arizona Avenue;
- Germann Road/Price Road; and
- Ocotillo Road/Alma School Road.

While Hunt Highway is classified as a collector, speeds are often typically more in the range of what would be expected on an arterial due to minimal access points and no development on the south side of the roadway. It is recommended that a study be conducted to assess potential traffic calming features that could slow speeds on Hunt Highway between Cooper Road and Val Vista Drive. The construction of these traffic calming features should be coordinated with the construction of separated/buffered bike lanes on this same segment of Hunt Highway to better promote safe bicycle travel. This project would likely qualify for federal funding from the bicycle/pedestrian, surface transportation block grant program (STBGP), and congestion mitigation/air quality (CMAQ) programs.

Buses serving the park-and-ride facility south of Germann Road at Hamilton Street currently access Loop 202 using Arizona Avenue, which leads to increased travel time and congestion. The City is currently evaluating potential direct high-occupancy vehicle (DHOV) ramps on Loop 202 at the Hamilton Street alignment with a new connector street going between the Loop 202 DHOV ramps and the park-and-ride lot. The construction of the Loop 202 DHOV ramps and freeway to park-and-ride connector would reduce congestion on Arizona Avenue between Loop 202 and Germann Road, so this potential improvement is included herein. This project would likely qualify for regional or federal funding.

4.2.4.4 Capital Improvement Arterial Roadway Recommendations

The arterial roadway improvements recommended to maintain acceptable service levels though the 2040 horizon year need to be included in an implementation plan. The following methodology was used to determine the priority for each roadway system improvement:

- If the roadway segment operates at LOS E or LOS F under existing 2018 conditions, the specific improvement to bring the segment to LOS D or better conditions under forecasted 2040 volumes received highest priority and was placed into the 2020 - 2025 (near-term) improvement category;
- If the roadway segment operates at LOS D or better under existing 2018 conditions but at LOS E or LOS F before 2030, then the specific improvement to bring the segment to LOS D or better conditions by 2040 was placed into the 2026 - 2030 (mid-term) improvement category; and
- If the existing roadway segment operates at LOS D or better under existing 2018 and 2030 conditions but at LOS E or LOS F before 2040, or if other circumstances dictate roadway changes, the improvement was placed into the 2031 - 2040 (long-term) improvement category.

Additionally, the City has provided input on operational constraints within the network that may not be reflected in the level of service analysis, improvements due to impact fee collections, or recommended prioritization in a different time horizon than would be indicated by the above methodology. This direction has been considered as appropriate.

Based on the methodology described and input from the City, the roadway improvements have been placed into one of three categories corresponding to near-term, mid-term, or long-term horizon periods. These priorities are subject to change over time in conjunction with changes in land use, traffic congestion, traffic patterns, or other conditions.

Figure 4-18 through **Figure 4-20** display the recommended roadway improvements in each of the time categories based on the above methodology. Additionally, where applicable, these figures show programmed projects within the City as well as within the Town of Gilbert that are adjacent to the City limits. **Figure 4-21** shows all the roadway improvements that are programmed or recommended in the 2020 - 2040 timeframe to bring the projected 2040 horizon year operations to LOS conditions that are deemed acceptable by the City (as previously defined). **Figure 4-22** shows the arterial roadway network number of lanes after all recommended improvements have been implemented.

4.2.4.5 Capital Improvement Arterial Roadway Recommendation Costs

The City has provided estimated roadway improvement costs based on recent planning-level cost estimates in 2019 dollars. The cost of construction per mile of roadway includes the cost for design, ROW, construction phases, and other elements. Intersection capacity improvement costs were estimated based on proportion to the arterial widening costs. The following improvement cost estimates were assumed:

Roadway Segments

- Arterial widening from two to six lanes = $18 million per mile;
- Arterial widening from two to four lanes = $16 million per mile;
- Arterial widening from four to six lanes (widen into 40-foot median) = $5 million per mile; and
- Arterial widening from four to six lanes (widen to outside of roadway) = $13 million per mile.

Intersection Capacity Improvements

- Major capacity improvements: Includes dual left-turn lanes, right-turn lanes, additional through lanes, major ROW acquisition, and major wet and dry utility relocations = $12 million per intersection; and
- Minor capacity improvements: Includes right-turn lanes, minor ROW acquisition, and minor utility relocations = $6 million per intersection.

It is understood that improvement costs can vary significantly between projects based on subsurface differences, physical features such as railroad, canal, or utility crossings, and other physical conditions such as signal installations, median construction, landscaping needs and ROW acquisition costs. Additional more detailed study will be needed in the future to refine improvement costs leading up to and during the design of improvements. However, these planning-level costs serve to provide a level-of-magnitude cost for anticipated improvements for preliminary programming purposes.

Table 4-10 through **Table 4-12** show the capital improvement roadway recommendations with their associated costs for each time period based on the type of improvement indicated. Programmed projects and their costs are not shown in these tables as these tables indicate what additional funding is needed beyond what is already programmed. It should also be noted that some improvements (i.e., Pecos Road between Ellis Road and Dobson Road, and Ellis Road between Frye Road and Pecos Road) are anticipated to be a joint City-developer responsibility where the City will likely incur some yet-to-be-determined percentage of the cost during the improvement process.

The total cost of all recommended arterial roadway improvements in 2019 dollars for the 2020 - 2040 timeframe calculates to $261.30 million, as shown in **Table 4-13**.

Figure 4-18. Capital Improvement Arterial Roadway Near-Term Recommendations 2020 - 2025

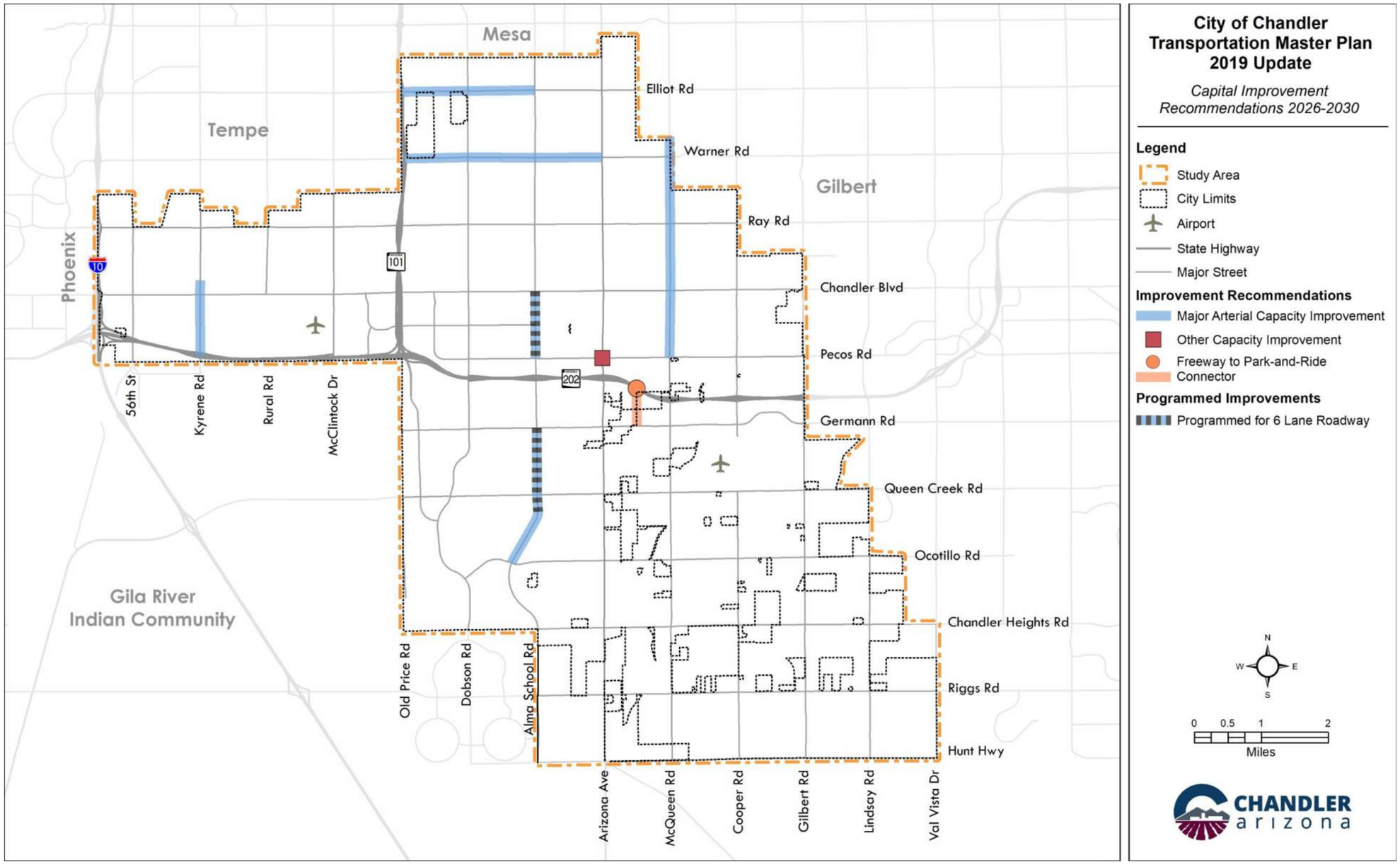


Figure 4-19. Capital Improvement Arterial Roadway Mid-Term Recommendations 2026 - 2030

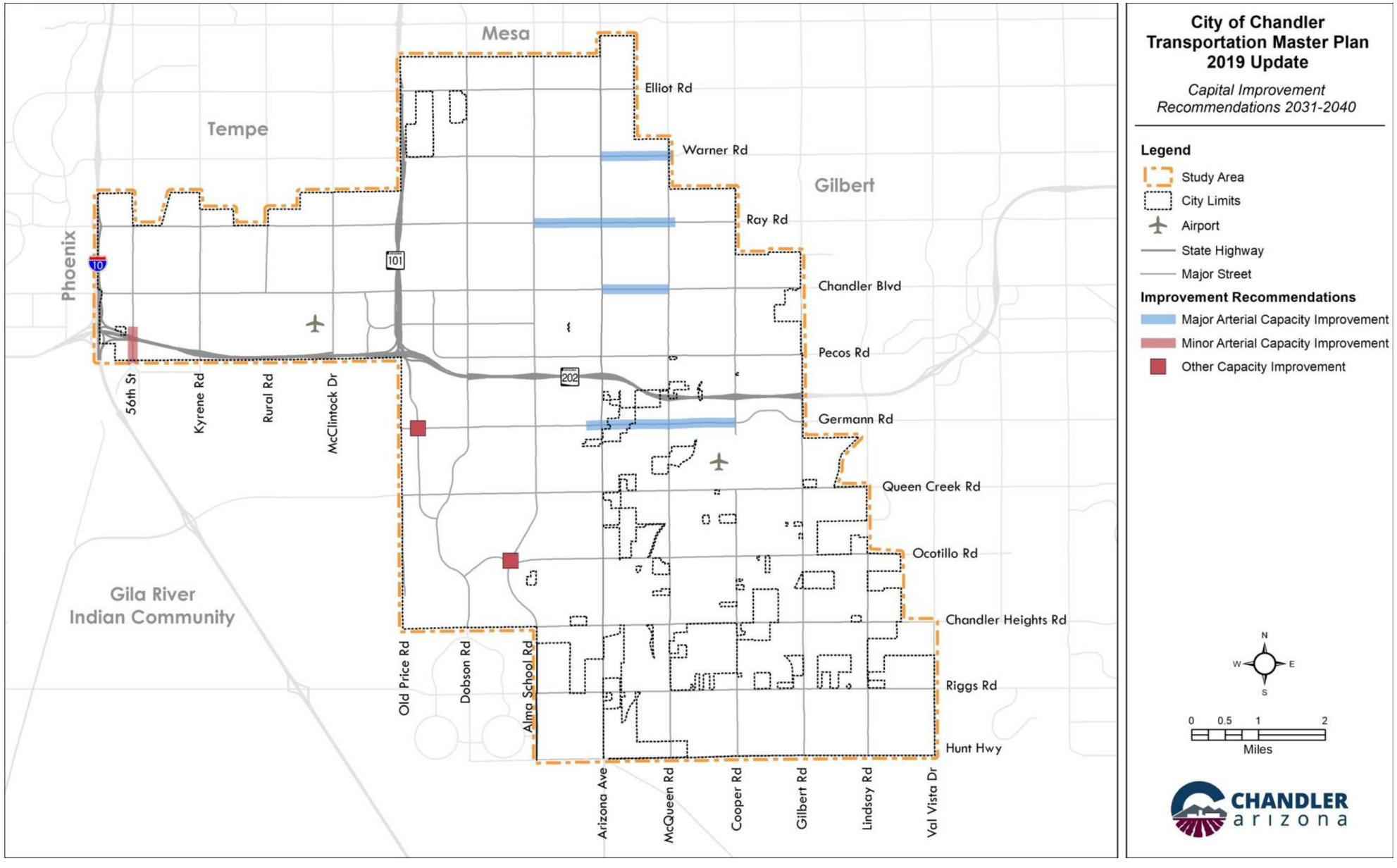


Figure 4-20. Capital Improvement Arterial Roadway Long-Term Recommendations 2031 - 2040

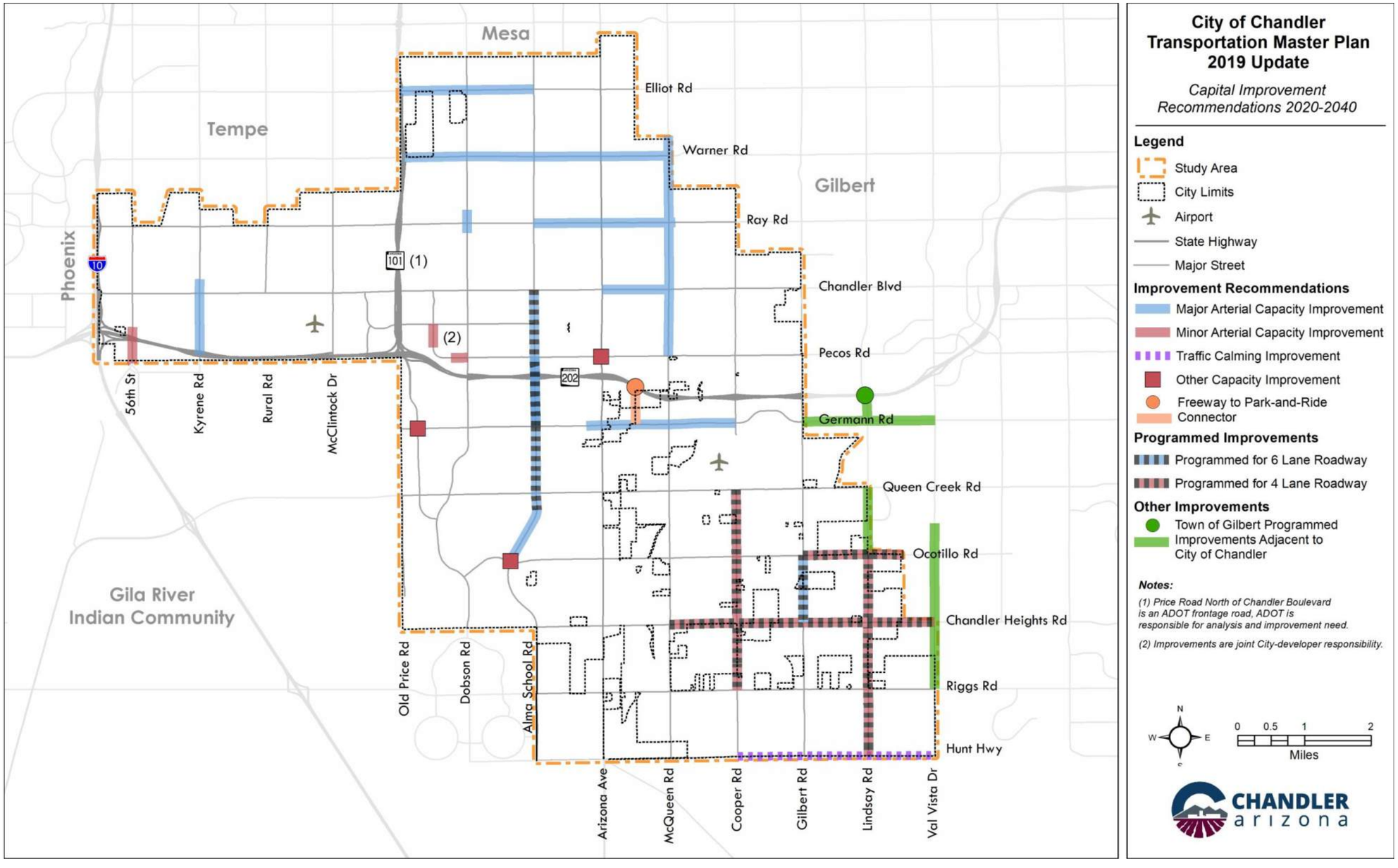


Figure 4-21. Capital Improvement Arterial Roadway Recommendations 2020 - 2040

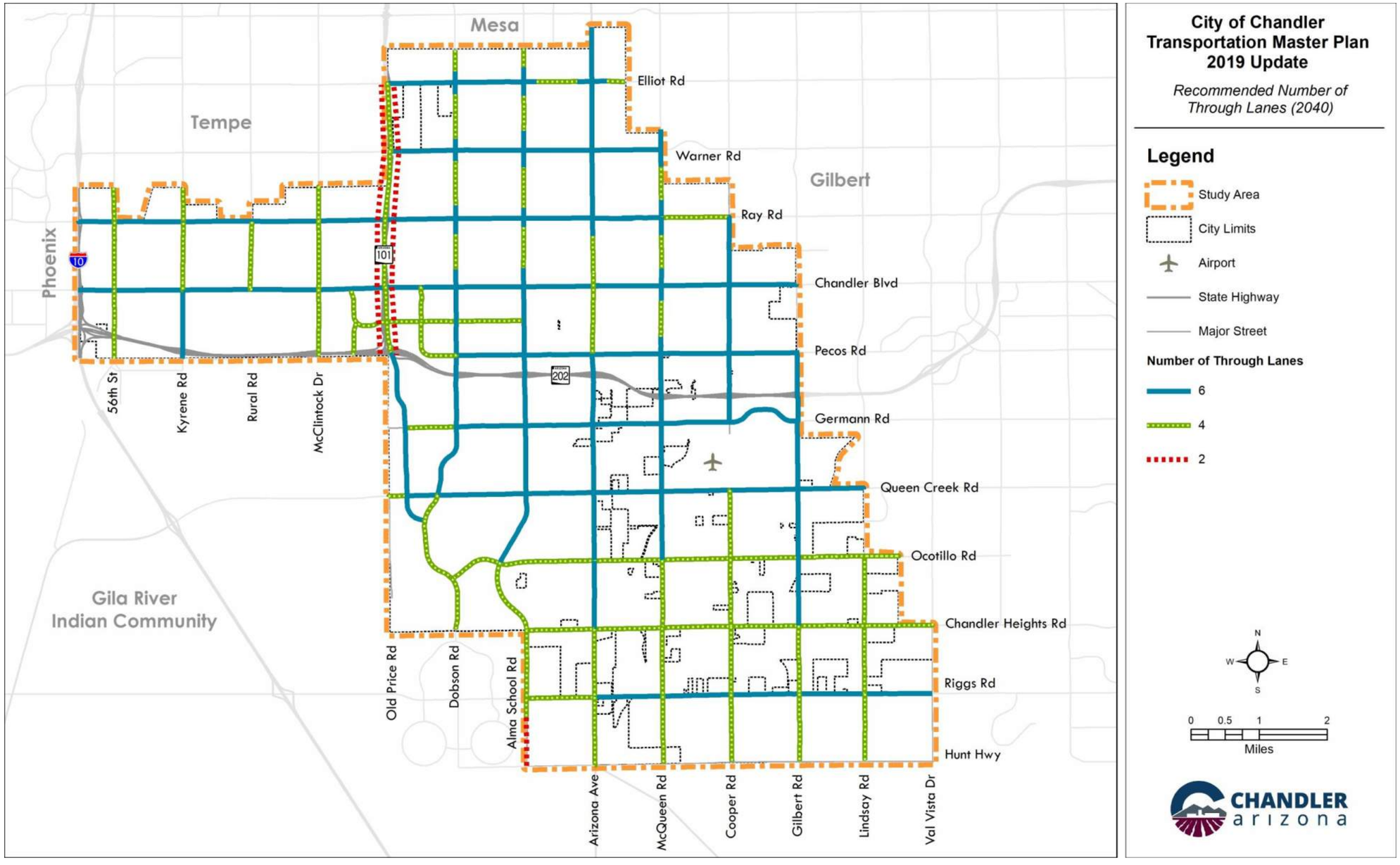


Figure 4-22. 2040 Recommended Number of Lanes on Arterials

Table 4-10. Capital Improvement Arterial Roadway Near-Term Recommendations 2020 - 2025

Roadway Improvements [1]					
Roadway	**Segment**		**Number of Lanes**		**2019 Cost (Millions)**
			Existing	**Recommended**	
Pecos Rd [2]	Ellis Rd	Dobson Rd	2	4	$ 4.0
Ellis Rd [2]	Frye Rd	Pecos Rd	2	4	$ 4.0
Dobson Rd	N. of Ray Rd	S. of Ray Rd	4	6	$ 4.0
Hunt Hwy [3]	Cooper Rd	Val Vista Dr	2	2	$ 18.0
Other Capacity Improvements					
Location		**Improvement Type**			**2019 Cost (Millions)**
Hamilton St between Loop 202 and park-and-ride facility		Predesign, design, and ROW for DHOV ramps and freeway to park-and-ride connector			$ 2.3
Subtotal for Near-Term 2020 - 2025 Recommendations					*$ 32.3*

Notes: (1) Programmed Projects Not Shown. (2) Joint City-Developer Project. (3) Traffic Calming Project: Coordinate with Separated/Buffered Bike Lane Project.

Table 4-11. Capital Improvement Arterial Roadway Mid-Term Recommendations 2026 - 2030

Roadway Improvements [1]					
Roadway	**Segment**		**Number of Lanes**		**2019 Cost (Millions)**
			Existing	**Recommended**	
Elliot Rd	Price Rd	Dobson Rd	4	6	$ 13.0
Elliot Rd	Dobson Rd	Alma School Rd	4	6	$ 13.0
Warner Rd	Price Rd	Dobson Rd	4	6	$ 13.0
Warner Rd	Dobson Rd	Alma School Rd	4	6	$ 13.0
Warner Rd	Alma School Rd	Arizona Ave	4	6	$ 13.0
Kyrene Rd	N. of Chandler Blvd	Loop 202	4	6	$ 18.0
Alma School Rd	S. of Queen Creek Rd	Ocotillo Rd	4	6	$ 5.0
McQueen Rd [2]	N. of Warner Rd	Ray Rd	4	6	$ 11.0
McQueen Rd [2]	Ray Rd	Chandler Blvd	4	6	$ 11.0
McQueen Rd [2]	Chandler Blvd	Pecos Rd	4	6	$ 13.0
Other Capacity Improvements					
Location		**Improvement Type**			**2019 Cost (Millions)**
Pecos Rd/Arizona Ave intersection		Intersection Capacity			$ 6.0
Hamilton St between Loop 202 and park-and-ride facility		Construction of DHOV ramps and freeway to park-and-ride connector			$ 19.0
Subtotal for Mid-Term 2026 - 2030 Recommendations					*$ 148.0*

Note: (1) Programmed Projects Not Shown. (2) 6 Lanes Assumed to Be Needed at Major Intersections Only.

Table 4-12. Capital Improvement Arterial Roadway Long-Term Recommendations 2031 - 2040

Roadway Improvements					
Roadway	**Segment**		**Number of Lanes**		**2019 Cost (Millions)**
			Existing	**Recommended**	
Warner Rd	Arizona Ave	McQueen Rd	4	6	$ 13.0
Ray Rd	Alma School Rd	Arizona Ave	4	6	$ 13.0
Ray Rd	Arizona Ave	McQueen Rd	4	6	$ 5.0
Chandler Blvd	Arizona Ave	McQueen Rd	4	6	$ 13.0
Germann Rd	W. of Arizona Ave	McQueen Rd	4	6	$ 8.0
Germann Rd	McQueen Rd	Cooper Rd	4	6	$ 11.0
56th St	Frye Rd	Pecos Rd	2	4	$ 6.0
Other Capacity Improvements					
Location		**Improvement Type**			**2019 Cost (Millions)**
Germann Rd/ Price Rd intersection		Intersection Capacity			$ 6.0
Ocotillo Rd/ Alma School Rd intersection		Intersection Capacity			$ 6.0
Subtotal for Long-Term 2031 - 2040 Recommendations					*$ 81.0*

Table 4-13. Cost of Capital Improvement Arterial Roadway Recommendations 2020 - 2040

Time Period	Total 2019 Cost of Recommendations (1)
2020 - 2025	$32,300,000
2026 - 2030	$148,000,000
2031 - 2040	$81,000,000
Total Costs	**$261,300,000**

Note: (1) Programmed Projects Not Included.

4.2.4.6 Other Potential Roadway Improvements

Freeway Access Enhancements

Potential freeway capacity and operational enhancements near the Loop 202/I-10 interchange, the Loop 101/Loop 202 interchange, and the Loop 101/Chandler Boulevard interchange were identified by the City. Although the potential enhancements have not been modeled or analyzed as part of the Transportation Master Plan 2019 Update, they are identified for further study and are shown schematically in **Figure 4-23** through **Figure 4-25**. These improvements will provide additional access to and from the freeway, thus improving and distributing arterial street traffic and reducing congestion. It is recommended that these proposed freeway improvements be reviewed by ADOT for consideration to be funded in the next Freeway Life Cycle Program that will likely be part of a Maricopa County Proposition 400 half-cent sales tax extension.

Figure 4-23. Potential Freeway Enhancement – Loop 202 Westbound Frontage Road at Kyrene Road

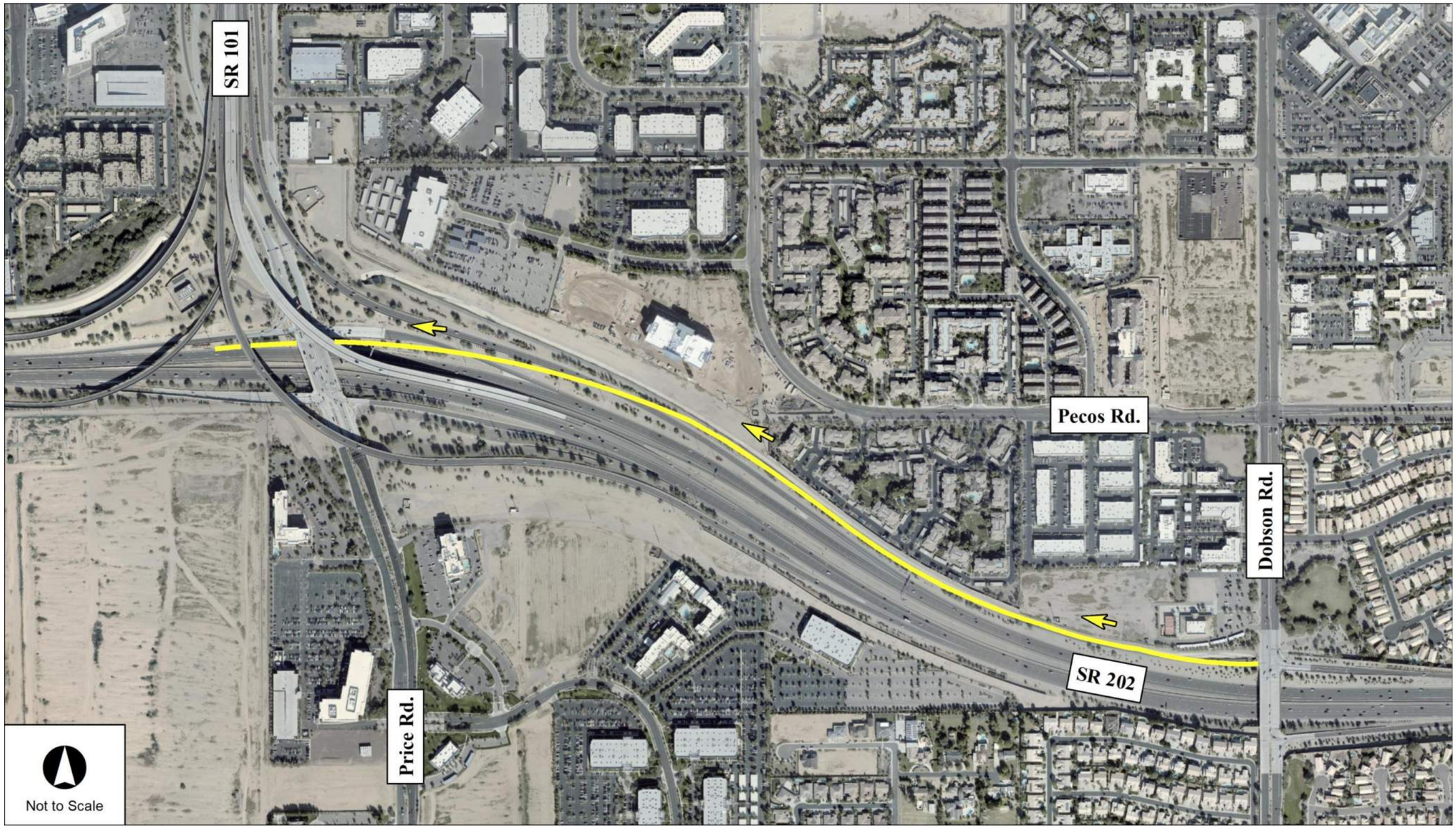


Figure 4-24. Potential Freeway Enhancement – Dobson Road Westbound Loop 202 On-Ramp

Figure 4-25. Potential Freeway Enhancement – Frye Road Northbound Loop 101 On-Ramp

The City provided high-level preliminary planning cost estimates for these three freeway access enhancements, which were $14M for the Loop 202 westbound frontage road at Kyrene Road, $18M for the Loop 202 Dobson Road westbound on-ramp, and $8M for the Loop 101 Frye Road northbound on-ramp.

Collector Street Enhancements

While collector streets are not the focus of this document, it is recommended that the City establish potential collector street alignments in the remaining larger undeveloped areas. These potential alignments should be coordinated with property developers for final alignment and any needed traffic calming. **Figure 4-26** shows these proposed collector street alignments with traffic calming that are the responsibility of the adjacent or nearby land developers for design and construction, and separately shows a few collector streets that the City currently has programmed for construction.

One of these potential collector streets of particular interest to the City is a new industrial collector street that extends north along the Cooper Road alignment from Queen Creek Road and then bends to the east, connecting into Ryan Road at Emmett Drive. This collector street would provide additional access on the south side of the Chandler Airport and improve the connectivity of the City's overall roadway network. Because this project benefits the airport, the City could potentially pursue federal and state airport improvement funds. The City provided a high-level preliminary planning cost estimate of $8M for this new industrial collector street.

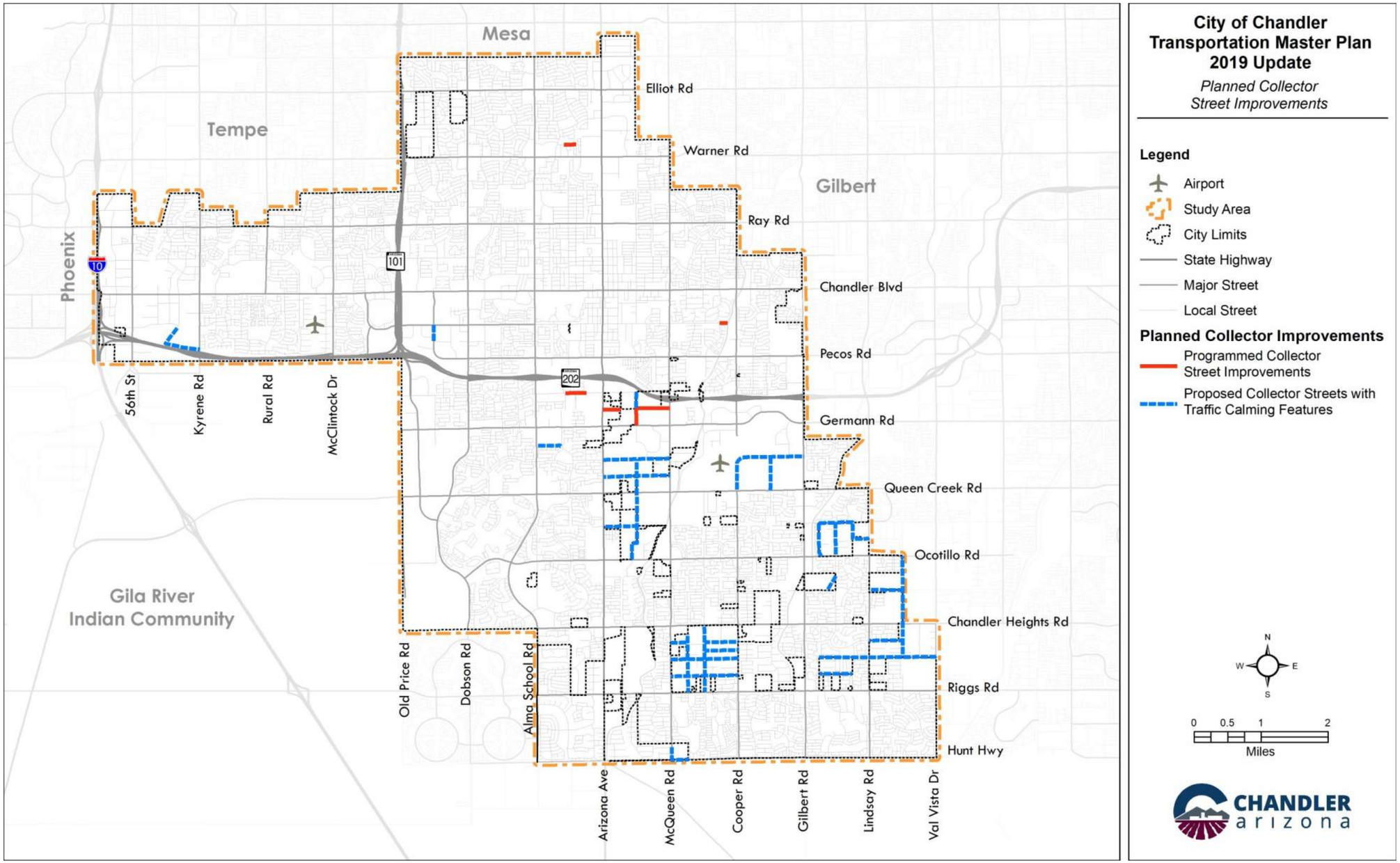


Figure 4-26. Potential Collector Street Enhancements

4.2.4.7 Roadway Maintenance

While the focus of the roadway recommendations within this document is on capital improvements, the City also needs to allocate funding for roadway maintenance. Maintenance will become an increasingly important activity to fund as the City's roadway infrastructure ages. Roadway maintenance includes all the elements of the roadway, including the pavement, landscaping, signing and striping, traffic signals, street lights, drainage features, and miscellaneous concrete and asphalt repairs.

Currently the City has a robust pavement maintenance program with funding programmed at about $12 million per year for street repaving (mill and overlay paving), and about $3 million for maintenance work that includes crack sealing and slurry seals. In addition, the City has capital funds programmed for equipment replacement, landscaping replacement and upgrades due to wear, traffic signals upgrades, street lighting replacement, system-wide LED street light replacement, and miscellaneous repairs. Operations funds are also programmed for power costs for street sweeping, street lighting, traffic signals, and irrigation controllers, water costs for landscape irrigation, small parts replacements, and other operational costs for equipment and personnel.

Pavement Maintenance: The management of the pavement maintenance utilizes an assigned pavement quality index (PQI) for every roadway segment in the City. All pavements segments are rated with a PQI from zero to 100, with 100 being a new pavement and zero being a completely disintegrated pavement.

The pavement maintenance is managed by using a large computer database program that tracks the PQI for all roadway segments in the City. The program keeps records of the PQI and is used to determine when pavement maintenance is needed, what the associated costs are, and what the resultant PQI will be after the pavement maintenance is performed.

To have consistency in the pavement management program, the City has established two pavement quality standards between the zero and 100 PQI levels.

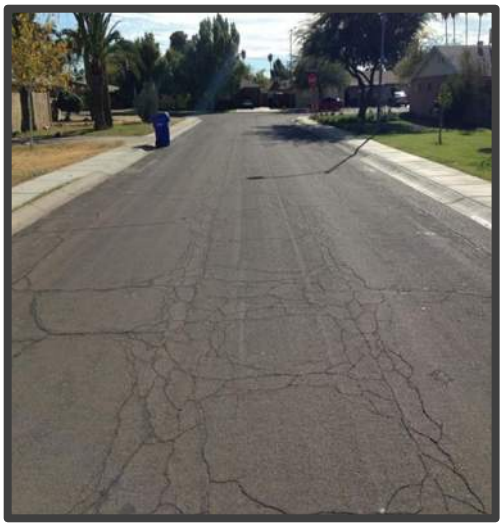
- A PQI of 100 to 70 is a pavement in good or satisfactory condition that needs minimal treatments, such as a fog seal, which is a light application of an asphalt-penetrating rejuvenator;
- A PQI of 70 to 40 is a pavement in fair condition that needs a surface treatment to extend the pavement life, such as a slurry seal or a micro-seal application; and
- A PQI of 40 to zero is a pavement in poor condition that needs to have the top surface replaced by milling off the top one to three inches of pavement and replacing the asphalt (often referred to as a mill and overlay), or completely replacing the pavement. In Chandler, the mill and overlay is performed when the PQI is in the range of 40 to 30 and full replacement is performed when pavement was milled and overlaid twice, or some other structural damage has occurred.

The PQI standards of 70 and 40 are somewhat subjective and are best documented by a visual comparison to pictures that represent the pavement quality Chandler uses for the PQI levels. The following pictures have been utilized to establish these quality points for about the last 15 years. Photos of a PQI of 75 and 45 are also provided to show the difference in quality at the standard of PQI of 70 and 40.

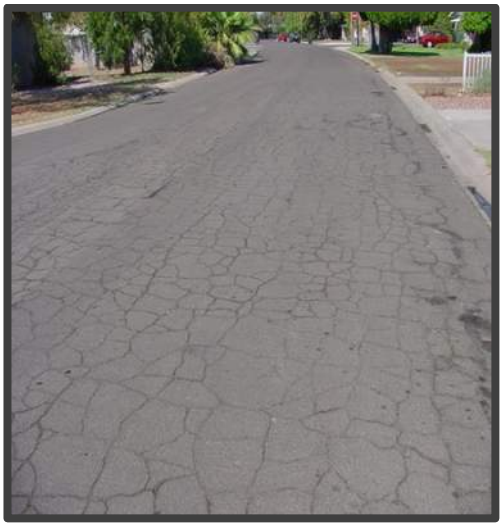
PQI 75

PQI 70

PQI 45



PQI 40



Landscape Maintence: The maintenance of the landscaping located within the public ROW in the medians, back of curb, and in the City-owned storm water drainage basins are likely the most noticed part of the roadway system. This landscaping significantly adds to the overall aesthetic quality of the City but robust landscape maintenance is needed to maintain this amenity.

Traffic Engineering Element: The traffic signal system and the signing and striping of the roadways is an important regulatory element of the City's roadway system. These elements need to be routinely maintained to ensure proper function of the traffic signals and clarity of the signing and striping. The City has 222 traffic signals, about 275 centerline miles of roadway striping and other regulatory striping, and

about 50,000 regulatory and informational signs. All signing and striping should be consistent with standard practice presented in the Manual on Uniform Traffic Control Devices (MUTCD). One striping modification that is recommended relates to the lane configuration that has an unexpected left-lane drop along the inside median curb. It is recommended for consistency and driver-expectation that the more commonly used right-lane drop along the outside curb lane be the City standard practice rather than a left-lane drop, except for locations where physical barriers do not allow for the removal of an existing left-lane drop because of considerable expense associated with the barrier reconstruction. Left-lane drop removals should be completed in the next two to three years, if feasible, and could be addressed as a programmed capital improvement project if needed.

Street Lighting: The City has approximately 28,000 street lights that are maintained. This street lighting promotes safety at night by improving visiblity of other cars, pedestrians, or any foreign objects in the roadway. The City is in the process of retrofitting the existing high-pressure sodium light fixtures to LED lighting throughout the City's street light system. The LED lighting is more environmentaly friendly and has lower power consumption and related costs than high-pressure sodium lighting.

Recommendations

Pavement Maintenance

- Continue to fund and perform the pavement maintenance as describe above;
- Any additional one-time funding for pavement maintenance would be beneficial to the program;
- Pavement maintenance (fog seals, slurry seals, and mill and overlay repaving) should be prioritized by each technique, doing the lowest PQI pavement first for each technique, regardless of roadway classification; and
- When preforming pavement maintenance on local streets in subdivisions, or large blocks of subdivisions, all the streets in that area should be maintained at the same time to avoid disrupting the area with similar work within the next five-year period.

Landscape Maintenance

- The landscaping maintenance should continue to maintain the aesthetic quality of the City. Trees, shrubs, and groundcover that are damaged or removed should be replaced with a similar size and species of plant on a one-for-one basis; replacement trees should not be less than two-inch (2") caliper and need not be larger than six-inch caliper; palm trees should be replaced with a similar size, height, and species; and
- Decomposed granite should be replaced or upgraded as the material degrades in visual quality. An ongoing replacement program is recommended on a 15-year to 25-year cycle, which has an estimated cost of $100,000 per year.

Traffic Engineering

- Annual funding for maintenance of traffic signals is recommended to continue;
- Annual funding for striping arterial streets and biennial striping of other streets is recommended to continue;

- The reflectivity of regulatory street signs should be checked, and the signs maintained, as described in the City's Traffic Engineering Division Practices & Procedures Manual, with ongoing funding provided for sign replacements as necessary; and
- Restripe in the next two to three years the left-lane drops that occur on Germann Road, Gilbert Road, and McQueen Road to be right-lane drops where feasible (i.e., not involving major street reconstruction).

Street Lighting

- The street light system should be upgraded to an all-LED system, preferably over the next ten years. A Smart Street Light pilot program should also be implemented, with $2 million allocated in the near-term, $5 million in the mid-term, and $10 million in the long-term.

Future Funding in Proposition 400 Extension

- The City should work with MAG and the other Valley cities to potentially include in the Proposition 400 Extension the cost for the maintenance of the arterial street system. This would include the maintenance of street pavement, landscaping, striping, signage, street lighting, and traffic signals. All of these items are an integral part of the arterial street system in Chandler and other Valley cities. The estimated cost of this maintenance was developed by the City for a 20-year life cycle, including an average annual inflation of 1.5%, and is as follows:

Street Pavement:	$157,900,000
Landscaping:	$62,400,000
Striping:	$4,100,000
Signing:	$3,200,000
Street Lighting:	$39,400,000
Traffic Signals:	$32,500,000
Total	**$299,500,000**

4.2.4.8 Roadway Technology

The pace of Intelligent Transportation Systems (ITS) technology innovation is accelerating. The City should continue deploying appropriate ITS technologies as a means of improving transportation safety or mobility. Potential opportunities include the vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) deployments, signal phasing and timing (SPaT) deployments, dedicated short-range communication (DSRC) applications, adaptive signal control, origin-destination and traffic data applications, and automated traffic signal performance measures (ATSPM).

Background information is provided below on available roadway ITS technologies. The ITS elements discussed in this section typically include sensitive electronic equipment that will require approximately the same level of maintenance as a traffic signal controller. Likewise, the lifespan of ITS devices is normally considered to be not more than ten years due to continuing advances in technology. Secure wireless networks with low latency and high bandwidth are also likely to be needed to enable safe autonomous vehicles.

Vehicle-to-Vehicle (V2V) Deployments

V2V deployments allow vehicles to communicate with each other in real time. Connected vehicles are equipped with technology to broadcast and receive information from sources such as other vehicles. A connected vehicle typically broadcasts a basic safety message (BSM) ten times per second that consists of information such as its speed, location, and acceleration or deceleration. Other connected vehicles can receive this information and use it to make control decisions. For instance, a connected vehicle can react very quickly to sudden braking by a vehicle in front of it—much more quickly than a human driver can react. While V2V communications is not anticipated to be a public agency function, familiarity with V2V helps foster an understanding of how vehicles will likely communicate in the future.

Signal Phasing/Timing and Vehicle-to-Infrastructure (V2I) Deployments

Public agencies are more likely to be involved in V2I deployments, in which vehicles can communicate with the City's infrastructure. A common V2I deployment involves traffic signal controllers equipped to broadcast a SPaT message, which typically includes the current and upcoming known state of the signal display. Certain connected vehicles can receive this message and use it, for instance, to inform the driver about the appropriate speed to approach the signal to minimize the need to stop. More advanced autonomous vehicles will be able to make independent control decisions based on the SPaT message. V2I also allows vehicles to communicate with the infrastructure; for instance, the technology could be used to allow connected transit vehicles to request secured signal priority or connected emergency vehicles to request secured signal preemption. Many other V2I applications exist, such as toll collection and freight logistics, but for public transportation agencies, traffic signal applications are by far the most common. Other applications include reduced-speed warnings, school zone warnings, or other traffic status warnings.

Connected vehicles currently comprise a minute portion of the overall vehicle fleet, so most V2I deployments are pilot programs, intended to demonstrate the capabilities of the technology. Some consumer vehicles sold today include connected vehicle technology, and it is expected that the percentage of connected vehicles in the fleet will continue to increase.

Communication between pedestrians and infrastructure (P2I) is also being demonstrated in a few jurisdictions. For example, smartphone apps have been developed for pedestrians with vision impairments that can receive a SPaT message and communicate the appropriate time to cross the street, based on a pedestrian's position and direction of travel.

Dedicated Short-Range Communication and 5G Applications

DSRC is a common communication technology for V2I deployments, for instance, to broadcast a signal's SPaT message. DSRC uses an open-source protocol and has advantages of high security, high speed, and effective performance in all weather conditions. Its range, while considered "short" in comparison to other technologies, is nominally about one-half mile, typically sufficient for most V2I applications.

5G refers to the fifth generation of wireless communication technology and is most often applied to the connection of mobile phones and other smart electronic devices. 5G offers the promise of higher speeds, lower latency, and the ability to efficiently connect more devices simultaneously. The wireless communication industry has already taken initial steps to transition communications from the existing 4G

technology to the newer 5G. However, the complete transition will take years, as much communication infrastructure will need to be replaced. 5G will also require a denser deployment of field equipment.

Implications of 5G for the City include the following:

- Arizona Revised Statues Title 11, Chapter 13, became effective in 2017. The new law allows wireless service providers easier access to public ROW, such as traffic signal and utility poles, for the purpose of co-locating wireless equipment;
- The City should consider how 5G and denser communications to enable data sharing might alter or augment the economics of its communication needs (this is being addressed partially through the City's current Fiber Master Plan efforts); and
- 5G may provide an alternative to DSRC for ITS technologies such as V2V and V2I.

Adaptive Signal Control

Adaptive signal control is an alternative to conventional coordinated signal timing that typically uses a fixed signal cycle length for the duration of a timing plan, transitioning to a new plan at pre-determined times of day. In contrast, adaptive timing responds to the real-time traffic patterns on a corridor and can gradually adjust a cycle length according to traffic demand. Adaptive control can also adjust signal phase order and duration in an attempt to provide better overall service.

Unlike some other ITS technologies, adaptive signal control is well established and is used successfully by many jurisdictions. Studies of adaptive control have shown that it is unlikely to provide significant improvement in operations in the peak period of a highly congested, well-timed signal corridor. However, it can likely improve service during slightly less-congested periods and is an ideal way to respond to incidents, special events, or other unusual traffic patterns that a conventional timing plan cannot address without intervention of a human operator.

Adaptive signal control typically requires a greater concentration of vehicle detectors (video detection or other technology) than conventional signal operations. Adaptive control operates best when the detectors are fully operational and well-maintained.

Origin-Destination and Traffic Data Applications

Two general technological methods are available to collect real-time origin-destination information, as well as real-time traffic volumes and speeds:

- It is possible to deploy field equipment, typically at traffic signals, to capture the unique media access control (MAC) address of electronic devices in vehicles passing nearby. The field equipment is often referred to as Anonymous Re-Identification (ARID) detectors. When the same mobile device is detected at multiple ARID sites, it is possible to draw conclusions about the vehicle's travel time, origin and destination, and make inferences about its route. Mesa, Tempe, and Gilbert have deployed ARID devices at hundreds of signalized arterial intersections to create the East Valley Arterial Travel Time Map, which allows the public and agency staff to be aware of real-time traffic conditions on the arterial street network. Chandler's proximity to these other East Valley jurisdictions would make it a logical candidate for an expansion of the program.

- Agencies can also acquire similar information from service providers such as INRIX. INRIX also gathers its base information from mobile electronic devices, but its business model involves selling subscriptions to access its data for a particular street network. Acquiring data from a service provider allows quicker access to data with less capital cost, but it is likely to involve higher long-term subscription costs than deploying ARID devices.

Automated Traffic Signal Performance Measures

Automated traffic signal performance measures (ATSPMs) allow agencies to monitor the operations of traffic signals. Signals can be equipped to provide reports on elements such as phase duration and skips, pedestrian and vehicle actuations, and other features. Both past and real-time information can be accessed, which is useful for comparing current conditions to previous normal conditions at the same time of day and week.

ATSPMs would allow Chandler staff to identify signal maintenance needs more quickly. For instance, ATSPMs may show that a particular pedestrian phase is called every cycle overnight at a signal where pedestrian activity at that time is normally very low. This suggests a malfunction of the pedestrian detector, for which Chandler would deploy a maintenance crew for repair. Rather than waiting for a member of the public to observe and report the problem, which could take days or weeks, ATSPMs allow the problem to be identified much more quickly.

Agencies can also set alerts to notify them of features that require urgent attention. For example, when a signal phase serves its maximum green time every cycle for many consecutive cycles, it could indicate a detection problem or a nearby incident increasing volume on a certain movement to an unusually high level. In either case, an operator may want to investigate the problem in real time to decide on an appropriate action, which may include activating an alternative incident timing plan to help relieve congestion.

Historical ATSPMs can also be used to assist with the process of routine signal retiming by better understanding the actual signal operations over a long period of time for all times of the day and week.

Roadway Technology Recommendations and Costs

The City should account for roadway technology in the bigger discussion about leveraging technology across all modes to improve the travel experience for all. The City should develop an ITS Strategic Plan to identify a path forward for application of evolving technologies. The ITS Strategic Plan can further consider the phased implementation of roadway technology, identify staffing needs, identify data collection tools and resources needed, and identify funding opportunities and potential partnerships with the private industry. The ITS Strategic Plan should be developed in the next two to three years.

Costs for the ITS Strategic Plan, implementation of recommendations from the ITS Strategic Plan, and ongoing operations and maintenance of technology elements associated with roadway technology are shown in **Table 4-14**. See Section 7.3.4 of this document for a detailed discussion of technology recommendations and associated costs.

Table 4-14. Total Cost of Roadway Technology Recommendations 2020 - 2040

Time Period	Capital Cost of Recommendations	Operations and Maintenance Cost of Recommendations	Total 2019 Cost of Recommendations
2020 - 2025	$750,000	$1,200,000	$1,950,000
2026 - 2030	$750,000	$1,250,000	$2,000,000
2031 - 2040	$2,000,000	$3,000,000	$5,000,000
Total Costs	**$3,500,000**	**$5,450,000**	**$8,950,000**

4.2.5 TOTAL ROADWAY RECOMMENDATION COSTS

Table 4-15 shows the capital, operations and maintenance, and total costs for the near-term, mid-term, and long-term roadway facility and technology recommendations. The total cost of all recommended roadway improvements in 2019 dollars for the 2020 - 2040 timeframe calculates to $617.75 million.

Table 4-15. Total Cost of Roadway Improvement Recommendations 2020 - 2040

Time Period	Capital Cost of Recommendations (1)	Operations and Maintenance Cost of Recommendations	Total 2019 Cost of Recommendations
2020 - 2025	$33,050,000	$75,100,000	$108,150,000
2026 - 2030	$148,750,000	$71,350,000	$220,100,000
2031 - 2040	$131,000,000 (2)	$158,500,000	$289,500,000
Total Costs	**$312,800,000**	**$304,950,000**	**$617,750,000**

Notes: (1) Programmed Projects Not Included. (2) Capital Costs Include ADOT Freeway Connections and Cooper Road Extension Collector Street.

5.0 TRANSIT ELEMENT

5.1 TRANSIT EXISTING CONDITIONS

5.1.1 TRANSIT-DEPENDENT POPULATION

Transit dependency refers to portions of the population that rely on transit service to increase their overall mobility. The population within the City of Chandler is diverse and contains several population groups with a propensity to use transit. Such groups include zero and one car households, those with annual median household income less than $35,000, persons with disabilities, limited mobility population of age 16 and below and age 65 and over, and working public transit users of age 16 and over. The City of Chandler's transit-dependent population was identified using census data from the 2017 American Community Survey (ACS) collected on the census tract-level. The transit-dependent population characteristics evaluated for the City of Chandler are identified in **Table 5-1**.

Table 5-1. Transit-Dependent Population Characteristics

Population Characteristics	City of Chandler
Zero and One Car Households	34,163 households
Median Household Income < $35,000 annually	25,193 households
Disabled Population	22,844 individuals
Limited Mobility Population (age 16 and below and age 65 and over)	105,762 individuals
Public Transit Users (workers age 16 and over)	1,180 individuals

Source: U.S. Census Bureau, American Community Survey (2017)

Each transit-dependent population characteristic is divided into five value ranges based on the population/household counts of each census tract within the City of Chandler. The City has a total of 60 census tracts, so each value range consists of 12 census tracts. The highest value range for each population characteristic, which consists of the 12 census tracts with the highest number of each population characteristic, are rated a value of five (most transit-dependent). The lowest value range for each population characteristic, which consists of the 12 census tracts with the lowest number of each population characteristic, are rated a value of one (least transit-dependent). Thus, each value range is given a score that ranges from five to one representing varying levels of transit dependency. **Table 5-2** illustrates the levels of transit dependency for each population characteristic analyzed in the City.

