ARIZONA AVENUE ALTERNATIVES ANALYSIS

Final Report

JUNE 2021

VALLEY METRO

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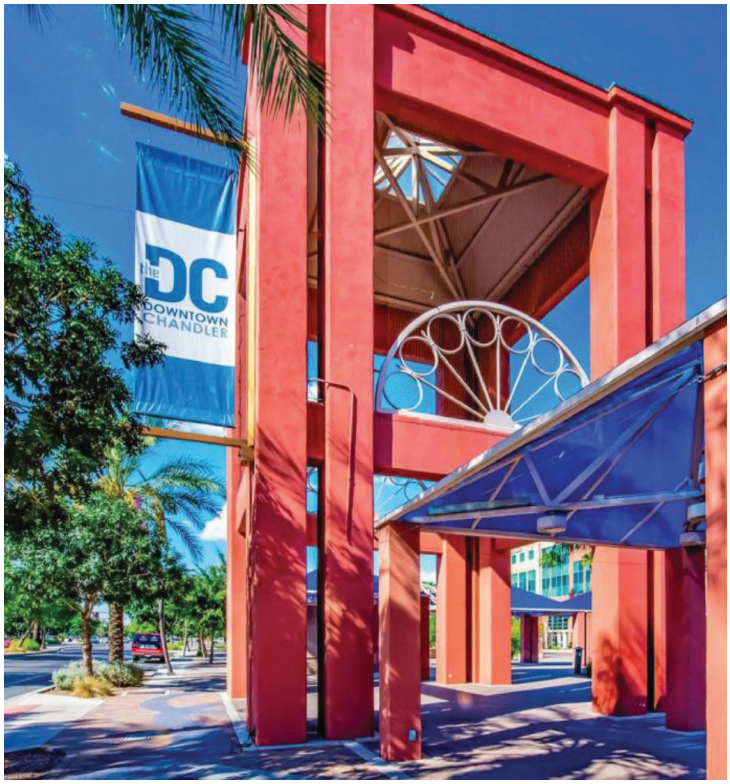


Introduction

Valley Metro, in coordination with the City of Chandler, conducted the Arizona Avenue Alternatives Analysis (AAAA) to evaluate the potential of a future high-capacity transit (HCT) system to connect points of interest, planned developments and emerging transit corridors in Chandler and the greater East Valley.

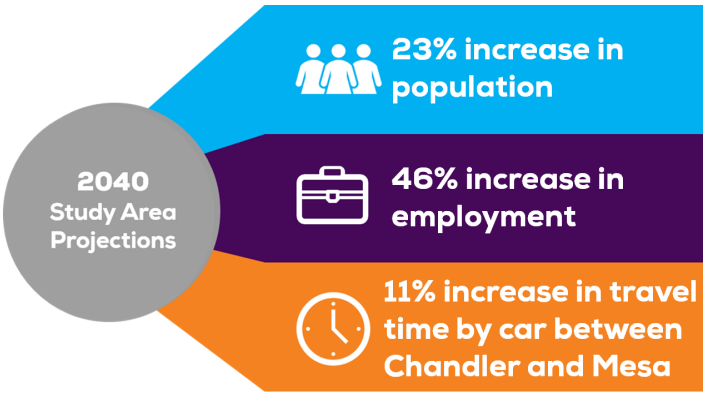
The study identified and analyzed potential corridors for a future HCT system to serve Chandler. The results of the study will help Chandler plan and prioritize future transit investments. This report summarizes the study's methodology, recommended corridors and next steps to realize a future HCT corridor in Chandler.

Background

What is the Purpose of studying HCT in Chandler?

- To enhance HCT connectivity to the existing light rail and potential future projects in the Fiesta District in Mesa
- To support growing population and employment in the study area
- To assist with travel demand within the study area especially between Downtown Chandler and surrounding activity centers
- To further the momentum of economic and transit-oriented development in the study area
- To support regional efforts for congestion mitigation and air quality improvement
- To aid mobility of transit-dependent population

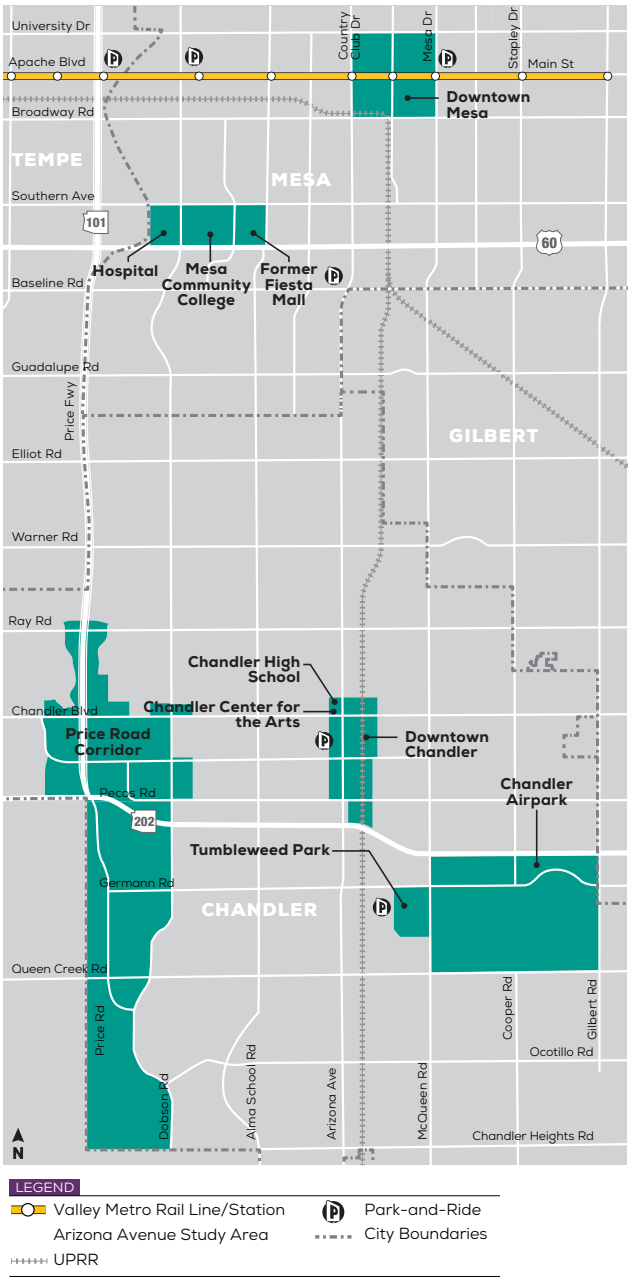
The study area has a relatively high population density, demonstrates existing transit use and includes many economic development opportunities.



Source: MAG 2017 Regional Transportation Model

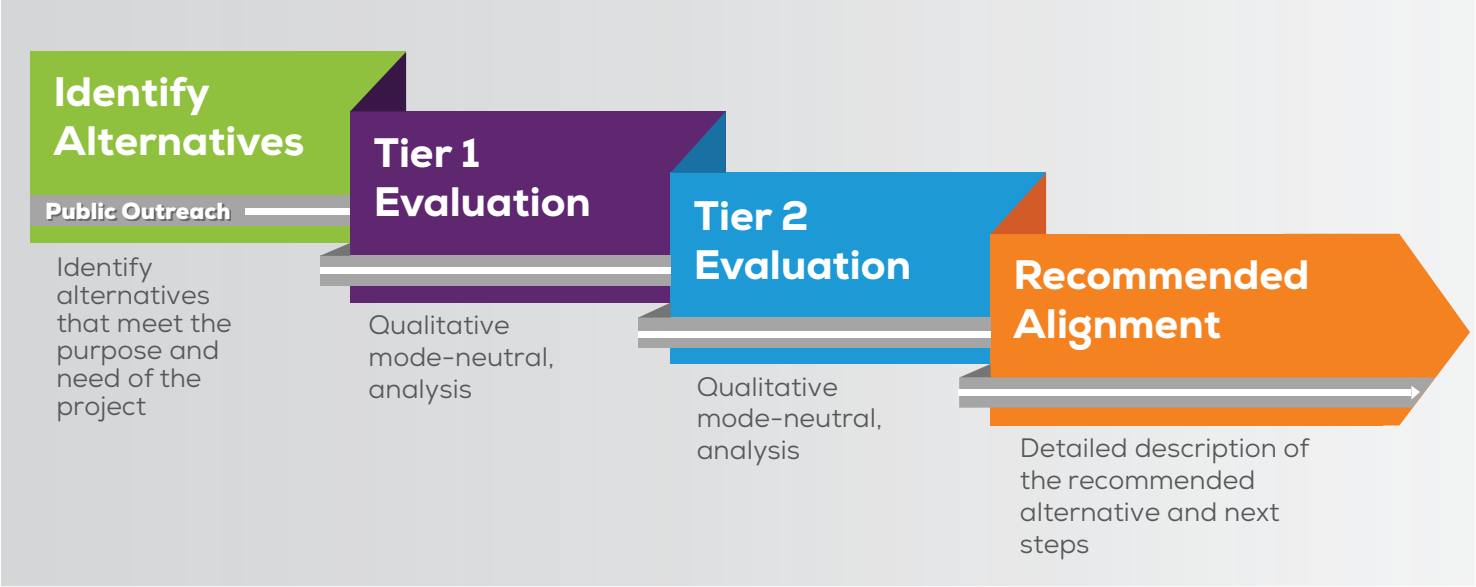
The characteristics of the study area suggest strong future growth and travel demand that warrants a future investment in HCT and other transit services.