Table 5-2. Transit-Dependent Value Ranges

Population Characteristic	Transit-Dependent Population Scores				
	1	2	3	4	5
Zero and One Car Households	< 260	261 - 495	496 - 647	648 - 796	797 - 1,357
Median Household Income < $35,000 annually	< 161	162 - 261	262 - 434	435 - 688	689 - 1,236
Disabled Population	< 210	211 – 288	289 – 418	419 – 532	533 – 966
Limited Mobility Population	< 1,082	1,083 - 1,553	1,554 - 2,009	2,010 - 2,178	2,179 - 7,226
Public Transit Users	0	1 - 5	6 - 20	21 - 29	30 - 146

Source: U.S. Census Bureau, American Community Survey (2017)

Each census tract was assigned a score (1 to 5) for each transit-dependent population characteristic as shown in **Table 5-2**. The sum of those five population characteristic values determined an overall transit dependent value (5 to 25) for each census tract within the City of Chandler. The result of that calculation is shown in **Figure 5-1,** which illustrates the areas that may have the greatest propensity to use transit. The darkest census tracts on the map indicate highest transit dependency (score 20-25) and the lightest census tracts (score 5) indicate lowest transit dependency. Based on this analysis, areas along Arizona Avenue between Elliot Road and Chandler Boulevard and around Chandler Downtown show high transit dependency. There are a few other residential areas south of Loop 202 and west of Loop 101 that indicate high transit dependency.

5.1.2 EXISTING FIXED-ROUTE TRANSIT SYSTEM

5.1.2.1 Service Area

Valley Metro provides fixed-route transit services in Chandler and throughout the Phoenix metropolitan area. Valley Metro operates bus service 365 days a year. The fixed-route bus transit system in Chandler is comprised of approximately 50 miles of local and express services, all of which also provide service in at least one of Chandler's neighboring cities. Several Chandler bus routes make connections to the light rail in Mesa that provides train service to Tempe and Phoenix. **Figure 5-2** shows the existing fixed routes, park-and-ride lots, and transit center that are located within Chandler. The sections below summarize existing transit services that operate within the City of Chandler.

5.1.2.2 Service Characteristics

Types of Services

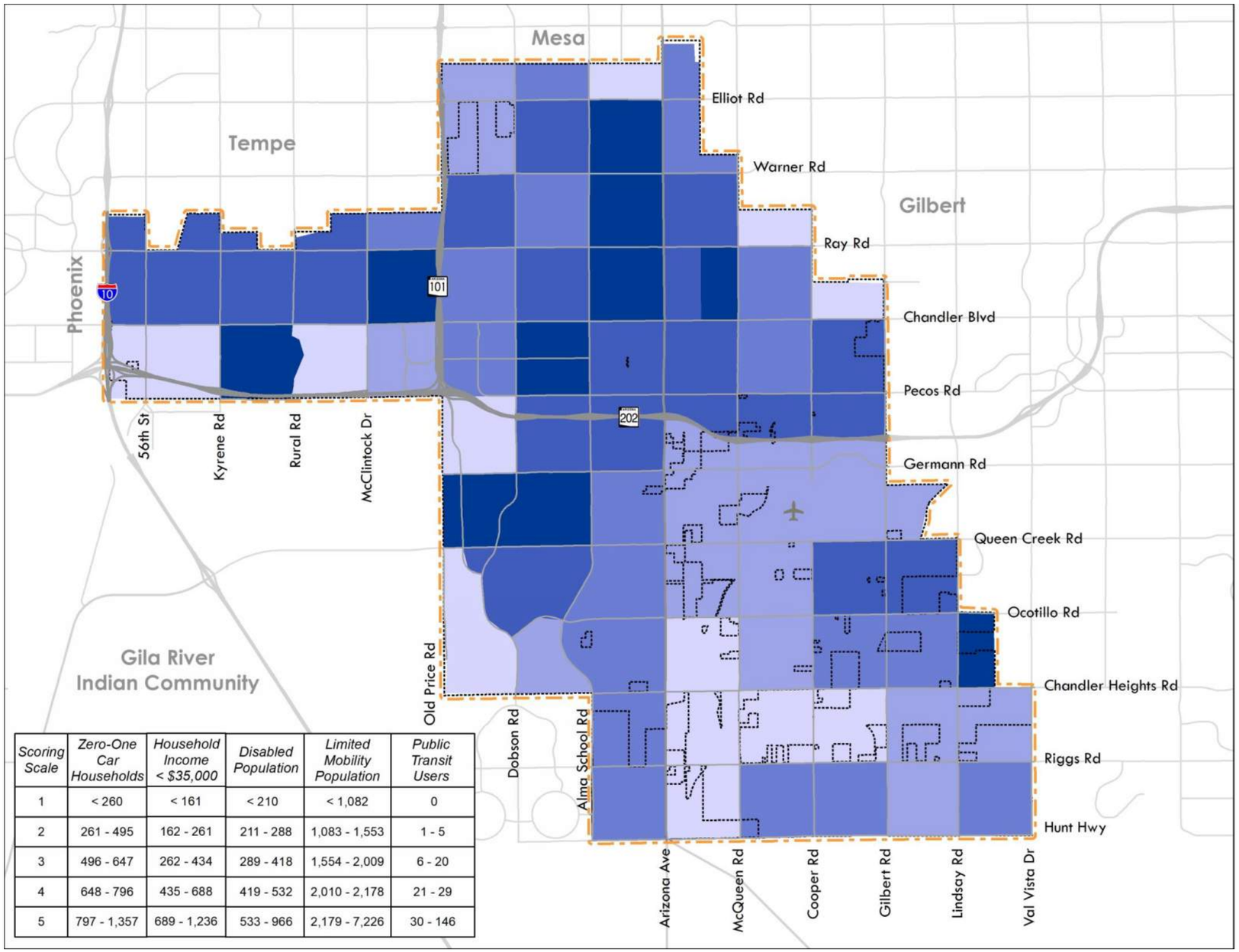
Express Routes

Chandler is served by two express bus routes that operate during the peak commute hours. These routes reduce travel times by making a limited number of stops before entering a freeway for non-stop travel. On the freeway, express buses travel in high-occupancy vehicle (HOV) lanes and use HOV exit/entrance ramps, where available. Express routes serving Chandler are listed in **Table 5-3**. Route 541 originates at Arizona Avenue and Ray Road and travels to downtown Phoenix with stops on Arizona Avenue, Knox Road, Alma School Road, and the West Mesa park-and-ride before entering US 60. Route 542 stops only at the Chandler park-and-ride lot adjacent to Tumbleweed Park before entering Loop 202 and connecting to downtown Phoenix.

Table 5-3: Express Fixed-Route Transit Services

Route	Name	Days of Operation	Trip Frequency
541	Chandler/Mesa Express	Monday-Friday	4 inbound trips in the morning; 4 outbound trips in the evening
542	Chandler Express	Monday-Friday	8 inbound trips in the morning; 8 outbound trips in the evening

Source: Valley Metro



Scoring Scale	Zero-One Car Households	Household Income < $35,000	Disabled Population	Limited Mobility Population	Public Transit Users
1	< 260	< 161	< 210	< 1,082	0
2	261 - 495	162 - 261	211 - 288	1,083 - 1,553	1 - 5
3	496 - 647	262 - 434	289 - 418	1,554 - 2,009	6 - 20
4	648 - 796	435 - 688	419 - 532	2,010 - 2,178	21 - 29
5	797 - 1,357	689 - 1,236	533 - 966	2,179 - 7,226	30 - 146

City of Chandler Transportation Master Plan 2019 Update

Transit-Dependent Population

Legend

- Airport
- Study Area
- City Limits
- State Highway
- Major Street

Transit-Dependent Scoring

1 5 10 15 20 25

Transit-Dependent Population Characteristics

- *Zero - One Car Households*
- *Household Income < $35,000*
- *Disabled Population*
- *Limited Mobility Population (aged ≤ 16 and 65 ≤)*
- *Public Transit Users (Workers aged 16 ≤)*

N W E S

0 0.5 1 2

Miles

CHANDLER arizona

Source: U.S. Census Bureau, American Community Survey (2017)

Figure 5-1. Transit-Dependent Population

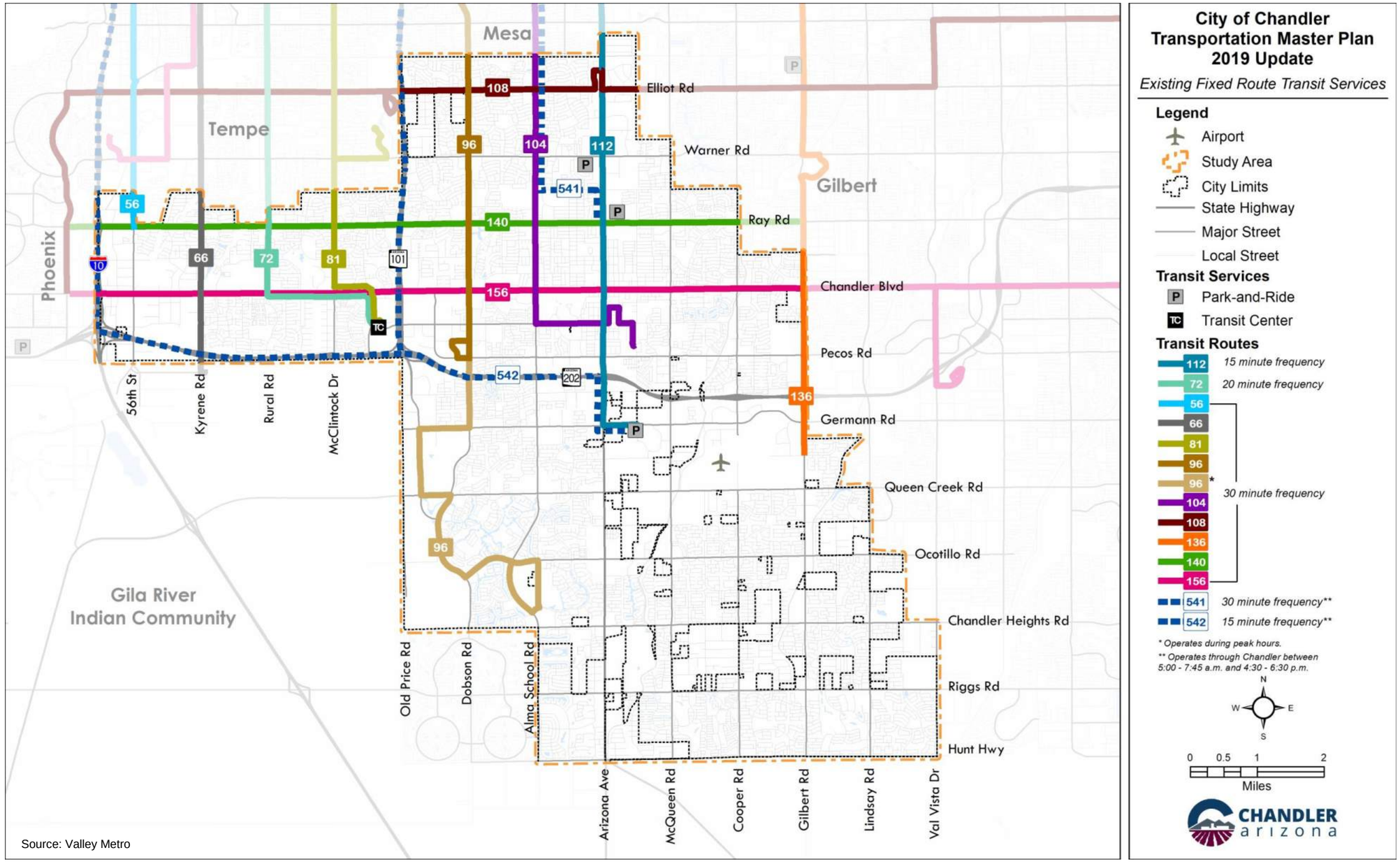


Figure 5-2. Existing Fixed Route Transit Services

Many Chandler residents also take advantage of the I-10 East RAPID, an express bus service operated by the City of Phoenix that originates at the Pecos Road/40th Street park-and-ride lot in Ahwatukee. Route 541 primarily uses local bus stops as pick-up/drop-off points in Chandler. By contrast, Route 542 and I-10 East RAPID use park-and-ride lots as the only pick-up/drop-off points, traveling minimally on surface streets for the fastest time to downtown Phoenix. The base fare for express and RAPID services is $3.25 per trip.

Local Bus Service

Local fixed-route services have established service schedules with bus stops typically located every ¼ mile along an established route several miles long. Local fixed-route services comprise the majority of transit service miles in Chandler. Local services operate as part of the Valley Metro regional transit system, crossing city boundaries and offering a uniform fare structure. The base fare for local service is $2 per trip.

Local fixed-route services that serve Chandler also provide access to regional routes and regional destinations throughout the Valley. Routes serving Priest Drive, Kyrene Road, Rural Road, McClintock Drive, Dobson Road, Alma School Road, Arizona Avenue, and Gilbert Road each connect to the light rail, which provides high-quality transit service to downtown Mesa, Arizona State University (ASU)/downtown Tempe, downtown Phoenix, and the Central Avenue corridor.

Table 5-4 provides service details on Chandler's local transit routes.

Neighborhood Circulators

Several Valley cities have implemented neighborhood circulator routes that operate on collector and residential streets with frequent, all-day service. The City of Chandler does not currently have any neighborhood circulator service in operation. Circulator vehicles are small and provide services to areas that are not easily serviceable by standard regional buses or are simply more efficiently served by a small bus. Circulator service may be free to passengers or may have a small fare.

Transit System Quality and Performance

Ridership

Ridership data is collected and summarized on a monthly and annual basis by Valley Metro. Ridership data, measured as the number of boardings, is available for the system as a whole and is broken out by route and by jurisdiction. **Table 5-5** shows the annual bus ridership in Chandler in fiscal year (FY) 2018 and FY 2017, and the percent change in ridership between the two years. The FY 2018 annual boardings and revenue miles have gone up significantly compared to FY 2017. The increased ridership may be due to increased demand or transit system upgrades like route modifications, route extensions, addition of new routes, increased weekday frequencies, and weekend/holiday bus services.

Table 5-4. Local Fixed-Route Transit Services

Route Index	Route Name	Days of Operation	Frequency in Chandler* (minutes)
56	Priest Dr	Monday-Friday	30
		Weekends	30
66	Mill Ave/Kyrene Rd	Monday-Friday	30
		Weekends	60
72	Scottsdale Rd/Rural Rd	Monday-Friday	20
		Weekends	30
81	Hayden Rd/McClintock Dr	Monday-Friday	30
		Weekends	60 (Saturday only)
96	Dobson Rd	Monday-Friday	30
		Weekends	30 (Saturday only)
104	Alma School Rd	Monday-Friday	30
		Weekends	None
108	Elliot Rd/48th St	Monday-Friday	30
		Weekends	60
112	Country Club Dr/Arizona Ave	Monday-Friday	15
		Weekends	30
136	Gilbert Rd	Monday-Friday	30
		Weekends	30 (Saturday only)
140	Ray Rd	Monday-Friday	30
		Weekends	30 (Saturday only)
156	Chandler Blvd	Monday-Friday	30
		Weekends	30

Source: Valley Metro

* Note: Peak daytime frequency shown; some routes have lower service levels in evening

Table 5-5. FY 2018 and 2017 Annual Ridership Summary of Chandler

Measures	FY 2017	FY 2018	% Difference	Percentage of the overall transit system (2017)
Bus Boardings	882,354	958,920	8.68%	1.44%
Revenue Miles	1,018,381	1,164,388	14.34%	3.04%
Bikes on Bus	43,756	43,821	0.15%	3.10%
Wheelchairs on Bus	3,765	4,363	15.88%	1.36%
Bus Boardings per Mile	0.87	0.82	-5.75%	-

Source: Valley Metro

Table 5-6 shows the annual ridership in FY 2018 and FY 2017 on the routes that operate in Chandler, and the percent change in ridership between the two years.

Table 5-6. FY 2018 and 2017 Annual Ridership for Individual Routes within Chandler

Route	FY 2017 Total Boardings	FY 2018 Total Boardings	% Difference
56	4,627	7,794	68.45%
66	27,136	29,774	9.72%
72	87,856	80,227	-8.68%
81	32,330	34,587	6.98%
96	90,750	91,629	0.97%
104	63,970	57,249	-10.51%
108	65,136	66,596	2.24%
112	196,860	253,422	28.73%
136	8,559	9,754	13.96%
140*	-	40,367	-
156	218,639	226,210	3.46%
AZ Ave LINK**	24,760	-	-
541	6,663	6,391	-4.08%
542	55,068	54,920	-0.27%
Total	**882,354**	**958,920**	**8.68%**

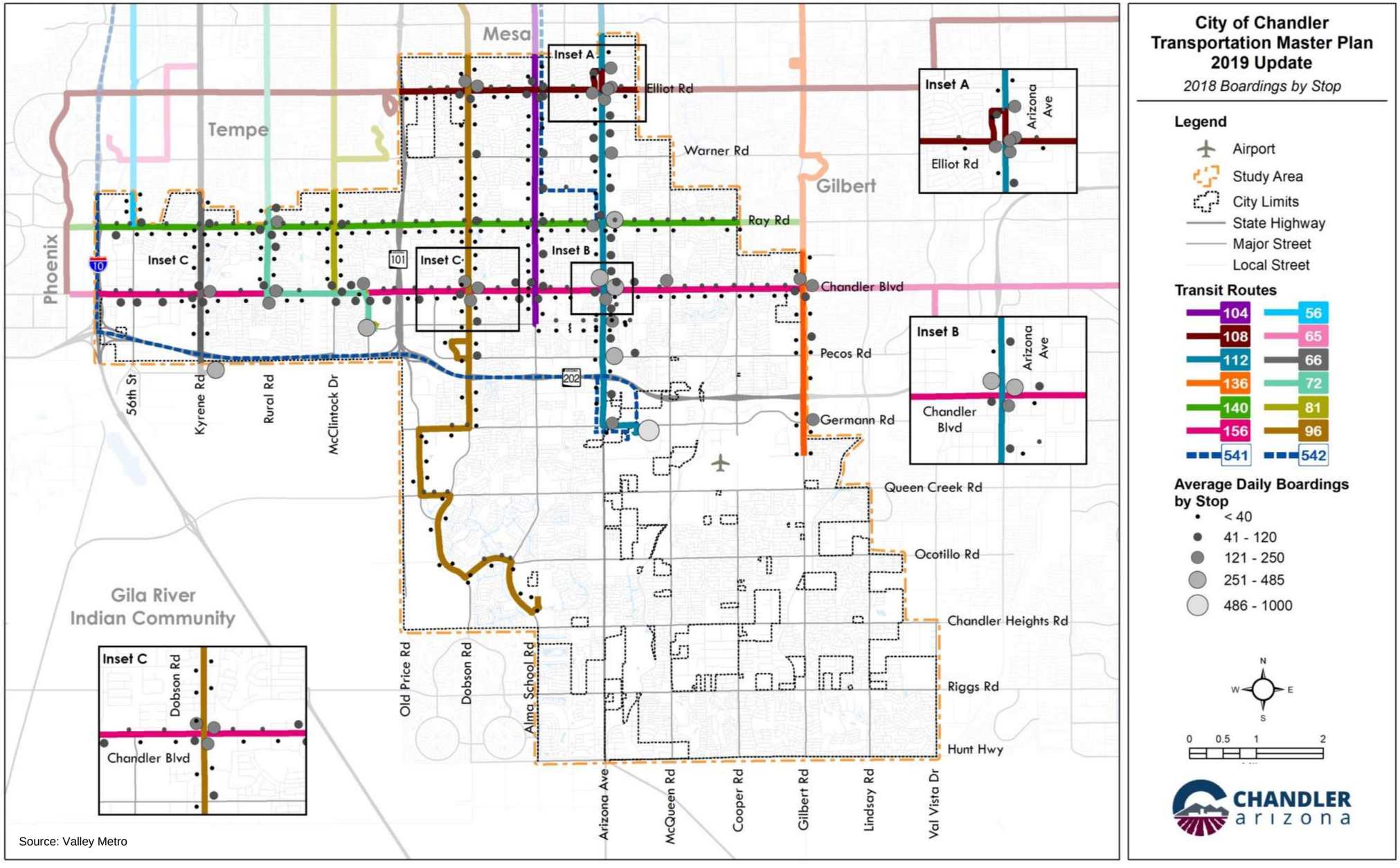
Source: Valley Metro

* Route 140 was established in FY 2018 and therefore no ridership data is available for FY 2017

** AZ Ave LINK was eliminated in FY 2017 so no data exists for FY 2018

The most popular route in Chandler, in terms of total boardings, is Route 112, which operates on Country Club Drive/Arizona Avenue. The overall ridership on Route 112 has increased by 28.73% compared to the previous year. Routes 56, 66, 81, 96, 108, 112, 136, and 156 have also shown an increase in total boardings. By contrast, Routes 72 (Scottsdale Road/Rural Road) and 104 (Alma School Road) have shown a decrease in total boardings by 8.68% and 10.51%, respectively. Ridership on the City's two express routes (Routes 541 and 542) shows a decline in total boardings compared to the previous year.

Figure 5-3 summarizes average daily boardings by stops on the routes that operate in Chandler.



Source: Valley Metro

Figure 5-3. Average Daily Boardings by Stop

5.1.2.3 Existing Intermodal Connections

Park-and-Ride Lots

Park-and-ride lots provide parking for transit passengers, where individuals may drive their personal vehicle or ride their bicycle to the lot and park before boarding the bus. People can also walk to the lot or access the lot using local transit routes. Park-and-ride lots may be dedicated, meaning that their sole function is to provide parking space for transit passengers. A park-and-ride lot may also be shared-use, which provides parking for transit passengers during peak commute periods and parking for other purposes during non-commute periods. Common locations for shared-use parking lots are shopping centers and churches.

Chandler currently has one dedicated City-operated park-and-ride lot, located at the southwest corner of Germann Road and Hamilton Street, adjacent to Tumbleweed Park. This facility has 463 parking spaces, 180 of which are covered. Local Route 112 and Express Route 542 bus service to downtown Phoenix originate at this facility. The Route 112 bus connects to the light rail in Mesa via Arizona Avenue. In addition, the Chandler park-and-ride lot provides a meeting point for residents to carpool or vanpool. The Paseo Trail is nearby, enabling commuters who live nearby to walk or ride their bike. Secure bicycle parking is located at the park-and-ride lot.

Additionally, Chandler has three shared-use park-and-ride lots:

- City Hall parking garage at the southeast corner of Chicago Street and Arizona Avenue, serving Routes 104 and 112;
- Carl's Jr. parking lot at the southwest corner of Warner Road and Alma School Road, serving Routes 104 and 541; and
- Food City Plaza parking lot at the northeast corner of Arizona Avenue and Ray Road, serving Routes 112, 140, and 541.

Shared-use park-and-ride lots exist as informal agreements and the park-and-ride status may be removed at the request of the property owner. In addition to the park-and-ride lots within the City's limits, some Chandler residents use the Ahwatukee park-and-ride lot located at Pecos Road/40th Street in Phoenix, which serves the I-10 East RAPID service and Ahwatukee Local Explorer (ALEX) neighborhood circulator, and the Gilbert park-and-ride lot located in downtown Gilbert, which serves Local Route 136 and Express Route 531.

Transit Center

A transit center acts as a coordination point for multiple transit routes. A transit center generally has limited or no passenger parking but may be adjacent to a park-and-ride lot. Transit centers often provide passenger information and may provide additional transit amenities such as ticket sales, restrooms, and operator layover locations.

Chandler currently has one transit center, which is located on the south side of Chandler Fashion Center (south of Chandler Boulevard at Price Road) and serves Local Routes 72 and 81.

5.1.2.4 Transit Infrastructure

Bus Infrastructure Policies

The City of Chandler has adopted Maricopa Association of Governments (MAG) Standard Specifications and Standard Details for street design and access control. Several MAG standards have been modified in the City's Standard Details and Specifications. Bus bays and shelter design and placement standards are part of the City's Street Design and Access Control (Technical Design Manual #4, May 2018) code and are reproduced below with minor City-requested text refinements.

Bus Bays

Placement

- All bus bay locations must have prior written approval by the City's Transportation Engineer and Transit Staff, and must be consistent with the City's Transportation Master Plan;
- Bus bays will generally be placed at one-mile intervals along arterial streets with existing or planned bus routes, adjusted as necessary to ensure that boarding and deboarding will be convenient for service to abutting land uses. Additional bus bays, if warranted, may be spaced at one-half mile intervals, but in no case spaced less than one-quarter mile apart;
- Generally, bus bays should be installed only at signalized intersections;
- Bus bays should be located at the far side of street intersections (on departures from the intersection) and within two hundred feet of signalized intersections when possible;
- Bus bays should not be installed at mid-block locations;
- Bus bays should be integrated with right-turn deceleration lanes when possible. The integrated design will provide a constant lane cross-slope with no existing or constructed valley gutter between the through travel lanes and the combination bus bay/deceleration lane;
- Bus bays should be located at route transfer points, time points, and layover locations at the end of bus routes;
- Bus bays should be considered for stops with high peak period passenger boardings, or at stops with a high proportion of wheelchair or bicycle boardings;
- Right-of-way impacts and utility relocations should be avoided or minimized when determining bus bay locations;
- Bus bay locations will be prioritized and programmed in the City's Capital Improvements Program based on the following criteria: average daily traffic volumes, street lane capacity, frequency of bus service and average number of passenger boardings; and
- The City will require dedication of right-of-way from new developments along existing and planned transit routes for construction of bus bays and associated landing and shelter pads.

Design and Construction

- Bus bays shall be constructed of concrete and designed in accordance with City of Chandler Standard Detail C-230 when not integrated with a deceleration lane and with C-231 when integrated with a deceleration lane;
- Bus bays should be incorporated into the design and construction of larger arterial street and intersection improvement projects to reduce costs; and
- All bus bays should include a concrete pad of sufficient dimensions located behind the adjacent sidewalk to accommodate a passenger shelter, bench, trash receptacle, bicycle parking, open space for wheelchair boarding, and advertising/information kiosk.

Bus Shelters

- Advertising at bus stops located on arterial street areas are permitted to offset the costs of installing, maintaining, and cleaning passenger shelters and associated fixtures;
- Advertising revenues will be used to offset bus stop maintenance and capital replacement costs;
- All new passenger shelters should be lighted or located in proximity to an existing streetlight;
- Where irrigation is available, landscaping and shade trees should be provided in proximity to the shelter pad to increase shade to the passenger waiting area;
- Bus shelter design and orientation should maximize shade for seating areas throughout the day;
- The design of developer-installed bus shelters and associated fixtures requires prior written approval by the City Engineer and Transit Staff before construction. Shelter ownership, long-term maintenance responsibilities, and replacement cost due to damage are primary considerations;
- All new bus stops shall meet Americans with Disabilities Act (ADA) accessibility requirements;
- For existing bus stops, any necessary upgrades to meet ADA requirements shall occur with adjacent projects including mill and overlay, private development, and capital improvement program (CIP) projects; and
- Bus shelters should only be installed along streets served by a transit route.

ADA Compliance

A pilot study for pedestrian access was part of the City's ADA Self-Evaluation and Transition Plan, which assessed sidewalks, intersections/curb ramps, signals, benches, and bus stops in limited work-study areas. Fifteen bus stops were evaluated as part of the pilot study. Areas that were evaluated for each bus stop included access to the bus stop, landing and alighting areas, clear floor space adjacent to seating and signage. Eleven of the fifteen locations were found to have minor issues that made them non-compliant. The City of Chandler has already addressed many of these ADA issues.

Achieving Transit Accessibility Now Projects

MAG, in partnership with Valley Metro, developed the Achieving Transit Accessibility Now (ATAN) program to address immediate and critical needs for improved accessibility to bus stops. The City of

Chandler recently completed two ATAN-funded projects for the Chandler park-and-ride lot and various bus stops improvements, with plans to apply for additional ATAN funding in the near future.

5.1.3 EXISTING PARATRANSIT

Paratransit service complements the existing fixed-route transit system by providing transportation to people who are unable to utilize local bus service due to a disability or age. Paratransit service operates in response to calls from passengers to the transit operator, who then dispatches a vehicle to pick up the passengers and transport them to their destinations. Paratransit operations do not operate over a fixed route or on a fixed schedule; instead, a vehicle is dispatched to pick up several passengers at different pick-up points before taking them to their respective destinations and may even be interrupted en route to these destinations to pick up other passengers. Several types of paratransit services operate throughout Chandler.

5.1.3.1 Valley Metro Paratransit

Valley Metro Paratransit, previously known as the East Valley Dial-a-Ride, provides ADA and non-ADA paratransit service in Chandler. This service provides door-to-door, shared-ride public transportation services for seniors and persons with disabilities. The service is operated by Valley Metro and funded by the participating cities. Both ADA and non-ADA paratransit service are provided seven days a week, from 4:00 a.m. until 1:00 am. The Valley Metro Paratransit service area includes Chandler, Gilbert, Mesa, Scottsdale, Tempe, and unincorporated Maricopa County, also known as the East Valley region.

Valley Metro provides region-wide ADA paratransit service to certified riders who live within Chandler. The ADA paratransit trips within Chandler are city-wide, but for travel outside Chandler, the service areas of destination cities apply. Users of ADA paratransit service are required to be certified as eligible for ADA services by Valley Metro at the regional mobility center. ADA regulations require that the ADA paratransit fare to be no more than twice the comparable fixed-route fare, that personal care attendants (PCAs) ride free, and that companions pay the same fare as eligible riders. Within the service area, ADA riders pay $4 per trip, their PCAs ride free, and their companions pay $4. Regional paratransit was introduced in the region about three years ago to allow ADA riders to travel within and outside the service area.

Non-ADA paratransit services are available to Chandler residents who are 65 or above or who have ADA Paratransit eligibility. Seniors are required to complete an application and provide documentation of age and proof of residency to Valley Metro. Non-ADA paratransit service is not required by law and is not subject to the restrictions imposed on ADA paratransit service. Valley Metro Paratransit service uses a zone fare system for its non-ADA paratransit trips; riders travel for a $4 fare for trips up to 5 miles in length. From 6 to 15 miles, there is an additional charge of $0.50 per mile. After 15 miles, there is an additional charge of $1 per mile added to the base fare and the 6-15 mile surcharge.

Figure 5-4 shows the paratransit trip origins within Chandler for July-September 2018, highlighting the areas with higher numbers of trip origin counts. The darkest areas on the map indicate the highest number of origin counts. Similarly, **Figure 5-5** shows the paratransit trip destinations within Chandler for July-September 2018, highlighting the areas with higher number of trip destination counts. The darkest areas on the map indicate the highest number of destination counts. **Figure 5-6** shows the most common paratransit trip-pairs for July-September 2018 within Chandler. A review of these three figures indicates that the areas having the highest number of origin and destination trips are northwest of the Elliot Road/Arizona Avenue intersection (where the Chandler Gilbert Arc facility is located that serves those with intellectual and developmental disabilities) and the City Hall area in downtown Chandler.

5.1.3.2 RideChoice Program

RideChoice is a program in which the rider's cost of transportation is partially subsidized by the participating communities. Since 2008, Chandler has participated along with Mesa, Tempe, and Gilbert in the RideChoice program. The program is administered by Valley Metro and provides transportation service via transportation network companies (TNCs), taxis or other providers at a discounted rate to ADA paratransit certified people with disabilities and seniors age 65 and above who reside in participating communities.

This service costs $3 for each trip up to eight miles, with any additional miles costing $2 per mile. There is no additional charge for wheelchair-accessible service and service dogs. RideChoice service has easier access to a larger network of transportation providers including TNCs, taxicabs, and other wheelchair-accessible vehicles. A ride can be requested when needed without any prior booking. No restrictions are placed on trip origin, destination, purpose, or length, but users must pay any fare balance. **Table 5-7** shows the RideChoice program performance for FY 2018.

Table 5-7. Chandler RideChoice Program Data, FY 2018

Metric	Value
Active users	110
One-way trips	7,3I7
Avg. daily trips	20
Annual cost	$115,882
Avg. cost/trip	$15.84

Source: City of Chandler 2018
Note: Cost information shown is net of fare and federal grant funding

5.1.3.3 About Care

The City of Chandler has been supportive of a local non-profit agency called About Care. About Care provides free transportation services to medical and/or social appointments for seniors and persons with disabilities in Chandler, Gilbert, and Queen Creek.

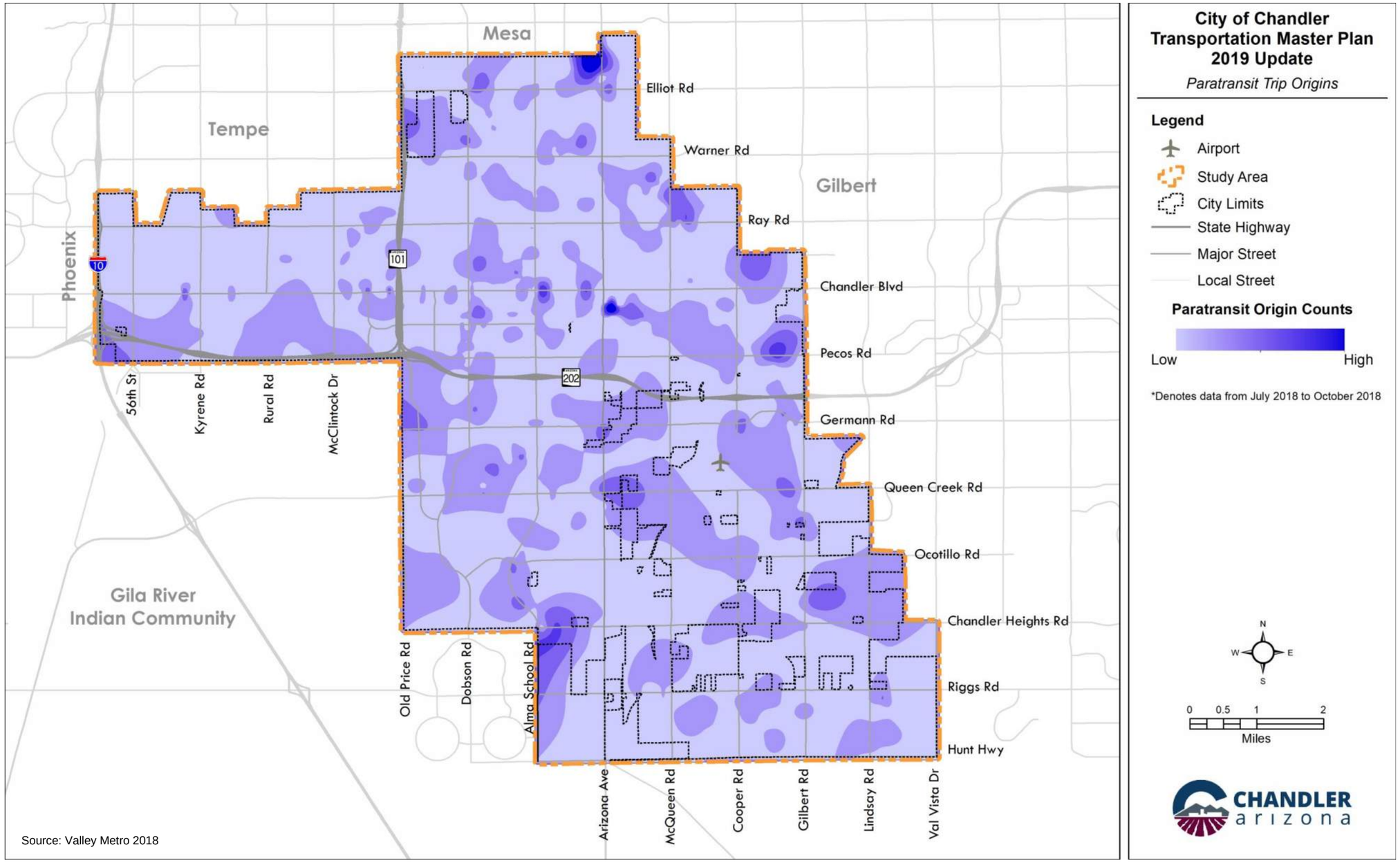


Figure 5-4. Paratransit Trip Origins

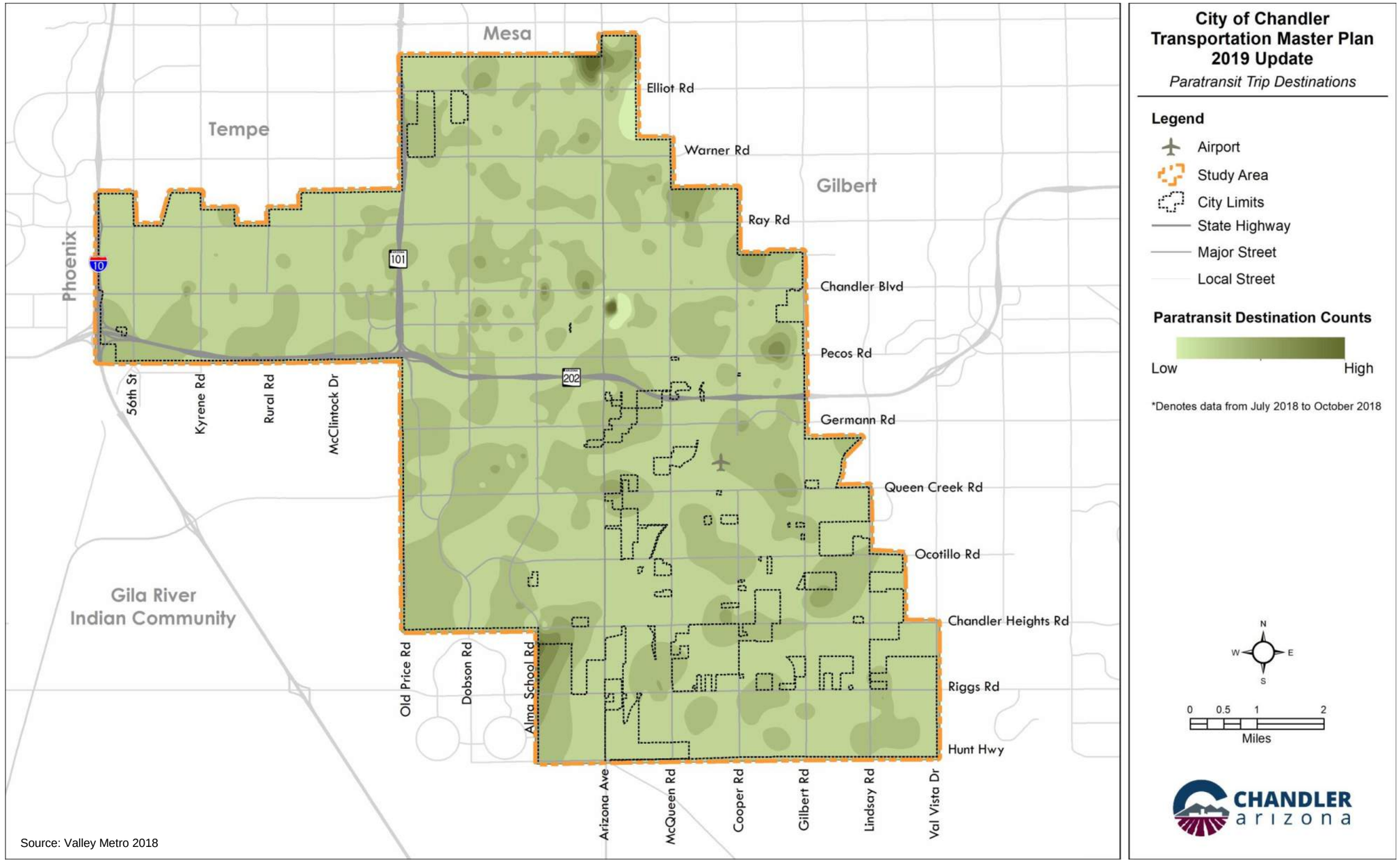


Figure 5-5. Paratransit Trip Destinations

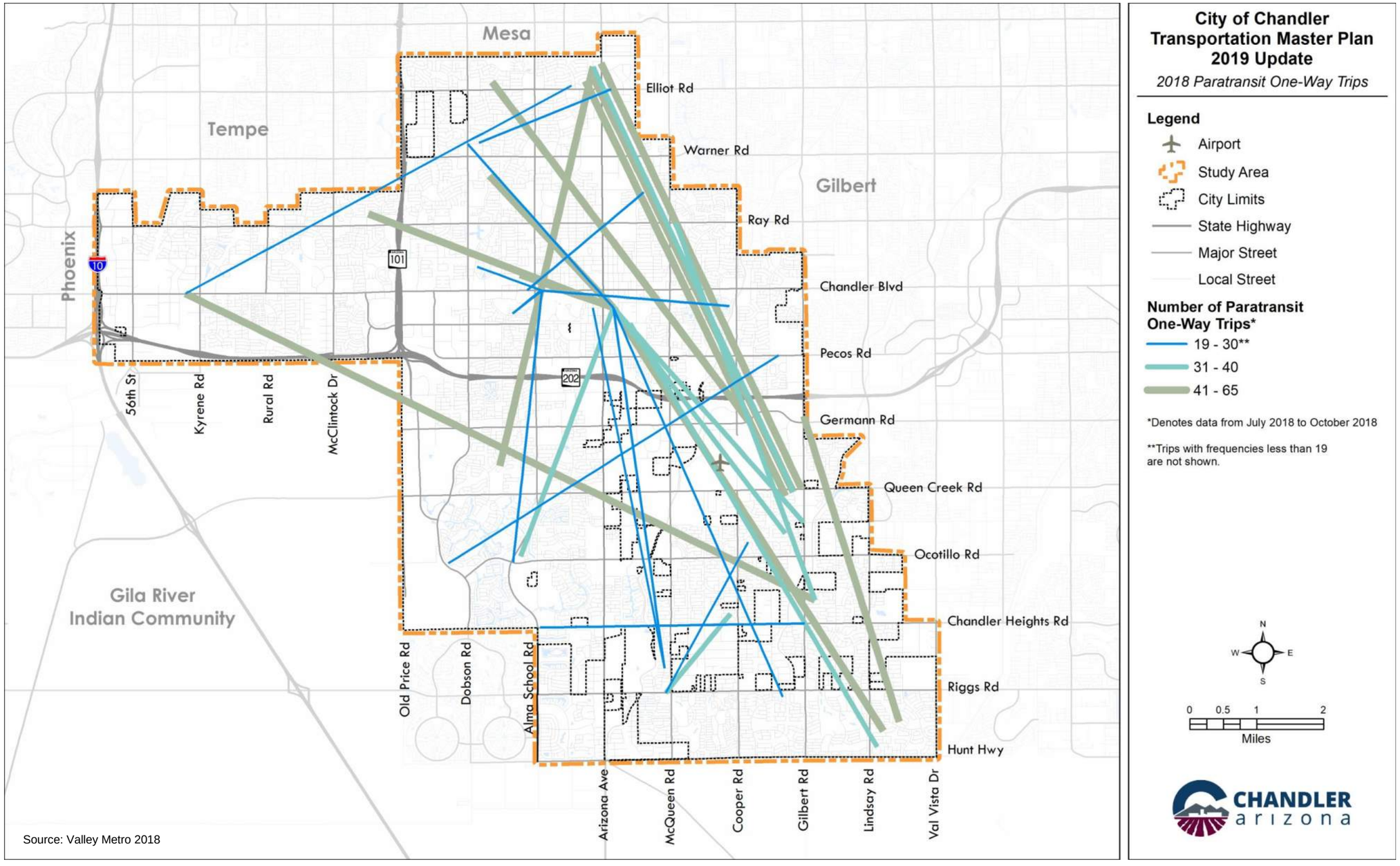


Figure 5-6. Most Common Paratransit One-Way Trips

5.1.4 EXISTING RIDESHARE SERVICES

5.1.4.1 ShareTheRide

ShareTheRide is Valley Metro's free and secure online ride-matching service. Commuters are matched based on proximity, destination, travel route, schedules, and preferences. Ridesharing commuters can either carpool using their private vehicles or vanpool using vans provided by Valley Metro. Commuters that are carpooling or vanpooling can save time by using HOV lanes on freeways, where available. Carpooling/vanpooling also saves gas money and reduces stress and vehicle wear.

5.1.4.2 Transportation Network Companies

Several TNCs provide ride-hailing services in Chandler. TNCs are private entities that use mobile apps to enable people to secure individual and carpooling rides from drivers who use their own vehicles. The geolocation capabilities of smartphones identify the pick-up location and keeps the customer informed in real time when the TNC vehicle will arrive. While TNCs do not employ the drivers, in most cases they do provide insurance coverage when the drivers are engaged in the transportation of paying passengers.

Valley Metro has entered a partnership with Waymo to see if an autonomous (self-driving) ride-hailing service is viable. The first phase started in August 2018, when Waymo started offering its ride-hailing services to Valley Metro employees who need to reach public transportation. The second phase will extend Waymo's services to Valley Metro RideChoice users. Eventually, it is expected that the service will be opened up to the public at large, offering first- and last-mile solutions that could make public transportation even more accessible.

5.1.5 EXISTING TRANSIT TECHNOLOGY INFRASTRUCTURE

5.1.5.1 Signal Infrastructure and Onboard Technology

The City of Chandler uses NEMA TS2 traffic signal controllers to control traffic at intersections. These controllers have the ability for-peer-to-peer communication and implementing advanced Transit Signal Priority (TSP) features. Currently, the TSP system provides signal priority to buses at all stoplights along Arizona Avenue from Willis Road to Chilton Drive (north of Elliot Road), providing an extended green light for buses running behind schedule. Although major arterial intersections do not have a TSP system, all the other intersections do have a functioning TSP.

Valley Metro is in the process of installing a Computer-Aided Dispatch and Automatic Vehicle Location system on all its buses. This system will provide opportunities for additional TSP enhancements.

Queue jumpers are installed and functioning along Arizona Avenue at Ray Road, Warner Road, and Elliot Road, providing buses with the opportunity to pass through the intersection before the other vehicles stopped at a red light. This allows the buses to pull ahead of traffic if they do not have to stop at a far side bus stop.

5.1.5.2 Valley Metro Rider Communications

NextRide

The NextRide electronic service provides quick access to next bus and train schedule information. Commuters need a phone or access to the internet and need to know the route number and stop number

(STOP#). Each bus stop and light rail station around the Valley is labeled with a unique STOP#. The STOP# is a five-digit number posted on the bus stop sign, shelter, or light rail station. Valley Metro buses and trains are equipped with geolocation technology, allowing commuters to access real-time scheduled arrival times. Commuters can call or text and enter the STOP# to get the most updated arrivals times for the bus stop or light rail station.

RideKick

Valley Metro has developed a mobile app "RideKick" that pulls real-time schedule data to help commuters plan their trip with up-to-the-minute arrival times. The app shows available public transit options based on a commuter's current location, allows the commuter to bookmark their favorite stops, and provides current service alerts. The app includes the following features:

- An interactive map that displays bus and rail stops and park-and-ride locations;
- Geolocation capabilities and filters to find the best and closest public transit options based on needs and current location;
- An extensive trip planner that can bookmark favorite destinations, locate nearby stops, and help plan trips;
- A comprehensive breakdown of fares and fare retailers to find the pass that fits the needs; and
- Real-time service alerts to help plan the trip.

5.1.5.3 State of the Transit Technology Market

The rapid acceleration of internet improvements, including wireless communication and high-speed data sharing, coupled with the Internet of Things, has enabled enormous advancement for emerging mobility service technologies such as automated vehicles (AVs), connected vehicles (CVs), vehicle electrification, shared mobility services, and multimodal mobility platforms. This section describes the current state of the market for emerging transit technology infrastructure.

Automated Vehicle Technology

AVs use sensors, cameras, and geolocation technology to read information about the surrounding environment and navigate to their destination with limited or no human assistance. The Society of Automotive Engineers defines levels of automation on a scale from zero to five. Level zero contains no automation and requires a human driver to operate the vehicle at all times. Level five is full automation where no human driver is required and the automated system controls all driving tasks in all conditions that a human could perform.

AV technologies have been tested and deployed on full-size buses as well as smaller shuttle buses. The technology has ranged from level one driver-assist systems to level four highly automated vehicles. For example, since 2010, the Minnesota Valley Transit Authority has deployed lane-assist technology on shoulder-running buses. This technology has allowed drivers to stay in the shoulder 10% longer and drive on average three mph faster.

In January 2017, Las Vegas launched electric automated shuttles on local streets as a temporary demonstration project, making them the first automated shuttle service operating on public roads in the United States. Starting in November 2017, the shuttles were re-introduced as a one-year pilot program.

Connected Vehicle Technology

CVs communicate to each other through in-vehicle and wireless technology. They can communicate position, direction, and speed to give the driver or the vehicle the situational awareness to react quickly to incidents, thereby reducing the likelihood of crashes and smoothing traffic flow. CVs also can communicate with smart infrastructure and other connected devices like smartphones or wearable technology, further promoting safety across modes and enhancing transportation system operations.

There are several new applications related to connected vehicle technologies that improve transit services:

- Connection Protection (T-CONNECT): enables different transit service providers to coordinate and communicate to optimize passenger transfers between services;
- Dynamic Transit Operations (T-DISP): links available transportation service resources with users through dynamic scheduling, dispatching, and routing; and
- Pedestrian in Signalized Crosswalk Warning: alerts transit operators on pedestrians' presence within the intended path for transit vehicles.

There are several examples of transit agencies implementing these technologies. The Greater Cleveland Regional Transit Authority started testing two CV technology programs: The Enhanced Transit Safety Retrofit Package (E-TRP) and the Transit Bus Stop Pedestrian Warning (TSPW). The E-TRP program includes Vehicle to Infrastructure (V2I) technology to avoid collisions at intersections and Vehicle to Vehicle (V2V) technology to alert bus operators of potential crashes. TSPW alerts pedestrians when a bus is about to enter or leave a bus stop so the pedestrians know to stay clear of the bus travel path.

Santa Clara Valley Transportation Authority demonstrated the Smart Stop application in June 2016. This application promotes collision avoidance, encourages fuel efficiency, and enables communication between passengers and bus drivers on desired trips and bus location using V2I, V2V, and dedicated short-range communications (DSRC) technologies.

Dynamic Carpooling

Dynamic carpooling is an application-enabled service that conveniently matches drivers and passengers in real time, filling empty seats and reducing congestion and auto emissions. Dynamic carpooling applications facilitate cost-sharing among travelers. While the concept of dynamic carpooling has been around for decades, the recent advances in geolocation, smartphone, and social network technologies have made dynamic carpooling much more convenient and viable.

Electric Vehicle Technologies

Electric Vehicles (EVs) run at least partially on battery power, which can be recharged from the electricity grid or a renewably-powered charger. EVs include battery electric vehicles (BEVs) and battery electric buses (BEBs), which are 100% electric powered by an onboard battery, as well as plug-in hybrid electric vehicles, which are fueled by both a battery and another fuel source (usually gasoline-powered internal combustion engine). Many transit agencies across the United States and around the world are utilizing BEBs. Transitioning to electric buses reduces fuel and maintenance costs, noise pollution, and air pollution.

Mobility as a Service (MaaS)

MaaS is typically viewed as a software platform that provides people with on-demand access to a wide range of public and private shared mobility services. MaaS-related services include bikeshare, carshare, EV charging, smart parking, and microtransit. MaaS enables a transition from a system where vehicle ownership is all but required for people to freely move about, to a system where people have access to an array of transportation services. Transportation access can be purchased as-needed, is competitive with the private automobile, and provides more convenient, efficient, and potentially less expensive travel options.

MaaS has the potential to bring public transit together in a single package with other shared mobility services to create a flexible suite of mobility services available on an on-demand basis. An example of this is Xerox's Mobility Companion app, which was launched in Denver and Los Angeles in 2016. The app integrates transit service, shared mobility, and walking into a single trip planning interface. Users can book and pay for trips via the app and determine if they want to select modes based on length of trip, price, number of calories burned, and carbon dioxide released into the air.

Microtransit

Emerging services such as microtransit add to the suite of mobility services and can incorporate parts of the technologies discussed above. Microtransit is an on-demand ridesharing service that is in between conventional public transit and private vehicle ride-sharing. Microtransit uses small shuttles to transport over short distances riders that have the same destinations. Early research shows that microtransit has the potential to expand access to public transportation. However, due to its typically small operating zones and lower capacity shuttles, it is also possible that microtransit could decrease the need for local neighborhood bus service while increasing the need for trunk-route service.

5.1.6 PREVIOUS PUBLIC AND STAFF INPUT ON TRANSIT

To increase understanding of transit opportunities and constraints in Chandler, public and City staff inputs related to transit from previous studies and plans were reviewed and are summarized below.

Chandler General Plan 2016

Chandler residents voiced support for a variety of transportation options in the 2016 General Plan. A poll was conducted in April 2015 to understand residents' top priority options to improve circulation over the next decade. 82 residents responded to the poll, and the results of the poll are shown in **Figure 5-7**.

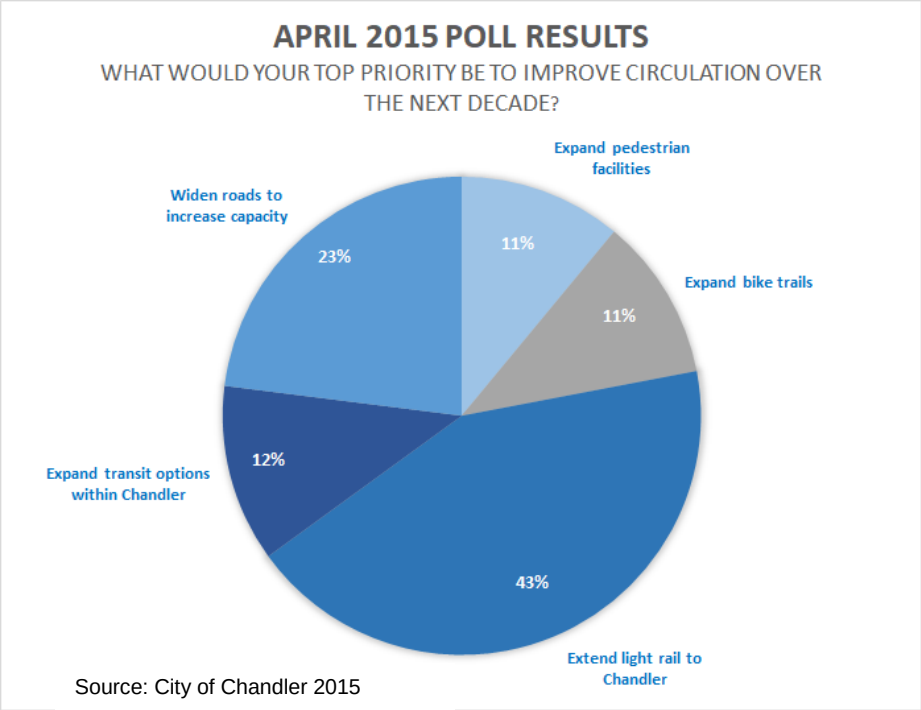


Figure 5-7. Chandler General Plan 2016 - Poll Results

Fiesta-Downtown Chandler Transit Corridor Study 2017

While no public survey or poll was conducted for this study, an interview was conducted with City of Chandler staff, including representatives from Planning and Development, Transportation and Transit, Economic Development, and Public Works departments. The discussion centered on future development plans for the City, as well as a general discussion regarding how the City needs to be in a position to support future transit investments. Through the discussion, the following information related to transit was provided and/or discussed:

- Chandler recognizes the importance of Arizona Avenue as a future high capacity transit corridor;
- New activity centers are under consideration for Arizona Avenue;
- Support of increased transit service and identification of Ray Road as a candidate for additional transit investment;
- Acknowledgement that Arizona Avenue is not currently a transit/pedestrian-oriented environment; and
- Support of a future transit investment and willingness to make necessary land use adjustments as needed.

Southeast Valley Transit System Study 2015

Residents in the Southeast Valley were asked to complete an online survey to assess community transit likes, dislikes, needs and over all support. Over 1,100 individuals responded to the survey. Feedback included:

- About 80% of the respondents did not work in the same community as they lived;
- Personal vehicle was the primary transportation mode;
- Majority of respondents did not use transit because it did not meet their needs; and
- Majority would support a tax or fare increase to support transit.

5.1.7 FUNDING OVERVIEW

Public transit funding is provided through multiple federal, state, regional, and local funding sources as well as passenger fares and advertising revenue. Regional and local funds are combined to fund entire routes or specific route segments and can be used for either operational or capital purposes. Fares paid by passengers contribute significantly to the operational funding of transit services.

5.1.7.1 Federal Funding

Federal allocations are awarded to the region through multiple federal programs including formula distributions that are based on the region's population, level of on-going transit investments, and existing transit system performance. Discretionary investments are awarded on a limited basis. Formula programs are the largest Federal Transit Administration programs that support bus and bus facilities. Currently, the federal funding benefits the City of Chandler with 85% of its bus capital costs, park-and-ride construction, and bus stop capital improvements.

5.1.7.2 State Funding

The Arizona Lottery Fund is a source of funds from multistate Powerball lottery revenues that the Arizona legislature allocates to Maricopa County for transit administered through Valley Metro. This funding is part of a state implementation plan, as required by the Clean Air Act, to meet the national ambient air quality standards. Valley Metro disburses the money among member municipalities and has been using a population-based formula to distribute funds through an application process wherein member cities identify the targeted use for the funds. Powerball revenue fluctuates from year to year. Proceeds available for transit have varied from $5 million to $18 million. City of Chandler typically receives approximately $700,000 per year, with proceeds funding fixed route bus and paratransit operations.

5.1.7.3 Regional Funding

The current 0.5% regional sales tax that funds transportation, including transit, is set to expire after 2025. 33.30% of the revenue from this source is allocated to transit, with the remainder going to highways and arterial roadways. These funds are distributed based on jurisdictional equity, with Chandler receiving 9.5% of non-rail transit funds, which equates to approximately $130 million over the 20-year life of the tax.

5.1.7.4 Local Funding

City of Chandler provides general fund money to help fund transit. The City also collects $150,000 - $250,000 annually in bus stop advertising revenue that funds bus stop capital improvements and heavy maintenance. Additionally, the City gets free bus stop cleaning and light maintenance as a part of its advertising agreement. Currently, the City does not have local transit-specific taxes.

5.2 TRANSIT FUTURE CONDITIONS

5.2.1 PROCESS

Street width is a finite resource and favors the most space-efficient modes of transportation. Transit has the potential to maximize the movement of people while utilizing a minimal amount of space if it is planned well and operated properly. Keeping this in mind, a comprehensive process was developed to understand the existing resources and transit needs within the City, and accordingly frame potential recommendations for an efficient future transit system. The process used in the preparation of the transit recommendations included a combination of technical research and analysis, coordination with City staff, input from the Transportation Commission, and a series of public and stakeholder engagement activities.

The technical research included a review and analysis of existing transit plans, transit services and ridership, existing and future socioeconomic conditions, and transit-dependent populations to develop an understanding of transit needs and inform potential transit recommendations. Analysis of collected demographic data identified that a multitude of different types of Chandler residents use and depend on transit services. Low income populations, zero- or single-car households, disabled populations, and age restricted populations (under 16 or over 65 years) have limited transportation options and therefore are more likely to rely on transit services. Other residents prefer using transit and are considered users of choice.

The Technical Advisory Committee and Transportation Commission provided input into the technical evaluations and recommendations. The public and stakeholder engagement activities included public meetings, a stakeholder workshop, project webpage, and online survey.

5.2.1.1 Planned and Programmed Projects

Documents and planning studies were reviewed to better understand the planned transit network and programmed transit services within Chandler. The findings and relevance of each study to the Chandler Transportation Master Plan 2019 Update process are summarized below.

Valley Metro Arizona Avenue Alternatives Analysis (ongoing)

This ongoing study analyzes different high-capacity transit (HCT) types along the Arizona Avenue corridor with the goal of defining a locally preferred alternative with a recommended route, station locations, and street configuration.

MAG Regional Transit Framework Study (2019 and 2010)

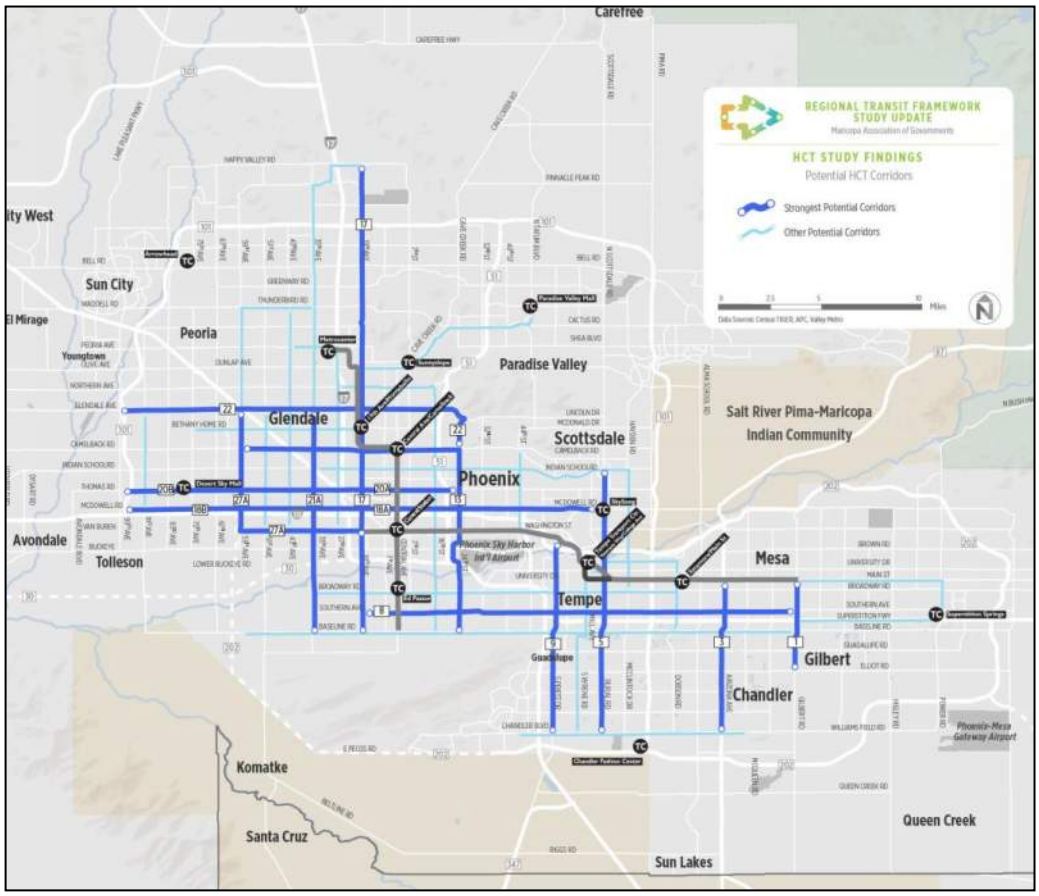
The 2010 Regional Transit Framework Study (RTFS) identified current and future transit deficiencies to define a long-range regional approach for addressing transit needs. In the 2010 study, key 2030 transit needs identified within Chandler included headway improvements and new local services in areas with infrequent headways and minimal service coverage. A recent update to this study revised the horizon year to 2040 and accounted for changes in market conditions, development patterns, and rapid advancements in transportation technology and innovation. The purpose of the update is to identify, validate, and prioritize future HCT investments through a data-driven, system-wide planning approach. Based on the RTFS May 2019 draft update, the following corridors were identified as “strongest potential” and “other potential” HCT corridors within Chandler (see also **Figure 5-8)**.

Strongest Potential HCT Corridors:

- Priest Drive between Loop 202 (Red Mountain) and Chandler Boulevard;
- Rural Road between Indian School Road and Chandler Boulevard; and
- Arizona Avenue between Main Street and Chandler Boulevard.

Other Potential HCT Corridors:

- Kyrene Road between Baseline Road and Chandler Boulevard; and
- Chandler Boulevard between 44th Street and McQueen Road.



Source: MAG Regional Transit Framework Study Update, Findings and Next Steps | Draft May 2019

Figure 5-8. RTFSU Findings - Potential HCT Corridors

Valley Metro Fiesta-Downtown Chandler Transit Corridor Study (2017)

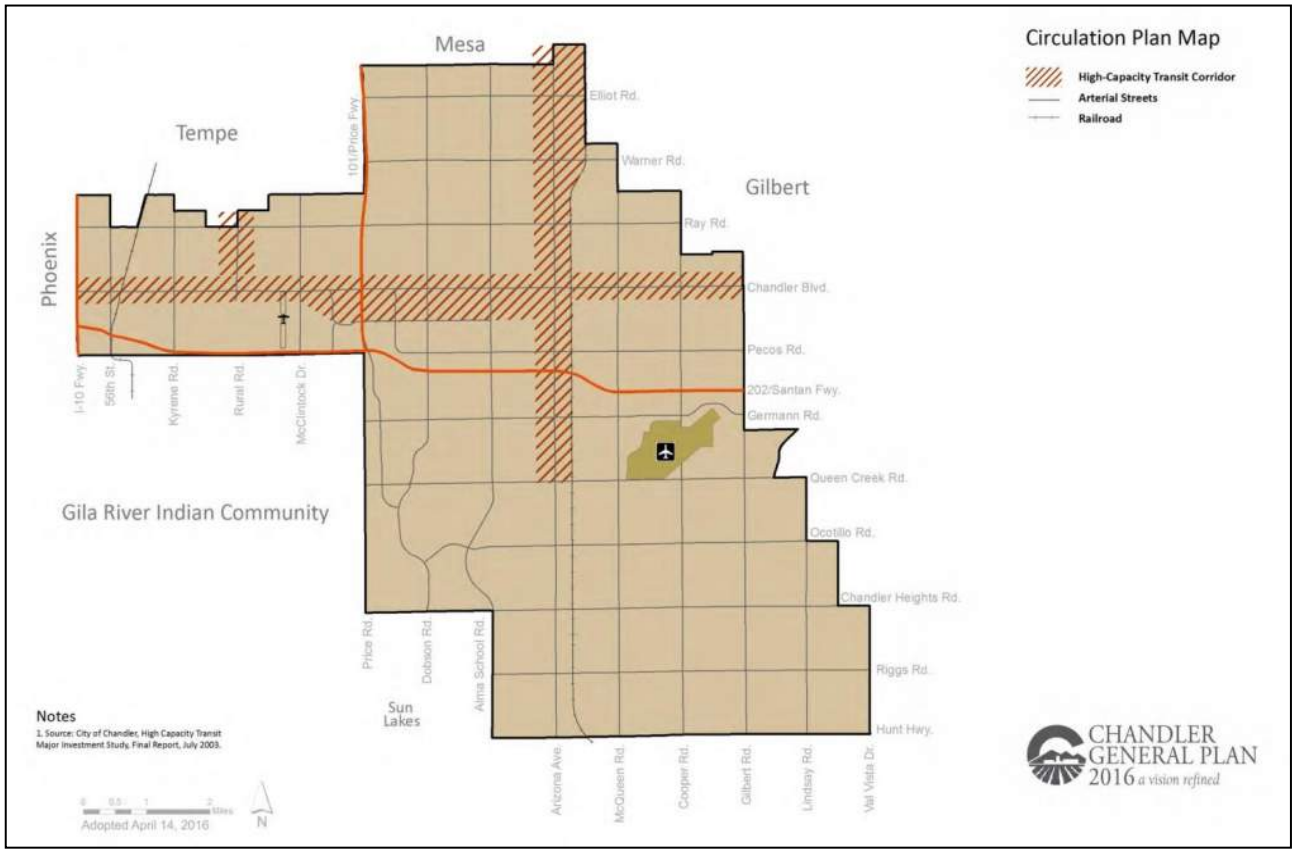
The Fiesta-Downtown Chandler Transit Corridor Study (FDCTCS) evaluated various transit modes and two distinct scenarios along existing arterial roadways to recommend a transit option that can improve mobility in the study area. Valley Metro's study partners, including the municipalities of Mesa, Chandler, and Gilbert as well as MAG, identified potential land use adjustments and transit investments, including local bus service and HCT appropriate in the short-term (2020), mid-term (2030), and long-term (2040) to meet the anticipated travel demand in the area.

Specifically, the recommendation was for HCT along Dobson Road from Main Street to Southern Avenue continuing on Country Club Drive/Arizona Avenue to downtown Chandler. This recommendation was split into two phases where Phase I would implement light rail transit (LRT) in Mesa, and Phase II would continue HCT into downtown Chandler. The study made specific recommendations to enhance plans and policies to support the development of HCT, as well as land use scenarios that would support higher densities and a more pedestrian-friendly environment.

Chandler General Plan (2016)

The General Plan identified three HCT corridors along three arterial roads: Arizona Avenue, Chandler Boulevard, and Rural Road (**Figure 5-9**). These corridors are defined as routes for consideration of efficient, expedited public transit service such as bus rapid transit (BRT), streetcar, or light rail. These HCT corridors are areas where the City allows higher density and mixed-used developments that would provide opportunities for residents to live within walking distance from everyday destinations.

The plan also identified a need for small circulator vehicles to connect neighborhoods and the Price Road commercial corridor to the wider transit network. Neighborhood circulators could provide connections between downtown Chandler, the Price Road corridor, and the Medical/Regional Retail Growth Area (in the vicinity of Loop 101/Loop 202) as well as from neighborhoods to major activity centers.



Source: Chandler General Plan, 2016

Figure 5-9. Chandler General Plan Circulation Map

MAG Southeast Valley Transit System Study (2015)

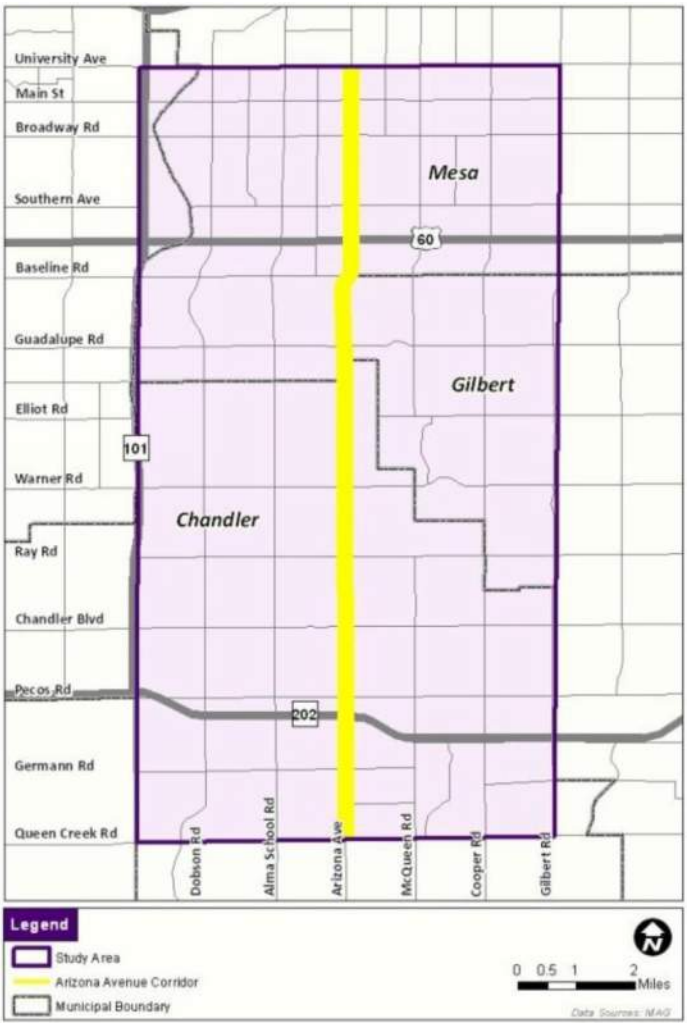
The purpose of this study was to identify short-term, mid-term, and long-term recommendations that will advance the transit system throughout the study area. The study evaluated existing transit conditions followed by an analysis of the transit needs for the area. This MAG study documented transit performance of the existing transit network. It recommended extending service routes, starting new service routes, and adjusting service headways to a maximum of 30 minutes for local bus service throughout Chandler.

Some of the important recommendations include:

- **Route #96, Dobson Road**: Explore circulator or flex service type to serve area south of Fairview Street to replace this segment of Route 96;
- **Route #104, Alma School Road**: Monitor boardings on the Frye Road segment of Route 104 to determine if the deviation to downtown Chandler is worthwhile or if another service mode (e.g., circulator) would be more efficient;
- **Route #156, Chandler Boulevard**: Improve frequency to 15+ minute frequency all day between 48th Street and Power Road and consider enhanced/limited local service. As ridership increases, work with the Town of Gilbert to explore ways to eliminate deviation to Gilbert Mercy Hospital to reduce the time penalty for through-riders;
- **Explore commuter services between south Tempe/north Chandler and downtown Tempe**: Consider improved limited stop service during peak hours;
- **Route #56, 56th Street (Priest Drive)**: Extend service along 56th Street and 48th Street to Chandler Boulevard;
- **Route #112, Arizona Avenue**: Extend service south one mile to Queen Creek Road;
- **Route #136, Gilbert Road**: Extend service south one-half mile to Queen Creek Road;
- **New service along Queen Creek Road between Price Road and Gilbert Road or Val Vista Drive**: Extend farther east as population and employment grow; and
- **Consider new transit centers in downtown Chandler and south Chandler**.

Arizona Avenue High Capacity Transit Long Range Study (2012)

The Arizona Avenue High Capacity Transit Long Range Study evaluated alternative land use scenarios and transit service concepts that could result in improved trip generation and make the Arizona Avenue corridor (see **Figure 5-10**) viable for HCT service. The study recommendations include higher residential and commercial density, improved local bus service, the implementation of transit-supportive plans and policies, and developing a more pedestrian-friendly environment. In addition, this study provided a review of the necessary capital and operating costs that would be associated with HCT development in this corridor.



Source: Arizona Avenue High Capacity Transit Long Range Study, 2012

Figure 5-10. Arizona Avenue Study Area

City of Chandler Transportation Master Plan (2010)

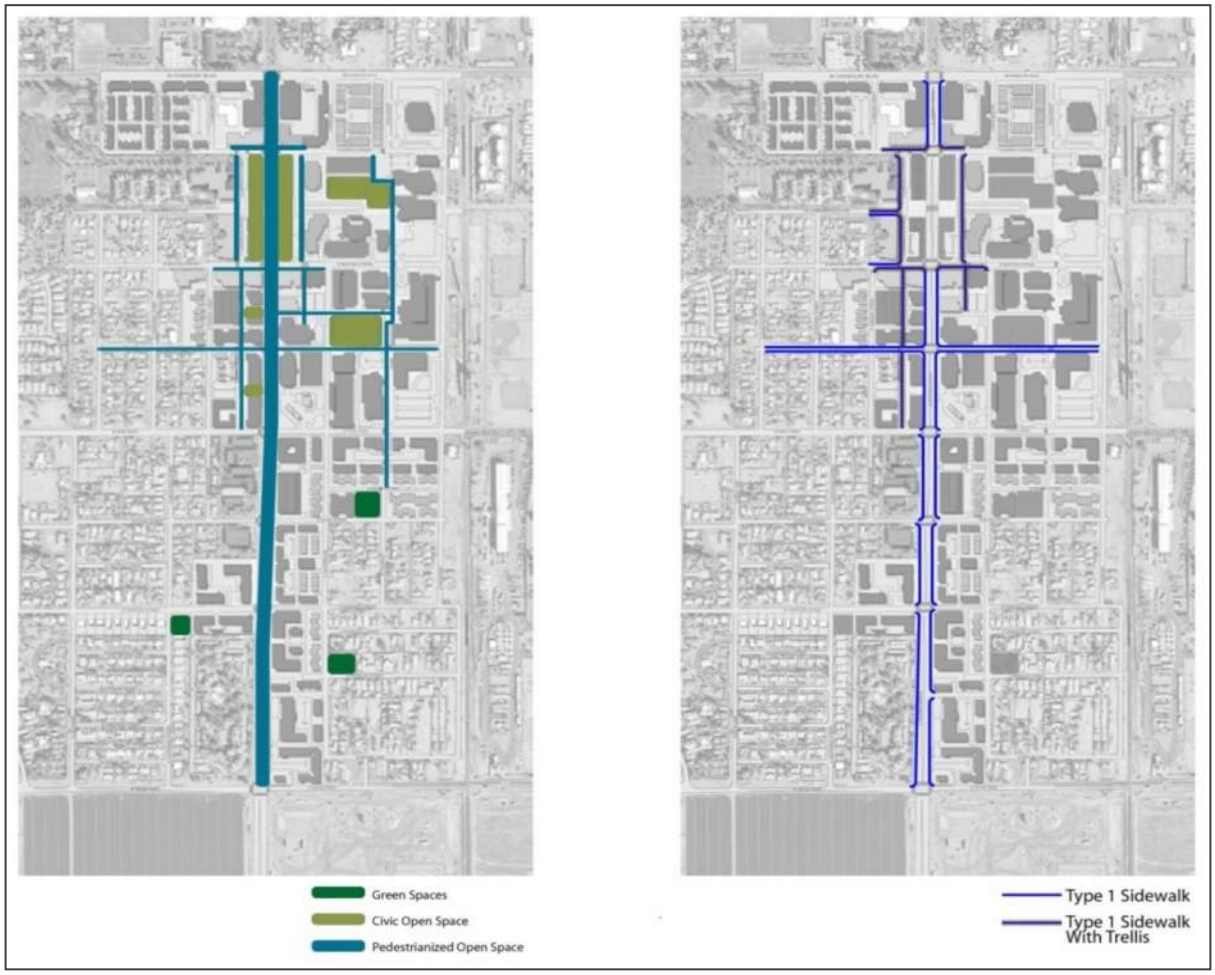
The 2010 Transportation Master Plan outlined transportation goals and strategies, documented existing and future conditions, and developed recommendations. This document serves as the starting point for the current Transportation Master Plan 2019 Update. The previous recommendations were based on providing a mix of transit services that support all residents of Chandler, from transit-dependent riders to those residents who use transit for convenience or to support sustainability efforts. Thus, the recommendations of the previous Transportation Master Plan supported the following objectives for transit service in Chandler:

- Expand transit service throughout the city and enhance service levels;
- Support paratransit service and fixed-route alternatives, including educational programs;
- Enhance commute-oriented express services;

- Introduce local circulator routes and small bus operations to connect activity centers and areas of the city beyond the reach of fixed-route services;
- Provide adequate levels of amenities at bus stops;
- Encourage development and design practices to support the increased use of transit; and
- Evaluate long-term needs for HCT services.

City of Chandler South Arizona Avenue Design Guidelines (2010)

The South Arizona Avenue Design Guidelines established a vision for the corridor between downtown Chandler and the Santan Freeway (Loop 202), located ¾ mile to the south. The City has implemented portions of this plan to develop this corridor with high-density residential and commercial mixed uses to create a dynamic new "front door" for Chandler. The design guidelines encourage well-designed and maintained pedestrian infrastructure on Arizona Avenue, as shown in **Figure 5-11**. The guidelines specify that pedestrian infrastructure should provide access to transit stops to facilitate first mile/last mile trips.

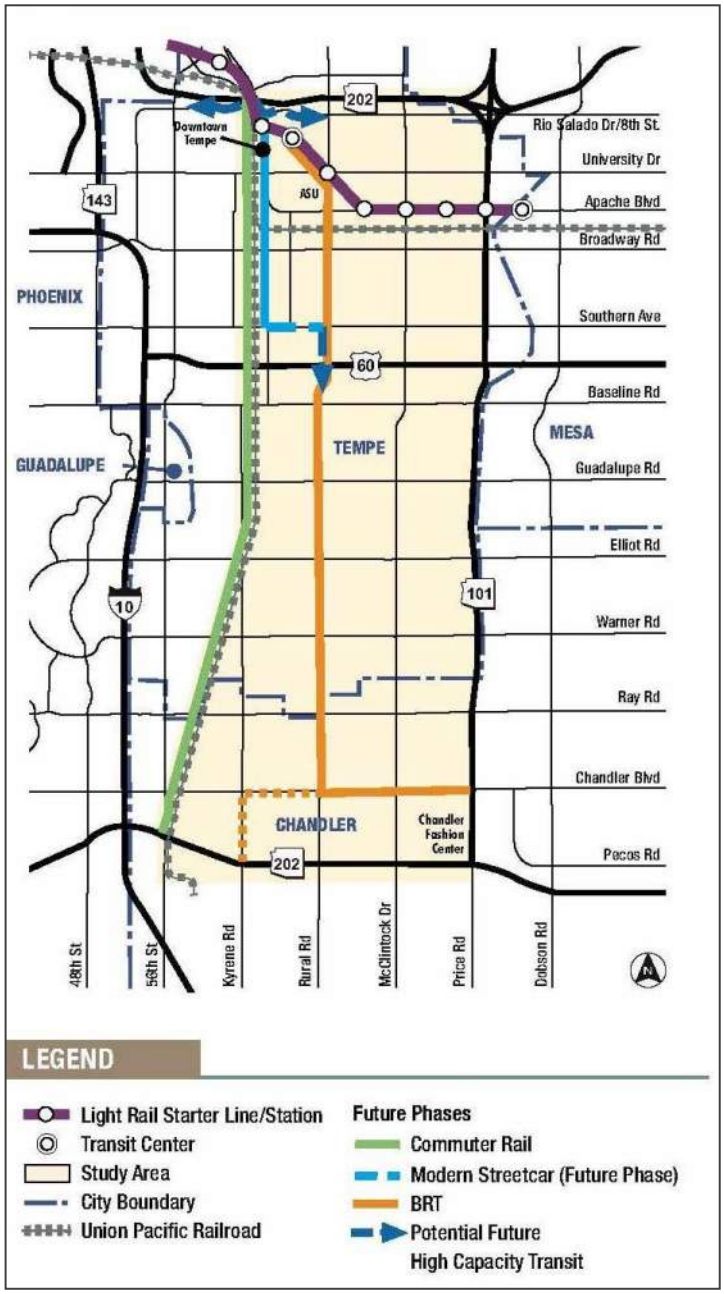


Source: City of Chandler South Arizona Avenue Design Guidelines, 2010

Figure 5-11. Gathering and Open Spaces and the Pedestrian Network

Tempe South High Capacity Transit Study (2010)

Valley Metro, along with the cities of Tempe and Chandler, conducted this study to evaluate various transit options for the Mill Avenue/Rural Road corridor. The study analyzed the desire for BRT service along Rural Road terminating at the Chandler Fashion Center and ultimately recommended the corridor (see **Figure 5-12)**; the project is slated to be built as funding becomes available.

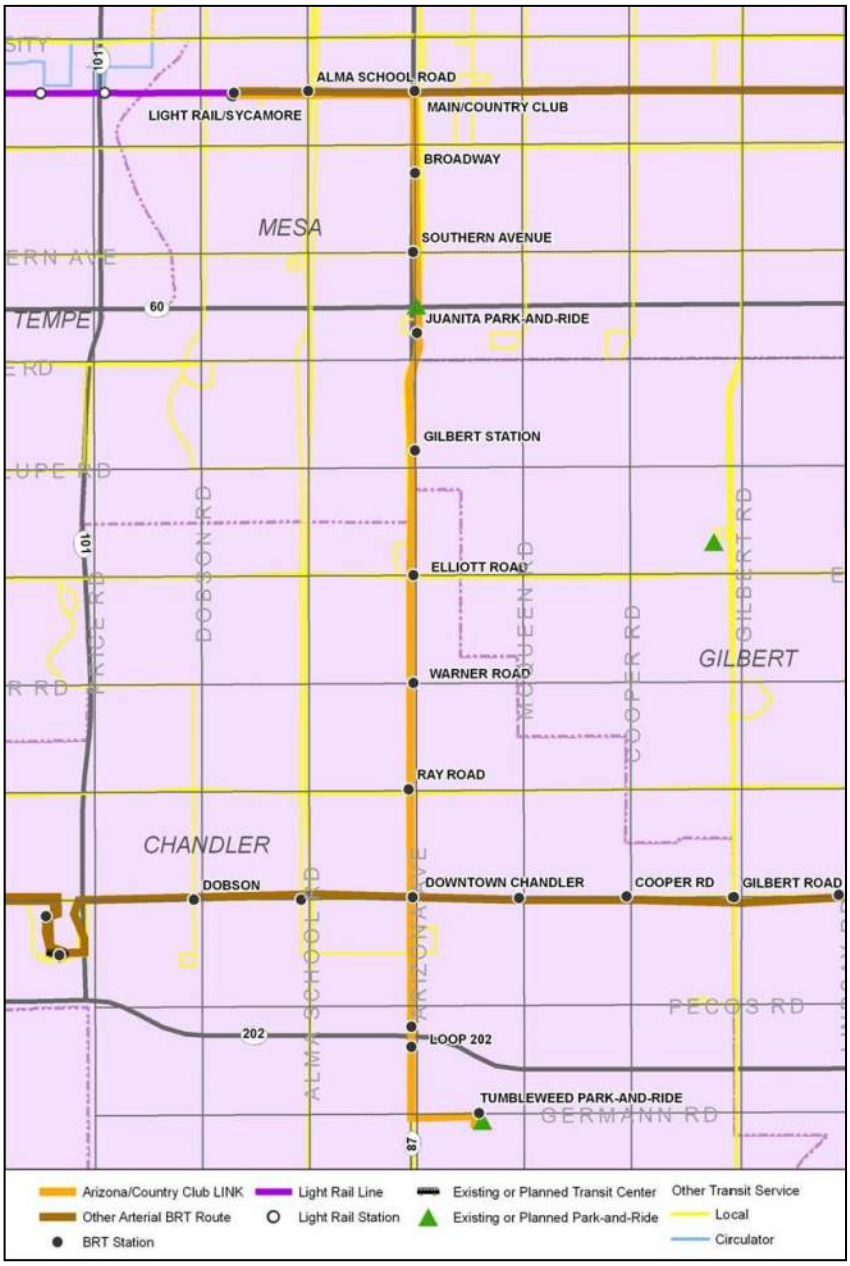


Source: Tempe South High Capacity Transit Study, 2010

Figure 5-12. Proposed Rural Road BRT Line

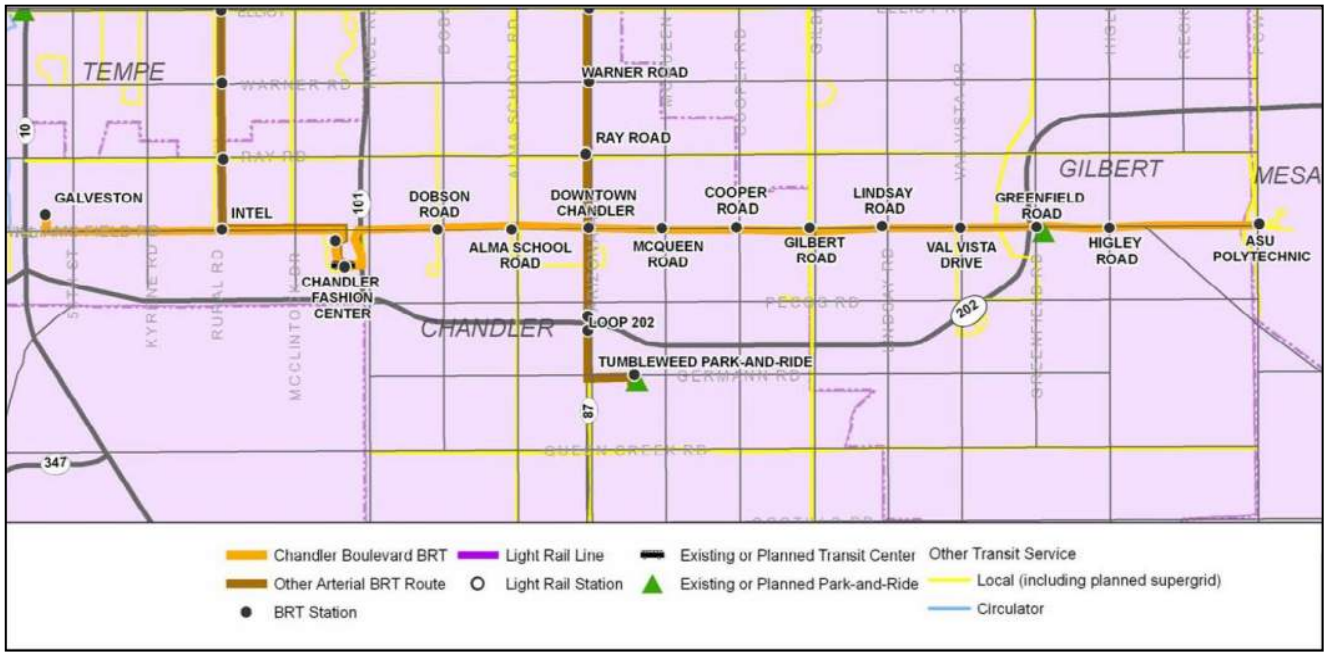
Valley Metro Comprehensive Arterial Bus Rapid Transit Planning Study (2009)

This study identified the demand for BRT service and defined operational characteristics, capital infrastructure needs, and fleet requirements for arterial BRT corridors throughout the region. The study considered how operational characteristics and corridor needs may change as the regional transit network develops. This study described the vision for the BRT system and each of the corridors planned for future implementation, including BRT services for the Arizona Avenue LINK and Chandler Boulevard, as shown in **Figure 5-13** and **Figure 5-14**.



Source: Valley Metro Comprehensive Arterial Bus Rapid Transit Planning Study, 2009

Figure 5-13. Proposed Arizona Avenue/County Club LINK Corridor



Source: Valley Metro Comprehensive Arterial Bus Rapid Transit Planning Study, 2009

Figure 5-14. Proposed Chandler Boulevard BRT Corridor and Station Locations

Chandler High Capacity Transit Major Investment Study (MIS) (2002)

The Chandler High Capacity Transit Major Investment Study identified projects that could address future travel demands in Chandler through high capacity transit. A systematic review process considered multiple factors including travel patterns, regional rail and express service plans, physical and financial requirements of alternatives in three separate tiers of analysis. The MIS framework showcased long range transit improvements and complimented the Transit Plan Update which was adopted by the Chandler City Council in August of 2002. The study concluded Alternatives 2 (Chandler Boulevard BRT) and 3B (Arizona Avenue BRT) were the highest scoring for prospective development. The locally preferred alternative (LPA) used this analysis to determine a phased approach most appropriate. The Chandler City Council adopted the transit plan improvement and priorities phasing with bus service improvements in the Transit Plan Update to take place in the subsequent 5-10 years as Phase 1 and the BRT services to be constructed in the following 10-15 years as Phase 2. This phased development was adopted by the Chandler City Council as a part of the Transit Development Strategy in February of 2003.

Short Range Transit Program for FY 2020 - 2024

The Short Range Transit Program (SRTP) identifies transit service change concepts for the next five years and builds upon previous and ongoing Valley Metro efforts. The SRTP identifies regional and local fixed-route service change concepts regardless of funding source (e.g., regional or local). The SRTP is based on input submitted by individual member agencies, as well as concepts developed by Valley Metro staff in conjunction with the approved Transit Standards and Performance Measures. The SRTP serves as input for processes such as the Transit Life Cycle Program (TLCP), Fleet Management Plan, bi-annual service changes and the Transportation Improvement Program.

Table 5-8 identifies future improvements to existing local bus routes within Chandler between FY 2020 and FY 2024. There are no planned future improvements for the Express/RAPID routes.

Table 5-8. Short Range Transit Program for FY 2020 - 2024

Route Index	Route Name	Impacted City	Change Type	Change Month	Change Year	Fiscal Year	Potential Service Change Concept
72	Scottsdale/ Rural	Chandler, Phoenix, Scottsdale, Tempe	Route Modification	October	2019	FY 20	Potential change to adjust run-time, depending on results from the Downtown Tempe Transit Study.
104	Alma School	Chandler	Service	October	2019	FY 20	Add weekday trips until 9pm for the short trips.
81/96	Hayden/ McClintock or Dobson	Chandler, Tempe	Service	October	2020	FY 21	Explore options to serve Price Corridor. Pending the results of the Transportation Master Plan. Estimated completion is December 2019.
136	Gilbert Road	Chandler, Gilbert	Service	October	2020	FY 21	Extend evening service weekdays and Saturdays to Chandler.
72	Scottsdale/ Rural	Chandler, Scottsdale, Tempe	Service	October	2021	FY 22	Potential improvement to increase peak headways to 15 minutes.
104	Alma School	Chandler	Service	October	2021	FY 22	Add Saturday until 9pm in Chandler
156	Chandler Boulevard/ Williams Field Road	Chandler	Service	October	2021	FY 22	15-minute peak frequency from Kyrene to Gilbert Road.
140	Ray Road	Chandler, Gilbert, Phoenix	New Route	October	2022	FY 23	Add Sunday service.
81	Hayden/ McClintock	Chandler, Tempe	Service	October	2023	FY 24	Weekday, improve service in Chandler by extending current service to add two evening round trips.
96	Dobson	Chandler. Mesa	Service	October	2023	FY 24	Weekday, improve service in Chandler by extending current service to add one evening round trip.

Route Index	Route Name	Impacted City	Change Type	Change Month	Change Year	Fiscal Year	Potential Service Change Concept
112	Country Club/ Arizona Ave	Chandler	Extension	October	2023	FY 24	Extend Route 112 to Hamilton High School.
120	Mesa Dr/ McQueen	Chandler, Mesa	Extension	October	2023	FY 24	Extend to Warner Road in Gilbert.
140	Ray Road	Chandler, Gilbert, Phoenix	New Route	October	2023	FY 24	Extend 140 from Gilbert Road to Power Road on Warner.
96	Dobson	Chandler. Mesa	Service	October	2024	FY 25	Improve peak weekday frequency to 15 minutes from Riverview to Elliot Road.

5.2.1.2 Community Input

The community outreach program for the Chandler Transportation Master Plan 2019 Update was initiated in January 2019. Outreach was geared toward capturing input from a broad range of stakeholders through several outreach methods, including public meetings, online surveys, and stakeholder workshops. This section provides information on the community outreach and the input received.

Public Meetings

Three public meetings were held throughout the first phase of the planning process at various locations within Chandler. Opportunities were provided for the public to speak one-on-one with project staff. Large maps, display boards, and fact sheets were provided so that meeting attendees could understand existing transit service routes, visually identify areas they were most concerned about, and determine where they would like to see transit service improved. Additional input was collected on comment forms. The following questions were asked to the meeting attendees and the responses are summarized below.

- To what locations would you like local transit service to take you?
- To what locations would you like regional transit service to take you?
- What transit services would you most use?

Chandler residents identified several local and regional destinations that they would like to access using transit services. The top ten local and regional destinations are noted below in order of most to least votes received; these results were considered while formulating the transit recommendations to improve connectivity and access.

Local Destinations

- Downtown Chandler;
- Chandler Fashion Center;
- Fulton Ranch Towne Center;
- Price Road Employment Corridor;
- Intel Ocotillo Campus;
- Ahwatukee Foothills Towne Center;
- Chandler-Gilbert Community College;
- Chandler Municipal Airport;
- Intel Chandler Campus; and
- Stellar Airpark.

Regional Destinations

- Downtown Phoenix;
- Arizona State University, Tempe Campus/Downtown Tempe;
- Arizona State University, Polytechnic Campus;
- Phoenix-Mesa Gateway Airport;
- Phoenix Sky Harbor International Airport;
- Downtown Mesa;
- Gilbert Town Square;
- Encanto Village Phoenix;
- Downtown Scottsdale; and
- Crossroads Towne Center.

Desired Transit Services

Meeting attendees were given a chance to select three preferred transit modes from nine mode options that they would most use to travel locally and regionally. Based on the attendee votes, light rail/streetcar was the most desired transit mode followed by circulator and shared microtransit (see **Figure 5-15**).

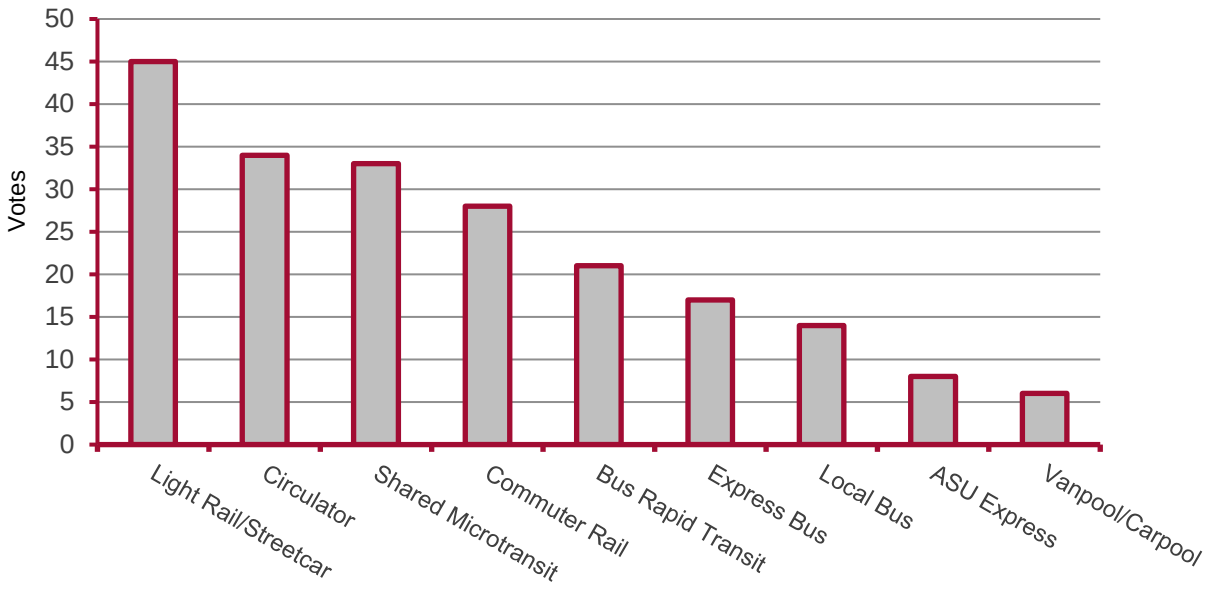


Figure 5-15. Desired Transit Modes

Stakeholder Workshop

Nineteen key community influencers were identified as transportation stakeholders by the City of Chandler to participate in a stakeholder workshop that convened on March 7, 2019 to solicit input and address specific issues or concerns regarding transportation within Chandler. The stakeholder workshop yielded significant insights into issues related to transit accessibility and connectivity. Issues identified during the stakeholder workshop also provided a framework for exploring the characteristics and qualities of recommended transit services. The key transit issues or topic areas identified during the stakeholder workshop include:

- Provide transit services that cater to a larger percentage of the population and encourage transit use;
- Need transit alternatives as population grows and roads cannot expand farther;
- Make public transportation accessible and efficient as everyone cannot afford or drive a car;
- Need better public transit options for seniors and those with disabilities. Service needs to be coordinated with senior living facilities providing access to shopping centers, medical services, and pharmacies;
- Need longer hours of local bus service to increase efficiency and minimize bus transfers during night time;
- Keeping in mind the intense summers, transit services need to be direct with fewer or no transfers;
- Additional direct/express bus routes to regional destinations are needed to reduce travel time;
- Need transit services for easy circulation within downtown Chandler;
- Use transit funding to provide neighborhood bus service in areas with schools;
- Improve transit services to south of Loop 202 as the area is currently underserved and growing businesses seek increased transit access;

- Potential connection to existing light rail route or future streetcar from Price Road employment corridor would provide better regional transit connectivity and help reduce Loop 101 congestion;
- There is a current gap in transit service from Chandler Fashion Center Mall to the Price Road employment corridor;
- Provide transit services (shuttle buses) from Chandler to remote locations like Maricopa and Queen Creek;
- Need HCT connectivity to employment centers within Chandler, and for students/workers travelling to downtown Tempe and/or ASU Campus;
- Consider BRT as one of the HCT options to close the gaps of underserved areas;
- Need first mile/last mile connectivity through shared transport;
- Facilitate corporate rideshare partnerships and subsidies or employer discounts, and potential micro-rideshare lots at key locations;
- Acknowledge that autonomous vehicles are the future and provide solutions that can best use the technological advancements;
- Students and younger working population are not inclined toward driving, and need demand-responsive mode alternatives like carpool, microtransit, ride-share, and ride-hailing services;
- Could potentially use existing railroad tracks for commuter rail service for regional connectivity; and
- The addition of transit services could potentially take away from automobile infrastructure.

Public Survey

An online survey was posted on the project webpage (KeepChandlerMoving.com*)* to assess community transportation likes, dislikes, needs, and overall support. Chandler residents and those traveling to Chandler for employment and other purposes were encouraged to participate in the survey. One thousand seventy-five (1,075) individuals responded to the survey. The purpose of the transit-related survey questions was to assess attitudes toward public transit and identify factors that might influence transit usage in the future. Key messages received through the online survey process were slightly different from the input received through public meetings and the stakeholder workshops. The following transit-related questions were part of the survey and the most popular responses are noted below each question, ordered in terms of the number of responses, with the most popular responses listed first.

- Why are you most interested in transit travel (e.g., bus)?
  1. Cost-effectiveness;
  2. Don't travel by transit but interested in the topic; and
  3. Convenience.

- For transit travel in Chandler, which of the following is most important to you?
  1. Quickest travel time;
  2. Ease of access to destination; and
  3. Feeling safe.

- Which destinations do you travel to most by transit?
  1. Employment;
  2. Shopping centers; and
  3. Parks/recreational facilities.
- Thinking of longer-term transit improvements, what transit mode(s) should the City prioritize in the future?
  1. Light rail;
  2. Emerging technologies (e.g., driverless buses, on-demand transit); and
  3. Commuter rail.
- What do you believe are important destinations that transit should serve?
  1. Downtown Chandler;
  2. Phoenix Sky Harbor International Airport;
  3. Chandler Fashion Center Mall;
  4. Downtown Phoenix; and
  5. Arizona State University.
- What should be done with transit routes that have low ridership?
  1. Modify where routes go;
  2. Provide more connections to other transit routes; and
  3. Replace the routes with demand-responsive microtransit.
- What mode of travel should the City invest in MOST in the future?
  1. Transit;
  2. Automobile; and
  3. Bicycle/scooter.

5.2.1.3 Land Use

Land use contributes to the productivity of transit systems and is considered an integral element of this study. Land uses are correlated with the potential for ridership as well as employment or activity center destinations. Land use policies that are compatible with transit and transit-oriented development may promote the success and support of transit investments within Chandler in the future.

The study area contains a variety of existing and planned future land uses, as shown in **Figure 5-16** and **Table 5-9**. The most prevalent existing land use in Chandler is Single Family Residential, which is almost 49 percent of the total area. Future land uses are defined based on data collected from the Chandler Planning Department and MAG. The data represents land use at the projected build-out stage for Chandler and does not necessarily reflect anticipated conditions in the year 2040. The majority of vacant and agriculture land is projected to be developed as mixed use and other employment. Most of the agriculture land south of Loop 202, along Price Road, and around Chandler Municipal Airport, is projected to be developed as mixed use and other employment. Thus, there is a potential for increase in population and employment density in these areas, which increases the potential need for future transit investments.

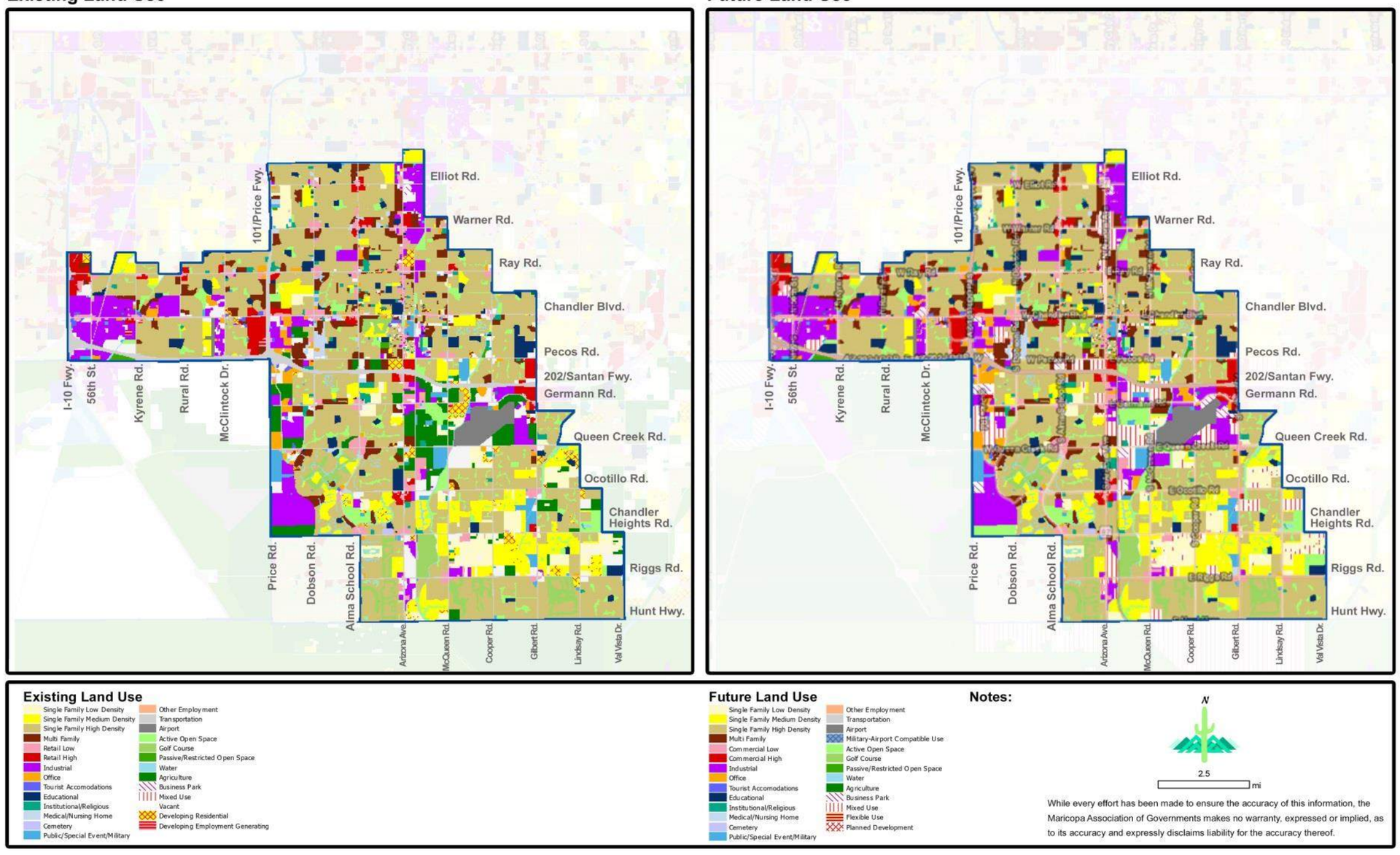


Figure 5-16. Existing and Future Land Use, 2015 and 2040

Table 5-9. Existing and Future Land Use Percentages

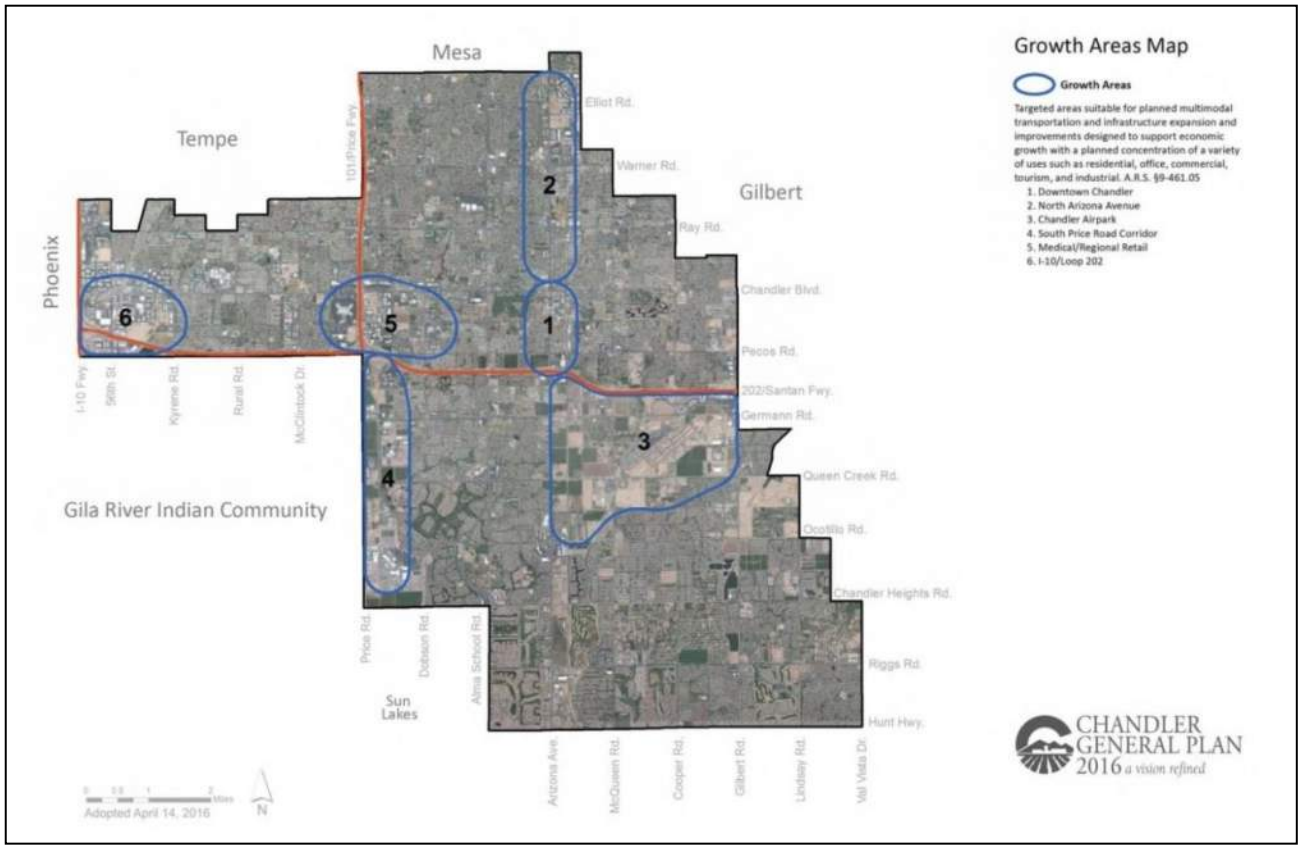
Land Use Sector	Existing Land Use		Future Land Use	
	Acres	Percent of Total	Acres	Percent of Total
Single Family	22,263	48.7%	23,182	50.7%
Multi Family	1,937	4.2%	2,276	5.0%
Commercial	2,265	5.0%	2,374	5.2%
Industrial	3,149	6.9%	3,406	7.5%
Office	604	1.3%	787	1.7%
Other Employment	2,783	6.1%	3,349	7.3%
Mixed Use	0	0%	2,542	5.6%
Transportation	3,686	8.1%	3,675	8.0%
Open Space	3,699	8.1%	4,105	9.0%
Agriculture	2,296	5.0%	0	0%
Vacant	3,016	6.6%	-	-
Total Acres	**45,697**	**-**	**45,697**	**-**

Source: Maricopa Association of Governments 2017, by Municipal Planning Area

Growth Areas

The Chandler General Plan 2016 identifies six growth areas within Chandler. Growth areas are targeted areas within the community that are suitable for planned multimodal transportation and infrastructure expansion. These improvements are designed to support economic growth with a planned concentration of a variety of uses such as office, commercial, tourism, industrial, and residential. Where appropriate, mixed use projects are encouraged to occur within new developments. **Figure 5-17** shows the six growth areas that provide a framework for anticipated development. Policies were identified in the General Plan 2016 that provide more specific direction for the development of various land uses located within each growth area. Some of the transit-related policies are provided below:

1. **Downtown Chandler**: Continue to redevelop downtown with higher densities, mixed-use, and transit-oriented developments;
2. **North Arizona Avenue**: Continue to study HCT; incorporate bike lanes and wide, shaded sidewalks for Arizona Avenue; promote higher densities and pedestrian-oriented development along the corridor;
3. **Chandler Airpark**: Continue to strengthen the circulation pattern around and gateways to Chandler Airpark, including from Santan Freeway (Loop 202) and Cooper Road as well as improving western access (e.g., Ryan Road and connection to Tumbleweed Park);
4. **South Price Road Corridor**: Provide pedestrian, bicycle, vehicular, and transit connections to adjacent residential and commercial uses to support businesses in the corridor;
5. **Medical/Regional Retail**: Encourage connectivity and ease of access within current campus environments and any future facility expansion.
6. **Loop 202/I-10**: Brand the Loop 202/I-10 Growth Area and encourage business development that can benefit from connectivity to regional, state, and interstate transportation key commerce corridors.