The AAAA study area includes portions of Chandler, Mesa and Gilbert and stretches from Southern Avenue to Chandler Heights Boulevard and follows the Loop 101/Price Road and Gilbert Road. It includes Downtown Chandler, the Price Road Corridor and the Chandler Airpark District.



Analysis Process

The evaluation process identifies alternatives and compares qualitative and quantitative data to determine a recommendation.



The alternatives analysis process is a two-tiered evaluation to assess HCT alternatives.

Tier 1 Evaluation is a qualitative, high-level review of potential HCT options within the study area. The assessment of potential alignments during the Tier 1 Evaluation is mode-neutral, assuming each alternative could accommodate either type of HCT mode under consideration, i.e. rail or bus rapid transit (BRT).

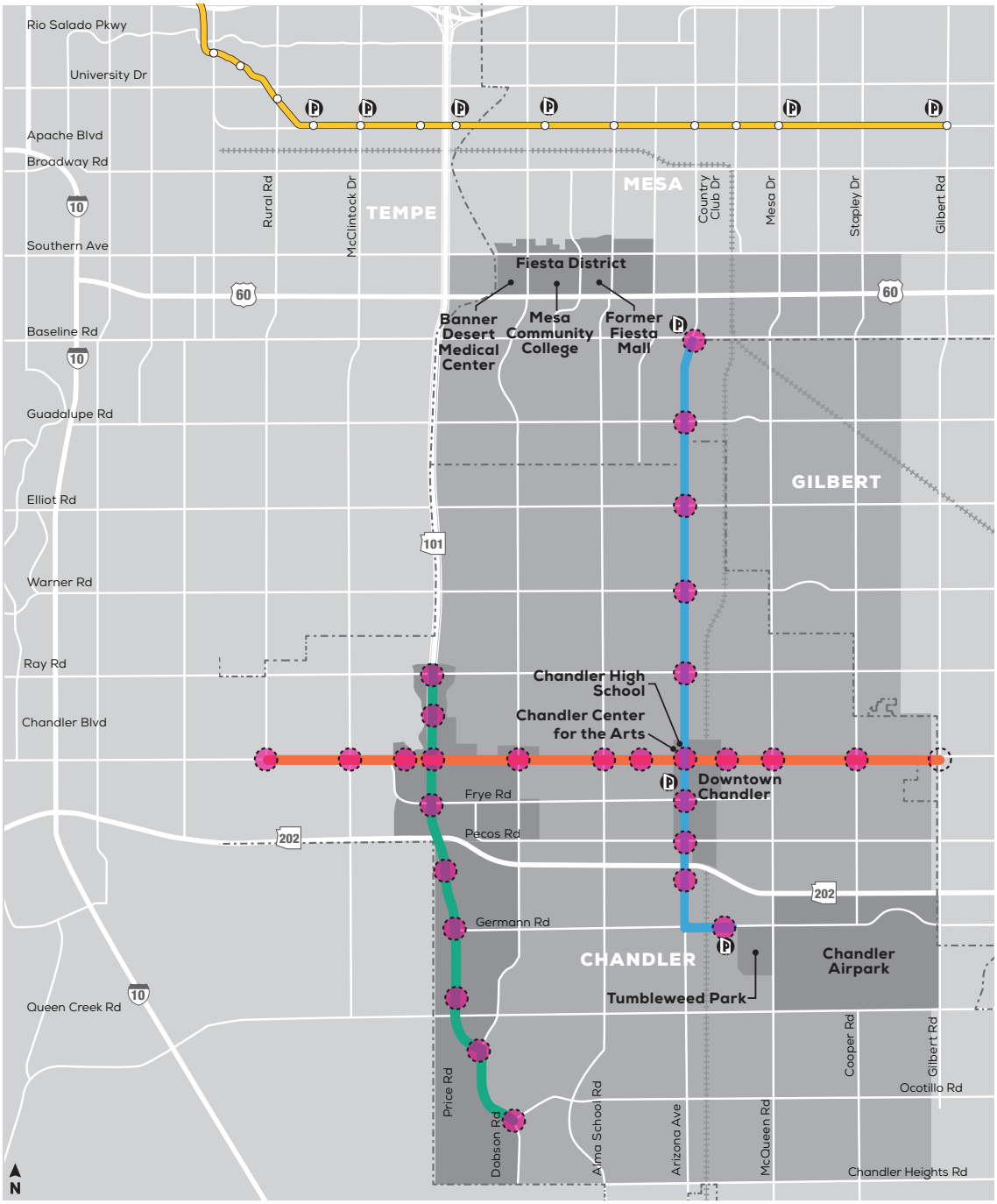
Tier 2 Evaluation assesses the alternatives through a detailed, primarily quantitative analysis with several considerations:

- **Consistency with existing plans and policies**
- **Opportunities for economic development**
- **Compatibility with existing and future transportation network**
- **Physical and engineering constraints**
- **Future population and employment**
- **Existing transit riders**

The results of the Tier 2 Evaluation indicate a Recommended Alignment for future evaluation for HCT in the AAAA study area.

Tier 1 Evaluation

In the Tier 1 Evaluation, Valley Metro and the City of Chandler defined three HCT alternatives informed by the recently adopted Chandler Transportation Master Plan, updated in 2019.



Defined Corridors

Each Corridor has unique opportunities and challenges to support a HCT investment.

Arizona Avenue

- Serves large activity centers such as Downtown Chandler
- Connects to existing bus network
- Multiple opportunities for phasing to connect existing HCT and activity centers such as Fiesta District
- Large amounts of vacant/underutilized properties with potential for transit supportive development

Chandler Boulevard

- Existing land use and transit market supports additional HCT investment
- Connects to existing bus network
- Provides numerous connections to local and regional activity centers such as Chandler Fashion Center
- Does not have a feasible direct connection to existing or future HCT routes

Price Road

- Connection to employment centers such as the Intel campus
- High opportunity of future economic development
- Low population density
- Limited existing transit service along the entire route of this corridor

Each corridor was examined with the intention of having a responsive mode suitable for the continued growth and development of Chandler. The corridor's ability to connect to future HCT projects in the region, as well as the ability to operate in mixed traffic where right of way is limited, such as Downtown Chandler, was considered.

Downtown Chandler

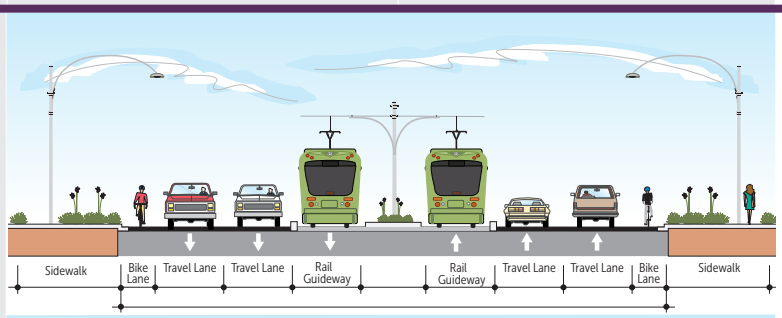
Conceptual Designs

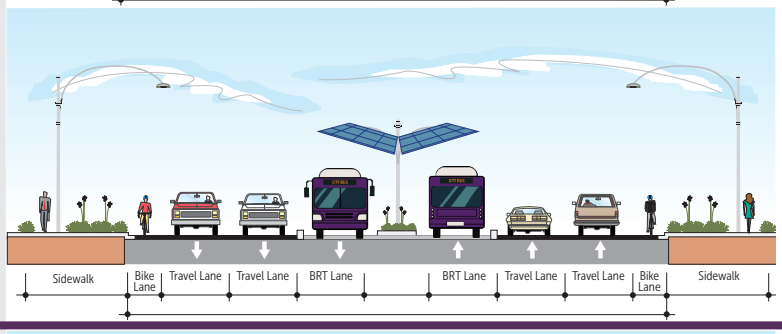
Conceptual designs were developed for a preliminary understanding of the constructability and potential impacts for two types of HCT technologies.