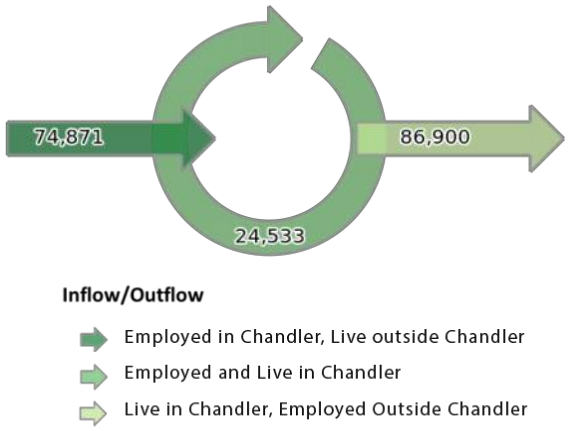


Source: Chandler General Plan, 2016

Figure 5-17. Chandler General Plan Growth Areas Map

5.2.1.4 Travel Patterns

Travel patterns illustrate where people travel and demonstrate future transit service needs. An analysis was performed using the U.S. Census Bureau 2015 travel pattern data to understand relationships between home and work destinations. This inflow/outflow profile was utilized to understand these travel patterns for Chandler. The inflow/outflow profile (see **Figure 5-18**) analyzes the number of individuals who live and work in Chandler. **Table 5-10** illustrates the relationship of individuals living and working in Chandler.



Source: U.S. Census Bureau 2015

Figure 5-18. Employment Inflow/Outflow Profile

Table 5-10. Employment Inflow/Outflow Profile

Employment	Count	Share
Total employed in Chandler	99,404	100.0%
Employed in Chandler but living outside Chandler	74,871	75.3%
Employed and living in Chandler	24,533	24.7%
Total employed population living in Chandler	111,433	100.0%
Living in Chandler but employed outside Chandler	86,900	78.0%
Living and employed in Chandler	24,533	22.0%

Source: U.S. Census Bureau, 2015

According to the U.S. Census Bureau, in 2015 there were a total of 99,404 people employed in Chandler and a total of 111,433 employed people living in Chandler. A total of 24,533 people both lived and worked within Chandler. In addition, 86,900 people were living in Chandler but working outside the city while 74,871 people lived outside of Chandler but were employed within the city.

Based on this data, there is a need to provide connectivity between major employment centers within Chandler, as well as regionally, as Chandler is importing and exporting a significant number of workers. Although this data does not capture all travel patterns in and out of Chandler, this provides background knowledge of how many individuals on average travel to and from Chandler.

Live-Work Travel Patterns

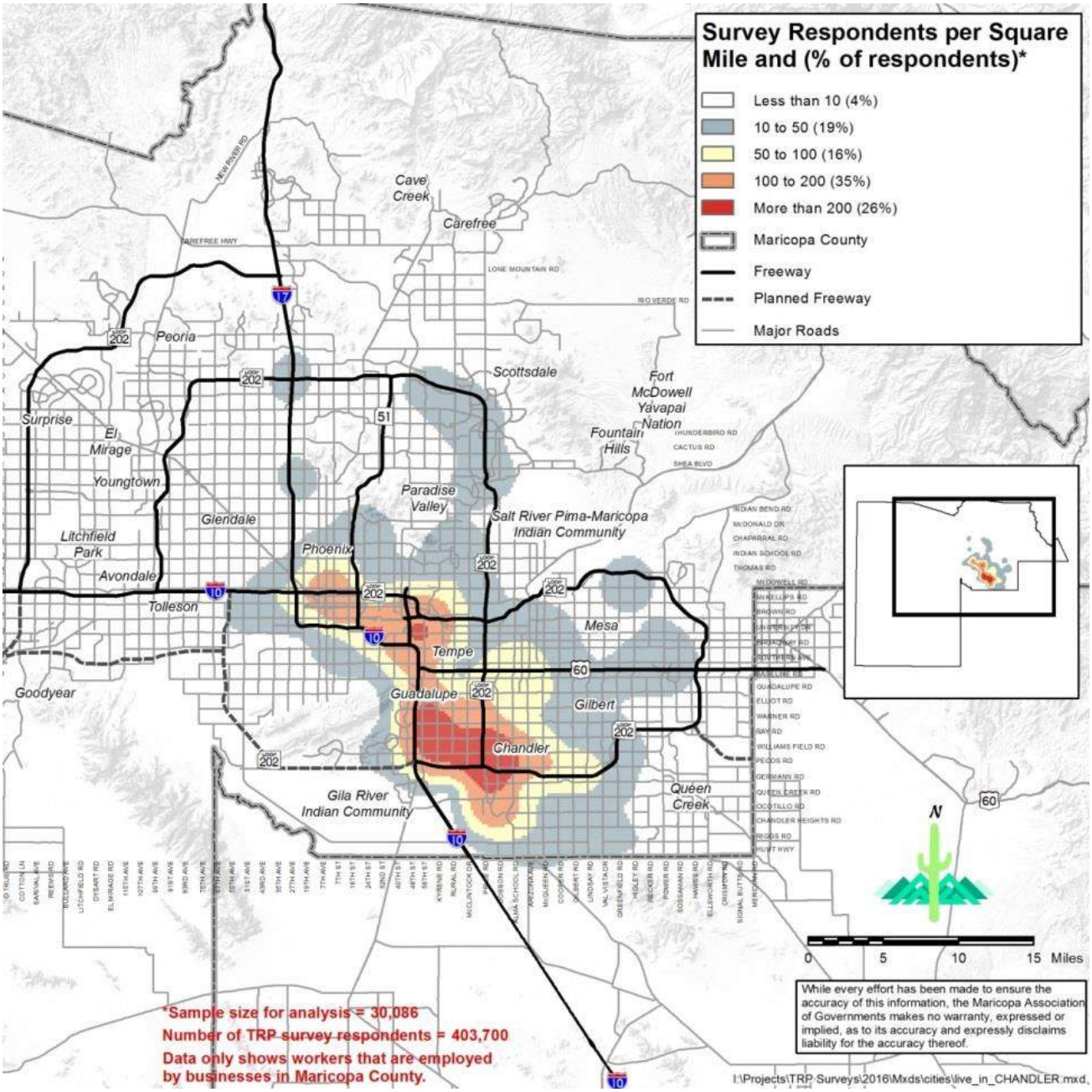
To better understand travel demand and trip patterns in Chandler and the MAG region, recent studies relevant to Chandler's travel patterns were examined. In addition, data collected through the Maricopa County Air Quality Department trip reduction program (TRP) survey was studied as well.

The Maricopa County Department of Air Quality annually conducts a trip reduction survey as part of its TRP with all employers in Maricopa County with 50 or more employees. It asks about interests in alternate modes (alternatives to the single occupant vehicle) and also obtains information on work and residential location. **Figure 5-19** and **Figure 5-20** are maps prepared by MAG showing where people live that work in Chandler, and where people work that live in Chandler. This information can inform key regional connections that would be important in development of the transit system.

The dark red areas on **Figure 5-19** demonstrate that a majority of people who live in Chandler work in the Price Corridor, Downtown Chandler, West Chandler, and Downtown Tempe. The orange areas show that a moderate number of people who live in Chandler travel to Downtown Phoenix, South Tempe, Phoenix Sky Harbor Airport, and Gilbert for work.

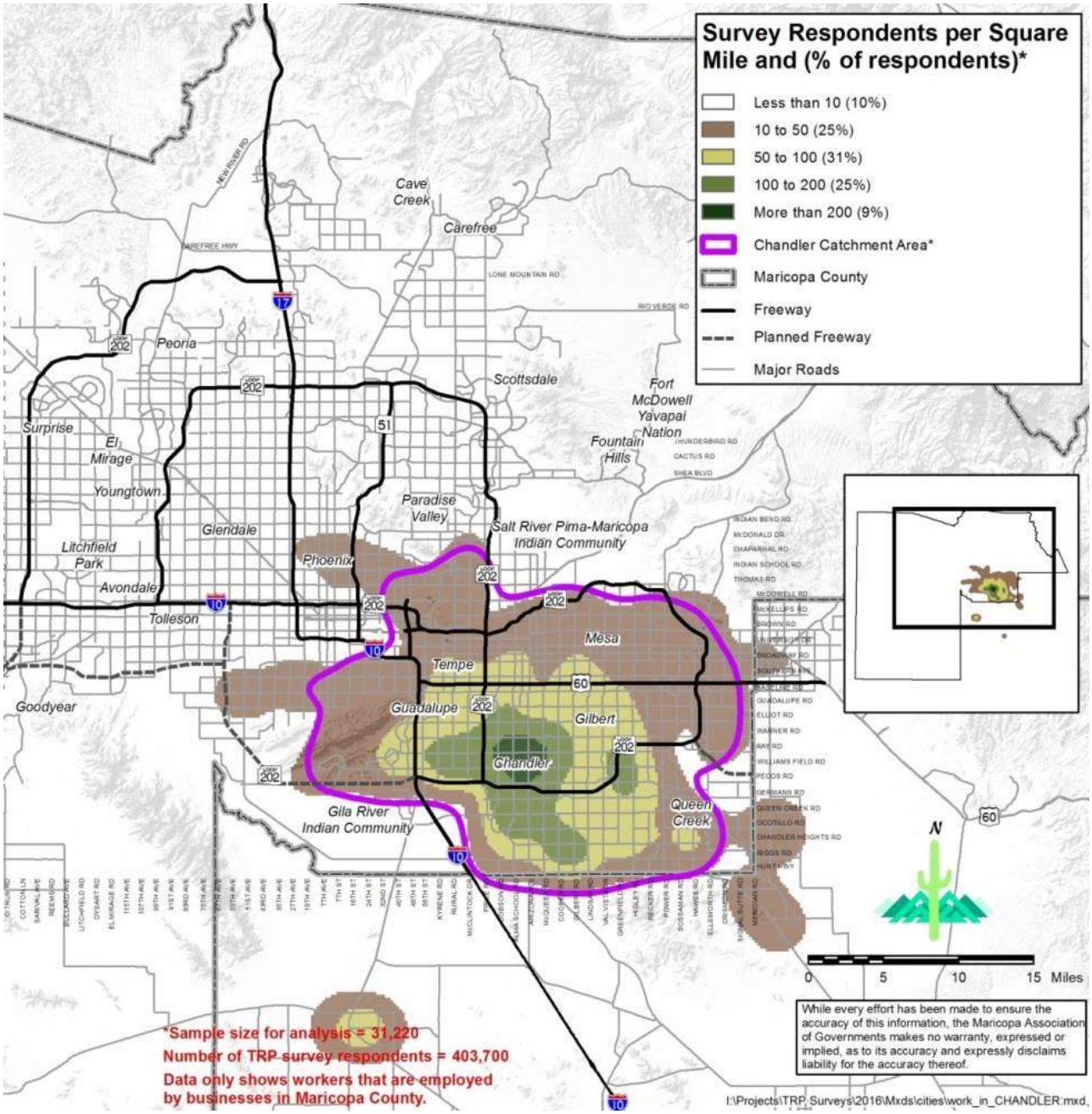
The green areas on **Figure 5-20** demonstrate there are a large number of employees who both work and live in Chandler. The yellow areas show that a moderate amount of people who work in Chandler live in other East Valley cities, such as Gilbert, Guadalupe, Queen Creek, south Mesa, and south Tempe, as well as in the City of Maricopa.

Figure 5-21 shows the work-live pattern for five major employment areas within Chandler: West Chandler, Downtown Chandler, North Chandler, Price Road (which combines the South Price Road area and the Medical/Regional Retail area), and Chandler Airpark. The figure demonstrates where people who work in these employment centers live in the East Valley region.



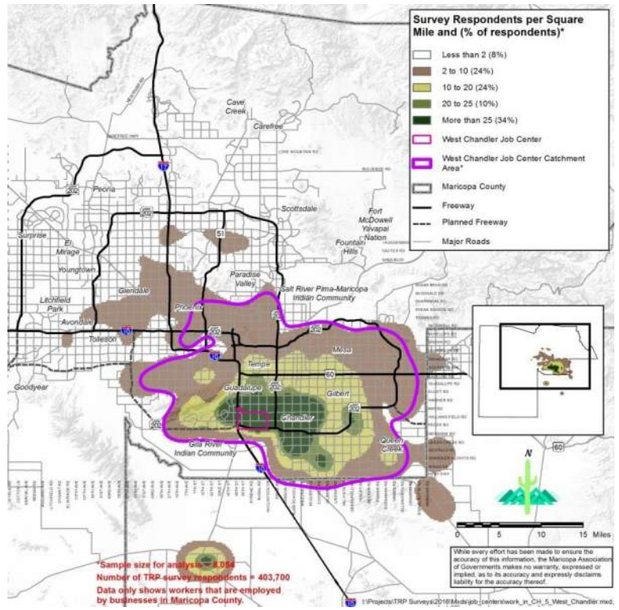
Source: Maricopa Association of Governments, 2016

Figure 5-19. Where People Living in Chandler Work

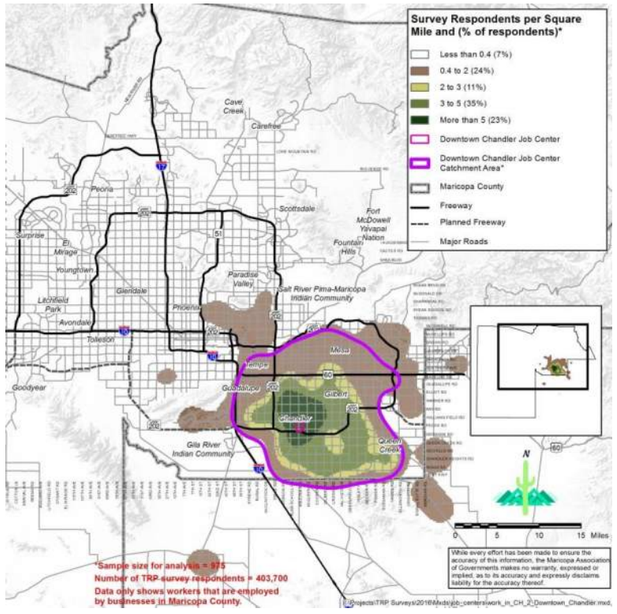


Source: Maricopa Association of Governments, 2016

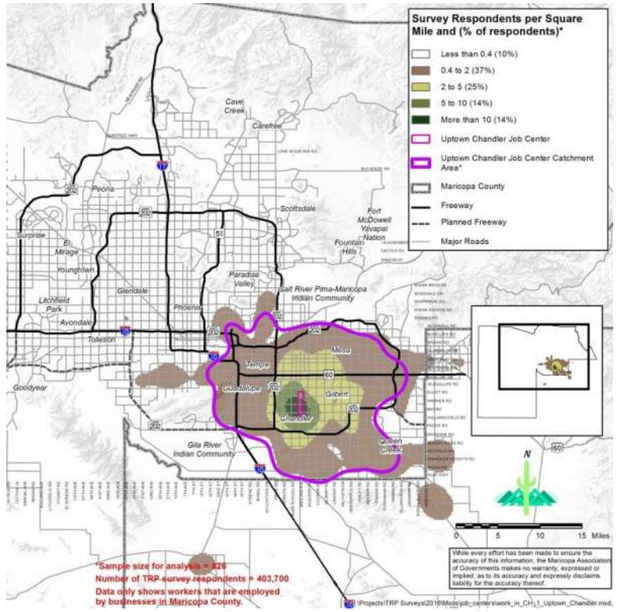
Figure 5-20. Where People Working in Chandler Live



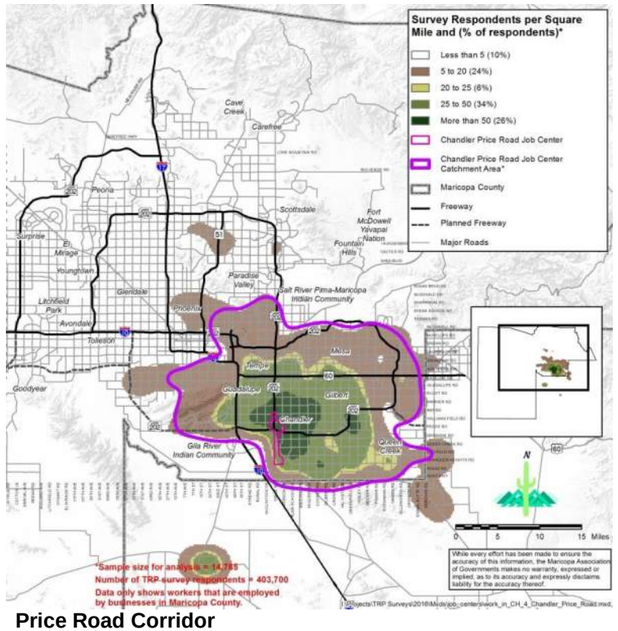
West Chandler



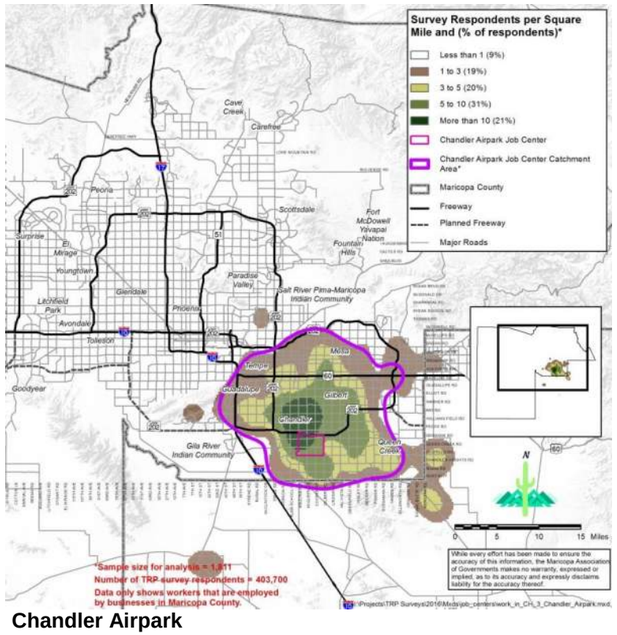
Downtown Chandler



North Chandler



Price Road Corridor



Chandler Airpark

Source: Maricopa Association of Governments, 2016

Figure 5-21. Where People Working at Employment Centers in Chandler Live

5.2.2 TRANSIT MODES

In the previous section, the existing and future conditions analysis identified the current and future transit needs within Chandler, as well as regional travel patterns. This section describes the general characteristics of various transit modes which may be considered within Chandler – either those that already exist within the Phoenix metropolitan area or emerging transit modes that are successful in other US cities – and outlines the differences in each transit mode with respect to typical service coverage, frequency, transit vehicle, service flexibility, technological adaptation, transit rider needs, and origins/destinations. Transit service areas range from neighborhoods or employment centers to citywide services, and further expand to intra- and inter-regional areas. Thus, service area coverage and need plays an important role in choosing the most appropriate transit mode that best caters to the transit riders.

5.2.2.1 Flexible Transit Services

Flexible transit services (sometimes referred to as micro-transit) can combine non-ADA (Americans with Disabilities Act) demand responsive service with flexible routes over a specific geographic area where traditional fixed-route service operates inefficiently. These services can be applied over a single independent coverage area or used as an overlay to traditional fixed-route service options. Flexible transit service would be anchored at existing transit facilities such as park-and-ride lots, transit centers, or at well-known landmarks like shopping centers or downtown areas. These anchors would provide a connection to higher level transit services throughout the rest of the region. Flexible transit service could take the form of a specialized peak period service, which during periods of lower demand may include curb-to-curb or a reservation-based service that will pick up riders and take them anywhere within the specified service zone. It is important to note that most flexible transit service vehicles are smaller in size and have a lower carrying capacity when compared to traditional buses; vehicle size can range from cars to vans to shuttles. **Figure 5-22** through **Figure 5-24** show commonly used flexible transit service vehicles and where they currently operate.

Figure 5-22. On-Demand Shuttle Service (Austin, Seattle, and New York City)

Figure 5-23. Shuttle with Pop-up Stops (Boston, D.C., and Kansas City)

Figure 5-24. FlexRide (Denver)

Similarly, flexible transit services vehicles can also be autonomous. There are several autonomous vehicle pilot programs currently taking place in cities across the nation, which serve as a form of flexible transit service. **Figure 5-25** through **Figure 5-27** denote a few of these programs.

Figure 5-25. The Olli, a Sacramento State Pilot Program

Figure 5-26. Waymo, Valley Metro Pilot Program Early Rider Program

Figure 5-27. Navya, Las Vegas Pilot Program

Flexible transit service allows extended trips between the regional fixed-route transit services and the surrounding area through timed connections at specified transfer points, although other non-scheduled trips could also be allowed. Flexible transit service can be operated all day with specific stops at park-and-ride lots, specified local fixed-route bus stops, and at HCT connections during the peak travel periods of the day. Customers would be able to book a ride via an application on a mobile device or make online reservations for trips anywhere within the service zone.

The benefit of operating flexible transit service would be to increase ridership and potentially reduce costs while providing improved local circulation as well as extensions to the regional transit network. Savings may be obtained over fixed-route service not only because the vehicle and service type are less expensive, but because fewer vehicles and vehicle hours would be necessary for the same service area compared to traditional fixed-route service.

5.2.2.2 Ride-share Services

Ride-share services are on-demand transportation services that are often provided by private Transportation Network Companies (TNCs). With ride-share services, passengers are able to request a ride at any time from any location within the TNC's service area. Passengers typically request a ride by using an application on a mobile device. After a passenger requests a ride, the TNC platform will assign one of its drivers to pick up the passenger and drop them off at their desired destination.

There are several different ways ride-share services could be used to support transit services. For example, ride-share services can be subsidized to provide paratransit trips. Ride-share services are more flexible than traditional paratransit services, allowing for passengers to have access to an on-demand, direct origin-to-destination transportation service.

Ride-sharing can also facilitate first mile/last mile trips by allowing people to connect to and from the transit network. Ride-sharing also connects people to and from the transit network during off-peak hours. For areas where transit stops may be infrequent and/or developments are located more than a mile away from the transit network, ride-share services can help people conveniently connect to the transit network, taking people from their origin and dropping them off at a transit stop and/or picking people up from a transit stop and driving them to their destination.

The benefit of ride-share services is that the on-demand platform can make riding transit more convenient for passengers by providing a solution to first mile/last mile trips. Additionally, ride-sharing services can support paratransit services by providing convenient, on-demand, and flexible door-to-door service. Chandler is already participating in the RideChoice program which subsidizes the cost of TNC trips for seniors and people with disabilities. Additionally, other communities around the Phoenix metropolitan area have begun to form partnerships with TNCs to provide first mile/last mile trips. Challenges related to TNCs providing transit service include difficultly with obtaining data to meet Federal Transit Authority (FTA) reporting requirements, maintaining drug and alcohol testing standards for drivers, as well as providing wheelchair-accessible vehicles.

5.2.2.3 Circulators

Circulators are fixed-route or deviated fixed-route transit services that can operate on collector and residential streets providing neighborhood-level transit service. In general, circulator routes tend to use smaller transit vehicles and provide services to areas that are not easily serviceable by standard bus routes.

Some circulator routes may have set stop locations, but other circulator routes opt for “flag” stops where the operator will pick up and drop off passengers in any safe location along the route. Additionally, circulator services typically have no fare or a lower fare than standard bus service.

Circulators improve neighborhood connectivity by connecting residential areas to local destinations, such as shopping centers, schools, and community services. By serving a small service area, circulators are able to provide frequent service to destinations throughout the neighborhood. Typically, circulators will also help people to transfer to other fixed-route transit service that can provide access to destinations outside of the neighborhood or to regional destinations.

There are many benefits of implementing circulator transit services. Circulators improve the coverage of the overall transit network by providing service to areas where it would be inefficient to implement other types of transit service. Circulators improve mobility throughout a particular neighborhood by providing convenient and frequent service to local destinations. Additionally, circulators improve regional transit connectivity by allowing people to transfer to routes with larger regional service areas. While the City of Chandler has not implemented circulator transit service at this time, other cities including Tempe, Mesa and Phoenix currently have circulator routes that are in operation.

5.2.2.4 Local Bus

Local fixed-route bus operates on an established service schedule along a fixed route. Typically, stops on local bus routes are ¼-mile apart. Local bus routes usually span several miles and serve arterial roadways. Local routes provide access to local, city, and regional destinations and provide connection opportunities to regional transit services.

Local bus routes make up a significant portion of the Valley’s transit network. Because the Valley’s roadways typically follow a grid pattern, most local bus runs along a linear route on an arterial roadway with the opportunity to transfer to other routes near intersections. Frequencies along local routes can vary from route to route (generally 15 - 30 minutes) and change during peak hours to provide additional service. Local routes usually allow passengers to transfer to other local routes, HCT lines, and/or circulator routes.

Chandler is currently served by several local bus routes that provide service along the city’s major arterial roadways.

5.2.2.5 Express Bus

Express bus is a fixed-route transit service that allows passengers to reach regional destinations faster by limiting the number of stops the bus makes. Express routes improve regional connectivity by allowing people to travel between cities within a metropolitan area. Typically, express routes operate during peak commute hours.

By limiting the number of stops and traveling in the high-occupancy vehicle (HOV) lanes on freeways, express routes allow people to travel between regional activity centers faster than other types of bus services. Express route stops typically incorporate a park-and-ride lot and/or provide transfer opportunities from other transit services to facilitate first mile/last mile trips.

Express routes support the overall transit network by providing faster travel times between regional activity centers for commuters. Chandler is currently served by two express routes and there are several other express bus routes operated throughout the Phoenix metropolitan area.

5.2.2.6 High Capacity Transit

HCT is a broad term for transit services that can carry a larger volume of passengers using larger vehicles, dedicated lanes, and/or more frequent service than other fixed-route transit services. HCT lines are designed to provide a higher quality of transit service to passengers by providing faster travel times. They also incorporate amenities at transit stations and on transit vehicles by implementing advanced technologies to improve customer convenience and reduce delays

Bus Rapid Transit

BRT uses buses for highly-flexible service that can operate on either exclusive transit guideways, bus-only lanes, or in mixed-traffic and can provide regional connectivity to major activity centers. The main features of BRT typically include modern low-floor buses, signal priority at intersections, ITS, off-vehicle fare collections, reduced headways, real-time information displays, and modern stations. Furthermore, BRT is known to advance economic development within a community by enhancing access and mobility to employment opportunities and other key destinations. At this time, there are not any operational BRT lines in the Valley; however, some jurisdictions have begun planning efforts to implement BRT.

Streetcar

Traveling on a rail track, the streetcar vehicle is a small rail car that operates individually. Streetcar stops can be similar to bus stops but occur more frequently than larger light rail stations and operate in mixed-traffic or exclusive guideways. The service area of a streetcar is generally more centered on a specific area within a city or region but can support regional connectivity by providing transfer opportunities to other forms of transit. It is intended to serve high ridership centers within a city by connecting neighborhoods, major business centers, and regional destinations. While there is not currently an operational streetcar within the Valley, the Tempe streetcar is currently under construction.

Light Rail

Also traveling on a rail track, light rail typically uses a system of linked rail cars that are powered by either an overhead catenary/electric line or by an on-board diesel or electric motor. Exclusive guideways provide more reliable service as they are less likely to be impacted by traffic delays when compared to other transit options. Additionally, features like off-board fare collection and signal priority decreases dwell time at stations and intersections, allowing for efficient travel through the system. Due to its reliability, light rail is known to support economic development within the communities it is implemented in. In the Valley, Phoenix, Tempe, and Mesa currently have an operating light rail system.

Commuter Rail

Commuter rail is designed to provide reliable and convenient transit for long distance commuters, connecting suburban areas to urban activity centers. Commuter trains typically travel longer distances and have fewer stations than light rail lines as they are intended to provide larger-scale regional connectivity. Additionally, commuter rail trains typically operate at higher speeds and have higher-capacity vehicles. The Valley does not currently have a commuter rail system; however, MAG has recently completed a commuter rail study to see if it would be a possibility in the future.

5.2.3 TRANSIT RECOMMENDATIONS

This section presents specific recommendations for improvements to transit services and infrastructure in Chandler to address existing and expected service needs. These specific recommendations are based on public input, a review of existing services, planned and programmed improvements, and information on future development.

The recommendations are based on providing a mix of transit services that support all residents of Chandler from transit-dependent riders to those residents who use transit for convenience or to support sustainability efforts. The transit elements listed below are the overarching recommendations to optimize the existing transit services and provide for future transit needs:

- Flexible Transit Services;
- First Mile/Last Mile Program;
- Local/Express Bus Service Changes;
- High Capacity Transit Options; and
- Transit Infrastructure Upgrades.

The following sections provide detailed recommendations for the above-mentioned transit elements. Recommendations are divided into three categories: near-term (2020 - 2025), mid-term (2026 - 2030), and long-term (2031 - 2040).

5.2.3.1 Near-Term Transit Recommendations

Near-term improvements include the recommendations detailed in the following section and summarized in **Table 5-11** and **Figure 5-28** that follow the discussion of the recommendations.

Flexible Transit Services

Framework for Flexible Transit Service

To understand the flexible transit service needs within Chandler, it is important to establish areas that encompass the entire city. These areas would be tied to the functional or character areas of Chandler, serving as a way to provide connectivity within the community and would help focus on appropriate routing and populations served within each of the areas. These areas need not cover the entire city initially, as they are developed over time as transit grows through the community. Based on the conditions analysis, growth areas, and MAG designated employment centers within Chandler, the following seven areas were identified for the near-term, mid-term, and long-term recommendations:

A. Price Road Area (near-term);
B. North Chandler Area (mid-term);
C. West Chandler Area (long-term);
D. Central Chandler Area (mid-term);
E. Ocotillo Neighborhood (long-term);
F. Chandler Airpark Area (long-term); and
G. South Chandler Area (long-term).

As each area has different land use and demand characteristics, it is recommended to study the areas before establishing flexible transit services. Each study will consist of community engagement to understand rider needs and desired local destinations, including establishing a working group comprised of community representatives and City staff. Additionally, it will identify the most suitable transit vehicle, service type, deployment scenarios, technological adaptations, service operations, businesses/employment centers for pick-up/drop-off zones, and potential amenities.

It is recommended that planning guidelines, branding, and service standards for flexible transit services be established in the near-term prior to the commencement of the studies. The following service characteristics should be considered while establishing the planning guidelines:

- Types of transit vehicles (shuttle buses, vans, or cars);
- Infrastructure needs/transit stop amenities;
- Service type (demand responsive, fixed-route, peak hour only, or a combination of services);
- Signage;
- Phasing or scaling strategies during peak and off-peak hours; and
- Technological adaptations (automated vehicles, web/phone- based applications, real-time tracking).

Near-Term Flexible Transit Service Areas

It is recommended that the Price Road area and the North Chandler area be studied in the near-term (see **Figure 5-28**), followed by a pilot program in the Price Road area. The flexible transit service in the Price Road area will provide access to Local Bus Routes #72 and #81 at Chandler Fashion Center Transit Center, Local Bus Routes #96 and #156, and technology companies along the Price Road.

Near-Term South Chandler First/Last Mile Subsidy Program

It is also recommended to explore the creation of a First Mile/Last Mile Subsidy Program for south Chandler (south of Loop 202) (see **Figure 5-28**) to provide connectivity to the nearest fixed-route transit stop of the regional transit system. Currently there are limited local bus routes and low-density residential population in south Chandler, and it is essential to offer connectivity to the regional transit system. Before establishing the subsidy program, it is crucial to understand the demand in the area to appropriately scale the program by conducting a study and establishing policies to implement the program. The program could be operated with possible collaboration from Valley Metro or existing TNC services, as it may make the system more cost-effective by reducing the operations and maintenance cost. Additionally, the subsidy should create a resident fare equal to the bus fare. The fare system should be coordinated with Valley Metro to allow fare purchase from the same platform as bus fare purchases.

Local Bus Routes

Near-term improvements to existing local bus services are recommended to ensure that transit is present where it is appropriate and that the routes provide an adequate level of service.

Service Extensions - Local Bus Route #112 should be extended south from Germann Road to Ocotillo Road to make transit services available to existing residential neighborhoods and local destinations, including Hamilton High School and Fulton Ranch Towne Center. The extension of Local Bus Route # 112 is included in the Prop 400 TLCP and funded.

Service Enhancements - Increase in service frequency for Local Bus Route #72 and Local Bus Route #156 to 15 minutes during peak hours is recommended. The service enhancement will help meet the transit demand along Rural Road and Chandler Boulevard during peak hours. The service frequency increase for Local Bus Route #156 is included in the Prop 400 TLCP and funded.

Service Elimination - Local Bus Route #96 should be eliminated south of Pecos Road once the flexible transit service is established in the Price Road area. The cost savings available through service elimination of the local bus route can be used to help fund the implementation of flexible transit service in the Price Road area.

Express Bus Routes

Express bus recommendations in the near-term feature the ongoing monitoring of existing express bus services to ensure their effectiveness in serving the community. To provide an increased level of express bus service, it is recommended to add one morning and one evening trips to Express Bus #542, starting at the Germann Road (Hamilton) park-and-ride lot.

Previously, Express Bus #511 provided eight trips per weekday along the Loop 101 corridor serving Scottsdale, Tempe, and Chandler, with two stops in Tempe at the Apache/Price light rail station and the ASU Research Park. After 18 months of service, the route did not generate substantial ridership and the service was eliminated from Chandler. However, recently the demand for a direct bus connection to Downtown Tempe has increased. Thus, it is recommended to add an express bus service serving Downtown Tempe to cater to the demand of students studying at the ASU Tempe campus and to employees working in Downtown Tempe. The service could run during peak hours with 5 northbound/southbound trips per day, start at the Germann Road park-and-ride lot, travel along Loop 202 and Loop 101, and connect to University Drive.

High Capacity Transit

In the Chandler General Plan 2016 and the ongoing MAG Regional Transit Framework Study, three corridors – Arizona Avenue, Rural Road, and Chandler Boulevard – are identified as potential HCT corridors. Based on the results from the conditions analysis and the input from the stakeholders and public meetings, it is recommended that these corridors remain as potential HCT corridors. The annual ridership for all the local buses operating on these corridors is high, and the demand would continue to grow with projected increases in population and employment density.

Additionally, these routes support other existing and proposed HCT routes within the region. Implementing HCT along Rural Road could connect to the Tempe Streetcar to further promote connectivity in the regional HCT network. HCT on Chandler Boulevard has the potential to support commuter rail stations that were identified in MAG's Commuter Rail System Study.

If the Arizona Avenue Alternatives Analysis results in a recommendation for an HCT corridor, that recommendation should be advanced to the next stage in project development, which could include preliminary design, environmental analysis, final design, and ultimately construction. The continued

advancement of the project and timeline will greatly depend on public input, political support, and available funding.

Similarly, it is recommended to conduct a High Capacity Transit study for Chandler Boulevard and Rural Road in collaboration with Valley Metro and MAG. It will also require support and coordination with the neighboring cities of Tempe, Phoenix, Gilbert, and Mesa.

Transit Infrastructure

Intermodal Connection - The enhancement and addition of transit services will create the demand for an intermodal connection hub in the future. Keeping this need in mind, it is recommended to start with a site selection study for a Downtown Transit Center and for a North Chandler park-and-ride lot.

A transit center site in close proximity to the parking structures in downtown Chandler along Arizona Avenue would benefit riders who intend to use the parking facilities. The transit center is envisioned to serve as a multimodal hub for local bus routes, potential HCT along Arizona Avenue, flexible transit services, and ride-share pick-up/drop-off. Similarly, the North Chandler park-and-ride lot is envisioned to serve the Express Bus #541, flexible transit services, and ride-share pick-up/drop-off. The park-and-ride lot could be located somewhere in north central Chandler. Bus routes would be modified as needed to access these new facilities.

Freeway to Park-and-Ride Connector - Buses serving the park-and-ride facility south of Germann Road at Hamilton Street currently access Loop 202 using Arizona Avenue, which leads to increased travel time and congestion. The City of Chandler is currently evaluating a potential connection to Loop 202 at Hamilton Street. Because the proposed freeway connector aligns with this plan, it is recommended to commence design in the near-term as part of ADOT's design of Loop 202 widening in this area.

Transit Technology

To continue to advance with technological innovations within the industry, it is important to establish how technology can be incorporated into the transit system. For this reason, it is recommended that the City of Chandler establish guidelines on transit technology. The guideline document should outline best practices for integrating technology into the transit system, including establishing scenarios where it would be appropriate to deploy certain types of technologies.

Additionally, it is recommended the City implement a Public Education Program on transit technology. The program will educate residents about how to interface with new technologies and inform them about the upcoming technological trends.

Table 5-11. Near-Term Transit Recommendations 2020 - 2025

No.	Type	Recommendations
Flexible Transit Services		
1	Policy	Establish planning guidelines for flexible transit services for various areas within Chandler. Establish branding and service standards for flexible transit services.
2	Study	Conduct flexible transit service studies for the below identified areas. A. Price Road Area B. North Chandler Area
3	Service Change - Addition	Provide flexible transit services in the Price Road area per the study findings. Identify pick-up/drop-off zones in each area and establish partnership with businesses/employment centers.
4	Study	Explore First Mile/Last Mile Subsidy Program for South Chandler (south of Loop 202) to provide connectivity to nearest fixed-route transit stop of the regional transit system
Local Bus Routes		
5	Service Change - Extension	Extension of Local Bus Route #112 - Country Club Drive/Arizona Avenue from Germann Road to Ocotillo Road
6	Service Change – Frequency Increase	Increase in service frequency to 15 minutes for Local Bus Route #72 - Scottsdale Road/Rural Road
7	Service Change – Frequency Increase	Increase in service frequency to 15 minutes during peak hours for Local Bus Route #156 - Chandler Boulevard
8	Service Change - Elimination	Elimination of Local Bus Route #96 - Dobson Road south of Pecos Road after establishing the flexible transit service in Price Road Area

Express Bus Routes		
9	Service Change - Addition	Addition of one morning and one evening trips to Express Bus #542
10	Service Change - Addition	Addition of Express Bus route from Germann Road Park-and-Ride lot to ASU Tempe Downtown Campus. With 5 northbound/southbound trips per day
High Capacity Transit		
11	Study	Conduct High Capacity Transit study for the recommended corridors as identified in the Arizona Avenue Alternatives Analysis
12	Study	Conduct High Capacity Transit study for Chandler Boulevard
13	Study	Conduct High Capacity Transit study for Rural Road
Transit Infrastructure		
14	Study	Commence Downtown Transit Center site selection study and environmental documentation
15	Study	Commence North Chandler Park-and-Ride site selection study and environmental documentation
16	Design	Commence design of Freeway to Park-and-Ride Connector, including direct high-occupancy vehicle ramps at Loop 202.
Transit Technology		
17	Policy	Establish guidelines for transit technology to be used for transit services and educate Chandler residents about the upcoming technological trends through a Public Education Program.

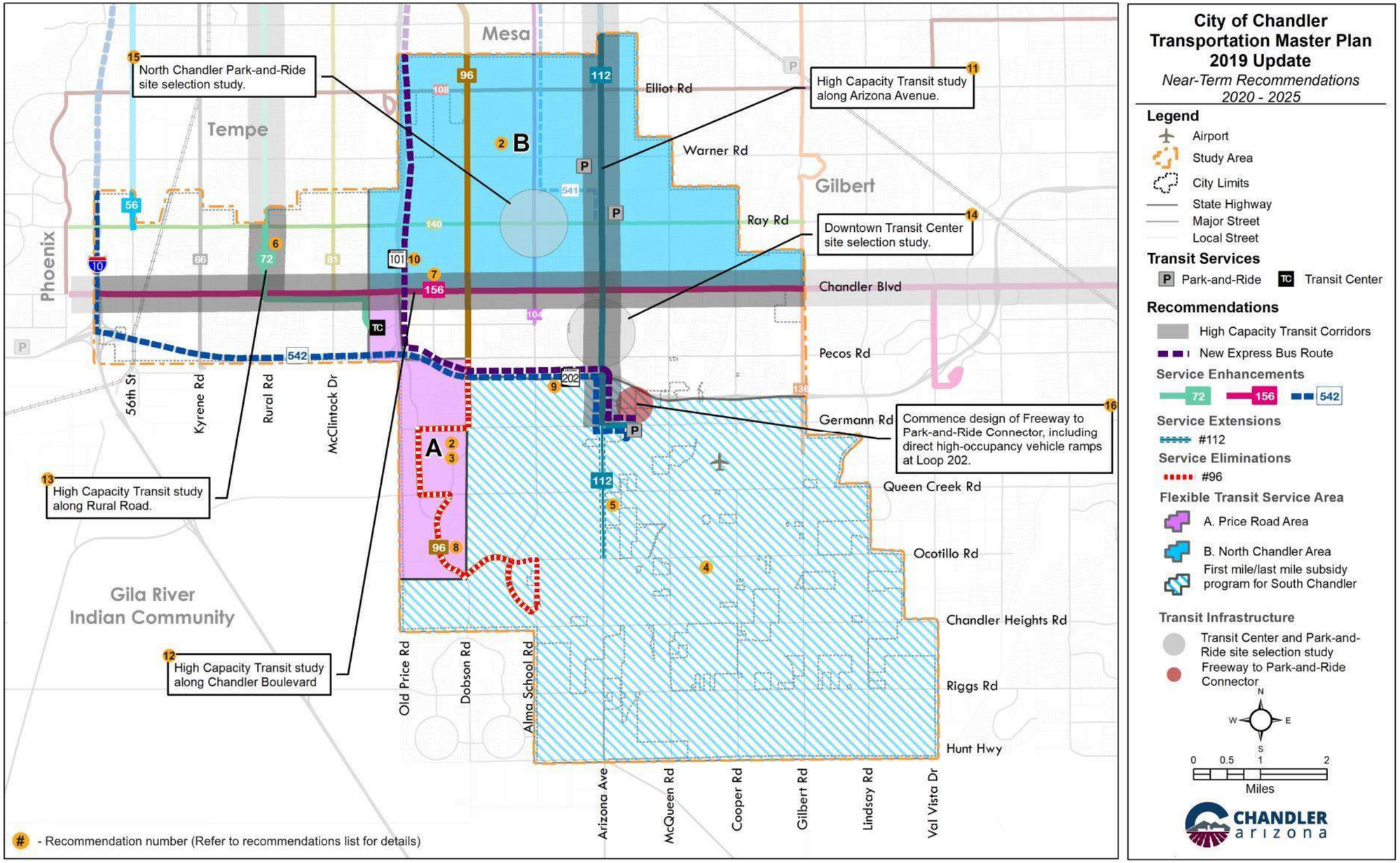


Figure 5-28. Near-Term Transit Recommendations 2020 - 2025

5.2.3.2 Mid-Term Transit Recommendations

Mid-term improvements include the following recommendations detailed in the following section and summarized in **Table 5-12** and **Figure 5-29** that follow the discussion of the recommendations.

Flexible Transit Services

Based on the North Chandler study for flexible transit service, the recommended service should be implemented in North Chandler. The flexible transit service in the North Chandler area is envisioned to serve the Food City Plaza, Carl's Jr. park-and-ride lot, and Express Bus #541. The transit service will connect local destinations in the area like retail/shopping and residential neighborhoods along Warner Road and Alma School Road, including NXP Semiconductors, Chandler High School, Chandler Preparatory Academy, and Mesquite High School.

It is recommended that the Central Chandler area be studied in the mid-term for feasibility of flexible transit services. Based on the study findings, flexible transit services should be established in the Central Chandler area (see **Figure 5-29**).

The flexible transit service in the Central Chandler area is envisioned to serve the future Downtown Transit Center (Local Bus Route #112 and potential HCT) and connect local destinations in the area, like the employment center east of Loop 101/202, Chandler High School, Chandler Library, Chandler Regional Medical Center, residential neighborhoods along Frye Road, Chandler City Hall, Folley Memorial Park, and Chandler-Gilbert Community College. Expansion of the service area with new micro transit options or stations is will be explored as a potential partnership with our neighbor city, Tempe.

Local Bus Routes

Mid-term improvements to existing local bus services are recommended to ensure that transit services are provided with the increase in transit demand as the population and employment density grows within Chandler.

Service Addition - It is recommended to add transit service along Queen Creek Road with potential deviated fixed-routes or peak hour service to provide east-west connectivity from Queen Creek and Gilbert to the Price Road corridor, with a focus on hours of operation to serve employees. This service addition would only be added if it is included in the Proposition 400 extension.

Service Extensions - It is recommended to extend Local Bus Route #136 from Ryan Road to Queen Creek Road. The extension of Route #136 would connect to the new east-west transit service along Queen Creek Road. Local Bus Route #56 should be extended south from Ray Road to Chandler Boulevard to make transit services available to existing high-density employment areas and connect to Local Bus Route #156 for east-west connectivity to major destinations and population centers.

Service Reduction/Elimination - Local Bus Route #81 should be eliminated south of Warner Road once flexible transit service is established in the West Chandler area. The cost savings available through service elimination of the local bus route can be used to help fund the implementation of flexible transit service in the West Chandler area. Similarly, Local Bus Route #104 can be reduced to peak hour service only south of Pecos Avenue, and eventually eliminated once the flexible transit service is established in North Chandler.

High Capacity Transit

Pending the results from the recommended near-term studies, it is recommended that HCT be advanced on Arizona Avenue, Chandler Boulevard, and Rural Road in the mid-term.

Express Bus Routes

To provide an increased level of express bus service, it is recommended to add one morning and one evening trips to Express Bus #542, starting at the Germann Road (Hamilton) park-and-ride lot.

Transit Infrastructure

Intermodal Connection - Based on the results of the site selection study conducted in the near-term, it is recommended to move ahead with the design and construction of the Downtown Transit Center and North Chandler park-and-ride lot in the mid-term. The commencement of design and construction will depend on funding availability; however, it is essential to establish these intermodal connections prior to the commencement of flexible transit service operations.

Freeway to Park-and-Ride Connector - Based on the near-term recommendation, it is recommended to commence construction of the freeway to park-and-ride connector in the mid-term, including direct high-occupancy vehicles ramps at the Loop 202. The design and construction timeline is subject to change based on regional funding availability in coordination with ADOT.

Table 5-12. Mid-Term Transit Recommendations 2026 - 2030

No.	Type	Recommendations
Flexible Transit Services		
18	Study	Conduct flexible transit service studies for the below identified areas: D. Central Chandler Area
19	Service Change - Addition	Provide flexible transit services to the below areas as per the study findings. Identify pick-up/drop-off zones in each area and establish partnership with businesses/employment centers B. North Chandler Area D. Central Chandler Area
Local Bus Routes		
20	Service Change – Elimination/ Extension	Elimination of Local Bus Route #56 - Priest Drive, between 56th Street and 48th Street, and extension of route to Chandler Boulevard
21	Service Change – Extension	Extension of Local Bus Route #136 - Gilbert Road from Ryan Road to Queen Creek Road
22	Service Change – Reduction/ Elimination	Initial service reduction by limiting the hours of operation to peak hours for Local Bus Route #104 - Alma School Road, and elimination of the route in future after establishing the flexible transit service in North Chandler Area
23	Service Change – Elimination	Elimination of Local Bus Route #81 - Hayden Road/McClintock Drive within Chandler after establishing the flexible transit service in West Chandler Area
24	Service Chance – Addition	Addition of transit service along Queen Creek Road with potential deviated fixed-routes or peak hour service to provide east-west connectivity from the Town of Queen Creek to Price Road
High Capacity Transit		
25	Policy	Continue to advance High Capacity Transit along Arizona Avenue if determined appropriate by study conducted in near-term
26	Policy	Continue to advance High Capacity Transit along Chandler Boulevard if determined appropriate by study conducted in near-term
27	Policy	Continue to advance High Capacity Transit along Rural Road if determined appropriate by study conducted in near-term

Express Bus Routes		
28	Service Change - Addition	Addition of one morning and one evening trips to Express Bus #542
Transit Infrastructure		
29	Policy	Advance Downtown Transit Center Plan based on the site selection study
30	Policy	Advance North Chandler Park-and-Ride Plan based on the site selection study
31	Construction	Commence construction of the Freeway to Park-and-Ride Connector, including direct high-occupancy vehicle ramps at Loop 202.