	RAIL	BRT
Operating Environment	Primarily dedicated guideway, mixed traffic	Semi-dedicated guideway, mixed traffic
Spacing of Stops	1/2 to 1 mile	1/2 to 1 mile
Passenger Capacity per Vehicle	130 to 160	60 to 90
Relative Capital Cost	$$	$
Relative Operating Cost	$$$	$

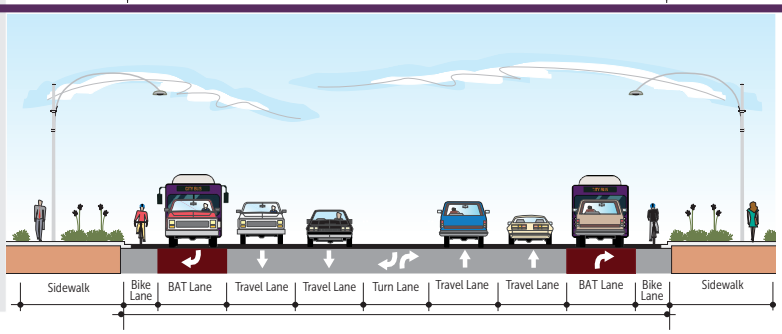
The Rail mode is a hybrid option between streetcar and light rail. It is envisioned as a streetcar vehicle with streetcar stops that operates in an exclusive guideway for a large portion of the alignment then in mixed traffic while downtown.

Bus Rapid Transit considered for analysis operates with semi-exclusive guideway in portions of the alignment.





Semi-exclusive guideway where the Rail or BRT travels in the median or on the side of the road without other vehicles requires re-purposing of automobile lanes or widening the street.



Mixed-flow guideway where automobiles and BRT share lanes together either in the median or curb lanes, uses the existing lanes.

Tier 2 Evaluation

The Tier 2 Evaluation is the secondary screening of the potential alternatives for advancement. The recommended alternatives underwent a detailed, primarily quantitative analysis. The three alignment alternatives, combined with transit types, were compared to each other across the identified criteria elements and given a rating of high(3), medium(2), or low performance(1).

	Evaluation Criteria	Evaluation Criteria Weight	Alternative 1 Arizona Avenue | 8.5 miles		Alternative 2 Chandler Boulevard | 8 miles		Alternative 3 Price Road | 5.5 miles	
			RAIL Score	BRT Score	RAIL Score	BRT Score	RAIL Score	BRT Score
Ridership Potential	Forecasted Daily Transit Trips per Mile	5	3	2	3	1	1	1
	Forecasted Percent Zero-Car Transit Trips	1	1	1	2	2	3	2
	Daily Transit Trips per Mile	1	3	3	2	2	1	1
		Subtotal	19	14	19	9	9	8
Transit Access	Population Density in Stop Area	1	2	2	3	3	1	1
	Employment Density in Stop Area	2	1	1	2	2	3	3
	Publicly-Supported Housing in Study Area	1	2	2	3	3	2	1
	Connections with Existing Transit Routes	2	3	3	2	2	1	1
	Connections with Future HCT Routes	2	3	3	2	3	2	2
	Connections with Bikeways/ Multi-Use Paths	1	2	2	3	3	2	2
		Subtotal	20	20	21	21	16	16
Physical & Engineering Constraints	Non-Transit Vehicle Lanes	1	2	3	2	3	3	3
	Right of Way and Land Acquisition	1	1	3	1	3	1	3
	Potential Environmental Impacts	1	2	3	2	3	3	3
	Utilities	1	2	3	2	3	1	3
		Subtotal	7	12	7	12	8	12
Land Use & Economic Development	Consistency with Adopted Land Use Plans and Policies	1	3	3	3	3	1	1
	Redevelopment/Transit-Oriented Development (TOD) Opportunities	1	3	3	2	2	2	2
	Opportunity for Integration into Emerging Developments/Districts	1	3	3	1	1	1	1
		Subtotal	9	9	6	6	4	4
Potential Costs	Capital Cost Estimate	1	2	3	1	3	1	3
	Operations and Maintenance (O&M) Cost Estimate	1	1	2	1	2	2	3
	Cost Effectiveness	1	3	3	3	3	1	1
		Subtotal	18	20	17	20	9	11
Transportation Efficiencies	Operating Efficiency	1	2	2	2	2	2	2
	Transit Speed and Reliability Impediments	1	2	2	2	2	3	3
	Scalability	1	2	2	2	2	1	2
		Subtotal	6	6	6	6	6	7
		Total	79	81	76	74	51	58
		Rank	2	1	3	4	6	5

Ridership Potential: forecasted number of riders that the route may attract (from STOPS computer modeling)

Transit Access: future population and employment, existing transit connections and bikeways/paths

Physical & Engineering Constraints: environmental, historic and cultural resources, right-of-way and utilities

Land Use & Economic Development Potential: consistency with local plans and available land for redevelopment

Potential Costs: high-level costs to build and operate Rail and BRT along the route

Transportation Efficiencies: how efficiently could the route be built and operated

In coordination with the City of Chandler, the project team identified three weighted categories in the evaluation: Ridership Potential, Transit Access and Potential Costs.

Community Outreach

Community outreach was conducted for this early-stage technical evaluation, which included opportunities for the public to see and comment on the study development and promote targeted stakeholder involvement.

Open House Meetings

Four public meetings were held at different stages of the study.

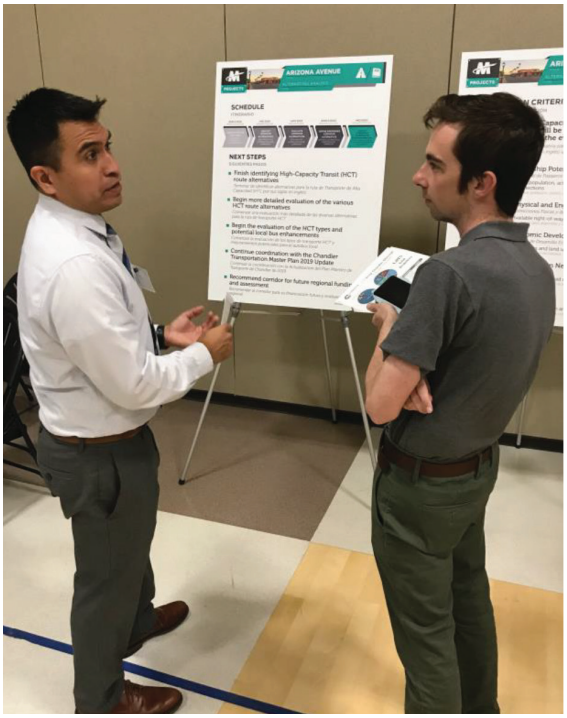
- January 23, 28, 30, 2019: presented project overview, descriptions of the corridors and the Tier 1 Evaluation process.
- October 24, 2019: stakeholders shown the three alternative corridor options.

Key Business Stakeholders

- 28 key business stakeholders attended the workshops.
- Stakeholders included large employers, special interest groups and commercial property owners.
- Discussion focused on understanding the study process and the future transit needs of the area.

Online Website and Social Media

- A webpage for the project was created on Valley Metro's website and updated quarterly or as needed.
- Valley Metro posted public meeting notifications on the agency's Facebook and Twitter pages.
- These notifications were frequently reposted by the City of Chandler Communications and Public Affairs Department and by several large Chandler Community Facebook groups.



AAAA open house meeting

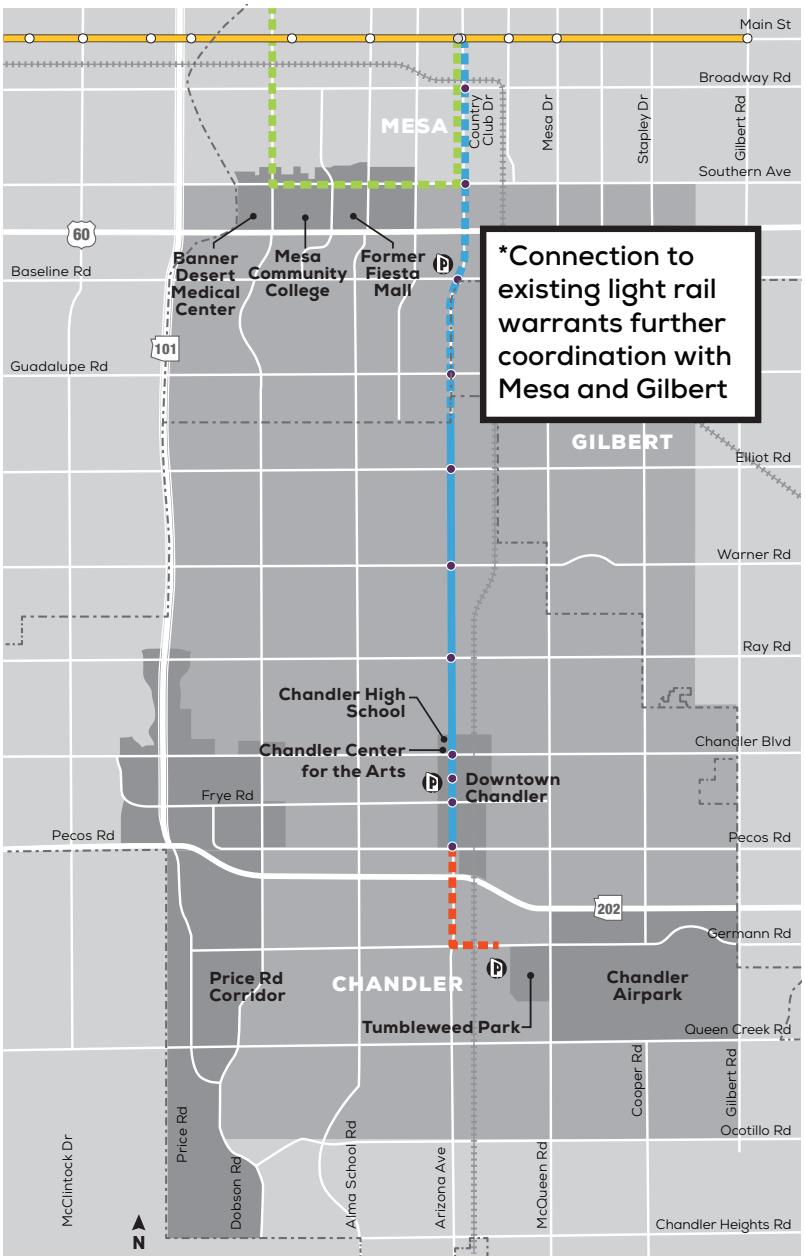
Notable Takeaways

- The majority of public input expressed support for HCT in Chandler.
- A desire to connect to existing HCT was conveyed.
- Arizona Avenue was commented as being the preferred alternative to Price Road and Chandler Blvd.