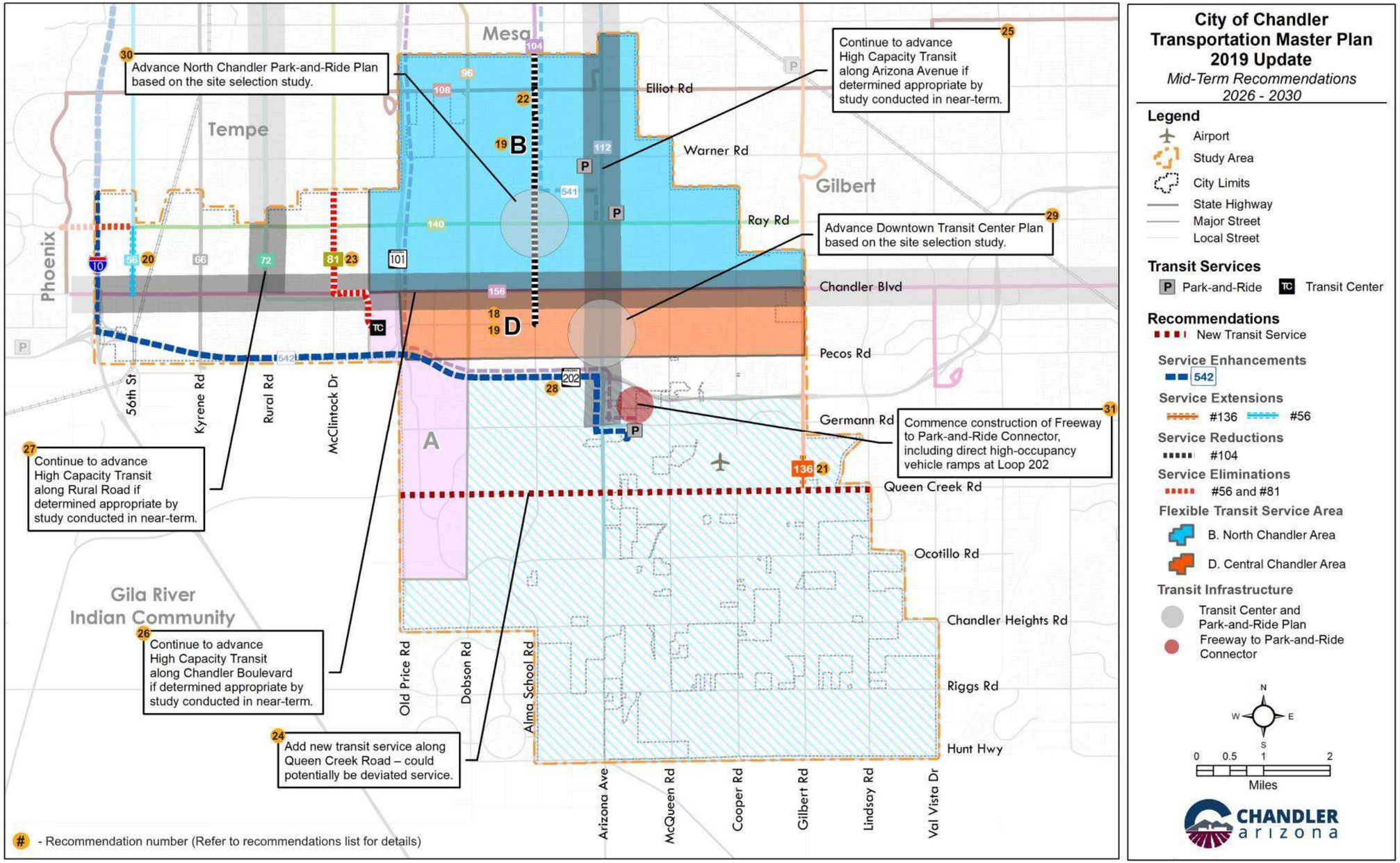


Figure 5-29. Mid-Term Transit Recommendations 2026 - 2030

5.2.3.3 Long-Term Transit Recommendations

Long-term improvements include the following recommendations detailed in the following section and summarized in **Table 5-13** and **Figure 5-30** that follow the discussion of the recommendations.

A compilation of all the near-term, mid-term, and long-term transit recommendations is provided in **Figure 5-31**.

Flexible Transit Services

It is recommended that the West Chandler area be studied in the long-term for feasibility of flexible transit services. Based on the study findings, flexible transit services should be established in the West Chandler area (see **Figure 5-30**).

The flexible transit service in the West Chandler area is envisioned to serve the Chandler Fashion Center Transit Center (Local Bus Route #72 and #81) and connect local destinations in the area like Intel - Chandler Campus, the employment center near 56th Street and Chandler Boulevard, Sunset Library, Retail/Shopping east of I-10, Stellar Airpark, and Desert Breeze Park.

The Ocotillo Neighborhood, Chandler Airpark area, and South Chandler area should be studied in the long-term (see **Figure 5-30**) for flexible transit services. Based on the study findings, flexible transit services should be established in the Ocotillo Neighborhood, Chandler Airpark area, and South Chandler area. It is also essential to understand the demand generated from the First Mile/Last Mile Subsidy Program and accordingly scale the flexible transit service in the South Chandler area.

The flexible transit service in the Ocotillo Neighborhood is envisioned to serve Express Bus #542, Park-and-Ride lot at Germann Road, and potential HCT along Arizona Avenue. The transit service will connect important local destinations in the area, like Snedigar Recreation Center, Fulton Ranch Towne Center, Hamilton High School, Hamilton Library, and residential neighborhoods along Alma School Road.

The flexible transit service in the Chandler Airpark area is envisioned to serve Express Bus #542, Park-and-Ride lot at Germann Road, and potential HCT along Arizona Avenue. The transit service will connect important local destinations in the area, like Chandler Municipal Airport, Tumbleweed Park, Crossroads Towne Center, Chandler 202 Auto Mall, Chandler-Gilbert Community College, and residential neighborhood along Pecos Road.

The flexible transit service in the South Chandler area is envisioned to provide access to fixed route transit along Queen Creek Road, Local Bus Route #112 and #136. The flexible transit service will connect important local destinations in the area, like Veterans Oasis Park, Hamilton High School, Hamilton Library, Basha High School, Basha Library, Mesquite Groves Aquatic Center, three retirement communities, and residential neighborhoods of south Chandler.

Local Bus Routes

Long-term improvements to existing local bus services are recommended to ensure that transit services are provided with the increase in transit demand as the population and employment density grows within Chandler.

Service Extensions – It is recommended to extend the Local Bus Route #112 from Ocotillo Road to Chandler Heights Road.

High Capacity Transit

Pending the results from the recommended near-term studies, it is recommended that HCT be advanced on Arizona Avenue, Chandler Boulevard, and Rural Road in the long-term.

Transit Infrastructure

Currently, the Germann Road park-and-ride lot operates at almost full capacity as many transit riders that use Express Bus #542 and Local Bus Route #112 park their vehicles at the park-and-ride lot. Understanding that the park-and-ride lot usage will likely continue to grow, it is recommended to utilize the parking facilities at neighboring Tumbleweed Park as an extension of the park-and-ride lot as an interim solution and then ultimately to expand the current park-and-ride facility to provide more parking.

Table 5-13. Long-Term Transit Recommendations 2031 - 2040

No.	Type	Recommendations
Flexible Transit Services		
32	Study	Conduct flexible transit service studies for the below identified areas: C. West Chandler Area E. Ocotillo Neighborhood F. Chandler Airpark Area G. South Chandler Area
33	Service Change - Addition	Provide flexible transit services to the below areas as per the study findings. Identify pick-up/drop-off zones in each area and establish partnership with businesses/employment centers C. West Chandler Area E. Ocotillo Neighborhood F. Chandler Airpark Area G. South Chandler Area
Local Bus Routes		
34	Service Change - Extension	Extension of Local Bus Route #112 - Country Club Drive/Arizona Avenue from Ocotillo Road to Chandler Heights Road
High Capacity Transit		
35	Policy	Continue to advance High Capacity Transit along Arizona Avenue if determined appropriate by study conducted in mid-term
36	Policy	Continue to advance High Capacity Transit along Chandler Boulevard if determined appropriate by study conducted in mid-term
37	Policy	Continue to advance High Capacity Transit along Rural Road if determined appropriate by study conducted in mid-term
Transit Infrastructure		
38	Facility Expansion	Facility expansion of Germann Road Park-and-Ride lot to accommodate potential Arizona Avenue HCT, Express Bus Routes, and flexible transit services

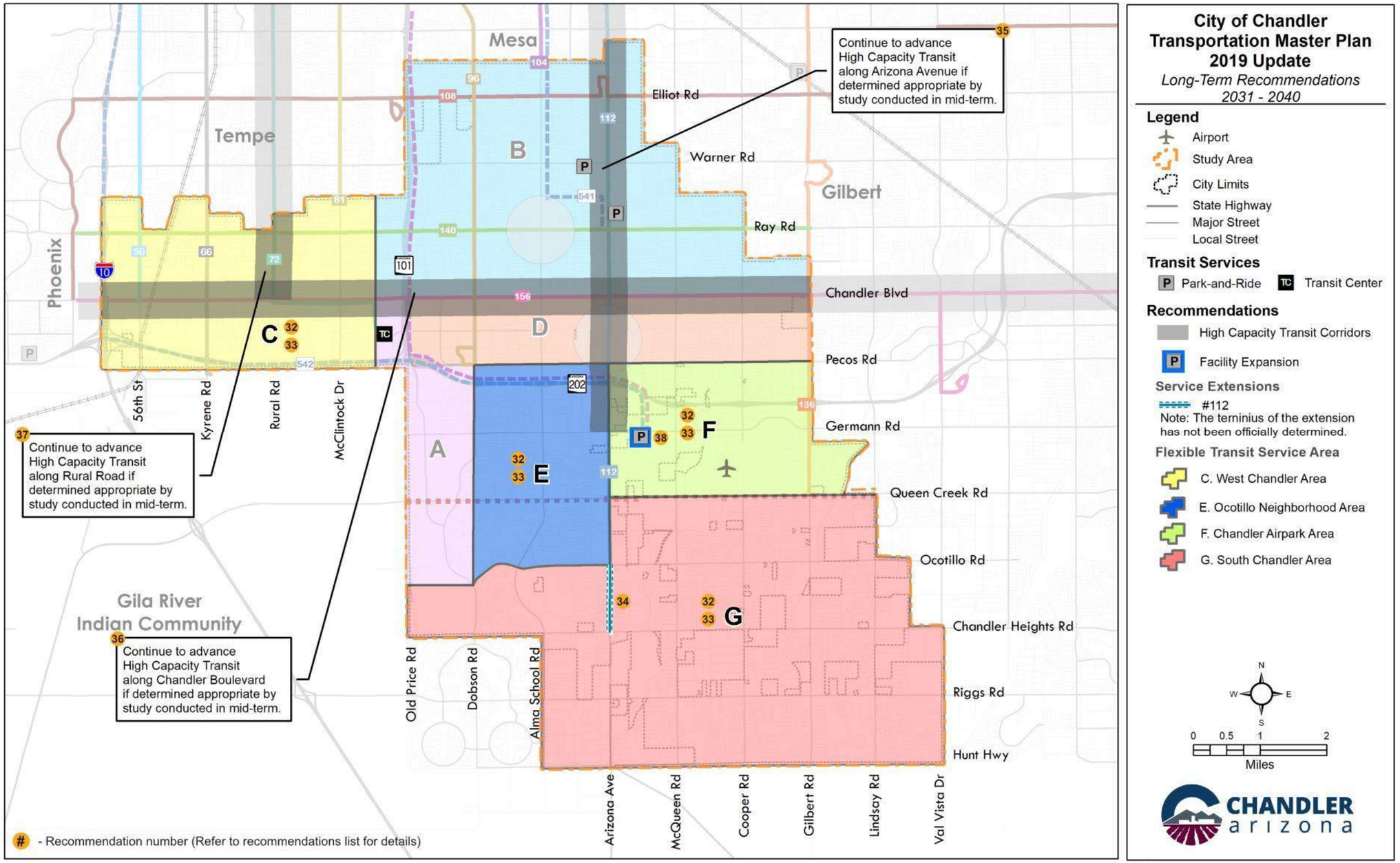


Figure 5-30. Long-Term Transit Recommendations 2031 - 2040

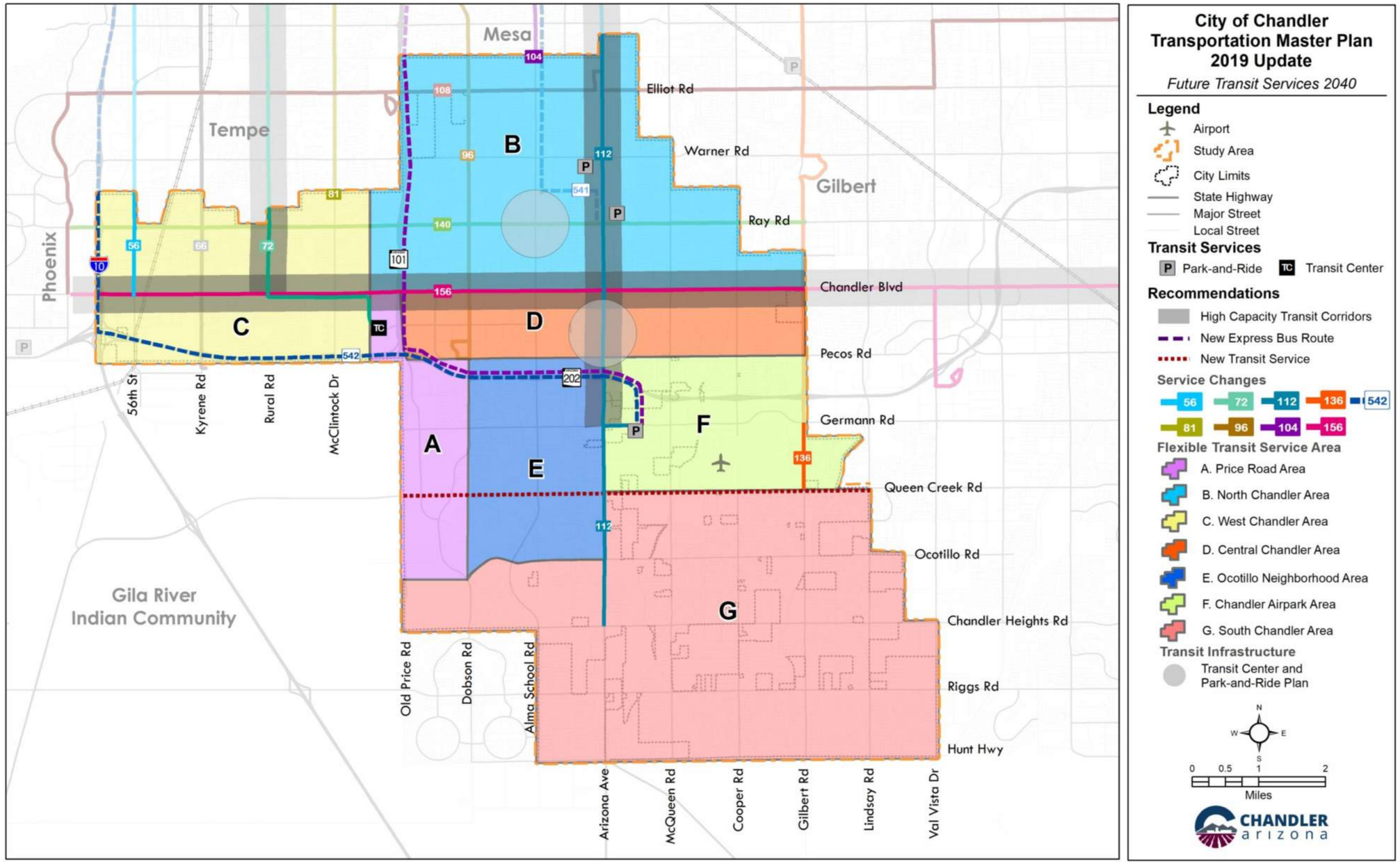


Figure 5-31. Future Transit Services by 2040

5.2.3.4 Implementation Costs

Preliminary planning-level cost estimates for the transit recommendations are provided in **Table 5-14** for the near-term, **Table 5-15** for the mid-term, **Table 5-16** for the long-term. Overall, the total cost of all recommended transit improvements in 2019 dollars for the 2020 - 2040 timeframe calculates to $183.79 million, as shown in **Table 5-17**. Operations and maintenance costs for the proposed recommendations will likely continue beyond 2040, at an estimated annual cost of $11.7 million per year.

Table 5-14. Cost Estimates for Near-Term Transit Recommendations 2020 - 2025

No.	Recommendations	Units	Cost/Each	Quantity	Cost Estimate	Notes/Assumptions
Flexible Transit Services						
1	a. Establish planning guidelines for flexible transit services for various areas within Chandler	Each	$100,000	1	$100,000	Potential to conduct all or part with in-house city staff *Guidelines can comprise, but are not limited to, the following components:* *- Types of transit vehicles (shuttle buses, vans, or cars)* *- Service type (demand responsive, fixed route, peak hour only, or a combinations of services)* *- Phasing or scaling strategies during peak and off-peak hours* *- Technological adaptations (automated vehicles, web/phone- based applications, real-time tracking)*
	b. Establish branding and service standards for flexible transit services	Each	$100,000	1	$100,000	
2	Conduct flexible transit service studies for the below identified areas A. Price Road Area B. North Chandler Area	Each	$100,000	2	$200,000	City staff will be involved *Each study will work with the community to identify the most suitable transit vehicle, service type, deployment scenarios, technological adaptations, operations, public involvement, and identify businesses/employment centers for pick-up/drop-off zones and potential amenities.*
3	Provide flexible transit services to the below area as per the study findings. Identify pick-up/drop-off zones in each area and establish partnership with businesses/employment centers					
	A. Price Road Area	Cost/ service hour	$90/hr/vehicle	annual	$1,600,000	Number of vehicles = 4 Peak/ 2 Off-peak and Weekends Number of hours/day =10 Peak/8 Off Peak/18 Weekends Number of days/week = 256 Weekdays, 52 Saturdays, 57 Sundays/Holidays
4	Explore First Mile/Last Mile Subsidy Program for South Chandler (south of Loop 202) to provide connectivity to nearest fixed-route transit stop of the regional transit system					
	a. Study	Each	$50,000	1	$50,000	Potential to conduct with in-house city staff. Recommend a study that involves 50% subsidy with TNC partners like Lyft.
	b. Implementation	-	-	annual	$100,000	Cost estimates based on First Mile/Last Mile programs of: - CapMetro (Austin, TX) Exposition Area Innovation Zone Pilot - DCTA (Denton Region, TX) Highland Village Lyft Discount Program Generally, it costs $15 - $20 per trip
Local Bus Routes						
5	Extension of Local Bus Route #112 - Country Club Drive/Arizona Avenue from Germann Road to Ocotillo Road	Cost/mile	$6.96/mile	annual	$260,000	1.6 miles/trip 32 nb trips/32 sb trips/Weekday 32 nb trips/32 sb trips/Saturday 27 nb trips/27 sb trips/Sunday 256 Weekdays, 52 Saturdays, 57 Sundays/Holidays *The cost/mile for local bus service is as per Valley Metro's FY 2020 costs*

No.	Recommendations	Units	Cost/Each	Quantity	Cost Estimate	Notes/Assumptions
6	Increase in service frequency to 15 minutes for Local Bus Route #72 - Scottsdale Road/Rural Road	Cost/mile	$6.96/mile	annual	$146,000	3.41 miles/trip 12 nb trips/ 12 sb trips/Weekday 256 Weekdays *The cost/mile for local bus service is as per Valley Metro's FY 2020 costs*
7	Increase in service frequency to 15 minutes during peak hours for Local Bus Route #156 - Chandler Boulevard	Cost/mile	$6.96/mile	annual	$405,000	10.5 miles/trip 12 eb trips/12 wb trips/Weekday 256 Weekdays Cut fare 10% in the afternoon (PM) *The cost/mile for local bus service is as per Valley Metro's FY 2020 costs*
8	Elimination of Local Bus Route #96 - Dobson Road south of Pecos Road after establishing the flexible transit service in Price Road Area	Cost/mile	$6.96/mile	annual	($202,000)	Route #96 South of Pecos FY 20 costs - $340,000 Total route length in Chandler - 12.8 miles Route length from Pecos to Fulton Ranch Blvd - 7.6 miles
Express Bus Routes						
9	Addition of one morning trip and one evening trip to Express Bus #542	Cost/mile	7.27/mile	annual	$100,000	27.8 miles/trip 1 nb trip/1 sb trip/Weekday 251 Weekdays Cut fare 25% in the afternoon (PM) *The cost/mile for Express bus service is as per Valley Metro's FY 2020 costs*
10	Addition of Express Bus route from Germann Road Park-and-Ride lot to ASU Tempe Downtown Campus with 5 nb/sb trips per day	Cost/mile	7.27/mile	annual	$182,000	10 miles/trip 5 nb trips/5 sb trips/Weekday 251 Weekdays *The cost/mile for Express bus service is as per Valley Metro's FY 2020 costs*
High Capacity Transit						
11	Conduct High Capacity Transit study for the recommended corridors as identified in Arizona Avenue Alternatives Analysis	Each	$900,000	1	$900,000	Valley Metro to conduct the study in coordination with City of Chandler. *Arizona Avenue, Chandler Boulevard, and Rural Road have been identified as High Capacity Transit corridors in the City of Chandler Transportation Master Plan 2010 and MAG Regional Transit Framework Study Update.*
12	Conduct High Capacity Transit study for Chandler Boulevard	Each	$200,000	1	$200,000	
13	Conduct High Capacity Transit study for Rural Road	Each	$200,000	1	$200,000	
Transit Infrastructure						
14	Conduct Downtown Transit Center site selection study and environmental documentation	Each	$200,000	1	$200,000	Potential to conduct all or part with in-house city staff
15	Conduct North Chandler Park-and-Ride site selection study and environmental documentation	Each	$200,000	1	$200,000	Potential to conduct all or part with in-house city staff
16	Design freeway to park-and-ride connector between Loop 202 and Hamilton Street/Germann Road, including direct HOV ramps at Loop 202					ROW assumed to be dedicated by Chandler. Note: Cost estimates for this project are included in the Roadway section of this report.
Transit Technology						
17	Educate Chandler residents about the upcoming technological trends through a Public Education Program	Each	$50,000	1	$50,000	City staff will be involved and will require Public Outreach Coordinator/Consultant in coordination with Valley Metro

Note: All costs are for FY 2020

Table 5-15. Cost Estimates for Mid-Term Transit Recommendations 2026 - 2030

No.	Recommendations	Units	Cost/Each	Quantity	Cost Estimate	Assumptions
Flexible Transit Services						
18	Conduct flexible transit service studies for the below identified area D. Central Chandler Area	Each	$100,000	1	$100,000	City staff will be involved *Each study will work with the community to identify the most suitable transit vehicle, service type, deployment scenarios, technological adaptations, operations, public involvement, and identify businesses/employment centers for pick-up/drop-off zones and potential amenities.*
19	Provide flexible transit services to the below areas as per the study findings. Identify pick-up/drop-off zones in each area and establish partnership with businesses/employment centers					
	B. North Chandler Area	Cost/ service hour	$90/hr/vehicle	annual	$2,625,000	Number of vehicles = 5 Number of hours/day = 16 Number of days/week = 7
	D. Central Chandler Area	Cost/ service hour	$90/hr/vehicle	annual	$1,575,000	Number of vehicles = 3 Number of hours/day = 16 Number of days/week = 7
Local Bus Routes						
20	Elimination of Local Bus Route #56 - Priest Drive, between 56th Street and 48th Street, and extension of route to Chandler Boulevard	Cost/mile	$6.96/mile	annual	($171,000)	0.88 mile/trip 39 nb trips/39 sb trips/Weekday 38 nb trips/39 sb trips/Saturday 34 nb trips/34 sb trips/Sunday 256 Weekdays, 52 Saturdays, 57 Sundays/Holidays *The cost/mile for local bus service is as per Valley Metro's FY 2020 costs*
21	Extension of Local Bus Route #136 - Gilbert Road from Ryan Road to Queen Creek Road	Cost/mile	$6.96/mile	annual	$63,000	0.5 mile/trip 30 nb trips/30 sb trips/weekday 24 nb trips/24 sb trips/Saturday 256 weekdays, 52 Saturdays *The cost/mile for local bus service is as per Valley Metro's FY 2020 costs*
22	Initial service reduction by limiting the hours of operation to peak hours for Local Bus Route #104 - Alma School Road, and elimination of the route in the long-term after establishing the flexible transit service in North Chandler Area	Cost/mile	$6.96/mile	annual	($395,000) for reduction to peak hours only ($605,000) for elimination of route in long-term	Route #104 FY 20 costs - $605,000. Retaining peak hour service would be a cost of $210,000, an annual net savings of $395,000. Elimination of the route in the long-term would be an annual net savings of $605,000.
23	Elimination of Local Bus Route #81 - Hayden Road/McClintock Drive within Chandler after establishing the flexible transit service in West Chandler Area	Cost/mile	$6.96/mile	annual	($275,000)	Route #81 FY 20 costs - $275,000
24	Addition of transit service along Queen Creek Road with potential deviated fixed-routes or peak hour service to provide east-west connectivity from Queen Creek to Price Road	Cost/mile	$6.96/mile	annual	$790,000	6.9 miles/trip 32 eb trips/32 wb trips/Weekday 256 Weekdays The service will be established in coordination with Valley Metro, Gilbert and Queen Creek, and the operational costs will be incurred accordingly *The cost/mile for local bus service is as per Valley Metro's FY 2020 costs*

No.	Recommendations	Units	Cost/Each	Quantity	Cost Estimate	Assumptions
High Capacity Transit						
25	Continue to advance High Capacity Transit along Arizona Avenue if determined appropriate by study conducted in near-term	Each	-	-	-	The study scope and cost will be determined based on the next steps identified in the near-term studies
26	Continue to advance High Capacity Transit along Chandler Boulevard if determined appropriate by study conducted in near-term	Each	-	-	-	
27	Continue to advance High Capacity Transit along Rural Road if determined appropriate by study conducted in near-term	Each	-	-	-	
Express Bus Routes						
28	Addition of one morning trip and one evening trip to Express Bus #542	Cost/mile	7.27/mile	annual	$100,000	27.8 miles/trip 2 nb trips/2 sb trips/Weekday 256 Weekdays Cut fare 25% in the afternoon (PM) *The cost/mile for Express bus service is as per Valley Metro's FY 2020 costs*
Transit Infrastructure						
29	Advance Downtown Transit Center Plan based on the site selection study					Land Price: $20 - $40 per square foot The costs are based on the Peoria park and ride.
	a. Right-of-Way	-	$500,000	-	$500,000	
	b. Planning and Design	Each	$200,000	1	$200,000	
	c. Construction	-	$6,000,000	-	$6,000,000	
	d. Maintenance	-	$50,000	annual	$50,000	
30	Advance North Chandler Park-and-Ride Plan based on the site selection study					Land Price: $20 - $25 per square foot The costs are based on the Peoria park and ride.
	a. Right-of-Way	-	$500,000	-	$500,000	
	b. Planning and Design	Each	$200,000	1	$200,000	
	c. Construction	-	$6,000,000	-	$6,000,000	
	d. Maintenance	-	$50,000	annual	$50,000	
31	Construct freeway to park-and-ride connector between Loop 202 and Hamilton Street/Germann Road, including direct HOV ramps at Loop 202					ROW assumed to be dedicated by Chandler. Note: Cost estimates for this project are included in the Roadway section of this report.

Note: All costs are for FY 2020

Table 5-16. Cost Estimates for Long-Term Transit Recommendations 2031 - 2040

No.	Recommendations	Units	Cost/Each	Quantity	Cost Estimate	Assumptions
Flexible Transit Services						
32	Conduct flexible transit service studies for the below identified areas. C. West Chandler Area E. Ocotillo Neighborhood F. Chandler Airpark Area G. South Chandler Area	Each	$100,000	4	$400,000	City staff will be involved *Each study will work with the community to identify the most suitable transit vehicle, service type, deployment scenarios, technological adaptations, operations, public involvement, and identify businesses/employment centers for pick-up/drop-off zones and potential amenities.*
33	Provide flexible transit services to the below areas as per the study findings. Identify pick-up/drop-off zones in each area and establish partnership with businesses/employment centers.					
	C. West Chandler Area	Cost/ service hour	$90/hr/vehicle	annual	$1,575,000	Number of vehicles = 3 Number of hours/day = 16 Number of days/week = 7
	E. Ocotillo Neighborhood	Cost/ service hour	$90/hr/vehicle	annual	$845,000	Number of vehicles = 3 Peak/ 2 Off-Peak Number of hours/day = 14 Number of days/week = 5
	F. Chandler Airpark Area	Cost/ service hour	$90/hr/vehicle	annual	$845,000	Number of vehicles = 3 Peak/ 2 Off-Peak Number of hours/day = 14 Number of days/week = 5
	G. South Chandler Area	Cost/ service hour	$90/hr/vehicle	annual	$845,000	Number of vehicles = 3 Peak/ 2 Off-Peak Number of hours/day = 14 Number of days/week = 5
Local Bus Routes						
34	Extension of Local Bus Route #112 - Country Club Drive/Arizona Avenue from Ocotillo Road to Chandler Heights Road	Cost/mile	$6.96/mile	annual	$190,000	1.2 mile/trip 32 nb trips/32 sb trips/Weekday 32 nb trips/32 sb trips/Saturday 27 nb trips/27 sb trips/Sunday 256 Weekdays, 52 Saturdays, 57 Sundays/Holidays Note: The official terminus of Route #112 extension has not been officially determined. *The cost/mile for local bus service is as per Valley Metro's FY 2020 costs*
High Capacity Transit						
35	Continue to advance High Capacity Transit along Arizona Avenue if determined appropriate by study conducted in mid-term	Each	-	-	-	The study scope and cost will be determined based on the next steps identified in the mid-term studies

No.	Recommendations	Units	Cost/Each	Quantity	Cost Estimate	Assumptions
36	Continue to advance High Capacity Transit along Chandler Boulevard if determined appropriate by study conducted in mid-term	Each	-	-	-	
37	Continue to advance High Capacity Transit along Rural Road if determined appropriate by study conducted in mid-term	Each	-	-	-	
Transit Infrastructure						
38	Facility expansion of Germann Road Park-and-Ride to accommodate potential Arizona Avenue High Capacity Transit, Express Bus Routes, and flexible transit services	-	$6,200,000	-	$6,200,000	Based on the Peoria Park and Ride. Cost estimation includes design and construction.

Note: All costs are for FY 2020

Table 5-17. Total Cost of Transit Improvement Recommendations 2020 - 2040

Time Period	Planning and Capital Costs of Recommendations (1)	Operations and Maintenance Costs of Recommendations	Total 2019 Cost of Recommendations
2020 - 2025	$2,200,000	$15,546,000	$17,746,000
2026 - 2030	$13,500,000	$35,015,000	$48,515,000
2031 - 2040	$6,600,000	$110,930,000	$117,530,000
Total Costs	**$22,300,000**	**$161,491,000**	**$183,791,000**

Notes: (1) Capital Costs for High Capacity Transit Not Included Because Costs Depend on Outcome of Studies.

5.2.3.5 Recommended Transit Technology

Emerging mobility technologies are changing the transportation industry and transforming the traditional transit market. Automated and alternate energy vehicles or shuttles can transport people in a cleaner and safer way, while transit signal priority (TSP), real-time bus scheduling information, driver assist technologies, and Mobility as a Service (MaaS) software platforms are facilitating smoother transfers, reducing transit travel time, and improving the user experience. On-demand transit services are expanding transit service coverage and alleviating mobility equity issues. Electrified and hydrogen powered transit services are reducing emissions and noise impacts, creating a more sustainable roadway environment. The following subsections provide an overview of emerging technologies.

Autonomous Vehicle Technologies – Applications in Transit

Autonomous vehicles (AV) rely on detection systems (e.g., cameras, radar, LiDAR, GPS, and other sensors) to interpret surrounding roadway features such as lane striping, signage, and curbs. AV detection systems installed on buses can, or in the future will, navigate buses through traffic lights and tunnels and identify pedestrians and cyclists. Sophisticated on-board and street-side computer systems are required to allow interactions between transit buses and infrastructure such as bus stations and bus-only lanes. This enhances boarding and alighting, resulting in smoother, more reliable travel.

For example, in 2016, a semi-autonomous bus manufactured by Mercedes-Benz made a 12-mile trip from Schiphol airport to Haarlem in the Netherlands. The bus was programmed to precisely navigate to stations, enabling easy boarding and alighting. It had a top speed of 43 miles per hour and used bus-only lanes, however, a driver was still present in the bus to monitor the vehicle's surroundings and overrule the automated system if needed.

Other examples include automated shuttle deployments within constrained areas. The following non-comprehensive list highlights several deployments within the past couple of years, as well as some planned deployments in the near future.

- First Transit operated two AV passenger shuttles partnering with EasyMile at the Bishop Ranch Office Park in San Ramon, California in November 2016;
- Auro Robotics offered its electric AV campus shuttles through a MaaS model on the campuses of Santa Clara University and California State University in 2016; and

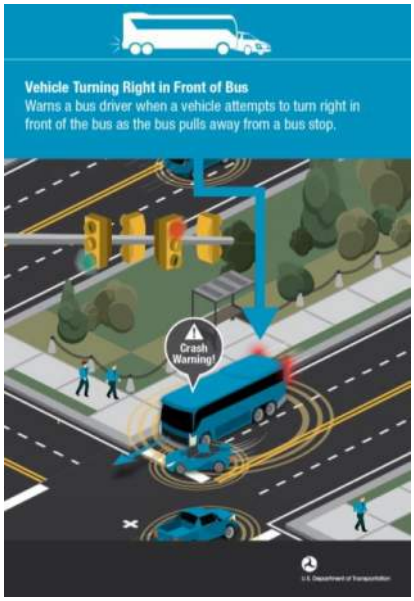
- Two AV transit projects in Florida have been formulated for future deployments; the Gainesville Autonomous Transit Shuttle, and Downtown Tampa Autonomous Transit Project.

There is growing interest from full-size bus manufacturers to implement automated technology on their vehicles and the City should encourage regional efforts to incorporate AV technologies into the regional transit network. If the City decides to pursue its own autonomous fleet in the near future, it could do so in a pilot program in a smaller and controlled environment such as a campus or small area of downtown that can be tested over a period prior to expansion.

Connected Vehicle Technologies – Applications in Transit

Connected vehicle (CV) technologies can be applied to transit vehicles or the interactions between vehicles and infrastructure. The technology consists of hardware transponders and receivers installed on either a vehicle and/or within the infrastructure environment, such as at intersections or other roadside locations. The transponders and receivers can transmit signals using either DSRC or 5G connections.

It is important to distinguish that CVs do not need to be automated. Application of CV technology can help improve safety, mobility, and the environment. Multiple examples of CV technology can be researched on the internet.



VTRFTV Concept Illustration. Source: U.S. Department of Transportation

While the City is not yet pursuing CV field infrastructure as there is no current broader traveler adoption of the technology, the City could partner with Valley Metro to create a pilot area along major or high-capacity transit corridors that could be outfitted with CV field infrastructure to serve specific City goals such as safety and efficiency of travel. A pilot project would help with industry adoption of the technology.

Transit Signal Priority

Transit Signal Priority (TSP) is capable of reducing transit delays by modifying signal phasing or timing at intersections. TSP modifies traffic signal timing or phasing when transit vehicles arrive at a signalized

intersection. To maximize TSP's efficiency, the signal needs to be accessible to transit vehicles, either with a dedicated lane, transit way, or another clear lane. The Valley Metro LRT and Tempe Streetcar are local examples of using TSP to improve transit travel times and manage vehicular traffic.

This City already has TSP functioning for Local Bus Route #112 on Arizona Avenue and Route #156 on Chandler Boulevard. This could be expanded to additional intersections and corridors in the city.

Automated Information

Pedestrian Transit Movement Warning (PTMW), Pedestrian in Crosswalk Warning (PCW), and Transit Stop Pedestrian Warning (TSPW) all provide a safety net for pedestrians through transit vehicle movement warnings. PTMW sends out informational warnings regarding a bus or streetcar's movements at an intersection to pedestrians within the proximity. Examples of recent deployments can be researched on the internet.

Real-time bus scheduling information and "Smart" park-and-ride facilities aid travelers to make smarter travel decisions. Real-time bus scheduling information includes the arrival and departure time of each bus, service spans of various bus routes, and other pertinent traveling details. "Smart" park-and-ride facilities are equipped with signs showing how many parking spaces are available at the park-and-ride lot.

The City should consider upgrading the passenger information provided at the Hamilton park-and-ride lot, the Chandler Fashion Center Transit Station, and at the future BRT stops along Arizona Avenue.

Shared Mobility Solutions

New shared mobility solutions related to transit include microtransit, usually a shared, short-distance circulator that either provides point-to-point mobility within a defined area and/or feeds a high-capacity transit corridor. Currently, there are multiple microtransit pilot projects in the U.S. that can be researched on the internet.

The City could pursue a similar structure and approach for its flexible microtransit areas, as well as focus on connections and feeders to future high-capacity transit corridors.

In addition to microtransit, other shared mobility solutions include dynamic carpooling and ride-hailing. Dynamic carpooling is an application-enabled service that matches drivers and passengers in real time, filling empty seats and reducing congestion and auto emissions. Dynamic carpooling applications facilitate cost-sharing among travelers but prohibit drivers from making a profit. Examples of private industry services partnering with public transit agencies include San Diego County, Bay Area Rapid Transit, and the Contra Costa Transportation Authority. These agencies have subsidized rides and/or provided preferential parking at park-and-ride lots in order to incentivize carpooling.

The City could partner with Valley Metro to identify carpool incentives that could also connect riders to the public transit network.

Alternate Energy Vehicle Technologies

Alternate energy vehicle technology innovations entail vehicle and infrastructure advancements. Technology advancements include both Electric Vehicles (EVs) and hydrogen power vehicles. Specifically, transit-related, Battery Electric Buses (BEBs) are completely powered by an onboard battery.

Plug-in, wireless conductive, and wireless inductive charging are three charging methods on the market for BEBs.

Plug-in charging primarily requires overnight charging in a depot, and a manual connection from the power supply to the BEB. Wireless conductive charging requires charging stations and still requires physical contact between power supply and BEB. However, the contact can be metal to metal, therefore reducing the need for physical cords and cables. Wireless inductive charging does not need the physical contact of wireless conductive charging. Additionally, it can be stationary or dynamic. Dynamic charging allows for in-motion charging; however, this specific technology is not yet widely available for commercial use. Either type of inductive charging is often referred to as in-route charging because they can be used by BEBs to charge along their routes. These systems can be researched further on the internet.

In addition to the battery electric vehicle (BEV) technology mentioned above, there are also hydrogen fuel cell EVs. Typically, these vehicles do not have large battery packs like BEVs but rather use an onboard fuel cell to generate electricity. A benefit of this technology is faster 'fueling' time compared to BEVs; however, hydrogen fueling stations are required. While the hydrogen fuel cell EV light-duty consumer market has been slow to take off compared to the more traditional BEV, adoption examples include an Amazon purchase commitment of nearly $600 million in a hydrogen fuel cell company, a pilot project with UPS, Toyota, and Kenworth for three drayage semi-trucks, and the Federal Transit Administration's (FTA) Fuel Cell Bus Program. One example under the FTA's program is a two-year demonstration period for a hydrogen fuel cell electric bus running normal operational routes for the Orange County Transportation Authority in California.

The City should encourage regional use of E-Buses and integrate them into a city fleet of micro transit. The City could identify locations where electric charging stations for BEVs and BEBs and hydrogen fueling stations for hydrogen fuel cell vehicles would be able to serve and support the growing industry toward vehicular electrification.

The city should also consider a partnership with Air Products to implement a fueling station at their facility for city owned cars and trucks, and for any Valley Metro owned buses.

Mobility as a Service (MaaS)

MaaS refers to a "one-stop shop" way for travelers to seamlessly schedule and pay for rides across various transportation modes. According to an estimate by ABI Research, the market for MaaS could be worth $1 trillion by 2030.

An example of this technology is Xerox's Mobility Companion app, which was launched in Denver and Los Angeles in 2016. The app integrates transit service, shared mobility, and walking into a single trip planning interface. Users are able to book and pay for trips via the app, and customize their decisions based on length of trip, price, number of calories burned, and carbon dioxide released into the air. Uber is another example in facilitating MaaS development. The company recently partnered with global ticketing and payment provider Masabi as a means to seamlessly access and serve public transit users. Masabi is a London-based technology company that facilitates mobile transit ticketing in 30 cities worldwide. Its customers include public transit agencies in Boston, New York, London, Athens, Las Vegas, and Los Angeles. Additionally, in April 2018 Uber acquired Jump, adding bike-share services to the company's portfolio, followed shortly thereafter by a significant investment in Lime for the purposes of e-scooter

market expansion. After major investments in Masabi, Jump, and Lime, Uber evolved into an enterprise entailing a wide range of services as well as a new MaaS platform provider.

A MaaS concept specifically for the City of Chandler is not recommended at this time, but the City should stay apprised of Valley Metro initiatives that lend themselves toward regional MaaS approaches of which the City will want to take a part in. Specifically, Valley Metro was awarded a USDOT Mobility on Demand (MOD) grant to find ways of combining the increasing number of mobility options to provide seamless, accessible, and inclusive transportation. Currently, they are working with Routematch, a technology partner, to create a smartphone platform to integrate multi-modal trip planning and payment.

Transit Security

Transit security systems cover a wide range of technologies that enhance the security and safety of transit customers, personnel, and assets. They incorporate radio communications, silent alarms, covert microphones, closed circuit television (CCTV) cameras, automatic vehicle location (AVL) and other equipment that assist transit agencies in monitoring and coping with situations during operations.

Transit security technologies are usually paired with each other to perform more effectively in a larger system. On-Board Surveillance requires the use of silent alarms that are accessible to a vehicle operator or remote personnel. GPS or other AVL systems are also needed to identify the location of an incident. Mobile data terminals will diversify non-verbal communication options when incidents happen.

The City should incorporate transit security technologies in all new infrastructure and upgrade existing infrastructure, such as park-and-ride lots and bus stop locations. This includes providing a fiber optic network connection at needed infrastructure points, as well as installing CCTV camera systems to monitor public areas.

User Trends

Transit users desire their service to be reliable, fast, integrated, and safe. However, transit ridership across the U.S. has generally declined in recent years. New forms of mobility such as TNCs, private microtransit, and dockless bike and scooter services are rising in popularity but are not typically releasing their data for public analysis. In some cases, these services can complement – or cannibalize – public transit ridership. High-capacity transit options, such as buses and rail, have an advantage in terms of capacity compared to most other modes. Street width is a finite resource and favors the most space-efficient modes of transportation.

While private mobility services have the potential to fill the gap in public transit service in low density suburban areas or other under-served areas, the same challenge of the past will certainly persist in the future: how to align priorities and public incentives to ensure that the private sector can provide the critical transit service needed if they are an extension of the public transit network. The increasing role of public private partnerships (P3s) and the future rebranding of a transit agency as a mobility provider can enable more effective coordination in the future, but the role of public transit is still just as critical no matter who owns or operates the service.

As emerging solutions such as MaaS gain popularity in the transit industry, future public transit services have the opportunity to be better integrated with other private transportation modes. By taking real-time travel conditions, user preferences, and seamless payment methods into account and identifying a customized optimal travel package, user experience of each individual and efficiency of the whole

transportation system could be maximized. The transit industry is currently poised to move forward with a system where different modes of transportation, technologies, and providers are synced and complementary.

Transit Technology Recommendations and Costs

Staying up-to-date and involved in transit technology is important for the City's role in the future of transportation. There are many opportunities for the City to coordinate with Valley Metro, spanning technologies and services from AV, CV, EV, and MaaS. Additionally, the City can pursue its own investments in transit technology such as automated microtransit services, further rollout of transit signal prioritization, street-side infrastructure upgrades for CV technology installation with both cellular network and fiber optic upgrades, and identifying EV charging stations and hydrogen refueling locations.

Table 5-18 Transit Technology Recommendations Summary

No.	Type	Recommendation
Automated Vehicles		
1	Regional Coordination	The City should encourage regional effort to incorporate AV technologies into the regional transit network.
2	Pilot Program	If the City decides to pursue its own autonomous fleet in the near future, it could do so in a pilot program in a smaller and controlled environment.
Connected Vehicles		
3	Pilot Program	The City could partner with Valley Metro to create a pilot area along major or high-capacity transit corridors that could be outfitted with CV field infrastructure to serve specific City goals such as safety and efficiency of travel.
Transit Signal Priority		
4	Technology Implementation	TSP could be expanded to additional intersections and corridors within the City.
Automated Information		
5	Technology Implementation	The City should consider upgrading the passenger information at the Hamilton park-and-ride lot, the Chandler Fashion Center Transit Station, and at the future BRT stops along Arizona Avenue.
Shared Mobility Solutions		
6	Incentive Program	The City could partner with Valley Metro to identify carpool incentives that could also connect riders to the public transit network.

Alternate Energy Vehicles		
7	Technology Implementation	The City should encourage the regional use of E-Buses and integrate them into a city fleet of micro transit.
8	Technology Implementation	The City could identify locations where electric charging stations and hydrogen fueling stations would be able to serve and support the growing industry toward vehicular electrification.
9	Technology Implementation	The City should consider a partnership with Air Products to implement a fueling station at their facility for city owned cars and trucks, and for any Valley Metro owned buses.
Transit Security		
11	Technology Implementation	The City should incorporate transit security technologies in all new infrastructure and upgrade existing infrastructure, such as park-and-ride lots and bus stop locations. This includes providing a fiber optic network connection at needed infrastructure points, as well as installing CCTV camera systems to monitor public areas.

The City should account for transit technology in the bigger discussion about leveraging technology across all modes to improve the travel experience for all. Costs for implementation of technology elements associated with transit technology are shown in **Table 5-19**. See Section 7.3.4 of this document for a detailed discussion of technology recommendations and associated costs.

Table 5-19. Total Cost of Transit Technology Recommendations 2020 - 2040

Time Period	Capital Cost of Recommendations	Operations and Maintenance Cost of Recommendations (1)	Total 2019 Cost of Recommendations
2020 - 2025	$0	(1)	$0
2026 - 2030	$3,350,000	(1)	$3,350,000
2031 - 2040	$5,800,000	(1)	$5,800,000
Total Costs	**$9,150,000**	(1)	**$9,150,000**

Notes: (1) Transit Technology Operations and Maintenance Costs are Incorporated into the Roadway Technology Maintenance Costs.

A recommendation that will help implement these technologies and engage stakeholders is a public education program framework. The overall program will need to identify and address the major components of an effective public awareness campaign regarding the effects of future technology and travel trends. These include:

- Overall messaging, including themes that are likely to resonate with key audiences;
- Necessary technical content, such as statistics on trends and examples of emerging technologies;
- Potential audience, stakeholder, and organizational interests, including champions who can amplify the message;
- Collateral materials, such as talking points, fact sheets, posters or flyers, emails, brochures or issue briefs;
- Coordinated media strategy, including social, earned, and paid media options;
- Opportunities for interactive pop-up events to connect with people where they are, using booths or mobile displays;
- Tailored communication strategies, including the use of multi-lingual or culturally responsive methods to broaden the reach of the campaign and ensure inclusiveness; and
- Implementation plan, including timing and responsibilities.

The program could place a special emphasis on addressing the misconception that public transit will be eliminated due to future technology. It will need to convey complex technical information in ways that are readily understandable and relate directly to everyday quality of life. Infographics, icons, and other user-friendly layouts that engage, as well as educate, could be incorporated into the program.

5.2.4 TOTAL TRANSIT RECOMMENDATION COSTS

Table 5-20 shows the capital, operations and maintenance, and total costs for the near-term, mid-term, and long-term transit improvement recommendations. The total cost of all recommended transit improvements in 2019 dollars for the 2020 - 2040 timeframe calculates to $192.94 million.

Table 5-20. Total Cost of Transit Improvement Recommendations 2020 - 2040

Time Period	Capital Cost of Recommendations	Operations and Maintenance Cost of Recommendations	Total 2019 Cost of Recommendations
2020 - 2025	$2,200,000	$15,546,000	$17,746,000
2026 - 2030	$16,850,000 (1)	$35,015,000	$51,865,000
2031 - 2040	$12,400,000 (1)	$110,930,000	$123,330,000
Total Costs	**$31,450,000**	**$161,491,000**	**$192,941,000**

(1) Capital Costs for High Capacity Transit Not Included Because Costs Depend on Outcome of Studies.

6.0 BICYCLE AND PEDESTRIAN ELEMENT

6.1 BICYCLE AND PEDESTRIAN EXISTING CONDITIONS

Providing an effective multimodal transportation system that includes a functioning bicycle and pedestrian network is crucial to keeping the City of Chandler connected and providing a great quality of life. Having a connected multimodal network gives residents options in transportation and encourages a healthy environment.

6.1.1 EXISTING BICYCLE FACILITIES

Arizona Revised Statute (ARS) 28-812 grants any person riding a bicycle on a roadway or on a shoulder of a roadway "all the rights and … all the duties" applicable to the driver of a motor vehicle. While bicyclists are allowed on any roadway that is not specifically prohibited to bicycling, bicycling is typically more fun, efficient, and safe for both motorists and bicyclists if bicycle-specific facilities are provided.

Existing bicycle facilities in the City of Chandler include bike lanes, designated bike routes, off-street shared-use paths (both paved and unpaved), and paved shoulders of roadways, park-and-ride lots that have bike lockers, overpasses/underpasses at freeways and canals, and signalized crossings, as depicted in **Figure 6-1**.

The City of Chandler has 347 lane-miles of bike lanes per data provided by the City of Chandler. Additionally, there are 7.4 miles of bike routes, 17.3 miles of paved shared-use paths, 23.9 miles of unpaved shared-use paths, and 11.6 miles of paved shoulders for bicyclists within the City limits.

A majority of the arterial street network of Chandler includes dedicated bike lanes as part of the roadway. Also, many collector streets around the City include dedicated bike lanes. A bicycle lane is a portion of the roadway that has been designated by striping, signage, and pavement markings for exclusive use of bicycles. The 2012 *Guide for Development of Bicycle Facilities*, 4th Edition prepared by the American Association of State Highway and Transportation Officials, recommends a minimum width of five feet for bike lanes adjacent to vertical obstructions (such as curbs or guardrail) and four feet with no adjacent vertical obstructions. Bicyclists typically use bike lanes for commuting or exercise.

A bike route is distinguished only by signage and includes both motorists and bicyclists using the same lane on the roadway. If a roadway is not wide enough to accommodate dedicated bike lanes, it may be signed as a bike route to alert motorists that bicyclists may still be in the lane and can use the lane.

Shared use paths, or trails, are located off-street or along canals and typically service more recreational riders rather than commuters. The paths are typically a minimum of ten feet wide and can be either paved or unpaved. Regional shared use paths and trails in the City of Chandler include those listed in **Table 6-1**.

Table 6-1. Regional Paths and Trails in Chandler

Path/Trail	Approximate Length (miles)	Surface in Chandler	Notes
Eastern Canal Path	20 (4.3 miles in Chandler)	About half paved and half unpaved	Runs north-south connecting Chandler, Mesa, and Gilbert on the eastern side of Chandler; one underpass crossing
Consolidated Canal Path / Paseo Trail	19 (8.5 miles in Chandler)	Primarily paved	Runs north-south connecting Chandler with Mesa and Gilbert through center of Chandler; four signalized crossings and six overpass/underpass crossings
Western Canal Path	22 (3.5 miles in Chandler)	Paved except at railroad crossing	Runs east-west connecting Chandler with Phoenix, Tempe, and Gilbert on the north side of Chandler; three signalized crossings and one overpass crossing
Kyrene Branch Canal Path	4 (1.1 miles in Chandler)	Unpaved	Runs north-south connecting Chandler and Tempe on the western side of Chandler
Highline Lateral Canal Path	10 (0.3 miles in Chandler)	Unpaved	Runs north-south connecting Chandler and Tempe on the western side of Chandler

Source: City of Chandler

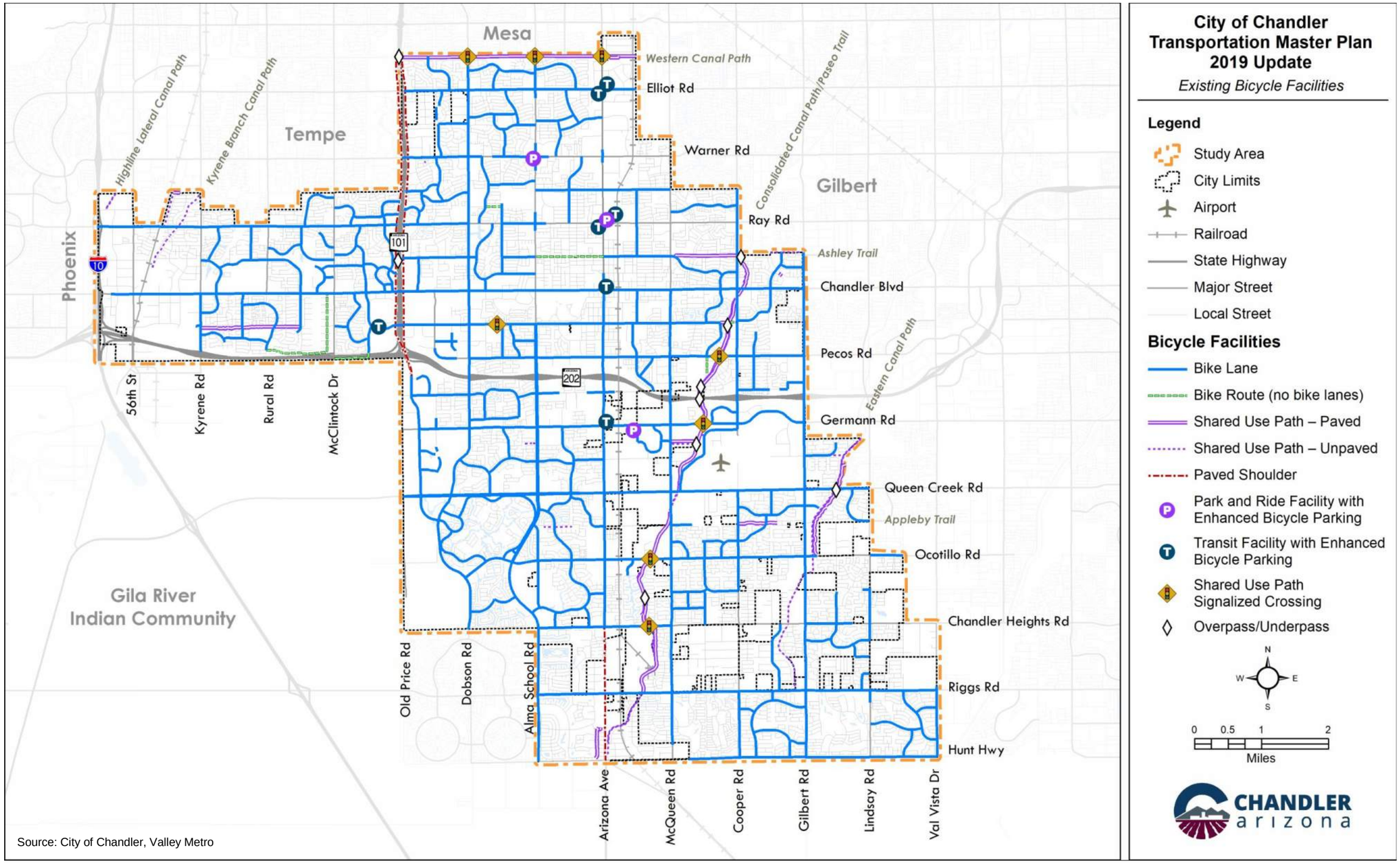
Paved shoulders are defined as additional pavement width of at least four feet adjacent to a roadway that can accommodate bicycles more safely than a typical roadway shoulder.