Recommendation

The recommended alignment alternative for future HCT is Arizona Avenue.

Different end-of-line options in the study area were assessed to measure ideal conditions for both BRT and Rail. For both modes Pecos Road was found to be the most feasible end-of-line option; however BRT has the ability to deviate from dedicated guideway and continue operating in mixed traffic like local bus service to the Chandler park-and-ride if desired.



Pecos Road is the recommended end-of-line option for BRT service with dedicated guideway. Future extensions that operate in mixed traffic could be made to;

- Chandler Park-and-Ride
- Germann Road

For potential rail service, the Arizona Avenue alignment begins at Pecos Road, travels north on Arizona Avenue to the Western Canal with opportunity for connection to the proposed Fiesta District HCT.

Compared to all other alternatives, Arizona Avenue ranked highest in two criteria categories:

- Mobility improvements
- Land use & economic development

Arizona Avenue rated highly in Transit Access as well.

LEGEND

- Valley Metro Rail/Station
- Planned Fiesta District HCT
- Arizona Ave HCT/Station
- Arizona Ave HCT Extension /Stations (subject to Mesa and Gilbert coordination)
- Arizona Ave Study Area
- City Boundries
- Possible Arizona Ave BRT Mode Extension (no dedicated lane)

The recommendation is mode neutral with characteristics compatible with dedicated guideway for BRT or Rail.

Future Technologies

How does transit fit into the future of transportation?

Scenario modeling allows planners, decision-makers and other key stakeholders to understand the potential impacts of a range of interrelated decisions. At some level the future is uncertain; therefore, scenario planning is not intended to predict the future. Scenario planning provides an understanding of potential future outcomes and supports decision making.

Four scenarios were modeled to explore the change in the annual number of transit riders over the next 50 years (2020-2070). The baseline indicated a continuation of existing services and conditions; Scenario 1 is personally owned autonomous vehicles (AV) as well as existing transit without service improvements; Scenario 2 is personal and shared AVs with some microtransit options, and Scenario 3 is personal and shared AVs with HCT, automated bus service and increased transit service.

Baseline

Continuation of existing service and conditions

Scenario 1

Personally owned AVs; existing transit; no service improvements

Scenario 2

Personal & shared AVs; some AV micro-transit

Scenario 3

Personal & shared AVs; Arizona Avenue HCT; AV buses; increase transit service

Scenario results indicate changes in annual transit riders compared to baseline (2070)

Project ridership in the study area based on MAG modeling forecasted population and employment growth.

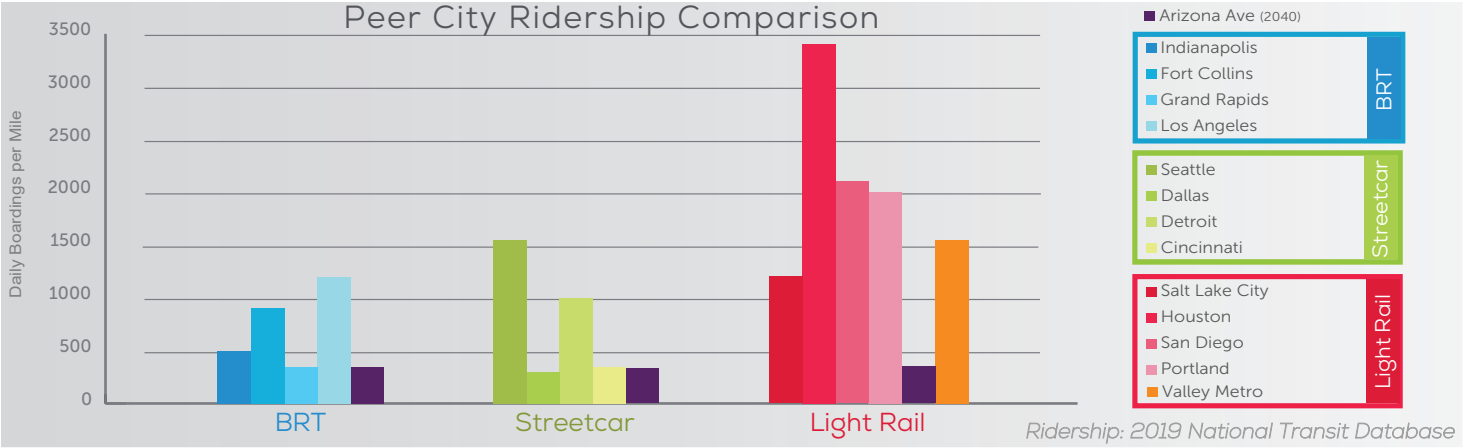
Takeaways

Personally owned AVs (Scenario 1) tend to make system performance slightly worse (lower transit ridership, more vehicles miles traveled, longer commute times) compared to the estimated baseline conditions. Adding transit investments tends to improve system performance for most of the performance measures.

Transit ridership was highest (Scenario 3) when plans and policies use AVs to provide multi-modal options.

Scenario modeling indicates transit should be part of the automated mobility future. Riders will use transit if the benefits of AV are applied to transit services.

Next Steps: Transit-Supportive Decisions



Ridership: 2019 National Transit Database

What can Arizona Avenue learn from existing HCT corridors?

- Almost all peer city BRT corridors in the comparison have some or total exclusive guideway with the exception of Grand Rapids BRT corridor, which has no exclusive guideway.
- Peer city streetcar corridors in the comparison are shorter in length than the Arizona Avenue corridor and travel a shorter distance to dense urban areas.
- Peer city light rail corridors in the comparison are full systems with multiple lines.

A number of actions can be taken to enhance HCT viability along the recommended route (Arizona Avenue). These actions include:

- Implement transit supportive policies that would encourage Transit Oriented Development, bike and pedestrian friendly connections.
- Limiting the amount of parking in the urban core, raising parking costs and providing more affordable housing in the corridor could make the corridor land use more suitable for HCT.
- Mobility improvements such as enhancing local bus network that feed into Arizona Avenue could build the transit market along the corridor.

1. Mixed use development (residential/office/retail)
2. High visibility bike lane improvements
3. Center lane exclusive guideway
4. Improvised pedestrian crossing with high visibility cross walks
5. Widened sidewalk and landscape features

Next Steps: Regional Planning

A project with regional impact requires regional support.

In early 2020, the Maricopa Association of Governments (MAG) announced a call for projects to inform their effort in developing a new regional transportation plan (RTP) and extending Maricopa County's dedicated transportation sales tax (Proposition 400). The City of Chandler submitted Arizona Avenue as a future HCT investment.

This corridor could compete for future regional funding from the extension of Proposition 400. A locally preferred alternative (LPA) will need to be approved by the City of Chandler to be adopted into the RTP.

Select a HCT Mode for Arizona Avenue.

One of the next steps to selecting the LPA for this corridor is deciding the best HCT mode. The study concluded Arizona Avenue as the recommended corridor, but the results were mode-neutral.

Two primary modes were evaluated to select the recommended corridor: 1) BRT and 2) Rail, which includes streetcar and light rail.

Goals of the future HCT mode analysis would include further evaluation of BRT and rail modes and:

- coordinating with the City of Mesa and the Town of Gilbert to evaluate HCT connections north of Arizona Avenue
- ensuring a straight forward connection with other HCT corridors and the regional HCT system to maximize use of the transit investment and minimize the need for riders to transfer between modes
- weighing the costs and impacts, including right of way, of each mode against the potential return on investment

Future steps following the selection of a regionally adopted LPA before design and construction include:

1) Preliminary Engineering

Develop 30% designs for the corridor, and perform right of way and utilities investigations to further understand costs and impacts

2) Environmental Assessment

Documentation of impacts and mitigation, community outreach and coordination with the Federal Transit Administration

Appendix

Arizona Avenue Alternatives Analysis Public Involvement Plan

INTRODUCTION

This Public Involvement Plan (PIP) serves as a guide to conduct the public participation program integral to the planning process for the initial phase of the Arizona Avenue Alternatives Analysis (AA) Study.