Standards for different facilities are included in the Chandler Unified Development Code. As part of the code, the Street Design and Access Control Technical Design Manual #4 (2018) states that all newly constructed or reconstructed arterial roadways shall be marked with bike lanes. The bicycle lane width shown in the City's design standards is a minimum of four feet (excluding the gutter), with five feet preferred. According to the City code, bike lanes should also be marked on collector streets selected by City staff together with developer or neighborhood representatives.

Chandler is recognized as a bronze level "Bicycle Friendly Community" by the League of American Bicyclists. This recognition reflects the City's commitment to bicycling and a bicycle-friendly environment.

6.1.2 EXISTING PEDESTRIAN FACILITIES

Existing pedestrian facilities include sidewalks, sidewalk ramps, overpasses/underpasses at freeways and canals, signalized crossings, and off-street shared use paths. Sidewalks are present on almost all arterial roadways, with sidewalk ramps at signalized and unsignalized intersections. The crossing facilities and shared use paths identified in **Figure 6-1** and **Table 6-1** are used by both pedestrians and bicyclists.



Source: City of Chandler, Valley Metro

Figure 6-1. Existing Bicycle Facilities

6.1.3 CRASH ANALYSIS

Safety is a top concern with any transportation system, particularly for pedestrians and bicyclists as they are more vulnerable than vehicles. Crossing arterial roadways presents many potential safety issues for bicyclists and pedestrians due to potential conflicts with vehicles.

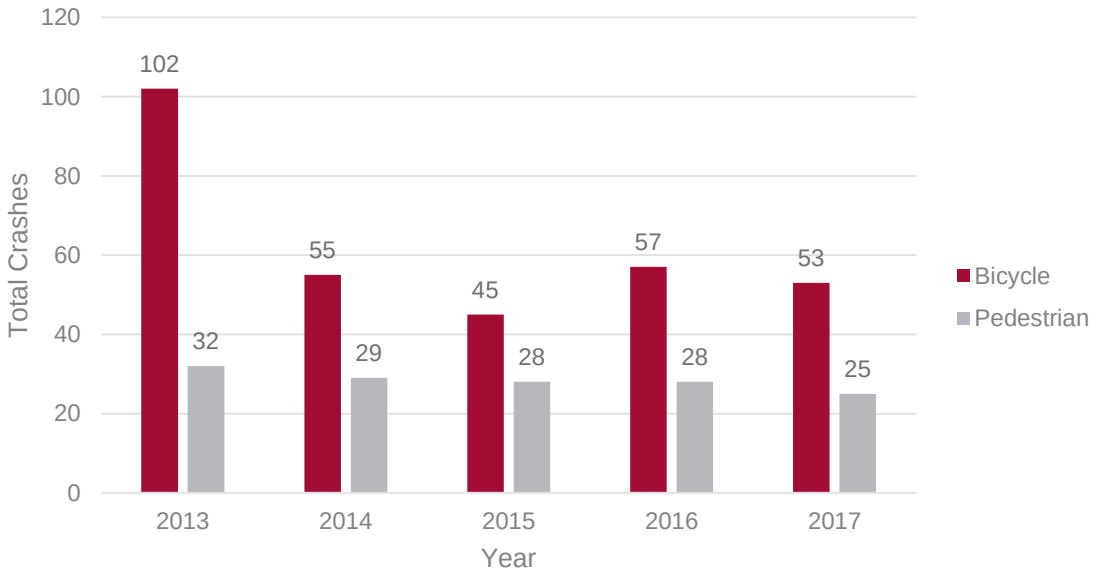
Of the 21,543 reported crashes in the City of Chandler from 2013 through 2017, 312 involved bicycles (1.4%) and 142 (0.7%) involved pedestrians. **Figure 6-2** through **Figure 6-5** show a breakdown of the bicycle and pedestrian crashes by year, by crash severity, by lighting condition, and by junction relation.

The number of bicycle crashes has varied year to year, with an unusually high number in 2013. The number of pedestrian crashes has decreased over the last five years.

Of the thirteen total fatal crashes from 2013 through 2017, ten involved pedestrians and three involved bicyclists. Just over 14% of all bicycle and pedestrian crashes resulted in either an incapacitating injury or fatality. Only 15% of bicycle and pedestrian crashes resulted in no injuries, showing the high likelihood of injury when a pedestrian or bicyclist is involved in a crash.

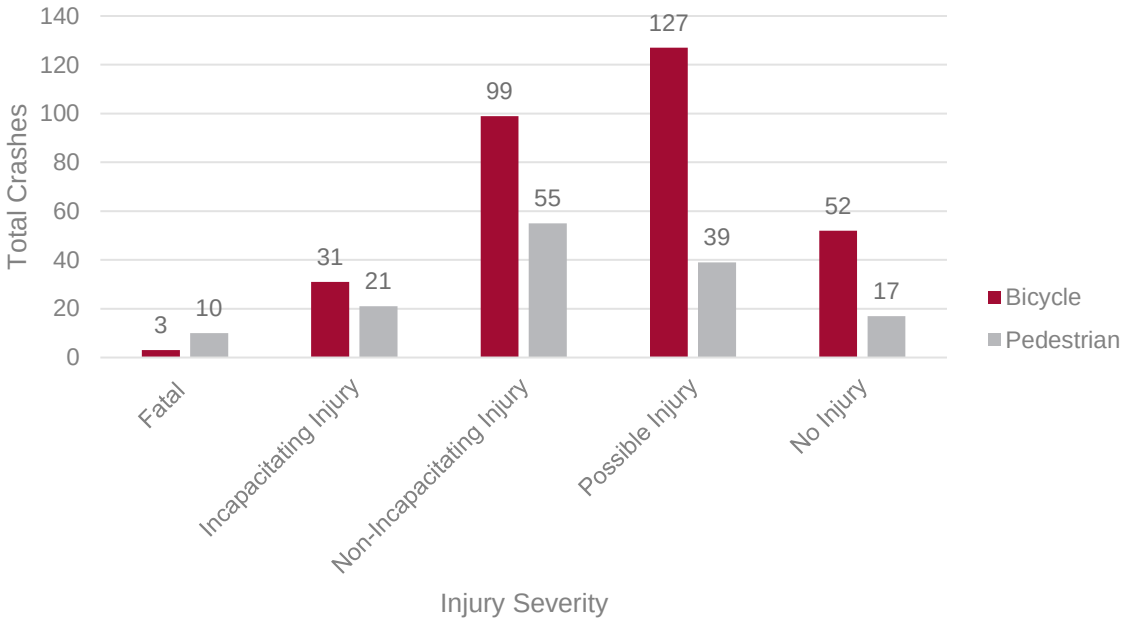
Of the 454 total bicycle and pedestrian crashes in the five-year analysis period, over 70% occurred in daylight conditions. Most of the crashes that occurred at night were on streets with existing streetlights.

A majority of the bicycle and pedestrian crashes occurred at intersections or at intersection-related areas. With a majority of the bicycle network on arterial roadways, major arterial intersections pose potential safety risks and navigating challenges.



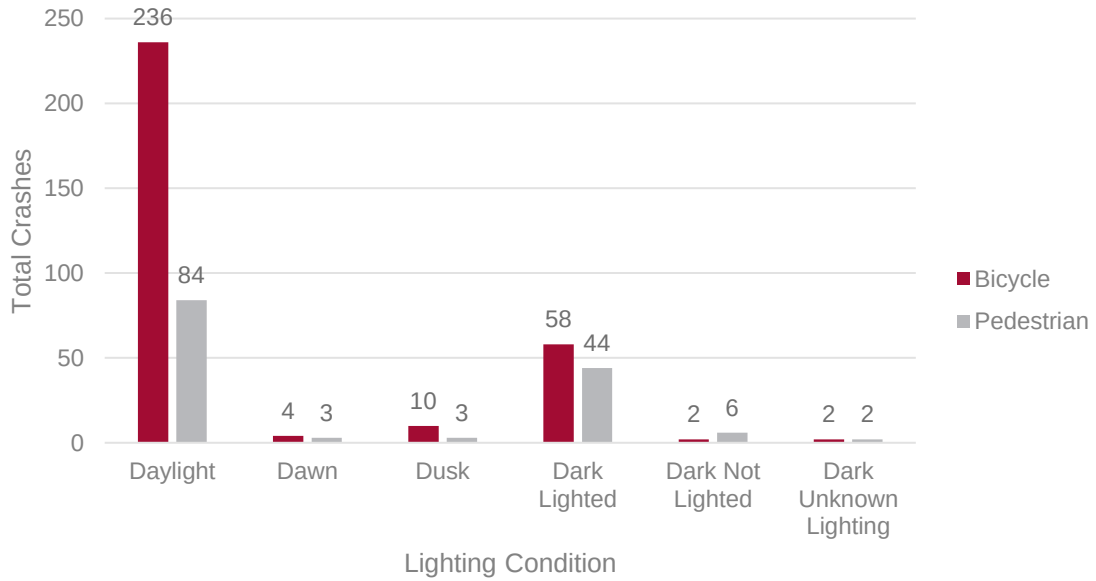
Source: Arizona Statewide Crash Database, 2013 - 2017

Figure 6-2. Bicycle and Pedestrian Crashes per Year, 2013 - 2017



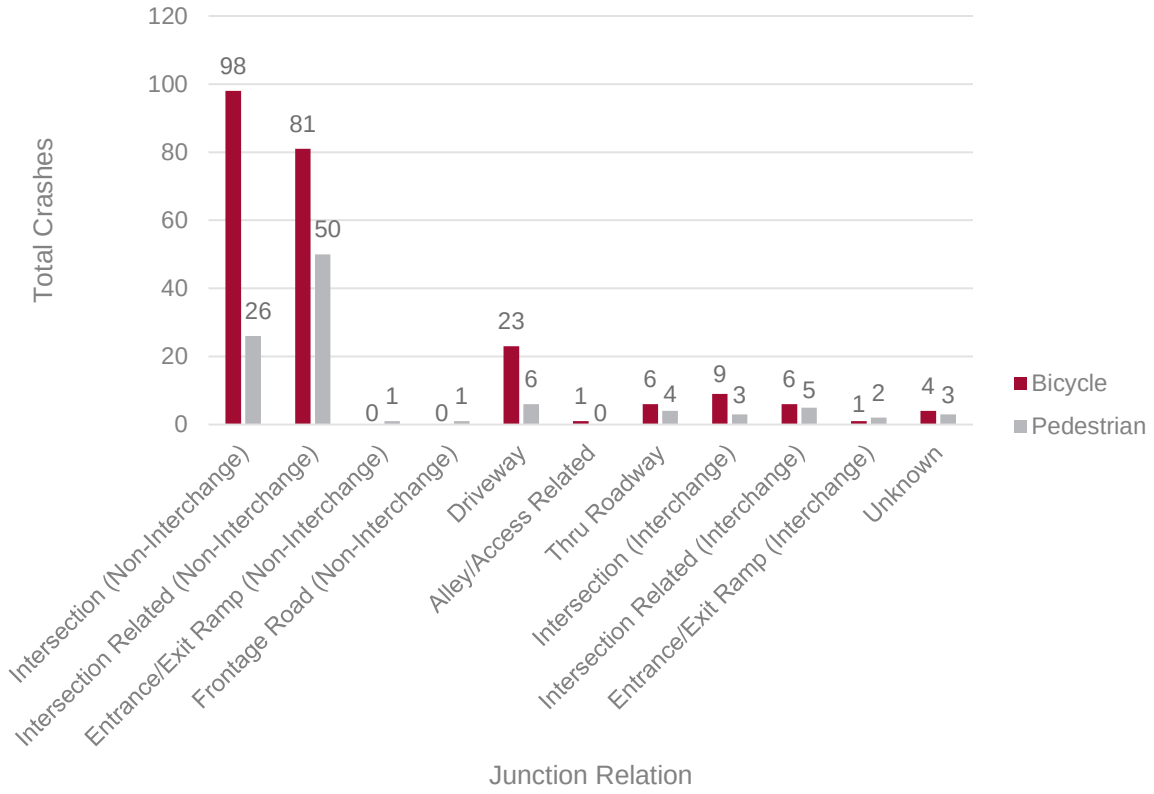
Source: Arizona Statewide Crash Database, 2013 - 2017

Figure 6-3. Bicycle and Pedestrian Crashes by Severity, 2013 - 2017



Source: Arizona Statewide Crash Database, 2013 - 2017

Figure 6-4. Bicycle and Pedestrian Crashes by Lighting Condition, 2013 - 2017



Source: Arizona Statewide Crash Database, 2013 - 2017

Figure 6-5. Bicycle and Pedestrian Crashes by Junction Relation, 2013 - 2017

Figure 6-6 and **Figure 6-7** respectively show the locations of all bicycle and pedestrian crashes and severe bicycle and pedestrian crashes in the City of Chandler from 2013 through 2017. **Figure 6-8** and **Figure 6-9** respectively show the locations of all severe bicycle and pedestrian crashes in the City of Chandler from 2013 through 2017. Severe crashes include those crashes that resulted in a fatality or incapacitating injury. From 2013 through 2017, there were a total of 13 fatal and 52 incapacitating injury bicycle or pedestrian crashes on Chandler roadways.

High bicycle and pedestrian crash areas were observed in the northern half of Chandler, particularly the northcentral and northeastern parts of the city. The high crash areas are consistent with where there are high traffic volumes and many activity centers that attract bicycle and pedestrian traffic. While Arizona Avenue and Chandler Boulevard in the downtown area show a concentration of crashes, the number of fatal crashes is relatively low, proportionally speaking. This is likely due to reduced speeds in the downtown area (see speed limits on **Figure 6-8**) and/or the expectation motorists have of pedestrians and bicyclists being in the area.

The southern half of Chandler has significantly fewer crashes, but the severity of those crashes is disproportionately high compared to the northern half. This is likely due to higher speeds, limited bicycle and pedestrian infrastructure, and motorists not expecting pedestrians and bicyclists on those roadways.

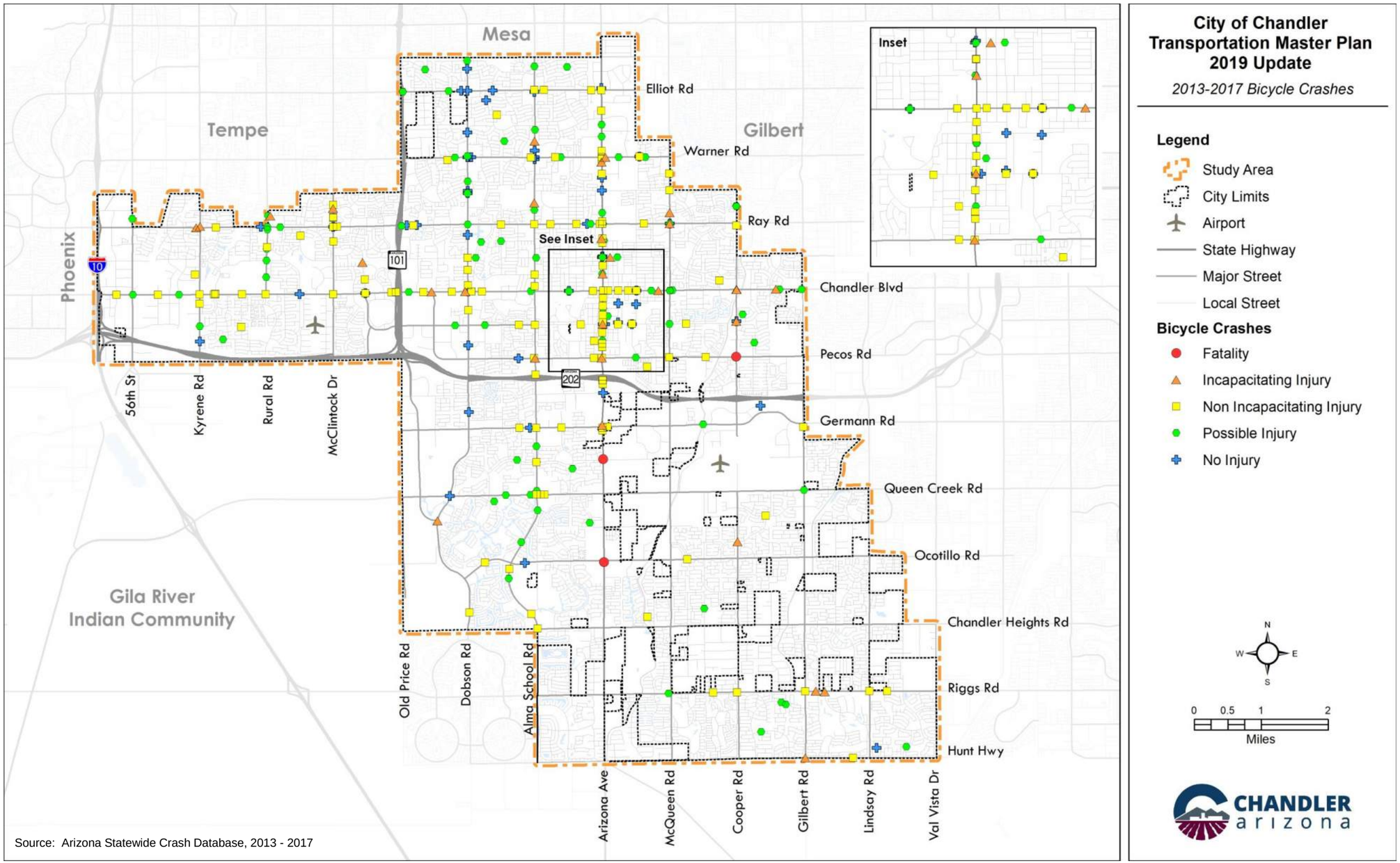


Figure 6-6. 2013 - 2017 Bicycle Crashes

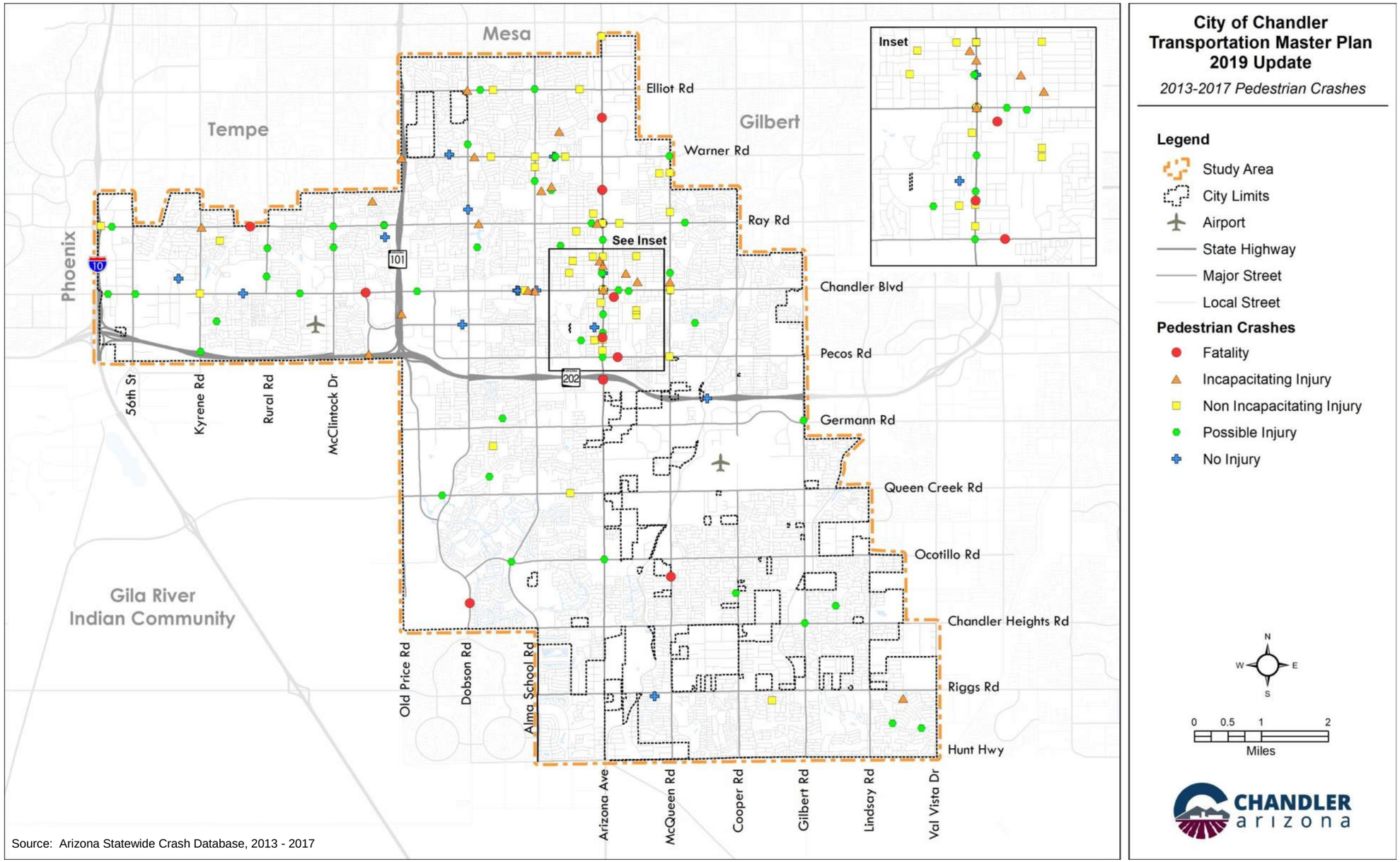
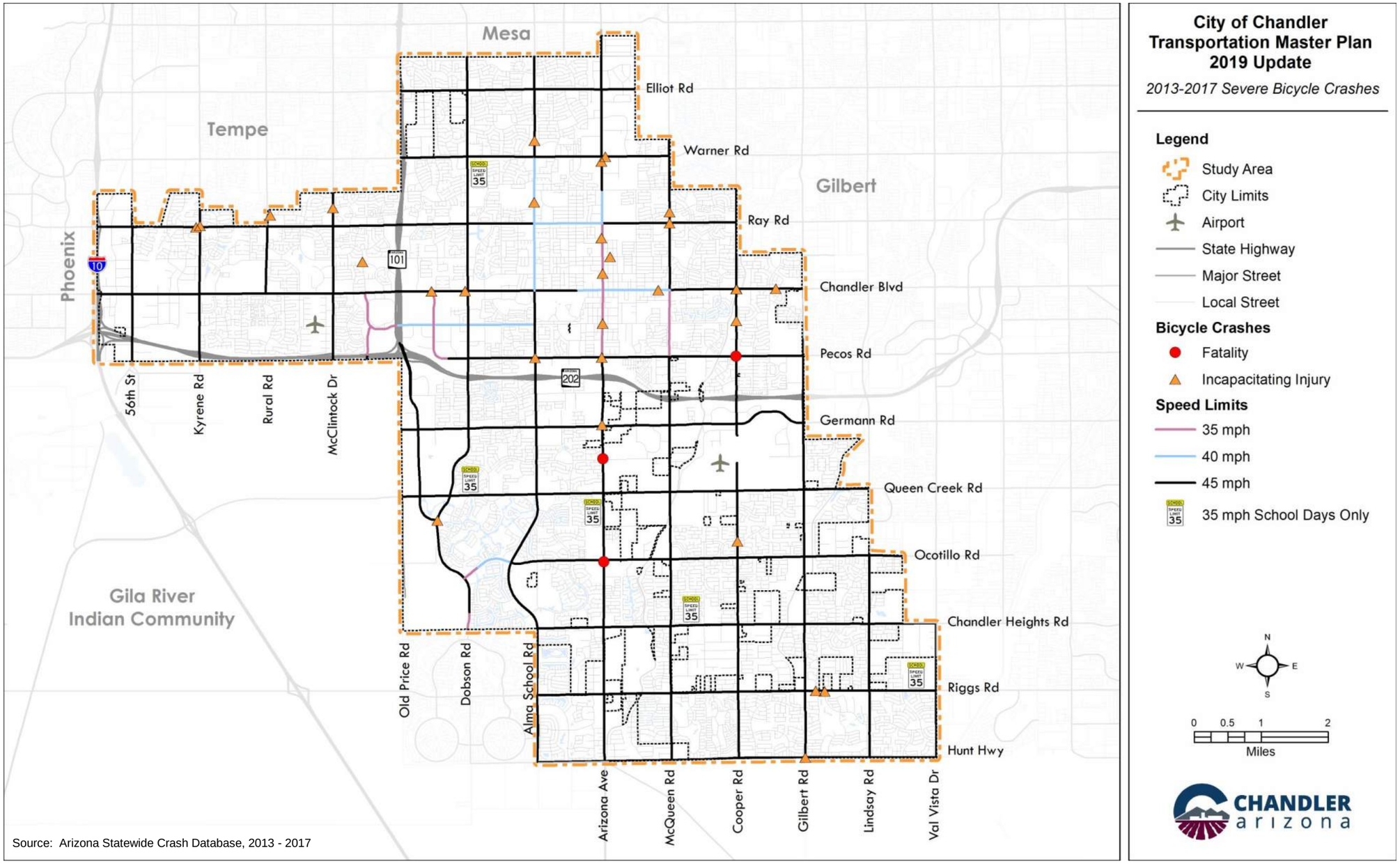


Figure 6-7. 2013 - 2017 Pedestrian Crashes



Source: Arizona Statewide Crash Database, 2013 - 2017

Figure 6-8. 2013 - 2017 Severe Bicycle Crashes

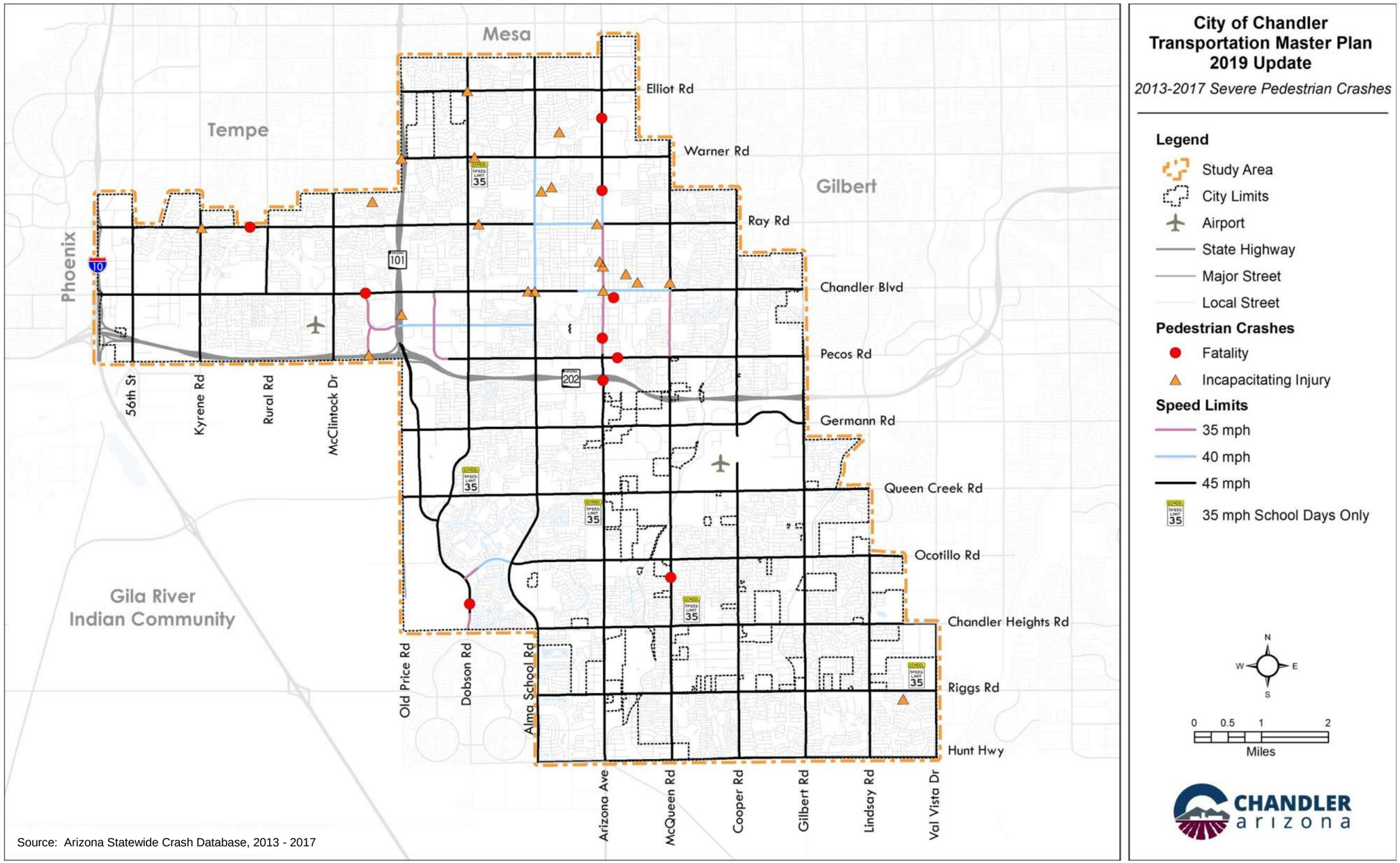


Figure 6-9. 2013 - 2017 Severe Pedestrian Crashes

6.1.4 BICYCLE AND PEDESTRIAN FACILITIES TECHNOLOGY

New and changing technologies are changing bicycle and pedestrian travel. Just within the last few years, a privately-owned dockless bicycle-share program came and went and a privately-owned dockless scooter-show program was recently introduced. These shared active transportation services utilize technology to attract users. Bicycles and scooters are equipped with geolocation devices, so they can be staged anywhere and rented via a smartphone. These shared active transportation services fill a gap in the transportation system by providing convenient first-mile/last-mile modes of travel for short trips. Due to their relative newness, the City is still developing policies and practices for managing these shared active transportation services.

The City is also embracing technology to improve bicycle and pedestrian facilities and crossings. The City has installed Rectangular Rapid Flashing Beacons (RRFB) at four crossings and signalized many mid-block shared-use path crossings. The City of Chandler is also installing traffic signal detection cameras that can detect bicyclists at 40 locations this year, with plans for additional cameras in future years.

6.1.5 FUNDING OVERVIEW

Funding for bicycle and pedestrian improvements is provided primarily through a combination of local funds and federal Congestion Mitigation and Air Quality (CMAQ) funds administered by the Maricopa Association of Governments (MAG). Local funds are typically used for design while CMAQ funds with a local match are typically used for construction. Many bicycle and pedestrian facilities are constructed as part of larger roadway improvement projects as City arterial street design standards call for bike lanes and sidewalk.

6.2 BICYCLE AND PEDESTRIAN FUTURE CONDITIONS

This section describes the process used to identify and recommend bicycle and pedestrian facilities improvements for short-, mid-, and long-term planning horizons. As used in this document, the term “bicycle and pedestrian” covers all forms of personal mobility, from traditional bicycling and walking to emerging “micromobility”/”shared mobility” modes such as scooter-share and bike-share programs.

A review of existing facilities, public input and outreach, and connectivity opportunities were used to form the bicycle and pedestrian recommendations. Improvement recommendations are designed to provide a convenient, connected, safe, and functional bicycle and pedestrian network that contributes to the quality of life of residents. The bicycle network will recommend facilities for users of all skill levels, from younger kids learning to ride, to recreational users desiring safe facilities, to very experienced users who commute or otherwise desire faster travel options.

6.2.1 ANALYSIS PROCESS

Existing bicycle facilities in the City of Chandler include bike lanes, designated bike routes, off-street shared use paths (both paved and unpaved), paved shoulders of roadways, bike lockers and racks at park-and-ride lots and transit centers, overpasses/underpasses at freeways and canals, and signalized crossings.

Public input helped identify where bicycle and pedestrian improvements to the existing facilities should be focused. Respondents were asked to give suggestions on where they would like to see bicycle and pedestrian improvements and also which types of improvements were preferred. Three public meetings were held in January 2019 at locations throughout the City and a workshop was held in March 2019 with key stakeholders. Interactive activities asked attendees to locate on maps and through discussion where improvements are needed.

The public also provided feedback for bicycle and pedestrian facilities via an online survey that received 1,075 responses.

Comments from the public were reviewed to identify repeating patterns, which included the following:

- Provide more off-street bicycle and pedestrian facilities that are separated or buffered from vehicle traffic for safety and comfort;
- Provide enhanced/signalized intersection and mid-block crossings so bicyclists and pedestrians can safely cross arterial streets;
- Fill in gaps in the on-street bike lane network; and
- Determine the role and place of shared mobility devices such as bicycles and scooters.

Another pattern of note was that most respondents identified themselves as “interested but concerned” bicyclists, meaning they would ride a bicycle more frequently if facilities were available on which they felt safe and comfortable riding.

Additional information regarding future bicycle and pedestrian plans was provided by City staff and a review of the City of Chandler General Plan (2016) and the City Capital Improvement Program. These documents identify focus areas, needed bicycle and pedestrian improvements, and policies to implement for a well-connected community and transportation network, and to promote a healthy Chandler.

Bicycle and pedestrian solutions, including location and improvement types, systematic programs, and policy recommendations were developed based on the input received.

6.2.2 OVERARCHING STRATEGIES

For the bicycle and pedestrian network in Chandler, the highest priority should be eliminating any relatively inexpensive gaps in the on-street bike lane network, gaps in the shared use paved paths of the existing path/trail network, and gaps in areas of high pedestrian and bicycle activity such as along Arizona Avenue. The elimination of multiple small gaps could potentially be combined into a single project. Opportunities to address network gaps include the following:

- Complete missing bike lane segments on arterial streets in older developed parts of the City such as Alma School Road, Arizona Avenue, McQueen Road, and Ray Road;
- Complete missing shared use path segments and pave existing unpaved canal paths; and
- Coordinate with the Town of Gilbert to address bicycle and pedestrian network gaps on major arterials that cross jurisdictional boundaries such as Ocotillo Road, McQueen Road, and Cooper Road.

6.2.3 BICYCLE AND PEDESTRIAN RECOMMENDATIONS

The recommended bicycle and pedestrian projects will improve bicycle and pedestrian safety, connectivity, and access between nodes and activity centers throughout the City and regionally. Nodes and activity centers include current and future community facilities, schools, parks, and commercial centers.

Table 6-2 shows different bicycle facility types. While not all of these facilities are included in the subsequent detailed recommendations, as opportunities arise the City should consider locations where each of these facilities could be implemented.

Recommended bicycle and pedestrian facility improvements to the existing network include installing new bike lanes, paved shared use paths, signalized crossings, crossing signage improvements, on-street separated/buffered bike lanes, and overpasses. Recommended bicycle and pedestrian signalized crossings should utilize a standard traffic signal, as recommended in the MUTCD and as allowed in Arizona Revised Statues, and similar to the one the City installed on Frye Road about 400 feet west of Arrowhead Drive. The City's current policy is that other types of unconventional signalized crossing devices, such as five-phase pedestrian hybrid beacons, should not be used, as they may be somewhat confusing to drivers, resulting in lower driver compliance than a standard signal (97% vs 99.3%), and could be construed to be in conflict with Arizona Revised Statutes.

Table 6-2. Types of Bicycle Facilities for Consideration

Facility Type	Description	Example
Bike Route	A roadway designated with unique routing designation or with signage indicating vehicles and bicycles to share the lane; often found when streets are not wide enough for dedicated bike lanes but can also be used on roadways that have dedicated bike lanes	
Bike Lane	A portion of the roadway designated for exclusive use by bicyclists, usually established on arterial or collector roadways; created by use of striping and pavement markings in the same direction as the adjacent traffic; includes no physical barrier; should be a minimum of 4 feet wide (excluding the gutter pan)	
Separated/Buffered Bike Lane	A buffered bike lane includes a designated “buffer space” separating the bike lane and the travel lane and/or the parking lane; typically accomplished with horizontal or chevron-style striping, delineators, or rolled curb	
Cycle Track/Protected Bike Lane	An exclusive bike facility that is physically separated from vehicle lanes, parking lanes, and sidewalks, while still located on the roadway; separation accomplished by raised medians, on-street parking, bollards, raised pavement, etc.; cycle tracks can be one-way or two-way	
Bicycle Boulevard	A street segment, or collection of segments, that has been prioritized for bicycle traffic by minimizing through motor traffic via signage, traffic calming implementation, and vehicle restrictions; local neighborhood trips are still accommodated	
Shared Use Path	Paved or unpaved 10 feet to 14 feet wide paths or trails physically separated from vehicles or located off-road (e.g., along canals) for bicyclists, walkers, runners, skaters, etc.; can look similar to a cycle track/protected bike lane but differs in that facility is not exclusively for bicyclists	

The recommendations discussed below were categorized based on the proposed timeframe of implementation:

- Near-term recommendations: 2020 - 2025;
- Mid-term recommendations: 2026 - 2030; and
- Long-term recommendations: 2031 - 2040.

6.2.3.1 Near-Term Bicycle and Pedestrian Recommendations

Near-term recommendations are listed below and shown in **Figure 6-10**. These unprioritized and numbered recommendations correspond to the numbering found in the figure. Generally, near-term recommendations are either already programmed or are relatively low-cost and easily implementable. In addition, the City should start discussions in the near-term with ADOT, the County, the Union Pacific Railroad (UPRR), and canal owners (e.g., Salt River Project, Roosevelt Water Conservation District) regarding the implementation of the mid-term and long-term recommendations that require multijurisdictional coordination.

Bike Lanes

1. Install bike lanes on Ocotillo Road between Rincon Drive and 148th Street (programmed);
2. Install bike lanes on Chandler Heights Road between Sunland Drive and Gilbert Road (programmed);
3. Install bike lanes on Chandler Heights Road between White Place and Val Vista Drive (programmed);
4. Install bike lanes on Cooper Road between Kaibab Drive and Riggs Road (programmed);
5. Install bike lanes on Lindsay Road between Ocotillo Road and Chandler Heights Road and between Desert Jewel Boulevard and Hunt Highway (programmed);
6. Install bike lanes on Pecos Road between Dobson Road and Ellis Road and on Ellis Road between Pecos Road and Frye Road (included in recommended roadway widening);
7. Install bike lanes on McClintock Drive between northern City limit and Loop 202 (programmed);
8. Install bike lanes on Kyrene Road between northern City limit and Chandler Boulevard (programmed);
9. Install bike lanes on Chandler Boulevard between I-10 and 54th Street (programmed);
10. Install bike lanes on Orchid Lane between Highline Lateral Canal Path and 56th Street and on 54th Street between Orchid Lane and Ray Road and;
11. Coordinate with ADOT and the City of Tempe to install bike lanes on Conference Drive across Loop 101 between Elliot Road and Warner Road.

Paved Shared Use Path

12. Pave Highline Lateral Canal Path between the northern City limit and Orchid Lane; and
13. Install shared use path along Ashley Trail alignment between Cooper Road and the Consolidated Canal Path/Paseo Trail.

Signalized Crossing

14. Signalize Ashley Trail crossing of Cooper Road between Ray Road and Chandler Boulevard.

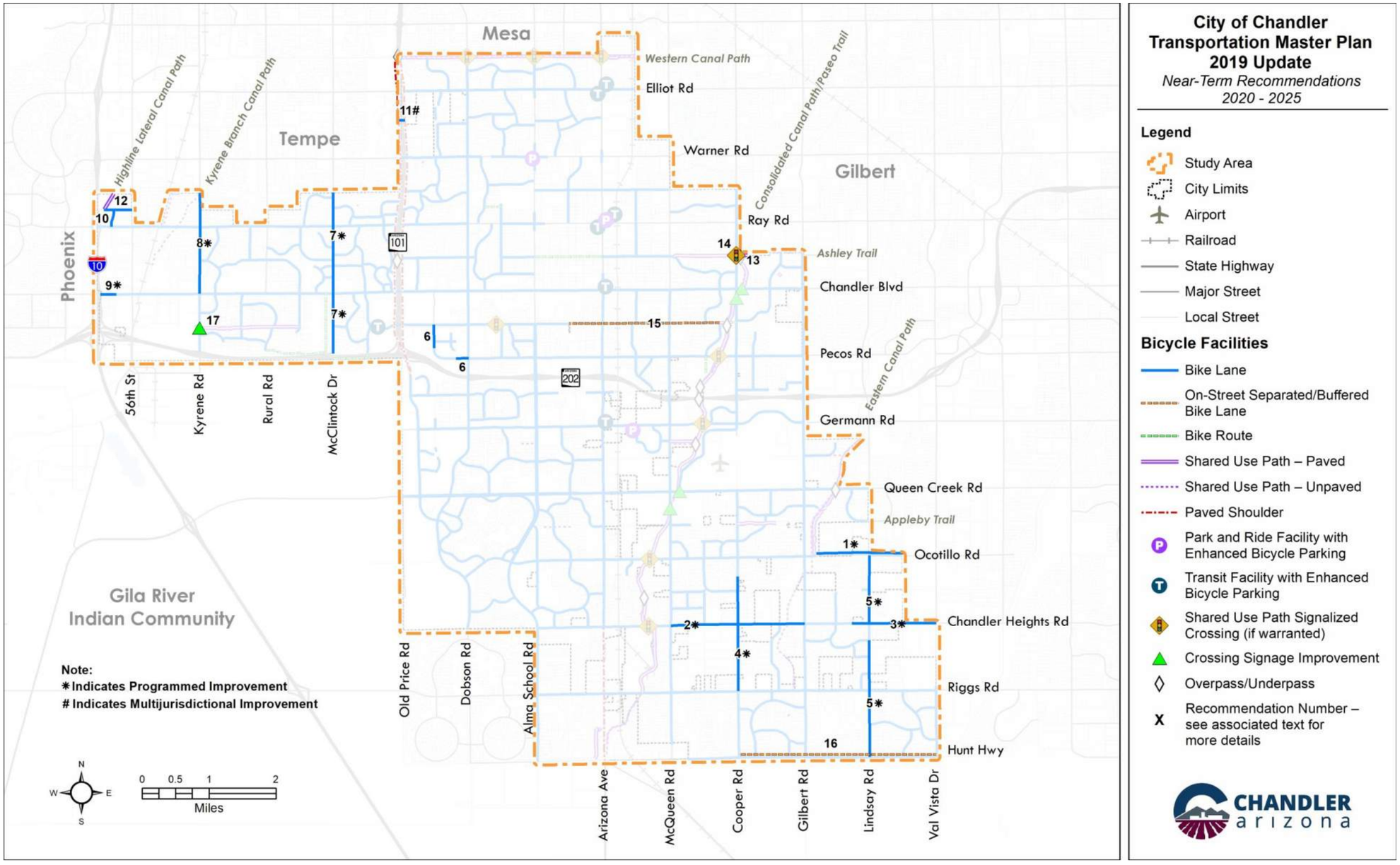


Figure 6-10. Near-Term Bicycle and Pedestrian Recommendations 2020 - 2025

On-Street Separated/Buffered Bike Lanes

15. Install on-street separated/buffered bike lanes on Frye Road between one-half-mile west of Arizona Avenue and the Consolidated Canal Path/Paseo Trail near Cooper Road;
16. Install on-street separated/buffered bike lanes on Hunt Highway between Cooper Road and Val Vista Drive in conjunction with proposed traffic calming project on Hunt Highway.

Crossing Signage Improvement

17. Install new signage directing users of existing shared use path east of Kyrene Road and south of Chicago Street to use the existing traffic signal at Kyrene Road/Frye Road intersection to cross Kyrene Road to connect to Nozomi Park.

6.2.3.2 Mid-Term Bicycle and Pedestrian Recommendations

Mid-term recommendations are listed below and shown in **Figure 6-11**. These unprioritized and numbered recommendations correspond to the numbering found in the figure. The near-term recommendations are shown in the figure as existing conditions under the assumption that the previous timeframe recommendations would be implemented by the time of the mid-term recommendations. Some of the mid-term recommendations will require coordination with neighboring municipalities and other agencies such as the County and canal owners to implement the recommendations. Although these are mid-term recommendations, discussions and ideas should be shared in the near-term between those likely to be involved in these mid-term recommendations to properly prepare for them.

Bike Lanes

18. Install bike lanes on Brooks Farm Road between Gilbert Road and Mustang Drive and bike route directional signage to Lindsay Road;
19. Install bike lanes on McQueen Road between Warner Road and Chandler Boulevard (included in recommended roadway widening);
20. Install bike lanes on Alma School Road between Chandler Boulevard and Frye Road (programmed); and
21. Install bike lanes on Warner Road between Alma School Road and Arizona Avenue (included in recommended roadway widening).

Paved Shared Use Path

22. Improve the shared use path and associated equestrian trail along arterial street sections of the Consolidated Canal path at Chandler Boulevard/Cooper Road and Queen Creek Road/McQueen Road and also improve the corresponding barriers and wayfinding signage to direct all users along the arterial streets;
23. Install shared use path along Appleby Road alignment between Kibler Drive (east of Cooper Road) and Lindsay Road (working with Markwood Homeowners' Association (HOA) on access to path between Cooper Road and Kibler Drive);
24. Install shared use path on Ocotillo Road between Dobson Road and the eastern City limit;
25. Install shared use path along Brooks Farm Road alignment between Cooper Road and Gilbert Road;
26. Coordinate with canal owner to pave Eastern Canal Path between Glacier Place (south of Ocotillo Road) and Riggs Road;
27. Support County paving Consolidated Canal Path between Riggs Road and Hunt Highway, with the County being the lead agency responsible for identifying funding;
28. Install shared use path on Price Road/Dobson Road between Loop 202 and Ocotillo Road; and

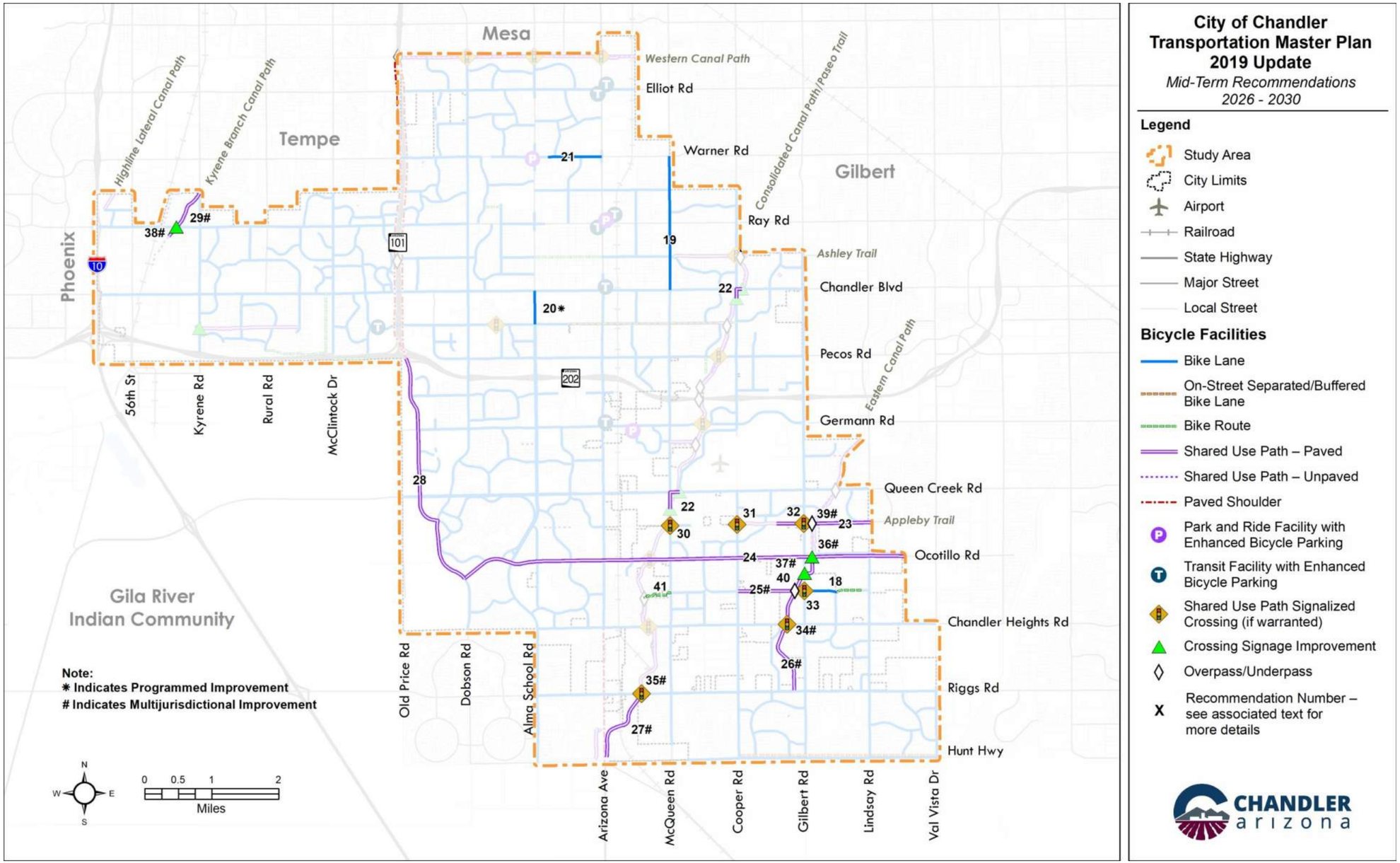


Figure 6-11. Mid-Term Bicycle and Pedestrian Recommendations 2026 - 2030

29. Coordinate with canal owner to pave Kyrene Branch Canal Path between the northern City limit and Linda Lane.

Signalized Crossing

30. Signalize path crossing in the area of the McQueen Road/Appleby Road intersection to provide protected crossing for users of shared use path along Appleby Road alignment and directional signage to the Consolidated Canal Path/Paseo Trail;
31. Signalize path crossing in the area of the Cooper Road/Appleby Road alignment to provide protected crossing for users of shared use path along Appleby Road alignment;
32. Signalize path crossing in the area of the Gilbert Road/Appleby Road intersection to provide protected crossing for users of shared use path along Appleby Road alignment;
33. Signalize path crossing in the area of the Brooks Farm Road/Gilbert Road intersection to provide protected crossing for users of shared use path along Brooks Farm Road alignment;
34. Signalize Eastern Canal Path crossing of Chandler Heights Road in the area of Riggs Ranch Road; and
35. Support County signalizing the Consolidated Canal Path crossing of Riggs Road.

Crossing Signage Improvement

36. Install signage at the Eastern Canal Path crossing of Ocotillo Road directing users to the traffic signal planned at the Ocotillo Road/Gilbert Road intersection;
37. Install signage at the Eastern Canal Path crossing of Gilbert Road directing users to the traffic signal planned at the shopping center driveways 660 feet south of Ocotillo Road; and
38. Coordinate with canal owner to install signage directing users of existing Kyrene Branch Canal Path to use the existing traffic signal at the Ray Road/McKemy Avenue intersection to cross Ray Road.

Overpass

39. Coordinate with canal owner to install bridge for non-motorized users over Eastern Canal for users of shared use path along Appleby Road alignment; and
40. Coordinate with canal owner to install bridge for non-motorized users over Eastern Canal for users of shared use path along Brooks Farm Road alignment.

Bike Route

41. Install bike route directional signage along Brooks Farm Road alignment between McQueen Road and Consolidated Canal Path/Paseo Trail.

6.2.3.3 Long-Term Bicycle and Pedestrian Recommendations

Long-term recommendations are listed below and shown in **Figure 6-12**. These unprioritized and numbered recommendations correspond to the numbering found in the figure. The near-term and mid-term recommendations are shown in this figure as existing conditions under the assumption that the previous timeframe recommendations would be implemented by the time of the long-term recommendations. Some of the long-term recommendations will require coordination with neighboring municipalities and other agencies such as ADOT, the County, and the railroad to implement the recommendations. Although these are long-term recommendations, discussions and ideas should be shared in the near-term between those likely to be involved in these long-term recommendations to properly prepare for them.

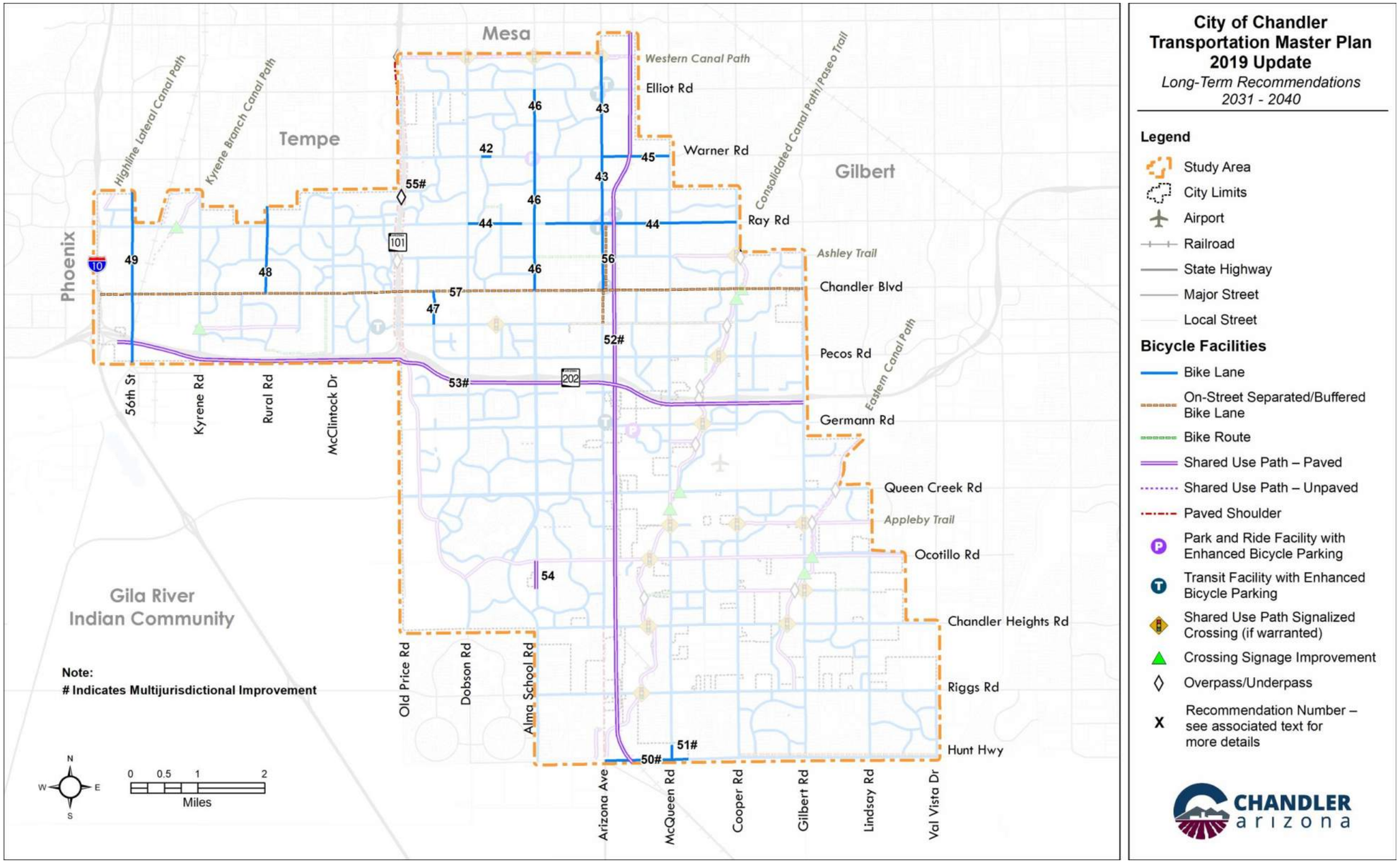


Figure 6-12. Long-Term Bicycle and Pedestrian Recommendations 2031 - 2040

Bike Lanes

42. Install bike lanes on Warner Road between North Pennington Drive and South Pennington Drive;
43. Install bike lanes on Arizona Avenue between Erie Street (south of Ray Road) and Western Canal Path;
44. Install bike lanes on Ray Road between Dobson Road and Comanche Drive and between Pleasant Drive and Cooper Road (portion between Pleasant Drive and McQueen Road is already included in recommended roadway widening);
45. Install bike lanes on Warner Road between Arizona Avenue and eastern City limit (included in recommended roadway widening);
46. Install bike lanes on Alma School Road between Elliot Road and Chandler Boulevard;
47. Install bike lanes on Ellis Road between Chandler Boulevard and Frye Road;
48. Install bike lanes on Rural Road between the northern City limit and Chandler Boulevard;
49. Install bike lanes on 56th Street through all of Chandler (portion between Frye Rd and Pecos Rd is already included in recommended roadway widening);
50. Support County installing bike lanes on Hunt Highway between Arizona Avenue and end of existing bike lanes east of McQueen Road, with the County being the lead agency responsible for identifying funding; and
51. Support County installing bike lanes on McQueen Road between end of existing bike lanes north of Hunt Highway and Hunt Highway, with the County being the lead agency responsible for identifying funding.