The Council on Environmental Quality (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) direct that, to the fullest extent possible, federal agencies must encourage and facilitate public involvement in decisions that affect the quality of the human environment. Additionally, the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) jointly issued "Public Involvement Techniques for Transportation Decision Making," encouraging public involvement throughout the location and design phases of transportation project, rather than only at decision-making milestones.

The intent of this PIP is to provide guidance for proactively conducting extensive and broad community-based collaboration that is integrated with the planning process to keep relevant agencies and interested public engaged in the development of the AA. The plan is structured to not only inform the community about the study's progress, but also to actively seek and incorporate input from the public into the decision-making process to ensure that the study meets the needs of the community.

Although the program discussed in Section 3.0 is systematic and organized, it will remain flexible to respond to modifications in the technical approach that may arise as a result of the studies, project scoping and additional agency and/or public input, or other influences that arise during the planning process.

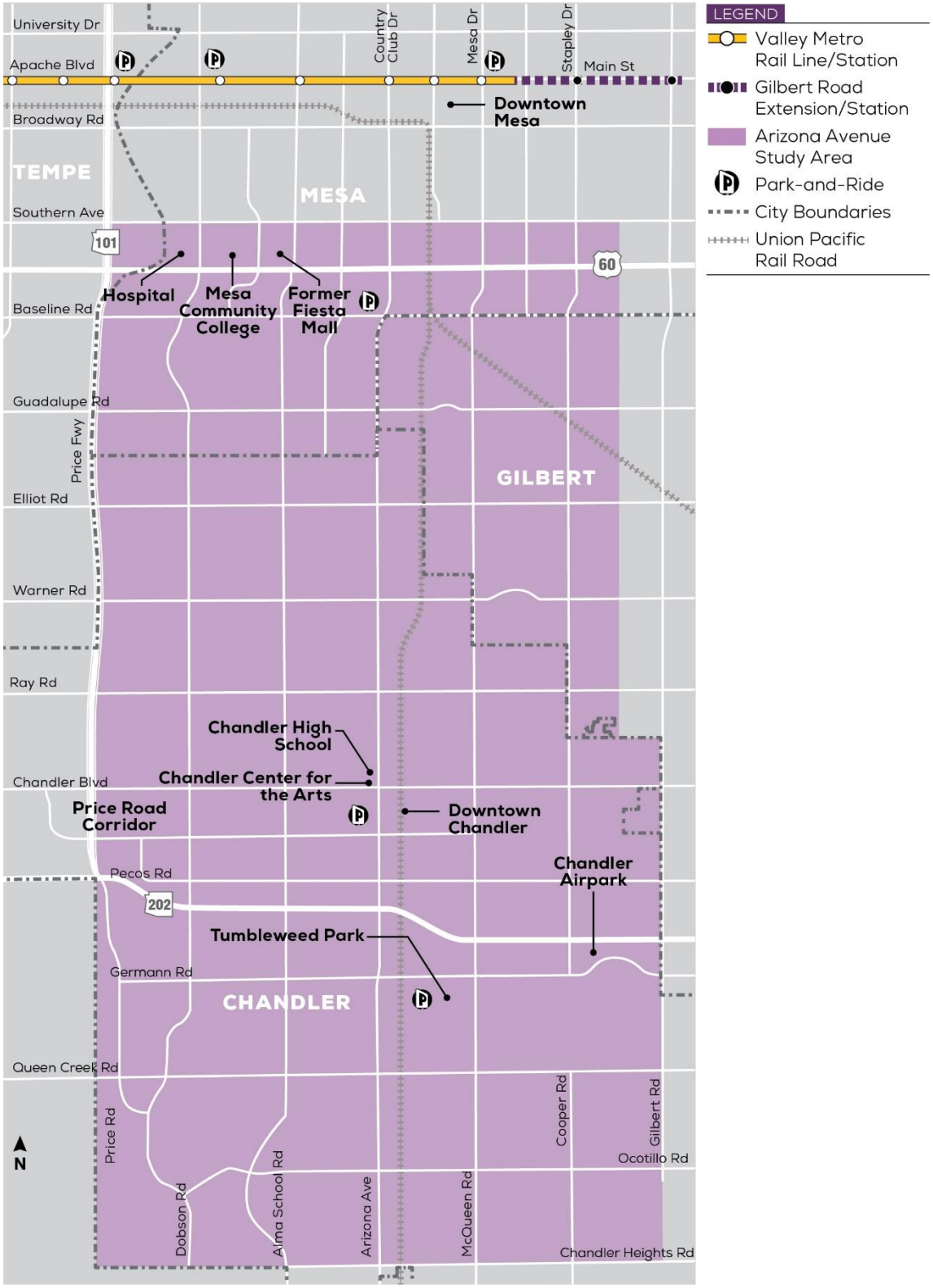
Background

Valley Metro, in partnership with the city of Chandler, initiated the Arizona Avenue AA to evaluate high capacity transit options in a corridor that would connect downtown Chandler to high capacity transit in the Southeast Valley. This study builds upon the results of a previous study conducted by Valley Metro, in partnership with the cities of Chandler and Mesa, and the town of Gilbert: the Fiesta- Downtown Chandler Transit Corridor Study (FDCTCS). That study identified potential land use adjustments and transit investments in a study area encompassing southern Mesa to downtown Chandler. The recommendations of the FDCTCS included conducting this alternatives analysis as the next phase of potential HCT development in the Arizona Avenue corridor.

During the course of the Arizona Avenue AA, the city of Chandler will be developing an update to the city's Transportation Master Plan (TMP). The AA will coordinate public outreach efforts with the staff developing TMP. This work will help avoid confusion about the goals and objectives of each individual

study, ensure consistent and accurate messaging between the two efforts, and leverage the public input received on one study to help inform the other.

Figure 1: Arizona Avenue AA Study Area



The AA phase will analyze and evaluate various types of HCT transit and potential transit routes according to criteria including:

- Ridership;
- Traffic impact;
- Capital costs;
- Operating costs;
- Cost-effectiveness;
- Utility impacts;
- Economic and community development potential;
- Environmental impacts (qualitative);
- Speed;
- Connectivity; and
- Compatibility with community plans.

Phase I of the Arizona Avenue AA is expected to take approximately thirty months and will include input from the general public, study stakeholders (e.g., adjacent neighborhoods, business owners, etc.), and local, regional, state and federal agencies. The study will produce a Locally Preferred Alternatives (LPA), that is, a recommended transit type and route. At the end of this study, citizens and local officials will have specific information to use in making a decision on the LPA.

Purpose of the Public Involvement Plan

The purpose of the Public Involvement Plan (PIP) is to facilitate successful completion of the Arizona Avenue AA by actively seeking and obtaining public and key stakeholder input throughout the study. The PIP is designed to ensure community engagement and integration of public and stakeholder input into the study findings and recommendations. The PIP will identify stakeholders and targeted activities and methods for obtaining community input. Engagement of the community throughout the process greatly increases the successful identification of community issues early on so that those issues may be adequately addressed. The activities undertaken via the PIP are intended to increase all parties' understanding of the goals, needs and potential solutions that best meet the community's needs.

The Public Involvement Plan (PIP) is built on the following guiding principles:

- Public involvement activities directly linked to study milestones, technical activities, and decision-making.
- Adequate opportunities for public involvement and time for public review and comment.
- Early identification of community issues and concerns so they can be effectively addressed during the study's development process.
- Reasonable access to technical and policy information.
- Demonstration of consideration and response to public input obtained.

Solicitation and consideration of the needs of those traditionally underserved by existing transportation systems to ensure their involvement in decision-making. Traditionally underserved populations include, but are not limited to, low income and minority households, Americans with Disabilities Act (ADA) populations, and Native Americans.

Periodic reviews and updates of the PIP are conducted to ensure full and open access is being provided to all who are interested or who could be interested in the study.

Provision of timely information to effected agencies and stakeholders, including those representing central city and other local jurisdiction concerns.

Goals of the Public Involvement Program

The goals of the PIP are as follows:

- Develop public understanding of the study.
- Encourage participation.
- Provide opportunities for continuous public participation.
- Maintain accountability, credibility and accessibility of the study team.
- Obtain meaningful input from a broad range of citizens.
- Incorporate public input into the development of the study recommendations.

Structure of the Plan

The structure of the PIP has been designed to encourage public input and comment and provide opportunities for meaningful communication between the study team and the public. The first step in the process to develop the structure was to identify target audiences, referred to in this document as "stakeholders." The next step was to determine the most effective method(s) for communication with those audiences.

STAKEHOLDERS

A stakeholder refers to any individual, group, or agency affected by or with an interest in the study, and includes the "general public." For this study, stakeholders can be organized into several categories, each with its own characteristics and with specific outreach techniques used to engage them. The stakeholder categories include Agencies/Organizations, General Public, Specifically-Targeted Stakeholders, and Business Community.

Agencies/Organizations

Composition: Individuals and members of government or civic organizations affected by the study. This includes agency staff, City/Town Boards and Commissions or Committees, and City/Town Councils. Examples for this study include:

- City of Chandler
  - Transportation Commission
  - City Council
  - City staff
  - Economic Development Advisory Board

Other special interest groups that comprise this category include various Chambers of Commerce, downtown or business district associations, key stakeholders and community groups. For this study, examples include:

- City of Chandler
  - Chandler Chamber of Commerce
  - Chandler Transportation Commission
  - Downtown Chandler Community Partnerships
  - Downtown Chandler

Valley Metro will collaborate with the study's Project Management Team (PMT) to determine the appropriate level of outreach warranted for the agencies and organizations listed in this section.

General Public

Composition: This group is all encompassing, including all individuals and groups in the study area and beyond. This group includes:

- Individuals more indirectly affected by the study than stakeholders, for example, someone who might live outside of the study area but either drives through the area and/or plans to use transit in the future.
- People with a general interest in the study.

Because of its size and diversity, the general public is typically the most difficult group to engage. Public involvement activities have been designed to reach both the "public" within the study area (aka "stakeholders") and the "public" within the region (the "region" is defined as the metropolitan area). Different groups may be identified based on their geographic location, role in the study and maybe impacted differently based on the stage of the study.

Specifically-Targeted Stakeholders

Composition: Within and among the stakeholder categories described above, there are a few distinct groups that may require targeted and creative collaboration.

- Current Transit Riders (including transit centers and park and rides)
- Persons with Disabilities
- Title VI and Environmental Justice Communities (Elderly/ Minority Community)
  - As part of the outreach efforts, partnerships with existing community organizations, neighborhood organizations, faith-based groups, and citizens' groups will be sought to ensure information is accessible to Title VI and Environmental Justice Communities.

Activities specifically designed to engage the Title VI and Environmental Justice Communities are incorporated into Section 5, Public Involvement Activities, below.

Business Stakeholders

Composition: This group includes individual and corporate business owners and business property owners within the study area. Owners may be local, in state, or out of state. This group includes, but is not limited to:

- Retail businesses
- Grocery stores
- Restaurants
- Service industry
- Motels and hotels
- Information technology
- Finance & insurance
- Real estate
- Professional services
- Transit-supportive industries
- Knowledge-based
- Entertainment

This is another challenging group to engage because of building vacancies, out-of-state owners, multiple management companies, and turnover of primary contacts. Community Relations staff will use the following methods to engage these stakeholders:

- Door-to-door canvassing as determined in coordination with the study team to provide residents and businesses in the area information on the study's status and to gain input.
- E-mail notifications of study materials.
- Development of a study stakeholder database to keep contact information and communication records.

PUBLIC INVOLVEMENT DURING ALTERNATIVES ANALYSIS

The structure of the public involvement program has been designed to encourage public input and comment and provide opportunities for meaningful communication between the study team and the public starting with the identification of key stakeholders and providing the appropriate mechanisms to disseminate information and gather input. The following section provides a description of the fundamental approaches to the implementation of the public involvement program.

The approach to public involvement will evolve throughout the study to ensure that public interests are being served, stakeholders are being educated, and input is reaching the study team. At the onset, study information will be distributed to a broad audience representing the Chandler community.

All public involvement activities will partner when opportunities coincide with the Chandler TMP throughout the study.

PUBLIC INVOLVEMENT ACTIVITIES

At each stage of the study, public involvement tools will be implemented to provide information and seek input specific to that stage. Additionally, the study team will collaborate to identify any other relevant studies and accompanying outreach activities for coordination with the outreach efforts for this study. For example, and as described earlier, outreach efforts and activities will be closely coordinated with the Chandler TMP Update with information that describes the goals of both efforts to minimize stakeholder confusion and maximize public input. The stages and planned outreach approach, objectives, and tools are described below.

STAGE 1: ALTERNATIVES ANALYSIS (AA) STUDY INTRODUCTION

For this initial stage of the study, it will be important to set the stage about the purpose and process of the study. The main objectives for community outreach during this phase are described below.

Objectives

- Introduce the study and describe the process.
- Seek input on community goals and objectives for the study and begin to identify any potential issues or concerns.
- Describe how this study effort relates to other, ongoing studies/projects within the study area.
- Describe how the study relates to concurrent transit effort such as the Chandler Master Transit Plan.
- Describe the importance of community input and how it will be integrated into and considered during the corridor study.

- Engage stakeholders and begin establishing rapport and trust.

Tools

- Public meeting (early 2019)
  - Conducted at an accessible, transit-served location within the study area
  - Strategy for meeting structure will include ways to maximize interactivity, including tactile displays, themed open house "stations," and/or other tools
  - Notified via:
    - Media advisory
    - Website
    - Website calendar
    - City publications
    - E-blast to distribution list
    - Nextdoor
- Electronic survey and/or feedback form
- Updated Fact Sheet describing the study background, status and next steps
- Updated webpage

STAGE 2: ALTERNATIVES DEVELOPMENT AND EVALUATION

In this phase, the team will be actively seeking input on alternatives that have been identified so far in the study. A main component of the information that the team will provide is the methodology for evaluating the alternatives, i.e., what criteria will be used and how in order to identify and compare feasible alternatives that meet the purpose and need. The main objectives for community outreach during this phase are described below.

Objectives

- Describe how alternatives were identified, what criteria will be used to evaluate them, and how.
- Seek input on methodology, communication processes, study-related community issues and concerns.
- Seek input on service areas, transit routes/corridors, destinations and linkages to existing transit services.
- Introduce the federal funding process and how it relates to studies like the Arizona Avenue Alternatives Analysis.
- Provide update information about other, ongoing studies/projects as appropriate.
- Describe the next steps and introduce "locally preferred alternative" (LPA) terminology and approval processes.

Tools

- Public meeting (target early 2019)
  - Conducted at an accessible, transit-served location within the study area
  - Strategy for meeting structure will include ways to maximize interactivity, including tactile displays, themed open house "stations," and/or other tools
  - Notified via:
    - Media advisory
    - Website
    - City publications
    - E-blast to distribution list
- Updated Fact Sheet describing the study progress, status and next steps
- Updated webpage

STAGE 3: PRELIMINARY EVALUATION RESULTS (LPA)

In this stage, the team will introduce the results of its analysis for near- and long-term transit service recommendations and a preliminary Locally Preferred Alternative. Messaging will focus on why the alternative(s) have risen to the top in evaluation and what the next steps are to advance the preferred route and mode. Community input will be sought regarding pros/cons of the leading alternative(s).

Objectives

- Describe how alternatives were identified, what criteria will be used to evaluate them, and how.
- Seek input on the study results and identify concerns/issues specific to the alternative(s).
- Provide update information about other, ongoing studies/projects as appropriate.
- Describe the next steps, e.g., council action, other agencies' actions, funding scenarios.

Tools

- Public meeting (late 2019 or early 2020)
  - Conducted at an accessible, transit-served location within the study area
  - Strategy for meeting structure will include ways to maximize interactivity, including tactile displays, themed open house "stations," and/or other tools
  - Notified via:
    - Media advisory
    - Website
    - City publications
    - E-blast to distribution list
- Updated Fact Sheet describing the study results and next steps
- Updated webpage

ADDITIONAL/ONGOING ACTIVITIES

In addition to the public meetings and study collateral described above, other activities and outreach efforts will simultaneously occur throughout the course of the study as described below.

Study Webpage

A dedicated webpage for the project is established (www.valleymetro.org/az-ave). It will be updated regularly and include notification of upcoming public meetings and posting of public meeting materials, including online surveys and/or versions of any feedback forms.

One-on-one/Neighborhood Group Meetings

Study staff will continually communicate that the team is available to meet with interested stakeholders or groups such as neighborhoods, commissions, committees and special interest groups. At these meetings, depending on the specific nature of the meeting request, members of the study team (e.g., community relations, planning, city staff) will provide an overview of the study and study status, seek input on the study, and address questions or concerns as appropriate.

Community Presentations and Events

Community presentations and events are an opportunity for the team to display study information, provide a forum for members of the public to ask study-related questions and gather input. The study team will support the City in any requests to present, including preparing meeting materials, presentations, handouts, etc.

Coordinating with City staff as well as local organizations like the Chandler Chamber of Commerce and the Downtown Chandler Community Partnership, the study team will strategically choose events to maximize the opportunity to share study information and gather input. Opportunites to partner with the Chandler TMP team will be used for presentations and events.

Collateral Materials

The team will develop study-related collateral materials such as fact sheets, surveys/comment cards, exhibits, and/or other relevant types of communication materials throughout the duration of the study. Collateral materials are intended to be clear, concise sources of important study information such as study summary, timeline, maps, study findings and contact information. Initial materials are created at the onset of the study and are tailored with regard to subject matter, distribution and other needs throughout the study. Fact Sheets are updated quarterly or as needed to accommodate specific outreach strategy. The public involvement team will work with the technical team to develop display and other collateral materials that convey technical information in a manner that is easy to understand.

Distribution of collateral materials may include meetings, mail and email. Materials will be made available in both electronic and hardcopy formats, as appropriate.