Paved Shared Use Path

52. Coordinate with railroad to explore feasibility of shared use path north/south along the UPRR railroad spur tracks from the northern City limit to Riggs Road between Arizona Avenue and McQueen Road;
53. Coordinate with ADOT to explore feasibility of shared use path along Loop 202 between I-10 and the eastern City limit; and
54. Install shared use path on Basha Road between Ocotillo Road and Snedigar Park.

Overpass

55. Coordinate with ADOT to build overpass on Loop 101 north of Ray Road, connecting the west side of Loop 101 and Calle Del Norte east of Loop 101. This project would likely need to be included in the potential Proposition 400 extension to be funded.

On-Street Separated/Buffered Bike Lanes

56. If high-capacity transit is installed on Arizona Avenue, as part of that construction install on-street separated/buffered bike lanes on Arizona Avenue between Ray Road and Frye Road; and
57. If high-capacity transit is installed on Chandler Boulevard, as part of that construction install on-street separated/buffered bike lanes on Chandler Boulevard through Chandler.

6.2.3.4 Ultimate Bicycle and Pedestrian Facilities

Figure 6-13 shows all the bicycle and pedestrian improvements that are programmed or recommended in the 2020 - 2040 timeframe. **Figure 6-14** shows the ultimate bicycle and pedestrian facilities for Chandler by 2040 if all near-term, mid-term, and long-term recommendations are implemented. The future bicycle and pedestrian facilities will create a well-connected, effective, and safe multimodal transportation network.

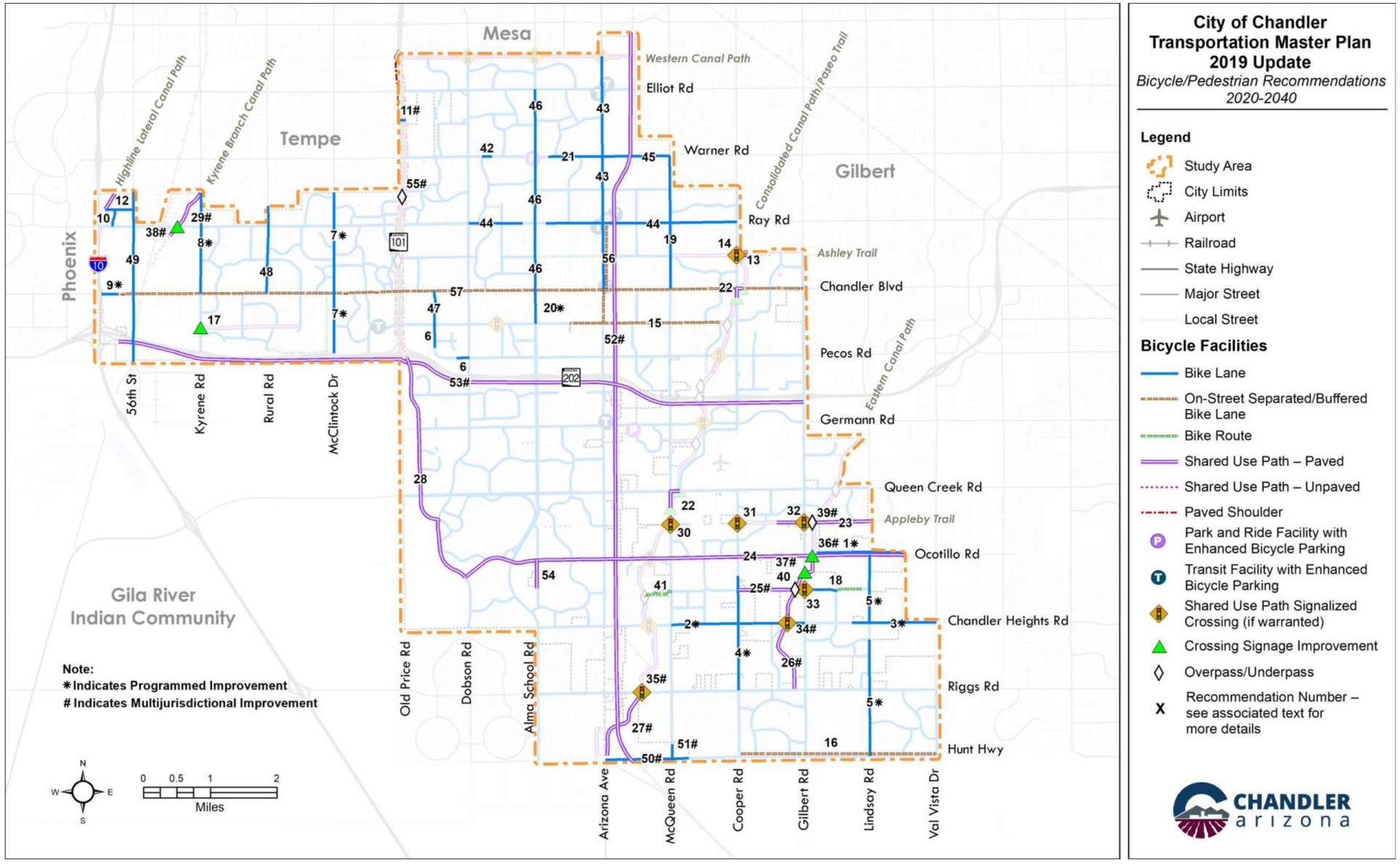


Figure 6-13. Bicycle and Pedestrian Recommendations 2020 - 2040

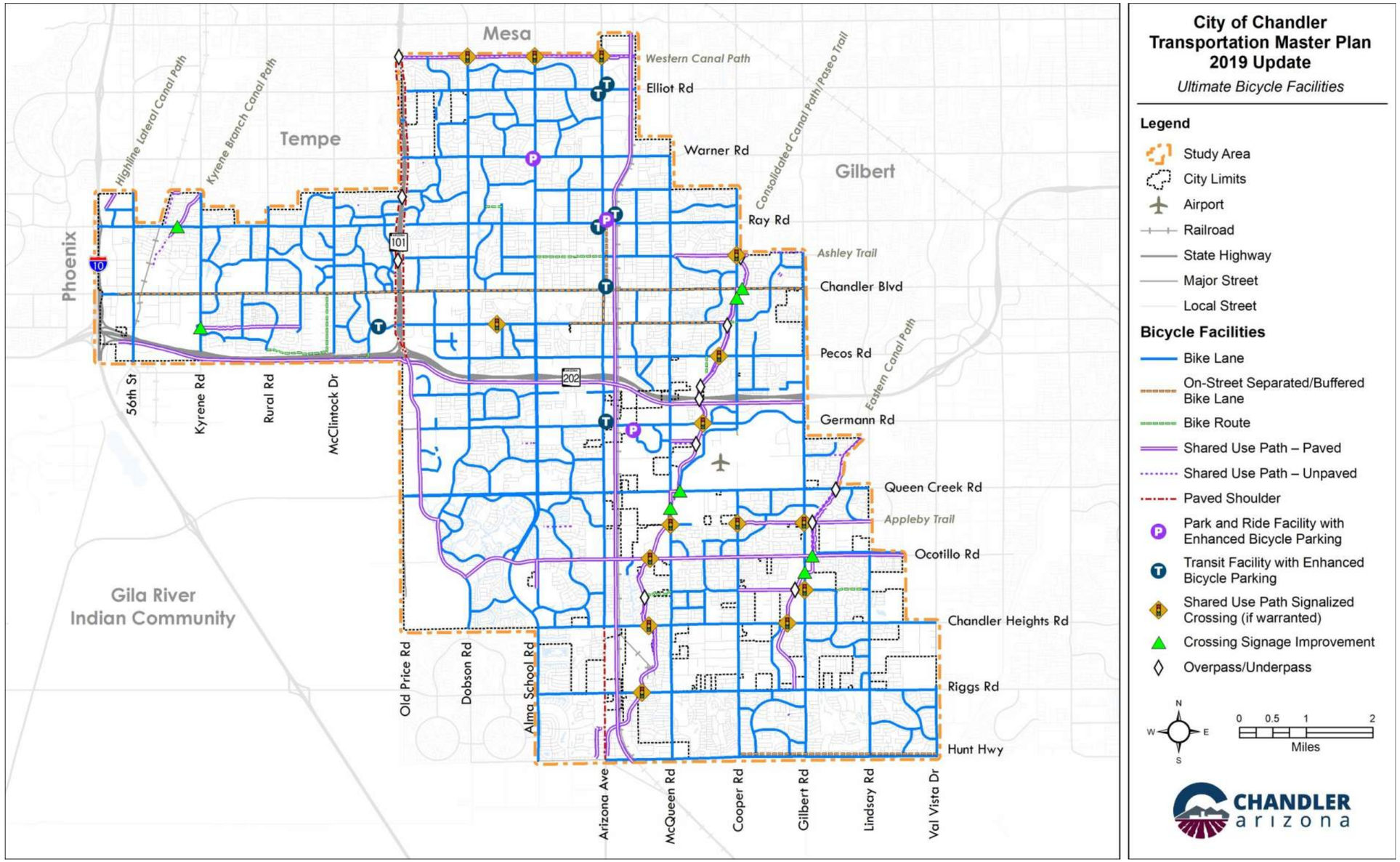


Figure 6-14. Ultimate Bicycle and Pedestrian Facilities by 2040

6.2.3.5 Bicycle and Pedestrian Recommendation Costs

Estimated bicycle and pedestrian facility improvement costs in 2019 dollars were developed based on unit costs derived from planned and recently completed projects in Chandler and throughout Arizona. The improvement costs include the cost for design, ROW, construction phases, and other elements. The following unit costs were assumed:

- Bike lanes on both sides of the road without new ROW required = $1 million per mile;
- Bike lanes on both sides of the road with new ROW required = $3 million per mile;
- On-street separated/buffered bike lanes on both sides of the road = $1.5 million per mile;
- 10-foot-wide shared use path without new ROW required = $2 million per mile;
- 10-foot-wide shared use path with new ROW required = $3 million per mile;
- Overpass bridge over freeway = $14 million per location;
- Overpass bridge over canal = $500,000 per location;
- Signalization of a bicycle/pedestrian crossing of an arterial roadway = $250,000 per location; and
- Signage improvements to direct shared use path users to cross an arterial roadway at a nearby traffic signal = $10,000 per location.

It is understood that improvement costs can vary significantly between projects based on subsurface differences, physical features such as railroad, canal, or utility crossings, and other conditions such as ROW acquisition costs. However, these planning-level costs serve to provide a level-of-magnitude cost for anticipated improvements.

Table 6-3 through **Table 6-5** show the bicycle and pedestrian facility recommendations with their associated costs for each time period based on the type of improvement indicated. Programmed projects and their costs are not shown in these tables as these tables indicate what additional funding is needed beyond what is already programmed. These estimates will need to be refined by the City as more information becomes available on anticipated costs.

It should also be noted that some improvements are anticipated to require coordination with other agencies (e.g., ADOT, Maricopa County, canal owner, railroad). For recommendations within City limits, the City will likely incur all of the cost or at least need to lead the charge in securing funding from other sources such as regional funds. For recommendations outside of the City limits but within the City's MPA boundary, the City can provide support and coordination but the agency with jurisdiction will be responsible for developing and funding any improvements.

Table 6-3. Bicycle and Pedestrian Near-Term Improvement Recommendations 2020 - 2025

Improvement Description [(1)]	2019 Cost (Millions)
Bike lanes on Orchid Ln: Highline Lateral Canal Path to 56th St and on 54th St: Orchid Ln to Ray Rd	$ 0.10
Bike lanes on Conference Dr across Loop 101	$ 0.01
Pave Highline Lateral Canal Path: Northern City limit to Orchid Ln [(2)]	$ 0.84
New shared use path along Ashley Trail alignment: Cooper Road to Consolidated Canal Path/Paseo Trail	$ 0.18
Signalize Ashley Trail crossing of Cooper Road	$ 0.25
On-street separated/buffered bike lanes on Frye Rd: ½-mile west of Arizona Ave to Consolidated Canal Path/Paseo Trail	$ 3.60
On-street separated/buffered bike lanes on Hunt Hwy: Cooper Rd to Val Vista Dr [(3)]	$ 4.50
Crossing signage improvements for shared use path at Kyrene Rd and Chicago St	$ 0.01
Subtotal for 2020 - 2025 Recommendations	*$ 9.49*

Notes: (1) Programmed Projects Not Shown. (2) Requires Coordination with Another Agency.
(3) Coordinate with Traffic Calming Project.

Table 6-4. Bicycle and Pedestrian Mid-Term Improvement Recommendations 2026 - 2030

Improvement Description [1]	2019 Cost (Millions)
Bike lanes on Brooks Farm Rd between Gilbert Road and Mustang Drive and bike route directional signage to Lindsay Rd	$ 0.50
Improve shared use path and associated equestrian trail along Consolidated Canal path: Chandler Blvd/Cooper Rd and Queen Creek Rd/McQueen Rd and also improve barriers and wayfinding signage	$ 2.10
New shared use path along Appleby Rd alignment: Kibler Dr to Lindsay Rd	$ 4.20
New shared use path along Ocotillo Rd: Dobson Rd to Eastern City limit	$ 13.40
New shared use path along Brooks Farm Rd alignment: Cooper Rd to Gilbert Rd	$ 3.00
Pave Eastern Canal Path: Glacier Place to Riggs Rd [2]	$ 6.30
Support County paving Consolidated Canal Path: Riggs Rd to Hunt Hwy [2]	$ 3.60
New shared use path along Price Rd/Dobson Rd: Loop 202 to Ocotillo Rd	$ 7.40
Pave Kyrene Branch Canal Path: Northern City limit to Linda Ln [2]	$ 1.80
Signalize Appleby Rd shared use path crossing of McQueen Rd and provide directional signage to Consolidated Canal Path/Paseo Trail	$ 0.25
Signalize Appleby Rd shared use path crossing of Cooper Rd	$ 0.25
Signalize Appleby Rd shared use path crossing of Gilbert Rd	$ 0.25
Signalize Brooks Farm Rd shared use path crossing of Gilbert Rd	$ 0.25
Signalize Eastern Canal Path crossing of Chandler Heights Rd [2]	$ 0.25
Support County signalizing Consolidated Canal Path crossing of Riggs Rd [2]	$ 0.25
Crossing signage improvements for Eastern Canal Path at Ocotillo Road	$ 0.01
Crossing signage improvements for Eastern Canal Path at Gilbert Road	$ 0.01
Crossing signage improvements for Kyrene Branch Canal Path at Ray Rd	$ 0.01
Bridge over Eastern Canal for Appleby Rd shared use path [2]	$ 0.50
Bridge over Eastern Canal for Brooks Farm Rd shared use path [2]	$ 0.50
Bike route directional signage on Brooks Farm Rd between McQueen Road and Consolidated Canal Path/Paseo Trail	$ 0.01
Subtotal for 2026 - 2030 Recommendations	*$ 44.84*

Notes: (1) Programmed Projects Not Shown. (2) Requires Coordination with Another Agency.

Table 6-5. Bicycle and Pedestrian Long-Term Improvement Recommendations 2031 - 2040

Improvement Description [1]	2019 Cost (Millions)
Bike lanes on Warner Rd: North Pennington Dr to South Pennington Dr	$ 0.16
Bike lanes on Arizona Ave: Erie St to Western Canal Path	$ 10.50
Bike lanes on Ray Rd: Dobson Rd to Comanche Dr and McQueen Rd to Cooper Rd	$ 1.80
Bike lanes on Alma School Rd: Elliot Rd to Chandler Blvd	$ 9.00
Bike lanes on Ellis Rd: Chandler Blvd to Frye Rd	$ 0.50
Bike lanes on Rural Rd: Northern City limit to Chandler Blvd	$ 3.90
Bike lanes on 56th St: Northern City limit to Frye Rd	$ 6.00
Support County installing bike lanes on Hunt Hwy: Arizona Ave to E. of McQueen Rd [1]	$ 1.30
Support County installing bike lanes on McQueen Rd: N. of Hunt Hwy to Hunt Hwy [1]	$ 0.30
New shared use path along the UPRR railroad spur tracks: Northern City limit to Riggs Rd [1]	$ 32.70
New shared use path along Loop 202: I-10 to Eastern City limit [1]	$ 21.40
New shared use path along Basha Rd: Ocotillo Rd to Snedigar Park	$ 0.80
Bridge over Loop 101 north of Ray Rd: W. of Loop 101 to Calle Del Norte E. of Loop 101 [1]	$ 14.00
On-street separated/buffered bike lanes on Arizona Ave: Ray Rd to Frye Rd [2]	$ 2.25
On-street separated/buffered bike lanes on Chandler Blvd: Western City limit to Eastern City limit [2]	$ 15.75
Subtotal for 2031 - 2040 Recommendations	*$120.36*

Notes: (1) Requires Coordination with Another Agency. (2) Contingent on, and Coordinate with, High-Capacity Transit Being Installed.

6.2.3.6 Bicycle and Pedestrian Facility Maintenance

While the focus of the bicycle and pedestrian recommendations within this document is on capital improvements, the City also needs to allocate funding for bicycle and pedestrian facility maintenance. Maintenance will become an increasingly important activity to fund as the City's bicycle and pedestrian infrastructure ages. Maintenance of on-street bicycle and pedestrian facilities (e.g., bike lanes and crosswalks) is already incorporated into the previously discussed roadway facility maintenance.

Maintenance of the off-street bicycle and pedestrian facilities (e.g., sidewalk, shared use paths), however, needs to be accounted for separately. It is estimated that annual off-street bicycle and pedestrian facility maintenance costs will average approximately $200,000 per year in the near-term, $250,000 per year in the mid-term, and $300,000 per year in the long-term (all in 2019 dollars). The maintenance costs increase over time to account for the recommended expansion of the off-street bicycle and pedestrian network and the fact that infrastructure ages over time.

6.2.3.7 Bicycle and Pedestrian Technology

Chandler has seen unregulated bike-share and scooter-share programs in recent years. Because they are still relatively new, best policies, practices, and management of these systems and modes of transportation are still developing, as are safety and aesthetic concerns associated with these programs.

Multiple discussions during the public review and comment period for this plan centered on scooter-share and bike-share programs and the proper location, use, storage, and maintenance of these (and other) micromobility options. Specific comments revolved around whether micromobility should be allowed on the sidewalk and in bike lanes.

Other technologies utilized by bicyclists and pedestrians include signalized crossings, potential collision alerts, and traffic signal detection. These technologies of interest to bicycle and pedestrian travel have been captured already in the aforementioned roadway recommendations.

The City is replacing traffic signal detection cameras at 40 locations this year with new generation cameras that have the ability to detect bicyclists. It is recommended that the City deploy traffic signal detection that can detect bicyclists at all signalized intersections in the City.

6.2.3.8 Recommended Policies and Guidelines

In addition to the location-specific project recommendations throughout the City, various system-wide improvements, studies, policies, and guidelines are recommended to help the City promote safe and effective bicycle and pedestrian facilities:

- Prepare bicycle and pedestrian policies and guidelines regarding items such as design standards on shared use path crossings, construction, maintenance, and proper facility amenities;
- Hire a bicycle and pedestrian system coordinator and allocate appropriate levels of funding for the deployment and maintenance of a connected bicycle and pedestrian network;
- Support the City's Police Department and other agencies in developing and implementing educational campaigns consisting of public outreach programs online via the City website for the following common safety concerns:
    - Distracted driving – An issue seen with phone calls, texting, eating, and infotainment distractions, among others. Observations included vehicles drifting into bike lanes, not acknowledging bike lanes, and near-crashes at busy arterial intersections where right-turning vehicles weren't aware of pedestrians or bicyclists in the crosswalk;
    - Bicycle education – Bicyclists need to be aware of motorist and bicyclist traffic laws and rights, obey traffic control devices, stay in designated lanes, and be aware of surrounding conditions;
- Develop specific regulations and explore a license agreement approach for managing micromobility providers;
- Conduct an alley conversion study to evaluate the feasibility of converting alley ways into bicycle and pedestrian corridors to help increase neighborhood and network connectivity;
- Expand bicycle facilities throughout the City by adding bike racks/lockers in major City activity centers such as downtown, near regional, community, and neighborhood parks, malls, and at transit centers and bus stops;
- Continue to coordinate with surrounding municipalities to plan and implement facility improvements that improve regional connectivity;

- Improve the visibility, safety, and comfort of non-motorized users through additional improvements such as lighting, shade, and colored bike lanes at conflict points as appropriate;
- Promote direct connections from local and collector streets to the off-street shared use path network, allowing users to bypass the arterial street network;
- Improve current at-grade shared use path crossings of arterial streets to include more signage, striping, or other features to improve safety;
- Continue to implement traffic signal timing and phasing that is better suited towards pedestrians and bicyclists as appropriate;
- Utilize regionally collected bicycle and pedestrian count data to track trends and hotspots that can eventually be used to prioritize funding;
- Make bicycle and pedestrian planning, facilities, and connectivity a higher priority in future planning and land use efforts while also looking for ways to incorporate bicycle and pedestrian facilities into other roadway improvements or development projects throughout the city;
- Look for opportunities in transportation technology to support regional efforts for communications between motorized and non-motorized users; and
- Consult the latest AASHTO Guide for the Development of Bicycle Facilities and National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide for development of bicycle facilities in the future.

Preparation and development of these recommended policies and guidelines is estimated to cost approximately $600,000 in the near-term in 2019 dollars. Refinement, expansion, and implementation of these policies and guidelines is estimated to cost approximately $750,000 in the mid-term and $2,000,000 in the long-term in 2019 dollars.

6.2.4 TOTAL BICYCLE AND PEDESTRIAN RECOMMENDATION COSTS

Table 6-6 shows the capital, operations and maintenance, and total costs for the near-term, mid-term, and long-term bicycle and pedestrian improvement recommendations. The total cost of all recommended bicycle and pedestrian improvements in 2019 dollars for the 2020 - 2040 timeframe calculates to $183.49 million.

Table 6-6. Total Cost of Bicycle and Pedestrian Improvement Recommendations 2020 - 2040

Time Period	Capital Cost of Recommendations (1), (2)	Operations and Maintenance Cost of Recommendations	Total 2019 Cost of Recommendations
2020 - 2025	$10,090,000	$1,200,000	$11,290,000
2026 - 2030	$45,590,000	$1,250,000	$46,840,000
2031 - 2040	$122,360,000	$3,000,000	$125,360,000
Total Costs	**$178,040,000**	**$5,450,000**	**$183,490,000**

Notes: (1) Programmed Projects Not Included. (2) Capital Costs Include Preparation and Implementation of Policies and Guidelines.

7.0 LEVERAGING TECHNOLOGY IN TRANSPORTATION

In Chandler, technology and information play a key role in connecting and integrating the City and the people who live, work, and visit here. While technologies such as rideshare, automated vehicles, and shared micromobility options often contribute to physical mobility and connectivity, another critical role of technology is to generate, collect, analyze, and disseminate critical data and information about transportation and mobility in the City.

In Chandler, there is a culture of residents embracing technology and innovation, which makes the City an attractive place to test and demonstrate technology because of resident acceptance. The City should continue to promote this culture while balancing an increasing role in the future direction of technology and innovation using its transportation network.

This section explores established and emerging technologies that the City can consider as a toolbox of ideas to support the transportation network and mobility environment as well as help the City better connect to the people it serves.

7.1 TECHNOLOGY EXPERT PERSPECTIVES AND INPUT

It is important for the City to be flexible in the changing landscape of technology and innovation. Rather than focusing on technology-related capital improvements to be programmed in future specific years, the City should recognize that mobility trends can quickly change the method that travelers use to get their information, the location of where they need to travel to and from, the mode by which they travel, and the relationship between modes. This will impact the way agencies plan for future growth. During the next few decades, autonomous vehicles will change how people think about and use transportation.

Interviews were conducted with technology experts, using questions generated specifically for this Transportation Master Plan. The perspectives and input provided by the technology experts are summarized into general concepts for the City to consider when planning for the future of transportation technology and innovation:

- **City guidelines or policies** – The City manages the ROW and access to public spaces. Thus, it is important for the City to establish policies and guidelines that allow for innovation to occur within reasonable limits. Privately-managed alternate modes of travel are occurring. If a private venture is requiring use of City ROW or property to serve its business model, the City could require the private venture to pay for improvements necessary to operate their business in a public space. The City could regulate its street space and curb space more efficiently. The City should also coordinate policies or guidelines with other jurisdictions in the region because if each agency in the region has substantially different rules it becomes difficult for the private sector to operate.
- **A flexible funding program for shorter-term planning horizons** – Planning for the future of transportation 20 years away **is** a challenging task. The City could develop programs and shorter-term funding pools that can be more flexible in their implementation to respond to systematic and trending needs. While capital programming five years in advance will always have a place in fiscal responsibility and forecasting, the City funding program could be more responsive with quick actions that address near-term needs through flexible budgeting.

- **Mode neutral planning** – The traditional transportation process plans for specific modes of travel. Reducing the focus on specific modes and increasing the focus on creating technology connections would allow the City to improve a corridor or area of the City in more of a "physical/virtual hub" concept. Technology is the tool that can be used to give people information to allow them to make informed mode travel choices. This would offer the traveling public various transportation options at many points within the City, which creates a more interconnected network rather than specific and isolated point-to-point connections. The City could subsidize, regulate, and standardize mode choice rather than focus on specific modes.
- **Build/develop away from the single-occupancy vehicle** – The cost of driving a single-occupancy vehicle is not yet outweighed by the benefits of mode shift to high-occupancy vehicle travel. Traditional transportation planning processes plan primarily for the single-occupancy vehicle with secondary focus on other modes. Providing more modes besides the single-occupancy vehicle encourages travelers to use technology to plan what modes they want to use to travel. The City could consider development policies such as reducing parking requirements for buildings/developments or allowing for more shared parking facilities as part of developments, thereby making the use of other modes more desirable.
- **Partner with private sector** – It is recommended the City continue its willingness to pilot/demonstrate particular technologies. This benefits the private sector by enabling them to develop specific solutions that are marketable to the public and other agencies. The City recently partnered with Waymo as a pilot to allow select City employees to use autonomous vehicles to travel to/from offsite meetings in a limited area. The City is currently working with a Transportation Network Company (TNC) for first-mile/last-mile connections to transit. By partnering with the private sector, the City could help showcase how the private and public sections can partner to accelerate the evolution to fully autonomous vehicles.
- **Focus on preservation** – The base of the City's transportation network is already in place to support many modes. The City should identify capital investments that preserve and maintain the existing transportation infrastructure to provide a reliable platform on which transportation can evolve. Preservation of the roadway markings and signage is a key element for the implementation of autonomous vehicles for they use them to "read the road".

7.2 PEOPLE MOVEMENT – PHYSICAL AND VIRTUAL HUBS

A successful transportation system connects people to the places that they want to go. Specific modal investments are made to accommodate specific types of trips – regional, commuting, recreational, and local – but it is challenging for one mode to accommodate all trip types. However, technology and data can be used to help to blend these different modes to address the mobility needs of all travelers.

For example, using technology to collect and disseminate real-time information on the estimated travel time to a destination by different modes can allow travelers to make decisions about their trip that will best meet their needs. Another example is using technology for "first-mile/last-mile" transit trips. New technologies and services like rideshare companies (e.g., Uber and Lyft) and shared micromobility (bike and scooter share) have emerged as options to help travelers complete these trips, enabling greater use of transit options.

To most efficiently take advantage of the opportunities afforded by technology for the City's transportation and mobility environment, a physical and virtual hub strategy has been identified.

Physical and virtual hubs should be implemented at locations where transportation services, amenities, and supporting technologies can work together to make it easier for communities to access destinations, amenities, and shared mobility choices. These hubs could be physical locations, such as a park-and-ride lot or City building, or virtual places such as data portals or websites, or some combination of both physical and virtual characteristics.

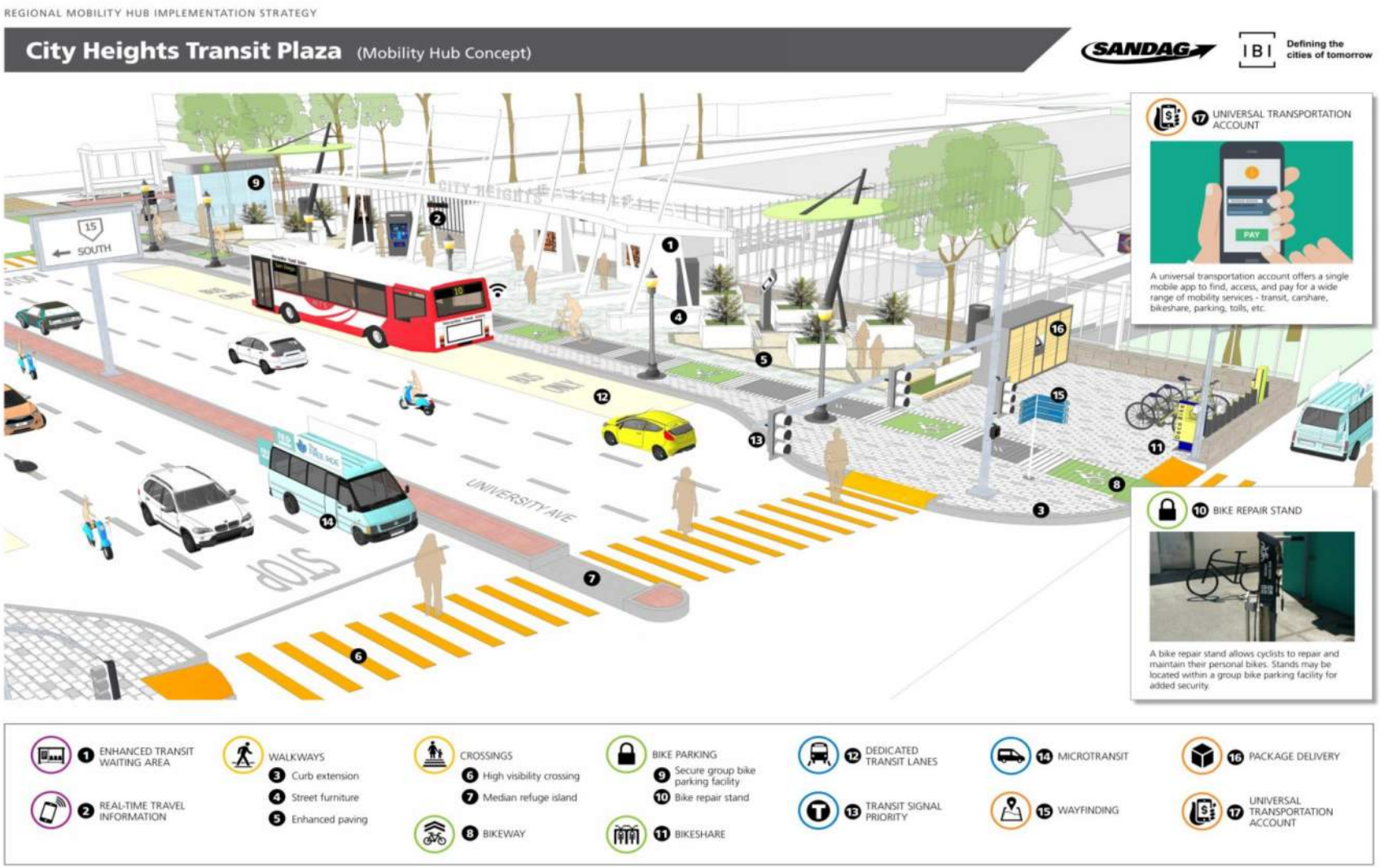
Sample Look and Feel of Physical/Virtual Hub Concept

The Metropolitan Planning Organization (MPO) for the San Diego, California metropolitan area, SANDAG, developed a regional mobility hub strategy as part of their regional transportation plan to demonstrate how transportation services, amenities, and supporting technologies can work together to make it easier for communities to access transit and other shared mobility choices. Many of the concepts from SANDAG are similar to those proposed for the City of Chandler, with the goal of creating locations that facilitate movement of people to the places that they want to go. SANDAG developed eight prototype sites within the San Diego region to show how mobility hub features should be tailored to different communities. These prototypes show many mobility hub features that have applicability to Chandler and the physical/virtual hub concept.

Figure 7-1 shows a proposed mobility hub at a transit plaza in City Heights in San Diego. The City Heights community includes several diverse neighborhoods that contain a mix of both high- and low-density housing, local businesses, educational facilities, and parks. The proposed mobility hub is near retail outlets and restaurants within a major business district. In this prototype, residents and employees have access to several express and local bus routes that connect to major destinations throughout the San Diego region. There are passenger waiting areas with seating and shade, and additional comfort and convenience is provided through integration of technology, retail, and place-making improvements. Riders are provided real-time travel information using interactive kiosks, so they can better plan their trip and reduce wait times. Bike parking and storage amenities allow people to utilize bicycles as the first-mile/last-mile connection and then connect to transit for the longer portion of their trip. Dedicated car-share parking increases the likelihood that a vehicle will be available for use, and designated curb space provides a safe and efficient way to hail rideshare.

Figure 7-2 shows a proposed mobility hub at a bus stop at Otay Ranch in the San Diego area. Otay Ranch is a suburb that provides a mix of townhomes and single-family residences. The bus stop is centrally located within a master-planned community and is adjacent to a major shopping area, the Otay Ranch Town Center. The community boasts an extensive trail network for pedestrian and bicycle travel as well as neighborhood electric vehicles, which residents use for shorter trips within the community.

The mobility hub shows a co-location of transit with the Otay Ranch Town Center, with the goal of promoting multi-purpose commuting trips (e.g., residents can run errands as a stop on their commute). A group bike parking facility equipped with a repair stand at the bus stop can help encourage biking as a commute alternative to driving alone. The shared parking lot also provides an opportunity to feature amenities like electric vehicle charging stations and smart parking technologies that provide information on available spaces, allow travelers to make parking reservations, and account for transitional use of parking areas based on changing needs. The integration and leveraging of the walking and biking networks, paired with other mobility amenities and technologies, can encourage use of transit for daily travel needs. This creates the ability for the City and the transit agency to partner with the Town Center to incentivize patrons to use alternative transportation options when visiting the shopping mall.



Source: San Diego Association of Governments (SANDAG), 2019

Figure 7-1. Concept for Transit Plaza Mobility Hub in San Diego

Source: San Diego Association of Governments (SANDAG), 2019

Figure 7-2. Concept for a Bus Stop Mobility Hub in San Diego

7.2.1 PHYSICAL AND VIRTUAL HUB CONCEPTS

The physical and virtual hub concept can have different types of services, amenities, and information depending on the transportation, technology/infrastructure, and data/information availability and the goals and priorities of the hub type being considered. There are four general investment categories that should be considered at each physical and virtual hub:

- Traveler Information and Support Services;
- Active Transportation;
- Transit; and
- Motorized Services.

Within each investment category, there is a menu of specific amenities, services, technologies, and information that can be provided. The applicability of each specific item is based on the needs and goals of both the hub type and the services and amenities being pursued. The technology is currently available today to pursue any of these concepts, but they each require specific data, partnerships, and infrastructure to implement. These investment categories are described in more detail below.

Traveler Information and Support Services

The items within this category are applicable to all hub types because they provide information to travelers to support their decision-making.

- **Information portal/display** – An interactive portal, such as a kiosk or bulletin board, that can provide information to support trip planning and wayfinding, which can include:
    - Transit schedule information, including arrival times and schedule adherence;
    - Comparative travel times to destinations between different modes;
    - Nearest shared mobility option (ride-share, shared micromobility, car-share);
    - Real-time traffic information for local or regional roadway network; and
    - Information and announcements about events and destinations in that area (could be from social media, news outlets, City communications staff, etc.);
- **Wayfinding** – This could be provided as part of an informational display/kiosk, but could also be physical wayfinding indications, such as signs or painted/marked pavement. Destinations needing wayfinding to include:
    - Nearest ride-share fixed location;
    - Points of interest or destinations in the vicinity (mostly applicable for Regional Center or Recreational Center character types);
    - Electric vehicle charging locations; and
    - Direction of nearest bicycle route or facility;

- **Smart lighting** – Lighting could be efficient (LED) and be illuminated any time someone is at the hub location. Smart lighting may use real-time information from detectors or sensors to identify times when no travelers are at the location (such as late at night/early in the morning), which would allow the lighting to shut off or dim to conserve power/energy when not needed;
- **USB charging** – Providing locations where people can plug-in and charge their personal devices while waiting for a portion of their trip, such as transit or ride-share;
- **Mobile retail** – City could permit private vendors that would be interested in providing food and beverage options at hubs for users. These establishments could include food trucks or vending machines and other types of vendors; and
- **Integrated payment** – This amenity is not a specific technology or piece of infrastructure located at a hub. Instead, this is a program to be put in place to create a single platform from which a user can plan and pay for all modes of transportation. Valley Metro is pursing the development of an application that can achieve this, although it is not complete at this time, and the actual capabilities of the application are unknown. These integrated payment systems would allow a user to buy a bus pass, pay for parking, hail and pay for a ride-share, or activate and pay for a bike-share from a single location and with a single payment method. This platform can be used to provide incentives for specific trip types; for example, a person can receive a discount or get offered a credit if they take an alternative mode of transportation to the hub.

Active Transportation

Hubs could have accommodations for active transportation options and users, such as bicyclists, motorized scooters, and pedestrians.

- **Shared micromobility** – Encourage micromobility companies to provide shared micromobility options, such as bicycles, e-bikes, and motorized scooters for people to make short trips between destinations, including first-mile/last-mile trips that are otherwise too long to walk. In Arizona, there are many private sector companies who are currently providing shared micromobility options. A partnership with the micromobility companies could also help the City obtain data and information about these short trips on alternative modes that could help with future planning, policies, and programming for transportation improvements;
- **Bicycle parking** – Provide facilities for bicyclists to lock up bicycles and utilize another transportation mode for a portion of their trip. Secure bicycle parking can include bike racks or bike storage/lockers, which may be appropriate at locations where people will store their bicycle for long periods of time. ‘Smart’ bicycle parking could be provided via the integrated mobility platform (previously described) to paying customers who want secure parking facilities and real-time information on parking availability. The City could also potentially obtain data on bicycle parking usage at smart bicycle parking lots; and
- **Bicycle repair self-service station** – Provide a bicycle self-service station that includes a bicycle repair stand, some common tools, and an air pump to allow bicyclists to perform basic bike repairs and maintenance, from changing a flat tire to adjusting a seat or brakes.

Transit

The cornerstone of many of hubs will be providing access to transit options. Hubs that attract many local and regional users will be better served by higher-capacity transit options where the focus is efficiency of the trip and its schedule. Hubs that attract more local trips, or trip users that include disadvantaged or limited mobility travelers, would likely have transit options that are more accessible and convenient. These transit services would provide pick-up and drop-off within the hub vicinity, either directly linked to, or within reasonable walking distance of, other modes available within the hub. The hubs would serve as anchors to provide a connection to higher level transit services throughout the rest of the region. More specifics on the different types of transit service and where these services are recommended in the City is found in the 'Transit' section of this Transportation Master Plan.

Motorized Services

The goal of a hub is to connect travelers to different mobility options. Currently, mobility in Chandler is predominately accomplished by personal vehicles. 'Motorized services' considers amenities and needs of both personal and shared vehicle options:

- **Smart parking** – Uses technology to make searching and paying for parking more convenient and efficient. These systems can include smart payment systems that provide multiple ways to pay for parking, real-time availability, and guidance systems to provide information to drivers on space availability and location;
- **Car-sharing** – Some private companies offer a fleet of on-demand rentable vehicles 24x7 where travelers can pay based on how long they use the cars or how far they drive. Depending on the car-sharing model, vehicles can either be picked up at a specified location, or vehicles can be picked up and dropped off anywhere within a service area. Autonomous and/or connected vehicle car-share programs should be considered. It is not envisioned that the City invests in a fleet of these vehicles, but rather that the City would permit the use of these private services at the hub;
- **Ride-sharing loading zones** – Create places where shared and on-demand mobility service passengers can be dropped off or picked up conveniently and safely. These loading zones are typically marked as designated curb spaces that can be used by shuttles, taxis, or on-demand ride-share services. The need for convenient passenger loading spaces will increase as more people use shared autonomous vehicles and ride-share services to connect to transit;
- **Park-and-ride lots** – While there are existing park-and-ride locations in Chandler, there may be a need to consider additional park-and-ride lots based on the location of hubs and the types of services that are provided. These park-and-ride facilities should be integrated with other hub amenities; and
- **Electric vehicle charging** – Electric vehicle charging stations at a hub allow people to charge plug-in electric vehicles, which might include e-bikes, e-scooters, vehicles, shuttles, or transit vehicles.

7.2.2 PHYSICAL AND VIRTUAL HUB TYPES

Because of the diverse destinations and travel needs throughout Chandler, there is not a 'one-size-fits-all' solution for transportation throughout the City. Each physical and virtual hub could be designed specifically for the area of Chandler that it serves. Hubs depend on technology to inform travelers of transportation options and conditions. The different physical and virtual hub types use and require

different levels of transportation technology. For example, making transportation investments in a hub at a high-density, high-traffic location such as Downtown Chandler may need to be more focused on pedestrian accessibility and wayfinding, whereas transportation investments in a hub at a neighborhood community center may benefit from a greater focus on providing connectivity between the neighborhood and key destinations.

To identify the different types of 'people movement' or mobility needs throughout Chandler, various hub types have been developed. Hub types are defined largely by land use and transportation characteristics, such as the type and mixture of uses (entertainment, recreation, community services), accessibility of different modes (on a transit route, connects to a dedicated bicycle path), types of users (residents, regional visitors, young, elderly, disabled, students), and whether the location is an origin or a destination for travelers.

The proposed hub types in Chandler are:

- **Regional Center** – A well-known destination where there is a mix of amenities and uses, which may include entertainment, retail, dining, or key community services/amenities. These locations attract both local and regional travelers and are already served by regional transportation services. Examples include Downtown Chandler and Chandler Fashion Center;
- **Recreational Center** – A well-known destination that provides recreational and community resources, such as regional parks and City-owned recreational facilities. Recreational centers may be accessed by regional and local visitors, including those with limited mobility options. Examples include Tumbleweed Park and Mesquite Aquatic Center;
- **Employment/Education Center** – Major employment centers or corridors, educational institutions, and community resources within Chandler may need to be accessed both by Chandler residents and regional visitors. These centers may be accessed by disadvantaged or limited-mobility populations. Examples include Intel campuses, Chandler Regional Hospital, Chandler-Gilbert Community College, high schools, and the Arizona Department of Economic Security (AZDES) campus;
- **Local Retail Center** – Neighborhood-scale shopping plazas with grocery stores, convenience stores, local dining, and other services that would be accessed mainly by residents of all demographics through short, local trips by a variety of modes, including local transit. Examples include Fulton Ranch Towne Center, Crossroads Towne Center, and Springfield Marketplace;
- **Neighborhood Hub** – Central gathering points within existing neighborhoods and residential communities; and
- **Park and Ride** – Existing stand-alone park-and-ride locations that provide access to regional transit. These facilities are typically not integrated with other uses that might be captured in other hub types.

7.2.3 PROPOSED PHYSICAL AND VIRTUAL HUBS IN CHANDLER

Table 7-1 shows which specific amenities are recommended for consideration by the City at each type of hub. Using the table as a general guide, the City can begin planning for and investing in hubs in association with public facilities or private development.

Figure 7-3 depicts proposed locations for major hubs in Chandler, including the Regional Centers, Recreational Centers, and Employment/Education Centers. **Figure 7-4** shows an example of how local hubs, including Local Retail Centers and Neighborhood Hubs would be identified. The identification of smaller, more prevalent hubs could be identified in partnership with neighborhood groups or associations to make sure there is support for the hub and to identify a location that would serve the most people in that area.

This should not be considered an exhaustive list of potential hubs. As the City continues to develop, hubs may evolve in the types of services and connections provided. Similarly, some locations that are initially not identified as key to local connectivity may emerge as critical components of future connectivity.

Table 7-1. Physical/Virtual Hub Alternatives

Character Type			Regional Center	Recreational Center	Employment/Education Center	Local Retail Center	Neighborhood Hub	Park-and-Ride
Characteristics			Visited by local and regional travelers; Served by regional transportation; Mix of destinations (entertainment, retail, dining, services)	Trips could be local or regional; Access to community resources/amenities/services; Could be accessible to limited-mobility population (young, elderly, disadvantaged)	Large employment hubs or corridors; Trips could be local or regional; Major community services; Could be accessible to limited mobility population (elderly, students, disadvantaged)	Local trips (within 5 miles); May be served by existing transit; Accessed by disadvantaged population (young, elderly, disadvantaged)	Residential land uses; Arterial-arterial connections	Park-and-ride lots that are not included in other character areas; Served by existing transit
Example Locations			Downtown Chandler Chandler Fashion Center Mall	Tumbleweed Park Mesquite Aquatic Center	Intel Campuses Chandler Regional Hospital Chandler Gilbert Community College AZDES Campus	Fulton Ranch Towne Center Crossroads Towne Center Ahwatukee Foothills Towne Center Springfield Marketplace	Community parks, clubhouses, or other central gathering points	Hamilton park-and-ride lot.
Location Purpose			Destination	Destination	Destination	Destination	Origin	Origin
Menu of Amenities								
Traveler Information and Support Services	Information portal/display	$7,000 - $10,000 per portal location	x	x	x	x	x	x
	Wayfinding	$7,500 - $10,000 per sign	x	x	x	x		
	Smart lighting	$600 per street light				x	x	x
	USB charging	$1,000 per location	x	x	x	x	x	x
	Integrated payment	No City cost – Valley Metro's cost	x	x	x	x	x	x
	Mobile retail	No City cost – permit private partners to offer services	x	x				x
Active Transportation	Shared micromobility	No City cost – permit private partners to offer services	x	x	x	x	x	
	Bicycle parking	$2,500 per rack + $3,000 per locker + $250,000 per secured parking facility equipped with repair and locking amenities	x	x	x	x	x	x
	Self-service bicycle repair station	$2,000 - $5,000 per location	x	x	x	x		
Transit	Regional bus/BRT	$7,500 - $10,000 per digital display of information – City cost only for station information displays or other local infrastructure	x		x			x
	Local bus	$7,500 - $10,000 per digital display of information – City cost only for station information displays or other local infrastructure	x	x	x	x		x
	Flexible transit	$7,500 - $10,000 per digital display of information – City cost only for station information displays or other local infrastructure	x	x	x	x	x	x
Motorized Services	Smart parking	$200 per space + $60,000 per smart parking ingress/egress infrastructure + $125,000 per software + $2,000/month	x	x				x
	Car-sharing	No City cost – permit private partners to offer services	x	x	x	x	x	
	Ride-sharing loading zones	$15,000 - $30,000 per retrofit or install of curb space location	x	x	x	x		
	Park-and-ride lots	$10,000 - $30,000 per lot infrastructure outfit (displays, kiosks, etc.) – not for the park-and-ride lot itself	x					x
	EV charging	$8,500 - $20,000 per station	x	x	x	x		x

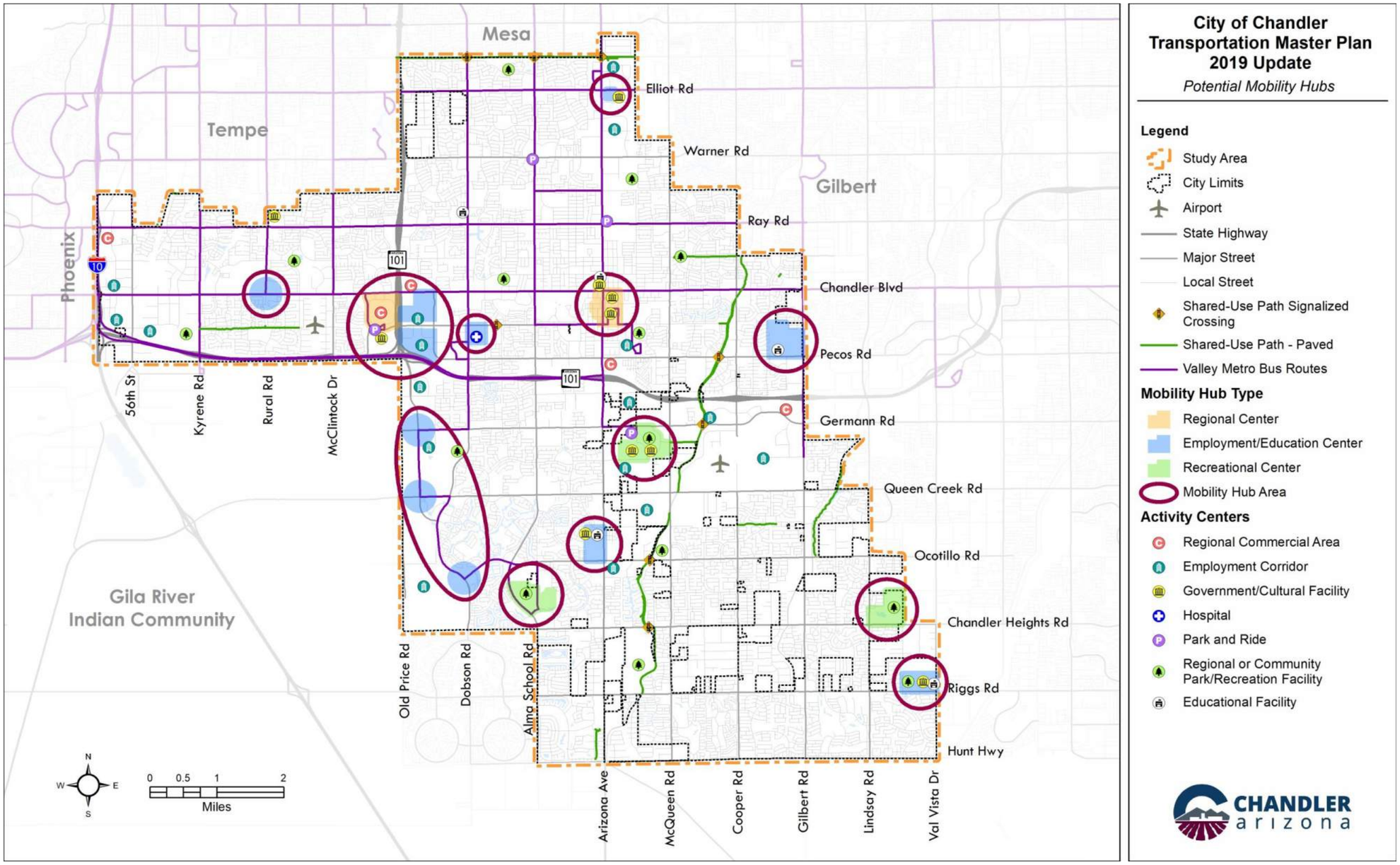


Figure 7-3. Potential Physical and Virtual Mobility Hubs

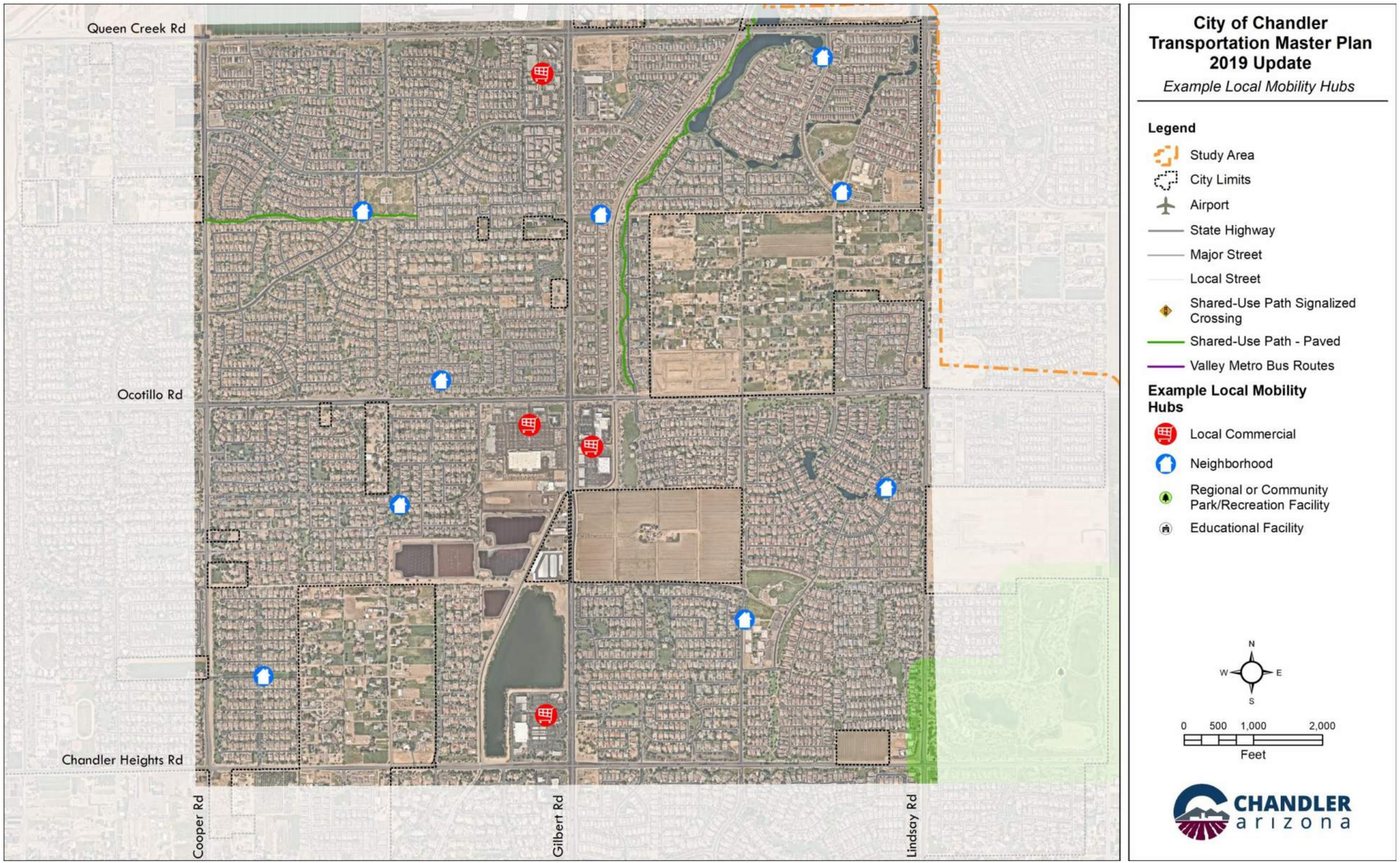


Figure 7-4. Localized Examples of Potential Local Retail Centers and Neighborhood Hubs

7.3 INFORMATION MOVEMENT – DATA MASTER PLAN

A critical, but sometimes overlooked, benefit of deploying or having access to technologies is the data that is generated and captured. Interpretation of data can provide a basis for issue awareness where there may not have been any before. It can provide evaluation metrics that can be used to support decision-making and generate cost-savings for the City. Interpretation of data can also provide a basis for long-range planning and before-and-after analyses to determine successes and failures associated with development and economic growth.