Comment Management

Logs and records of public and stakeholder contact will be maintained throughout the study via Valley Metro's stakeholder management system (Boréalis) which includes corresponding update of the study stakeholder/public database. The public involvement process requires consistent procedures for recording and responding to public comments and for relaying public comments to key study team members and decision-makers. Through Boréalis, the type of communication, actions taken, contact information and any additional comments will be documented and added to the permanent record of the study. Comment forms will be distributed at public meetings and other events. An online comment form will also be available to allow members of the public further capability to provide input.

A summary of each public meeting will be prepared to include an overview of the meeting logistics, materials, and input received.

Public comments received during the course of the study will be summarized and included in the public involvement summary report at the end of the study.

Telephone and Email Contact

A single point of contact – the Community Relations (CR) Coordinator – will be established for the study and all calls and emails will be managed by that person, resourcing other team members as needed to ensure up-to-date, timely and accurate information is being conveyed. Contact information (phone number(s) and email address) for the CR Coordinator will be included on all public documents (e.g., Fact Sheet, Feedback Form, webpage).

MEDIA PLAN

Good relationships with the community and news media are a critical component of planning and implementing transit systems. For the Arizona Avenue AA, media activities would occur as determined by the study team for major milestones such as public meeting notification or reporting study results. The Media Plan serves as a means to ensure the media and public are kept informed of notable study activity, progress and status. Highlights of the Media Plan include:

Updates

Study updates will be produced at key milestones as determined by the study team. Updates will provide information about the status of the study and announce upcoming public meetings. Hard copy updates will be produced and used to distribute at events, community meetings, etc. In addition, a PDF version will be available to distribute electronically to stakeholders and to post on the study websites.

Media Advisories

Media advisories or press releases may be prepared for key milestones in the study, as agreed upon by the study team. The advisory/release will be distributed to relevant media outlets such as the *East Valley Tribune*, *Arizona Republic* and local broadcast stations. Depending on the milestone, information may include:

- Meeting announcements
- Agency information
- Study team contacts
- Statistical information about region
- Study information
- Maps/photographs/graphics
- Fact Sheets
- Schedules and timetables
- Cost estimates
- News media clippings
- Quotes (elected officials, neighborhood activists)

INCORPORATING INFORMATION FROM THE PUBLIC

The PIP will include consistent procedures for recording and responding to public comment and for relaying public comment to key study team members and decision makers. As described in section the above, all comments will become a part of the permanent record. All communications with stakeholders within study area will be recorded in the Arizona Avenue AA community relations database, which records a running history of events and stakeholder communication.

Public comment received via e-mail, fax, mail, and telephone will be archived in the study files. Feedback forms and comment cards will be distributed at group presentations, public meetings, and events. These will be recorded and follow-up action (e.g., response to questions) taken when appropriate. Public comments received at public meetings will be recorded in the meeting minutes and will be part of the permanent record.

At the conclusion of the study, a summary report will be prepared, compiling and documenting public involvement activities.

EVALUATION AND MODIFICATION

Throughout the course of the implementation of the PIP, results and effectiveness will be evaluated and compared against the PIP goals and objectives. If particular activities are not meeting the objectives of the PIP, the program activity will be modified or replaced with an alternative activity.

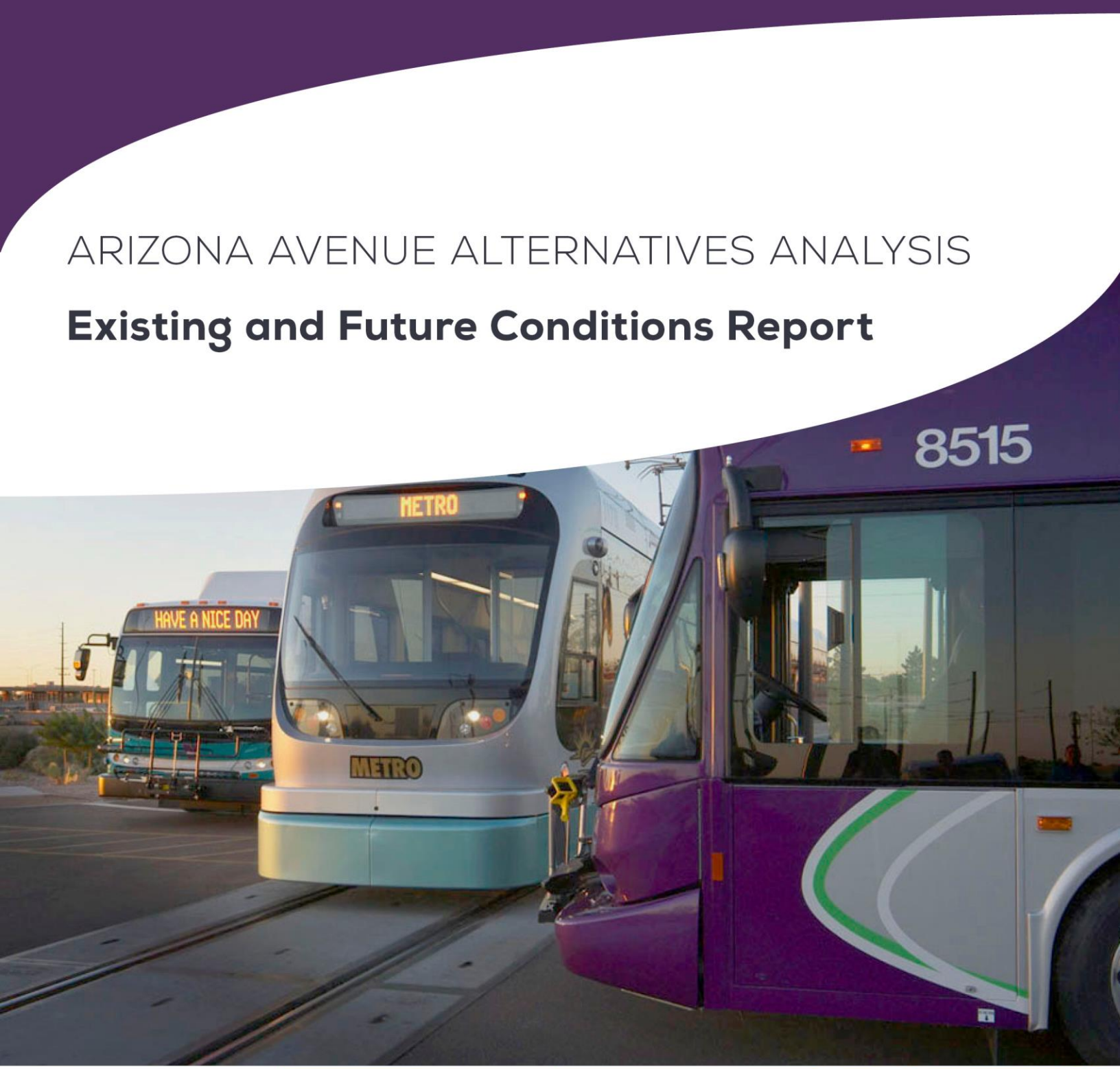
Tools to evaluate the effectiveness of the program will include:

- Program Review and Approval – the PIP will be reviewed by the study team and appropriate staff. Additionally, PIP products will undergo review processes to ensure consistency of messages and to ensure that study team members are apprised of information being distributed to the public.
- Comment Cards – comment cards will be provided at all public involvement events and meetings. These cards can be turned in at the time of the meeting, or mailed at a later date. The cards are preaddressed and have pre-paid postage to encourage mail back. The cards do not ask specific questions, rather, provide space for respondents to provide comments on any topic. The comment card will include an option for the person to be added to the study mailing list.
- E-mail – all e-mail received regarding the study is regularly monitored by Valley Metro's CR Coordinator. The CR Coordinator's e-mail address will be published on all public involvement communication materials and suggestions or comments about the study and/or the public involvement process encouraged. Those comments and suggestions will be recorded and included in the comment and response feedback process.

Information regarding the effectiveness of the program will be solicited from the study team.