The availability of new data is expanding in terms of breadth and depth as the transportation environment moves toward a smart and connected environment. The processing of data for issue awareness is quickly becoming a driver both locally and nationally for decision-making. Transportation departments can provide a wealth of data to support mobility, efficiency, economic, and community goals that the City is moving toward. One example of a rich source of data is the City's traffic management center (TMC), which can provide real-time data related to roadway and traffic conditions. The City already has a solid foundation of data collection; however, the data is not stored. There are plans to expand TMC operations to include more data collection – the communication media (fiber) exists, but it requires integration of data collection tools into existing devices (e.g., detection zones for counts) that will require time and resources.

This section serves primarily as education regarding the types of data and sources of data that could be leveraged by the City in the future. While there is a robust data environment available today, the scope and breadth of data that will become available in the near future is something that the City should stay apprised of as it may change investments being programmed today.

It is important to note that there are no specific recommendations for the City to begin using these data or implementing pilot programs in this section.

7.3.1 BACKGROUND ON AVAILABLE DATA COLLECTION METHODS

Background on available data collection technologies is provided below. There are various technologies that have a high potential to support the transportation services provided by the City. Leveraging these technologies can often be done through automated processes or one-time efforts of additional staff resource requirements. Currently, TMC staff time is dedicated to managing daily traffic operations, development activities, construction, and incident management.

Field ITS Infrastructure

Intelligent Transportation Systems (ITS) data can be collected via automatic detection technology. Vehicle presence detectors are primarily used to obtain vehicle counts and speed data along roadways. Bluetooth/Wi-Fi can be used to determine travel times and average speed data. Smart phones are equipped with accelerometers, instantaneous speed, and three-direction acceleration technology to collect anonymous data that can all be registered, creating a pseudo-connected vehicle environment via Bluetooth/Wi-Fi. Images from closed circuit television (CCTV) cameras have proven over time to be the most valuable data that the City can have access to because they support a multitude of real-time operational responses. CCTV cameras provide real-time assessment of the traffic conditions in response to incidents, events, or other non-recurring congestion, allowing the City to make adjustments to the traffic signal timing to manage traffic. The City does not store or archive images from traffic cameras per policy.

Cloud Computing

Cloud computing essentially moves computing from servers that must be owned and maintained by a TMC to a service accessed via high-speed communications. Using cloud computing, agencies can eliminate the need for local servers and remotely access elements of their software from any computer. There are other situational uses of this technology and it eliminates the need to maintain large, on-site servers. While there are many advantages to cloud computing such as resource savings, scalability, and privacy, it should be noted there can be potential issues related to reliability, security access, and cost.

Connected Vehicles

Connected vehicle technology is a collection of technologies that is still being researched and refined. The basic idea is that vehicles will be equipped with on-board equipment that can relay messages (warnings, traveler information, data, etc.) via short-range radio to other vehicles and to roadside equipment. This may change the way drivers receive information about conditions and it will significantly increase the availability of data at a TMC. This technology is evolving, and it is difficult to tell when it will become standard practice.

The City could collect and transmit signal timing information to data collectors that have a signed data agreement with the City, potentially in exchange for performance measure data from the data collector, if desired. Audi is an example of a company that has equipped some of its vehicles to be able to collect and display signal timing information on vehicle dashboards.

The City plans to expand TMC operations to include data collection. One option the City could consider is to not install its own new data collection devices and simply rely on a combination of existing data collection devices as well as purchasing data from a private data collection company, like Inrix, which is already collecting data in the Phoenix metropolitan area and across the nation. OnStar and other in-vehicle support services are also equipped to provide some data if they decide they are interested in entering that market. Using such companies for data collection may be beneficial, knowing connected vehicles could become mainstreamed in the near future. The City could partner with these private data collection companies by allowing them to implement and evaluate pilot connected vehicle technology projects in Chandler.

It is recommended that the City stay apprised of the use of connected vehicles on its transportation network. The City would need to invest in data collection tools if data were to come from City-owned devices.

7.3.2 AVAILABLE DATA TYPES

Table 7-2 presents a list of available data types for an ITS program. The data types range from data that is inherent in a device (whether it is on or off), to more involved data that may have to be actively created (hours of preventative maintenance).

It is important to note that these are not the data types necessarily recommended for the City, but rather are available for consumption or use by the City if it is determined necessary for supporting operations, maintenance, or programming for the future. For example, CCTV camera data types or AVL data types for emergency vehicles are currently utilized by City law enforcement, but they are not recommended for public distribution.

Table 7-2 identifies data type options for future consideration. A specific evaluation for data needs and resources for the future of the City could be conducted to determine what processes can be automated or one-time efforts to set up. These indicators can be useful, easy to track, and give a comprehensive picture of ITS system performance.

Table 7-2. Data Types for ITS Program

Detection	CCTV Camera	Dynamic Message Sign (DMS)
• Volume • Classification of vehicle • Vehicle occupancy • Pedestrian actuation and movement • Bicycle actuation and movement • Stopped vehicle notification • Turning movement counts	• Occupancy start/end • Stopped vehicle notification • Queue length	• Message display • Timestamp of start/end of message posting • Location of DMS with message displayed
Emergency Vehicle Preemption	**Wireless Radio**	**Transit Priority**
• Activation timestamp at location	• Bandwidth consumption • Location of bandwidth consumption • Timestamp of bandwidth usage	• Activation timestamp at location
Fiber	**ARID/Bluetooth/Wi-Fi**	**Automatic Vehicle Location (AVL)**
• Bandwidth consumption • Timestamp of bandwidth usage	• Origin/Destination • Delay • Speed • Location	• Transit AVL
TMC Operator	**System Activity**	**Maintenance**
• Incident response initiation of activity • Congestion response initiation of activity • Timestamp of sending notification by any method (email, system note, text, social media, etc.) • Incident location/time • Timestamp of receiving notification by any method (email, system note, text, social media, etc.) • Reason for signal timing change (manual log)	• Signal plan change time • Timestamp of time when camera image is accessed • Public entries into interactive map • Number of webpage views on interactive map • Length of time on interactive map webpage	• Hours of preventative maintenance time • Hours of repair time based on ticket • Install date • Replacement/update date • Ticket entry date • Ticket completion date

7.3.3 AVAILABLE METHODS FOR SHARING DATA

This section describes the various available methods for providing transportation data to other users. This section serves primarily as education regarding the method of sharing data that could be leveraged by the City in the future. It is important to note that there are no specific recommendations for the City to share data identified within this section.

Real-Time Data Feeds to Other Departments

Images from the TMC's real-time video feed of the City's CCTV cameras are already being shared with the City's Police and Fire Departments. These feeds are streaming in real-time to support incident response and situational awareness. The City has a Council-approved policy that addresses how other City departments can use or store video data from the TMC.

Additional traffic data that could potentially be shared with other groups or departments at the City includes real-time roadway conditions information. Data such as average vehicle speeds, travel times, crash locations, and construction restrictions could provide real-time roadway conditions to partner departments such as Police, Fire, and Public Works to help facilitate more efficient routing decisions for quicker response times.

The TMC is likely not going to be able to accommodate individual data feed requests, especially for data that the TMC does not already collect. The TMC could provide data feeds to departments in a raw format, with the department requesting data responsible for all analytics and how to use the data for their purposes. While transferring and sharing data with other departments is a benefit, there are also inherent risks involved. The source of data may be the ITS program, but the terms of use of the data that is transferred or shared with other City departments, or to third party or private sector companies, should state that the ITS program cannot be held liable for the use of that data. Data that is collected by the ITS program and shared with others needs to become the sole liability of the data recipient.

Dynamic Message Signs (DMS)

With the rise in use of smart phone technology and the current outlook of connected vehicle technology, DMS are serving specific purposes for immediate and local information-sharing with the traveling public. Smart phones can now allow for messages that would normally be on a DMS to be sent directly to the smart phone. One such example is with the Waze application where the City currently shares known construction or special event-related road restriction and closure data with Waze, which Waze then disseminates to its subscribers. This type of data-sharing could allow for personalized messages transmitted to drivers' smart phones well before they encounter a restriction if the driver has identified the planned route. Any messages to drivers would need to be audible such that a driver would not need to look at a phone while driving. Sending messages to connected vehicles would work the same way, except it would send the message to an interface on the car instead of to a user's phone.

Portable DMS are used primarily in construction zones where conditions can change regularly but they are also used for special event traffic including the Ostrich Festival, 4th of July, and downtown events. A phone or connected vehicle's ability to convey real-time messages posted on portable DMS about upcoming road restrictions has not been fully explored to date by Waze or other similar applications.

For the City arterial DMS that are fixed in-place, there are other options for their use as well. Travel times along a corridor or comparative travel times to destinations could prove a valuable use of the City's fixed DMS investment. While TMC staff can access the DMS remotely from any location during non-work hours, another use of DMS could be to provide the Police department with access to post messages on fixed DMS for hours that the TMC is not operational – evenings and weekends. This would require updating the City's DMS guidelines and defining an explicit standard operating procedure to allow for expanded use. The standard operating procedures could identify the hours of operation for the DMS, a hierarchy of messages, roles and responsibilities for changing messages, approved messages, or a process for getting messages approved and policies on using messages to support traveler information outside of the City boundaries. While this benefit of having another potential user of ITS infrastructure investments seems of value, there are primary and secondary functions that need to remain, particularly if federal funding is used to put additional fixed DMS in place. The City will need to determine their intended use and sharing of ITS resources as the City becomes more capable of supporting incident response.

Traveler Information Systems

Traveler information systems, such as radio, public information office media releases, social media alerts, or AZ511, allow for widespread distribution of information and provide travelers with route-specific information so they can plan travel based on current traffic conditions. Some City departments, such as Police and the Communications and Public Affairs departments, utilize these methods of traveler information services. Other departments could also leverage this available traveler information.

Social media, such as Facebook and Twitter, can also help the City to distribute traveler information at a low cost. Social media, in general, already has a significant market penetration, so the major effort would be to increase the number of Chandler residents and visitors that follow City accounts or associated feeds. Another benefit of social media is that it provides a two-way transfer of information, as followers can also provide information to the City on an incident or problem.

Other frequently used methods of disseminating traveler information include using radio announcements, web pages, and subscription e-mail lists. Some agencies run a radio station that constantly reports traffic information. Most private radio stations report traffic conditions regularly over peak periods as well, although sometimes this information comes from listeners to the station and not the TMC. Posting the information on the Internet through a website and Twitter incurs a very low cost compared to ITS installation. Many agencies are taking advantage of these options as dissemination through social media becomes more mainstream.

Connected Vehicles

It is estimated it will take roughly another 20-50 years for the majority of the public vehicle fleet to be available and equipped with connected vehicle technology. However, the application of connected vehicle data transmission could be tested today with smart phones to determine viability for supporting safety, mobility, and other City goals. The results of current connected vehicle test beds being demonstrated around the country will help inform the decision on benefits of fixed overhead DMS versus directly messaging users. Decision-makers could be made more aware of the emergence of connected vehicle technology as it could potentially replace certain aspects of the City's ITS program in the future, such as vehicle detection.

7.3.4 TECHNOLOGY RECOMMENDATIONS AND COSTS

In light of the preceding discussion of transportation technology trends and options, it is recommended that the City make the following technology investments:

- Near-Term: Develop an ITS Strategic Plan that includes detailed implementation plans/projects, staffing resources, and ongoing costs, including refining the hub concept; and
- Mid-Term: Develop and construct physical and virtual hubs – initial recommendation is two physical and two virtual hubs, but this will need to be refined in the ITS Strategic Plan;
- Long-Term: Develop and construct physical and virtual hubs – initial recommendation is two physical and eight virtual hubs, but this will need to be refined in the ITS Strategic Plan; and

- Ongoing Maintenance: Fully fund the required maintenance for roadway signs and pavement marking assets and continue maintaining and upgrading the City's ITS devices and other technology infrastructure as well-maintained and well-instrumented transportation infrastructure improves autonomous vehicle and connected vehicle functionality.

Making these technology investments will keep the City at the forefront of using transportation technology to improve the quality of life and the experience of travelers in Chandler.

Additional technology investments are being identified by other concurrent City activities including the Fiber Master Plan and developer improvements. The City's Fiber Master Plan will identify costs related to fiber communications upgrades, replacements, or adjustments that will be utilized by all City departments.

Table 7-3 shows the capital, maintenance, and total costs for the near-term, mid-term, and long-term leveraging technology improvement recommendations. Overall, the total cost of all recommended leveraging technology improvements in 2019 dollars for the 2020 - 2040 timeframe calculates to $18.10 million. More information on the costs and assumptions of these technology recommendations is provided in **Table 7-4**.

Table 7-3. Total Cost of Leveraging Technology Improvement Recommendations 2020 - 2040

Time Period	Capital Cost of Recommendations (1)	Operations and Maintenance Cost of Recommendations (1)	Total 2019 Cost of Recommendations
2020 - 2025	$750,000	$1,200,000	$1,950,000
2026 - 2030	$4,100,000	$1,250,000	$5,350,000
2031 - 2040	$7,800,000	$3,000,000	$10,800,000
Total Costs	**$12,650,000**	**$5,450,000**	**$18,100,000**

Note: (1) Technology capital and operations/maintenance costs have been separated as identified in Table 6-4 and included in the Roadway and Transit Total Cost tables.

Table 7-4. Details on Leveraging Technology Recommendations and Costs

Recommendations	Assumptions	Context	Near-Term: 2020 - 2025	Mid-Term: 2026 - 2030	Long-Term: 2031 - 2040
Roadway-Related Technology Recommendations and Costs					
Continue to fund the required maintenance for signs and pavement marking assets	Ongoing annual maintenance funding required for upkeep of signs and pavement markings	Upkeep of sign and pavement marking quality supports a future autonomous vehicle environment	See roadway maintenance costs	See roadway maintenance costs	See roadway maintenance costs
Technology ongoing maintenance program	Ongoing annual maintenance funding required for upkeep and replacement needs for City-owned technology	Includes traffic signals, ITS field infrastructure (e.g., cameras, detection, and communications), and TMC facility equipment ramped up over time, and physical and virtual hub maintenance	$1,200,000 ($200,000 per year for 6 years)	$1,250,000 ($250,000 per year for 5 years)	$3,000,000 ($300,000 per year for 10 years)
ITS Strategic Plan with implementation projects and costs	Complete study to define implementation needs of new technology functions and data recommendations as well as the implementation of any physical or virtual hub space in the mid- or long-term timeframes	Study would define technologies, corridors, and investments that the City desires to move toward including determining appropriate resources (equipment, staff, software, etc.)	$250,000	-	-
Implement recommendations from ITS Strategic Plan	Implement components of ITS plan related to field and communications infrastructure to support physical and virtual hubs and connected vehicle environment, data analysis and storage, and other recommendations	Includes new technology that is not considered replacement of existing capabilities or functions where the City is investing to support physical and virtual hubs, grow into new markets, and support emerging trends	$500,000	$750,000	$2,000,000
Subtotal Cost of Roadway-Related Technology Recommendations			*$1,950,000*	*$2,000,000*	*$5,000,000*

Recommendations	Assumptions	Context	Near-Term: 2020 - 2025	Mid-Term: 2026 - 2030	Long-Term: 2031 - 2040
Transit-Related Technology Recommendations and Costs					
Fixed physical hub space	Includes purchase of new acre of land (if needed), 2 information portal/displays, 10 wayfinding signs, public Wi-Fi, 20 smart lights, 2 USB charging stations, 3 bicycle lockers, 1 self-service bicycle repair station, 50 smart parking spaces, 4 ride-sharing loading zones, 1 park and ride lot outfitted with City-owned infrastructure, and 4 EV charging spaces, and City permitting for other private services to be served from physical hub spaces	Recommendations are scaled in the mid- and long-term timeframes to reflect potential changes in priorities in terms of location or amenities included as a result of the Technology Plan	-	$3,000,000 (covers 2 locations at Regional Centers)	$3,000,000 (covers 2 locations at Employment / Education Centers)
Virtual hub locations	Includes public Wi-Fi, 20 smart lights, 1 outfit of park and ride lot or facility that would serve as hub	Recommendations are scaled in the mid- and long-term timeframes to reflect potential changes in priorities in terms of locations or amenities included as a result of the Technology Plan	-	$350,000 (covers 2 locations)	$2,800,000 (covers 8 locations)
Subtotal Cost of Transit-Related Technology Recommendations			-	*$3,350,000*	*$5,800,000*
Total Cost of Leveraging Technology Recommendations			***$1,950,750***	***$5,350,000***	***$10,800,000***

8.0 SUMMARY OF COSTS

Table 8-1 shows the capital, maintenance, and total costs for the near-term, mid-term, and long-term improvement recommendations, combining the total costs of the roadway, transit, bicycle and pedestrian, and leveraging technology elements. The total cost of all recommended improvements in 2019 dollars for the 2020 – 2040 timeframe calculates to $994.18 million. A more detailed summary cost table is available in **Appendix A**.

Table 8-1. Total Cost of All Improvement Recommendations 2020 - 2040

Time Period	TMP Element (4)	Capital Cost of Recommendations (3)	Operations and Maintenance Cost of Recommendations	Total 2019 Cost of Recommendations
2020 - 2025	Roadway	$33,050,000	$75,100,000	$108,150,000
	Transit	$2,200,000	$15,546,000	$17,746,000
	Bicycle and Pedestrian	$10,090,000	$1,200,000	$11,290,000
	Subtotal	*$45,340,000*	*$91,846,000*	*$137,186,000*
2026 - 2030	Roadway	$148,750,000	$71,350,000	$220,100,000
	Transit	$16,850,000 (2)	$35,015,000	$51,865,000
	Bicycle and Pedestrian	$45,590,000	$1,250,000	$46,840,000
	Subtotal	*$211,190,000*	*$107,615,000*	*$318,805,000*
2031 – 2040	Roadway	$131,000,000 (1)	$158,500,000	$289,500,000
	Transit	$12,400,000 (2)	$110,930,000	$123,330,000
	Bicycle and Pedestrian	$122,360,000	$3,000,000	$125,360,000
	Subtotal	*$265,760,000*	*$272,430,000*	*$538,190,000*
2020 - 2040	**Roadway**	**$312,800,000**	**$304,950,000**	**$617,750,000**
	Transit	**$31,450,000**	**$161,491,000**	**$192,941,000**
	Bicycle and Pedestrian	**$178,040,000**	**$5,450,000**	**$183,490,000**
	Total	***$522,290,000***	***$471,891,000***	***$994,181,000***

Notes: (1) Capital Costs Include ADOT Freeway Connections and Cooper Road Extension Collector Street.
(2) Capital Costs for High Capacity Transit Not Included Because Costs Depend on Outcome of Studies.
(3) Technology Costs are Incorporated into the Roadway and Transit Costs. (4) Programmed Costs not Included.

9.0 COMMUNITY ENGAGEMENT

This 2019 Transportation Master Plan Update is being prepared to reflect the City's growth, changing trends in transportation and technology, and the corresponding existing and future transportation needs in Chandler.

Community engagement is an important component of the development process for the Transportation Master Plan. To ensure that residents, businesses, and those that may travel for work or pleasure in Chandler have an opportunity to provide their input or thoughts related to the future of transportation in Chandler, several opportunities for input were provided. A Community Engagement Plan was developed to guide community engagement throughout the study and is provided in **Appendix B**.

9.1 PROJECT HOTLINE AND WEBSITE

To provide communication mechanisms throughout the planning process, a project hotline was established, and a project website was developed (KeepChandlerMoving.com) where up-to-date information was provided and where visitors had an opportunity to provide comments or ask questions of the project team. In addition, the project website provided information and links for the project's online transportation survey and also for Valley Metro's Arizona Avenue Alternatives Analysis, a separate but related project running concurrently that is evaluating high-capacity transit options along the Arizona Avenue corridor.

9.2 ONLINE TRANSPORTATION SURVEY

As part of the public input process, an online transportation survey was developed and posted to the project website, the City of Chandler website, and announced at public meetings, the stakeholder workshop, and at various City events and on City collateral. The survey was launched in December 2018 and left open through the end of July 2019.

A total of 1,075 survey responses were received. Respondents were not required to respond to all questions and, in some cases, more than one response was permitted per question. Below is a brief summary of the responses received.

Respondents indicating the reason for their interest in Chandler transportation were split as follows:

- 85% live in Chandler as full or part-time residents;
- 9% are not residents but work in Chandler; and
- 6% are not residents but travel regularly in Chandler.

For respondents who indicated they were Chandler residents, their length of time living in Chandler was:

- 20%: 0 - 5 years;
- 17%: 6 - 10 years;
- 20%: 11 - 15 years;
- 19%: 16 - 20 years; and
- 24%: over 20 years.

The area of Chandler that respondents indicated they primarily travel was:

- 36%: north of Loop 202 and east of Loop 101;
- 21%: north of Loop 202 and west of Loop 101;
- 26%: south of Loop 202 and east of Arizona Avenue; and
- 17%: south of Loop 202 and west of Arizona Avenue.

Besides having overall results, results were reviewed with a split between those who primarily travel north of Loop 202 and those who primarily travel south of Loop 202 to see if response trends differed based on location – in general, response trends were similar for both categories.

Respondents were asked to explain why they were most interested in automobile, bicycle, pedestrian, and/or transit travel and what characteristics were most important to them about that mode of travel. The most frequent responses are summarized in **Table 9-1**.

Table 9-1. Survey Respondent Priorities by Mode Choice

Survey Question	Mode of Travel			
	Automobile	Bicycle	Pedestrian	Transit
Why are you most interested in this mode of travel?	1. Convenience 2. Cost-effectiveness	1. Leisure/recreation 2. Environmental sustainability	1. Leisure/recreation 2. Environmental sustainability	1. Cost-effectiveness 2. Convenience
Which characteristics of this mode of travel are most important?	1. Quickest travel time 2. Ease of access to destination	1. Feeling safe 2. Ease of access to destination	1. Feeling safe 2. Comfortable and attractive features	1. Quickest travel time 2. Ease of access to destination

Source: Chandler Transportation Master Plan 2019 Update Survey

For travel by transit, local bus routes and convenient bus stops were the most important existing features selected by respondents. For longer-term transit improvements, respondents most frequently indicated the City should prioritize light rail and emerging technologies in the future.

When asked what should be done with transit routes that have low ridership, priority responses were to modify where routes go, provide more connections to other transit routes, and replace the routes with

demand-responsive microtransit. Approximately one-third of those who responded to this question with an "other" response stated that further study or research should be done into the cause of low ridership.

When respondents were asked what their current primary mode of travel is, responses overwhelmingly indicated the personal automobile is the current primary model of travel. The most common current secondary mode of travel indicated in the responses is the shared automobile (e.g., Uber/Lyft).

When asked the mode of travel the City should invest in most in the future, the highest percentage of responses was for transit, followed by the automobile. When asked the mode of travel the City should invest in second most, the highest percentage of overall responses was for bicycle/scooter travel first, followed by transit.

When asked what they believe their primary mode of travel will be 20 years from now, the highest percentage of responses was for personal automobiles, followed by personal driverless automobiles.

Other questions asked about important destinations when determining how individuals travel. There was also an opportunity for general comments. General comments were categorized into mode of travel and provided to the City for consideration. An infographic summarizing the survey results and more detailed survey results are provided in **Appendix B**.

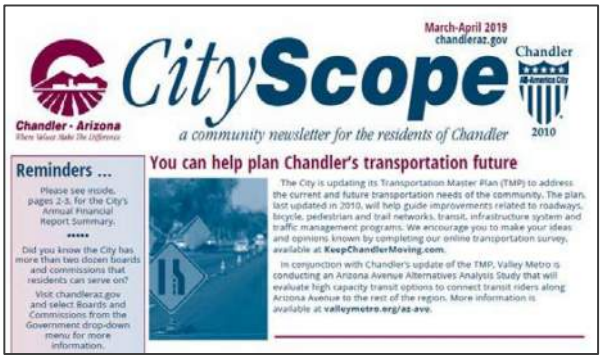
9.3 PUBLIC MEETINGS

There were two rounds of public meetings in the study. Meeting materials are provided in **Appendix B**. The first round was conducted in January 2019 and consisted of three meetings held at different locations throughout Chandler with a total of 88 attendees providing their thoughts and concerns about current and future transportation conditions. A total of 24 comment cards were submitted by attendees.

The second round consisted of one meeting held October 24, 2019 at the Chandler Community Center with a total of 33 attendees providing their thoughts and concerns about proposed recommendations. A total of six comment cards were submitted by attendees (three handed in at the meeting and three submitted via the project website).

Public meetings were held in an open-house format with exhibits related to roadway, bicycle, pedestrian, and transit facilities as well as transportation technology. In addition, the meetings provided information on the aforementioned Valley Metro Arizona Avenue Alternatives Analysis, with Valley Metro staff in attendance. Photos from the meetings are shown on the subsequent page.

Notifications for the public meetings were developed and distributed through the City's Communications and Public Affairs Department and Valley Metro's Public Involvement Coordinator via the traditional media channels and social media. In addition, eblasts were sent to over 1,700 email addresses collected from previous or current capital improvement projects to invite people to the public meetings to discuss the future of transportation in Chandler.


March-April 2019
chandleraz.gov
CityScope
Chandler
Chandler - Arizona
a community newsletter for the residents of Chandler
2010
Reminders ...
Please see inside, pages 2-3, for the City's Annual Financial Report Summary.
Did you know the City has more than two dozen boards and commissions that residents can serve on?
Visit chandleraz.gov and select Boards and Commissions from the Government drop-down menu for more information.
You can help plan Chandler's transportation future
The City is updating its Transportation Master Plan (TMP) to address the current and future transportation needs of the community. The plan, last updated in 2010, will help guide improvements related to roadways, bicycle, pedestrian and trail networks, transit, infrastructure system and traffic management programs. We encourage you to make your ideas and opinions known by completing our online transportation survey, available at KeepChandlerMoving.com.
In conjunction with Chandler's update of the TMP, Valley Metro is conducting an Arizona Avenue Alternatives Analysis Study that will evaluate high capacity transit options to connect transit riders along Arizona Avenue to the rest of the region. More information is available at valleymetro.org/az-ave.

January 23 Public Meeting

January 28 Public Meeting

January 30 Public Meeting

October 24 Public Meeting

In addition, a booth/table was set up at Chandler's Mayor on the Move event on May 14, 2019 with information provided about the process of updating the Transportation Master Plan. There were six individuals who visited the table to learn about the Transportation Master Plan. In addition, during the event, the emcee announced that the Transportation Master Plan was in the process of being updated.

9.4 STAKEHOLDER WORKSHOPS

To provide for broader, more detailed and interactive discussions with residents, businesses, and transportation "influencers" in Chandler, a stakeholder workshop was held on March 7, 2019. Twenty-two individuals attended the workshop to discuss the future of transportation in Chandler and provide their thoughts related to the feedback from the public meetings and initial survey responses (see **Appendix B**). A second stakeholder workshop was held October 17, 2019, with nine attendees. Invited stakeholders included a representative from the following neighborhoods, organizations or interest groups:

- Chandler Unified School District;
- Chandler-Gilbert Community College;
- Chandler Regional Hospital;
- Chandler Fashion Center;
- Downtown Chandler Community Partnership;
- Bashas';
- Mission Valley Neighborhood;
- Thunderbird Park Neighborhood;
- Pepperwood Neighborhood;
- Paseo Trail North Neighborhood;
- Ocotillo Community Association;
- Chandler Chamber of Commerce;
- Intel;
- Wells Fargo;
- Orbital;
- PayPal;
- Gilbert Road Business Center;
- Arizona Bicycle Club;
- Bicycle MeetUp Group;
- Coalition of Bicyclists;
- Mayor's Committee for People w/Disabilities;
- Arizona Multi-Family Housing Association;
- AZCEND;
- Chandler/Gilbert Arc;
- Pollack Investments;
- Red Development;
- Douglas Allred Company; and
- VanTrust.

9.5 TRANSPORTATION COMMISSION

There were three presentations to the Transportation Commission in this study. Presentations on study progress to date were made in December 2018, May 2019, and November 2019. The seven members of the City-appointed Transportation Commission serve in an advisory capacity concerning community transportation policy issues. At the November 2019 meeting, the Transportation Commission recommended that the Chandler Transportation Master Plan Final Report be transmitted to the City Council for consideration of approval and adoption of the document. The input provided by the Transportation Commission is provided in **Appendix B**.

9.6 CITY COUNCIL

The draft findings and recommendations of the Transportation Master Plan were presented to the City Council in October 2019 for review and feedback. The finalized Transportation Master Plan is anticipated to be presented to the City Council for final approval in late 2019 or early 2020.

9.7 INTERVIEWS WITH TECHNOLOGY EXPERTS

Interviews were conducted with transportation technology experts in the community and industry, using the questions below generated specifically for this study:

- *Latest and Greatest Innovations* – What are the innovations from your perspectives that will impact transportation as a whole?
- *Existing Transportation System* – What challenges/obstacles with the existing transportation network for the different modes have you experienced that have made evolving technology more difficult than you hoped it would be?
- *City Role* – What is the anticipated City role in the future of transportation?
- *Support to Private Sector* – What types of data, information, or support will need to be provided to the private sector to advance transportation technology innovation?
- *Equitable Mobility* – What ideas do you have to address mobility needs around the City regardless of user ability?
- *Transportation Master Planning* – What current initiatives, policies, and/or future plans should be included in this plan? How do any or all of these intersect with or rely on public sector data, infrastructure, or personnel?
- *Promote Private Sector Growth* – What do YOU (private sector) need to be successful? What can we do here in the City to support transportation tech business growth and attract/seed technology deployment?

Technology companies and agencies involved in transportation technology that responded to the interview request are listed on the following page. The perspectives and input provided by the technology experts were then summarized into general concepts.

- Arizona State University;
- City of Chandler;
- Contra Costa County;
- EasyMile;
- Lyft;
- Maricopa County Department of Transportation;
- Navya;
- NXP Semiconductor;
- PayPal;
- Rogers Corporation;
- Traffic Technology Services;
- TriMet;
- Verizon; and
- Waymo.

APPENDIX A – DETAILED SUMMARY COST TABLE

City of Chandler Transportation Master Plan - Detailed Summary of Improvements and Costs

Improvement Recommendation	Estimated Total Cost	Implementation Timeframe and Estimated Cost		
		Near-term (2020-2025)	*Mid-term (2026-2030)*	*Long-term (2031-2040)*
Roadway - Capital Improvements				
Widen Pecos Rd to 4 lanes: Ellis Rd to Dobson Rd (joint project with developer)	$ 4,000,000	$ 4,000,000		
Widen Ellis Rd to 4 lanes: Frye Rd to Pecos Rd (joint project with developer)	$ 4,000,000	$ 4,000,000		
Widen Dobson Rd to 6 lanes: N. of Ray Rd to S. of Ray Rd	$ 4,000,000	$ 4,000,000		
Hunt Hwy traffic calming improvements: Cooper Rd to Val Vista Dr (coordinate with on-street separated/buffered bike lanes project)	$ 18,000,000	$ 18,000,000		
Right-of-Way for DHOV ramp to Loop 202 from Hamilton St/Germann Rd	$ 400,000	$ 400,000		
Predesign and Final Design of DHOV ramp to Loop 202 from Hamilton St/Germann Rd	$ 1,900,000	$ 1,900,000		
Widen Elliot Rd to 6 lanes: Price Rd to Dobson Rd	$ 13,000,000		$ 13,000,000	
Widen Elliot Rd: Dobson Rd to Alma School Rd	$ 13,000,000		$ 13,000,000	
Widen Warner Rd to 6 lanes: Price Rd to Dobson Rd	$ 13,000,000		$ 13,000,000	
Widen Warner Rd to 6 lanes: Dobson Rd to Alma School Rd	$ 13,000,000		$ 13,000,000	
Widen Warner Rd to 6 lanes: Alma School Rd to Arizona Ave	$ 13,000,000		$ 13,000,000	
Widen Kyrene Rd to 6 lanes: N. of Chandler Blvd to Loop 202	$ 18,000,000		$ 18,000,000	
Widen Alma School Rd to 6 lanes: S. of Queen Creek Rd to Ocotillo Rd	$ 5,000,000		$ 5,000,000	
Widen McQueen Rd to 6 lanes at major intersections: N. of Warner Rd to Ray Rd	$ 11,000,000		$ 11,000,000	
Widen McQueen Rd to 6 lanes at major intersections: Ray Rd to Chandler Blvd	$ 11,000,000		$ 11,000,000	
Widen McQueen Rd to 6 lanes at major intersections: Chandler Blvd to Pecos Rd	$ 13,000,000		$ 13,000,000	
Capacity improvements at Pecos Rd/Arizona Ave	$ 6,000,000		$ 6,000,000	
Construct DHOV ramp to Loop 202 from Hamilton St/Germann Rd	$ 19,000,000		$ 19,000,000	
Widen Warner Rd to 6 lanes: Arizona Ave to McQueen Rd	$ 13,000,000			$ 13,000,000
Widen Ray Rd to 6 lanes: Alma School Rd to Arizona Ave	$ 13,000,000			$ 13,000,000
Widen Ray Rd to 6 lanes: Arizona Ave to McQueen Rd	$ 5,000,000			$ 5,000,000
Widen Chandler Blvd to 6 lanes: Arizona Ave to McQueen Rd	$ 13,000,000			$ 13,000,000
Widen Germann Rd to 6 lanes: W. of Arizona Ave to McQueen Rd	$ 8,000,000			$ 8,000,000
Widen Germann Rd to 6 lanes: McQueen Rd to Cooper Rd	$ 11,000,000			$ 11,000,000
Widen 56th St to 4 lanes: Frye Rd to Pecos Rd	$ 6,000,000			$ 6,000,000
Capacity improvements at Germann Rd/Price Rd	$ 6,000,000			$ 6,000,000
Capacity improvements at Ocotillo Rd/Alma School Rd	$ 6,000,000			$ 6,000,000
Loop 202 Westbound Frontage Rd: Kyrene Rd to Roosevelt Ave (joint project with ADOT)	$ 14,000,000			$ 14,000,000
Loop 202 Dobson Rd Westbound On-Ramp (joint project with ADOT)	$ 18,000,000			$ 18,000,000
Loop 101 Frye Rd Northbound On-Ramp (joint project with ADOT)	$ 8,000,000			$ 8,000,000
New Collector: Cooper Rd/Queen Creek Rd to Ryan Rd/Emmett Dr	$ 8,000,000			$ 8,000,000
Develop ITS Strategic Plan	$ 250,000	$ 250,000		
Implement recommendations from ITS Strategic Plan	$ 3,250,000	$ 500,000	$ 750,000	$ 2,000,000
Subtotal of Roadway - Capital Improvements	**$ 312,800,000**	**$ 33,050,000**	**$ 148,750,000**	**$ 131,000,000**
Roadway - Operations and Maintenance Recommendations				
Street Pavement	$ 157,900,000	$ 40,200,000	$ 36,400,000	$ 81,300,000
Landscaping	$ 62,400,000	$ 15,900,000	$ 14,400,000	$ 32,100,000
Striping	$ 4,100,000	$ 1,000,000	$ 900,000	$ 2,200,000
Signing	$ 3,200,000	$ 800,000	$ 700,000	$ 1,700,000
Street Lighting (including Smart Streetlight pilot program)	$ 39,400,000	$ 7,700,000	$ 10,200,000	$ 21,500,000
Traffic Signals	$ 32,500,000	$ 8,300,000	$ 7,500,000	$ 16,700,000
Technology ongoing maintenance program (including field and communications infrastructure as well as physical and virtual hub maintenance)	$ 5,450,000	$ 1,200,000	$ 1,250,000	$ 3,000,000
Subtotal of Roadway - Operations and Maintenance Recommendations	**$ 304,950,000**	**$ 75,100,000**	**$ 71,350,000**	**$ 158,500,000**
Transit - Capital Improvements				
Establish planning guidelines for flexible transit services for various areas within Chandler	$ 100,000	$ 100,000		
Establish branding and service standards for flexible transit services	$ 100,000	$ 100,000		
Conduct flexible transit service study for Price Road area	$ 100,000	$ 100,000		
Conduct flexible transit service study for North Chandler Area	$ 100,000	$ 100,000		
Conduct study to explore First Mile/Last Mile Subsidy Program for South Chandler (south of Loop 202)	$ 50,000	$ 50,000		
Conduct High Capacity Transit study for the recommended corridors as identified in Arizona Ave Alternatives Analysis	$ 900,000	$ 900,000		
Conduct High Capacity Transit study for Chandler Blvd	$ 200,000	$ 200,000		
Conduct High Capacity Transit study for Rural Rd	$ 200,000	$ 200,000		
Conduct Downtown Transit Center site selection study and environmental documentation	$ 200,000	$ 200,000		
Conduct North Chandler Park-and-Ride site selection study and environmental documentation	$ 200,000	$ 200,000		
Educate Chandler residents about upcoming technological trends through a Public Education Program	$ 50,000	$ 50,000		
Conduct flexible transit service study for Central Chandler Area	$ 100,000		$ 100,000	
Continue to advance High Capacity Transit along Arizona Ave if determined appropriate by study conducted in near-term	$ -		TBD	
Continue to advance High Capacity Transit along Chandler Blvd if determined appropriate by study conducted in near-term	$ -		TBD	
Continue to advance High Capacity Transit along Rural Rd if determined appropriate by study conducted in near-term	$ -		TBD	
Right-of-Way for Downtown Transit Center	$ 500,000		$ 500,000	
Planning and Design for Downtown Transit Center	$ 200,000		$ 200,000	
Construction for Downtown Transit Center Plan	$ 6,000,000		$ 6,000,000	
Right-of-Way for North Chandler Park-and-Ride	$ 500,000		$ 500,000	
Planning and Design for North Chandler Park-and-Ride	$ 200,000		$ 200,000	
Construction for North Chandler Park-and-Ride Plan	$ 6,000,000		$ 6,000,000	
Conduct flexible transit service study for West Chandler Area	$ 100,000			$ 100,000
Conduct flexible transit service study for Ocotillo Neighborhood	$ 100,000			$ 100,000
Conduct flexible transit service study for Chandler Airpark Area	$ 100,000			$ 100,000
Conduct flexible transit service study for South Chandler Area	$ 100,000			$ 100,000
Continue to advance High Capacity Transit along Arizona Ave if determined appropriate by study conducted in mid-term	$ -			TBD
Continue to advance High Capacity Transit along Chandler Blvd if determined appropriate by study conducted in mid-term	$ -			TBD
Continue to advance High Capacity Transit along Rural Rd if determined appropriate by study conducted in mid-term	$ -			TBD
Site Selection, Planning and Design for facility expansion of Germann Rd Park-and-Ride	$ 200,000			$ 200,000
Construction for facility expansion of Germann Rd Park-and-Ride	$ 6,000,000			$ 6,000,000
Fixed physical hub space	$ 6,000,000		$ 3,000,000	$ 3,000,000
Virtual hub locations	$ 3,150,000		$ 350,000	$ 2,800,000
Subtotal of Transit - Capital Improvements	**$ 31,450,000**	**$ 2,200,000**	**$ 16,850,000**	**$ 12,400,000**
Transit - Operations and Maintenance Recommendations				
Provide flexible transit service in the Price Road Area	$ 33,600,000	$ 9,600,000	$ 8,000,000	$ 16,000,000
Provide First Mile/Last Mile Subsidy Program for South Chandler (south of Loop 202)	$ 2,100,000	$ 600,000	$ 500,000	$ 1,000,000
Extension of Local Bus Route #112 - Country Club Dr/Arizona Ave: Germann Rd to Ocotillo Rd	$ 5,460,000	$ 1,560,000	$ 1,300,000	$ 2,600,000
Increase in service frequency to 15 minutes for Local Bus Route #72 - Scottsdale Rd/Rural Rd	$ 3,066,000	$ 876,000	$ 730,000	$ 1,460,000
Increase in service frequency to 15 minutes during peak hours for Local Bus Route #156 - Chandler Blvd	$ 8,505,000	$ 2,430,000	$ 2,025,000	$ 4,050,000
Elimination of Local Bus Route #96 - Dobson Rd south of Pecos Rd after establishing flexible transit service in Price Road Area	$ (4,242,000)	$ (1,212,000)	$ (1,010,000)	$ (2,020,000)
Addition of one morning trip and one evening trip to Express Bus #542	$ 2,100,000	$ 600,000	$ 500,000	$ 1,000,000
Addition of Express Bus route from Germann Rd Park-and-Ride lot to ASU Tempe Downtown Campus with 5 nb/sb trips per day	$ 3,822,000	$ 1,092,000	$ 910,000	$ 1,820,000
Provide flexible transit service in the North Chandler Area	$ 39,375,000		$ 13,125,000	$ 26,250,000
Provide flexible transit service in the Central Chandler Area	$ 23,625,000		$ 7,875,000	$ 15,750,000
Elimination of Local Bus Route #56 - Priest Dr: 56th St to 48th S, and extension of route to Chandler Blvd	$ (2,565,000)		$ (855,000)	$ (1,710,000)
Extension of Local Bus Route #136 - Gilbert Rd: Ryan Rd to Queen Creek Rd	$ 945,000		$ 315,000	$ 630,000

City of Chandler Transportation Master Plan - Detailed Summary of Improvements and Costs

Improvement Recommendation	Estimated Total Cost	Implementation Timeframe and Estimated Cost		
		Near-term (2020-2025)	*Mid-term (2026-2030)*	*Long-term (2031-2040)*
Reduction to peak hours only in mid-term for Local Bus Route #104 - Alma School Rd and then elimination of route in long-term after establishing the flexible transit service in North Chandler Area	$ (8,025,000)		$ (1,975,000)	$ (6,050,000)
Elimination of Local Bus Route #81 - Hayden Road/McClintock Drive within Chandler after establishing the flexible transit service in West Chandler Area	$ (4,125,000)		$ (1,375,000)	$ (2,750,000)
Addition of transit service along Queen Creek Rd with potential deviated fixed-routes or peak hour service to provide east-west connectivity from Queen Creek to Price Rd	$ 11,850,000		$ 3,950,000	$ 7,900,000
Addition of one additional morning trip and one additional evening trip to Express Bus #542	$ 1,500,000		$ 500,000	$ 1,000,000
Provide flexible transit service in the West Chandler Area	$ 15,750,000			$ 15,750,000
Provide flexible transit service in the Ocotillo Neighborhood	$ 8,450,000			$ 8,450,000
Provide flexible transit service in the Chandler Airpark Area	$ 8,450,000			$ 8,450,000
Provide flexible transit service in the South Chandler Area	$ 8,450,000			$ 8,450,000
Extension of Local Bus Route #112 - Country Club Dr/Arizona Ave: Ocotillo Rd to Chandler Heights Rd	$ 1,900,000			$ 1,900,000
Maintenance of Downtown Transit Center selection study	$ 750,000		$ 250,000	$ 500,000
Maintenance of North Chandler Park-and-Ride Plan	$ 750,000		$ 250,000	$ 500,000
Maintenance of facility expansion of Germann Rd Park-and-Ride	$ 750,000		$ 250,000	$ 500,000
Subtotal of Transit - Operations and Maintenance Recommendations	**$ 161,491,000**	**$ 15,546,000**	**$ 35,015,000**	**$ 110,930,000**
Bicycle/Pedestrian - Capital Improvements				
Prepare bicycle and pedestrian policies and guidelines	$ 600,000	$ 600,000		
Bike lanes on Orchid Ln: Highline Lateral Canal Path to 56th St and on 54th St: Orchid Ln to Ray Rd	$ 100,000	$ 100,000		
Bike lanes on Conference Dr across Loop 101	$ 10,000	$ 10,000		
Pave Highline Lateral Canal Path: Northern City limit to Orchid Ln (joint project with canal owner)	$ 840,000	$ 840,000		
New shared use path along Ashley Trail alignment: Cooper Road to Consolidated Canal	$ 180,000	$ 180,000		
Signalize Ashley Trail crossing of Cooper Road	$ 250,000	$ 250,000		
On-street separated/buffered bike lanes on Frye Rd: 1/2 mile west of Arizona Ave to Consolidated Canal Path	$ 3,600,000	$ 3,600,000		
On-street separated/buffered bike lanes on Hunt Hwy: Cooper Rd to Val Vista Dr (coordinate with traffic calming project)	$ 4,500,000	$ 4,500,000		
Crossing signage improvements for shared use path at Kyrene Rd and Chicago St	$ 10,000	$ 10,000		
Refinement/expansion and implementation of bicycle and pedestrian policies and guidelines	$ 750,000		$ 750,000	
Bike lanes on Brooks Farm Rd: Gilbert Rd to Mustang Dr and directional signage to Lindsay Rd	$ 500,000		$ 500,000	
Improve shared use path and associated equestrian trail along Consolidated Canal path: Chandler Blvd/Cooper Rd and Queen Creek Rd/McQueen Rd and also improve barriers and wayfinding signage	$ 2,100,000		$ 2,100,000	
New shared use path along Appleby Rd alignment: Kibler Dr to Lindsay Rd	$ 4,200,000		$ 4,200,000	
New shared use path along Ocotillo Rd: Dobson Rd to Eastern City limit	$ 13,400,000		$ 13,400,000	
New shared use path along Brooks Farm Rd alignment: Cooper Rd to Gilbert Rd	$ 3,000,000		$ 3,000,000	
Pave Eastern Canal Path: Glacier Place to Riggs Rd (joint project with canal owner)	$ 6,300,000		$ 6,300,000	
Support County paving Consolidated Canal Path: Riggs Rd to Hunt Hwy	$ 3,600,000		$ 3,600,000	
New shared use path along Price Rd/Dobson Rd: Loop 202 to Ocotillo Rd	$ 7,400,000		$ 7,400,000	
Pave Kyrene Branch Canal Path: Northern City limit to Linda Ln (joint project with canal owner)	$ 1,800,000		$ 1,800,000	
Signalize Appleby Rd shared use path crossing of McQueen Rd	$ 250,000		$ 250,000	
Signalize Appleby Rd shared use path crossing of Cooper Rd	$ 250,000		$ 250,000	
Signalize Appleby Rd shared use path crossing of Gilbert Rd	$ 250,000		$ 250,000	
Signalize Brooks Farm Rd shared use path crossing of Gilbert Rd	$ 250,000		$ 250,000	
Signalize Eastern Canal Path crossing of Chandler Heights Rd (joint project with canal owner)	$ 250,000		$ 250,000	
Support County signalizing Consolidated Canal Path crossing of Riggs Rd (joint project with County and canal owner)	$ 250,000		$ 250,000	
Crossing signage improvement for Eastern Canal Path at Ocotillo Rd (joint project with canal owner)	$ 10,000		$ 10,000	
Crossing signage improvement for Eastern Canal Path at Gilbert Rd (joint project with canal owner)	$ 10,000		$ 10,000	
Crossing signage improvements for Kyrene Branch Canal Path at Ray Rd	$ 10,000		$ 10,000	
Bridge over Eastern Canal for Appleby Rd shared use path (joint project with canal owner)	$ 500,000		$ 500,000	
Bridge over Eastern Canal for Brooks Farm Rd shared use path (joint project with canal owner)	$ 500,000		$ 500,000	
Bike route directional signage on Brooks Farm Rd: McQueen Rd to Consolidated Canal Path/Paseo Trail	$ 10,000		$ 10,000	
Refinement/expansion and implementation of bicycle and pedestrian policies and guidelines	$ 2,000,000			$ 2,000,000
Bike lanes on Warner Rd: North Pennington Dr to South Pennington Dr	$ 160,000			$ 160,000
Bike lanes on Arizona Ave: Erie St to Western Canal Path	$ 10,500,000			$ 10,500,000
Bike lanes on Ray Rd: Dobson Rd to Comanche Dr and McQueen Rd to Cooper Rd	$ 1,800,000			$ 1,800,000
Bike lanes on Alma School Rd: Elliot Rd to Chandler Blvd	$ 9,000,000			$ 9,000,000
Bike lanes on Ellis Rd: Chandler Blvd to Frye Rd	$ 500,000			$ 500,000
Bike lanes on Rural Rd: Northern City limit to Chandler Blvd	$ 3,900,000			$ 3,900,000
Bike lanes on 56th St: Northern City limit to Frye Rd	$ 6,000,000			$ 6,000,000
Bike lanes on Hunt Hwy: Arizona Ave to E. of McQueen Rd (joint project with County)	$ 1,300,000			$ 1,300,000
Bike lanes on McQueen Rd: N. of Hunt Hwy to Hunt Hwy (joint project with County)	$ 300,000			$ 300,000
New shared use path along the UPRR railroad spur tracks: Northern City limit to Riggs Rd (joint project with railroad)	$ 32,700,000			$ 32,700,000
New shared use path along Loop 202: I-10 to Eastern City limit (joint project with ADOT)	$ 21,400,000			$ 21,400,000
New shared use path along Basha Rd: Ocotillo Rd to Snedigar Park	$ 800,000			$ 800,000
Bridge over Loop 101 north of Ray Rd: Trail west of Loop 101 to Calle Del Norte east of Loop 101 (joint project with ADOT)	$ 14,000,000			$ 14,000,000
On-street separated/buffered bike lanes on Arizona Ave: Ray Rd to Frye Rd (contingent on, and coordinate with, high-capacity transit being installed on Arizona Ave)	$ 2,250,000			$ 2,250,000
On-street separated/buffered bike lanes on Chandler Blvd: Western City limit to Eastern City limit (contingent on, and coordinate with, high-capacity transit being installed on Chandler Blvd)	$ 15,750,000			$ 15,750,000
Subtotal of Bicycle/Pedestrian - Capital Improvements	**$ 178,040,000**	**$ 10,090,000**	**$ 45,590,000**	**$ 122,360,000**
Bicycle/Pedestrian - Operations and Maintenance Recommendations				
Ongoing maintenance of bicycle and pedestrian facilities (beyond that covered by roadway maintenance)	$ 5,450,000	$ 1,200,000	$ 1,250,000	$ 3,000,000
Subtotal of Bicycle/Pedestrian - Operations and Maintenance Recommendations	**$ 5,450,000**	**$ 1,200,000**	**$ 1,250,000**	**$ 3,000,000**

Subtotal of Roadway - All Costs	$ 617,750,000	$ 108,150,000	$ 220,100,000	$ 289,500,000
Subtotal of Transit - All Costs	$ 192,941,000	$ 17,746,000	$ 51,865,000	$ 123,330,000
Subtotal of Bicycle/Pedestrian - All Costs	$ 183,490,000	$ 11,290,000	$ 46,840,000	$ 125,360,000
Subtotal of All Capital Improvements	$ 522,290,000	$ 45,340,000	$ 211,190,000	$ 265,760,000
Subtotal of All Operations and Maintenance Recommendations	$ 471,891,000	$ 91,846,000	$ 107,615,000	$ 272,430,000
Total of All Recommendations	**$ 994,181,000**	**$ 137,186,000**	**$ 318,805,000**	**$ 538,190,000**

APPENDIX B – COMMUNITY ENGAGEMENT MATERIALS

- Community Engagement Plan;
- Transportation Survey Infographic;
- Transportation Survey Results;
- Public Meeting Materials;
- Stakeholder Workshop Presentation;
- Stakeholder Workshop Meeting Notes;
- Transportation Commission Presentations; and
- Transportation Commission Meeting Notes.

A hard copy of Appendix B is available to view at the City Clerk's Office, 175 S. Arizona Avenue, Chandler, Arizona 85225. An electronic version is available to view at the city's website: https://www.chandleraz.gov/residents/transportation