ARIZONA AVENUE ALTERNATIVES ANALYSIS

Existing and Future Conditions Report



MAY 2019

VALLEY METRO

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APPENDICES

1.0 INTRODUCTION

In 2015, Valley Metro and member cities, including Mesa, Chandler and Gilbert, collaborated to evaluate the feasibility of high-capacity transit (HCT) investments in the Fiesta District/Downtown Chandler corridor, such as light rail or bus rapid transit. The Fiesta/Downtown Chandler Transit Corridor Study (FDCTCS) resulted in the following key recommendations:

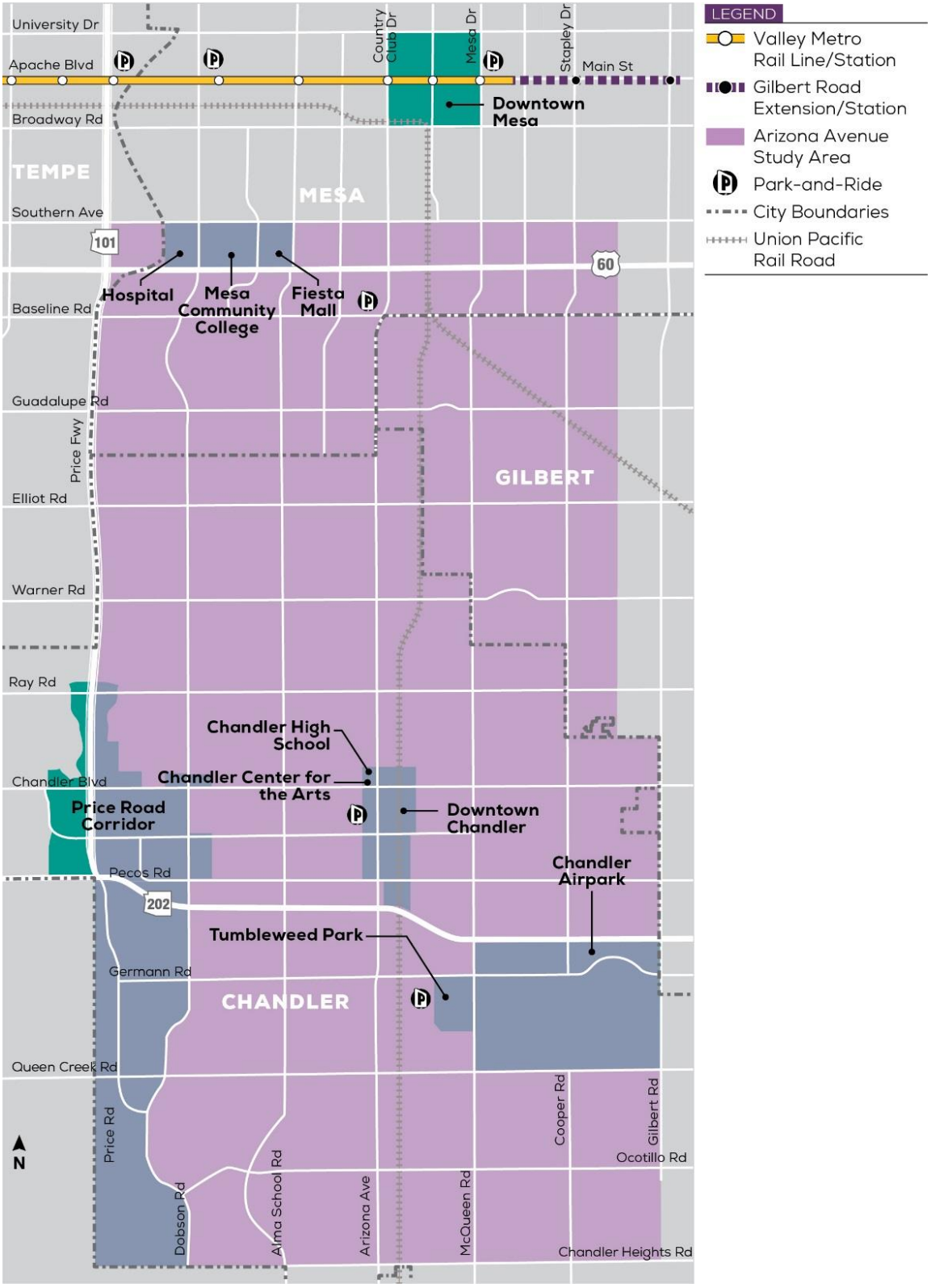
- Conduct an alternatives analysis (AA) study for a phased implementation of HCT in the corridor.
    - Phase I implementation would connect an HCT mode from the existing light rail line in downtown Mesa along Dobson Road and Southern Avenue, terminating in the vicinity of the Southern Avenue/Country Club Drive intersection or the Baseline Road/Country Club Drive intersection.
    - Phase II implantation would extend HCT from the Phase I terminus to Pecos Road and Arizona Avenue.
- Implement short-, mid- and long-term recommendations for transit investments and land use.

The FDCTCS concluded that the corridor along Arizona Avenue as described in the second phase of the alternatives analysis, provides opportunity for an HCT investment, contingent on transit and land use maturing, allowing for increased ridership. Valley Metro, in cooperation with the City of Chandler, is conducting the Arizona Avenue Alternatives Analysis (AAAA) that focuses on the Phase II corridor in Chandler. The AA will result in a recommended locally preferred alternative (LPA) for a new HCT corridor, including recommended specific alignment and transit mode. The LPA will also include recommendations for station locations, street configuration, future phasing scenarios and other important features. This document provides a complete overview of the existing and future conditions of the study area to help establish the basis for HCT investments.

1.1 PROJECT PURPOSE

The *Regional Transportation Plan* (RTP), adopted by the Maricopa Association of Governments (MAG), identifies the major high-capacity transit (HCT) corridors within the MAG region, of which 26 miles are currently operating. The Arizona Avenue Corridor is not part of the 66-mile regional high-capacity/light rail transit (HCT/LRT) system adopted in 2004; however, various studies, including the MAG Southeast Corridor Major Investment Study, found that the Arizona Avenue corridor has demand for all-day transit service. As Figure 1 below shows, the corridor connects major employment centers and other regional destinations, and has the potential for HCT to connect with the Fiesta District Corridor or downtown Mesa with the existing Central Phoenix/East Valley (CP/EV) LRT line. In addition, the *City of Chandler General Plan* (2016) identifies the Arizona Avenue corridor as a potential future HCT corridor.

FIGURE 1: AAAA STUDY AREA MAP



Source: Valley Metro, 2018

2.0 OVERVIEW OF THE STUDY AREA

This section summarizes an evaluation of the study area's existing and future characteristics, as well as the potential for a future HCT investment. The analysis presented in this section outlines relevant planning study recommendations, socioeconomic characteristics, land use patterns, transit needs and transportation network conditions of the AAAA study area featured in Figure 1.

2.1 RELEVANT PLANNING STUDIES

Table 1 summarizes the findings and relevance of documents and planning studies that relate to the study area based on local characteristics, planned transit network and land use guidelines.

TABLE 1: RELEVANT PLANNING STUDIES OVERVIEW

Agency	Summary	Relevance to AAAA
Area Plans		
City of Chandler	The City of Chandler has developed, and is currently implementing, area plans for specific sections of the city. These include the following plans: • Chandler Airpark Area Plan • Southeast Chandler Area Plan • Downtown-South Arizona Avenue Corridor Area Plan These area plans address specific issues unique to the area, but include goals to avoid incompatible land uses, agricultural heritage preservation, employment opportunity protection, dense urban walkable environments, and natural land preservation.	All three of the Area Plans cover the AAAA study area. Specifically, the Chandler Airpark Area and Downtown South Arizona Avenue Corridor cover a large portion of the AAAA study area that were targeted as suitable for planned multimodal transportation and infrastructure expansion to support economic growth by the City of Chandler. Economic revitalization within these growth areas will help strengthen the case for a future HCT investment in the AAAA study area.

General Plans		
City of Chandler General Plan (2016)	The Chandler General Plan is a compilation of policies, maps, text and graphics that guide future growth and development for the City of Chandler. The Plan includes an aspiration for the future of the city, as well as various elements that address specific areas of expertise. This includes land use, character areas, public facilities, transportation, public safety, natural resources and many more elements. It also provides implementation details for meeting the Plan's goals and objectives.	The Strategic Community Building section of the General Plan identifies "Growth Areas"; these are areas considered suitable for transportation and infrastructure expansion to support economic growth. There are identified growth areas that exist within the AAAA study area. The Strategic Community Building section also encourages live/work developments in high capacity transit corridors and pedestrian and bicycle connectivity to transit facilities. The section identifies Arizona Avenue as a transit corridor, which promotes HCT, dense development and a walkable environment. Overall, the goals and objectives exhibited in the General Plan are consistent with the expected outcomes of the AAAA.
Town of Gilbert General Plan (2012)	The Town of Gilbert's General Plan is the community's guide for future physical, economic and social development. This citizen-driven public document reflects the vision of the community and acts as the guide and direction for the town's progress. The plan includes long-range policies, goals and strategies for implementation to enhance economic development, public facilities, neighborhood preservation and revitalization in Gilbert.	The Gilbert General Plan identifies several growth areas that are particularly suitable for planned multi-modal transportation and infrastructure expansion. Although not actually in the AAAA study area, two of these growth areas lie along the edge of the study area boundary, well within range to improve HCT potential. The Heritage District and Gilbert & 202 growth areas are directly adjacent to the AAAA study area and have goals established by the City of Gilbert to reduce automobile dependency and provide priority funding for transportation/transit projects.

Transportation Master Plan		
City of Chandler Transportation Master Plan (2010)	The Chandler Transportation Plan is the city's intention for the continued development of a connected transportation network. The TMP is being updated for 2019, but the current plan's goals are various, and include connecting residents to key locations without the use of car if possible, as well as continuing the development of an integrated, balanced multi-modal transportation system. The Transportation Plan's goals and objectives relay different implantation tools with the intention of improving various modes of transportation as well as transportation upgrades in the form of complete streets, roadway optimization, pedestrian and bicycle way improvements, and intelligent transportation systems. The different Sections of the plan establish existing conditions, identify current needs and discuss future improvements. Lastly, the Plan discusses the overall circulation of the city and outlines goal and objectives for the implementation of projects.	Section 5 of the Transportation Plan discusses the future of transit in Chandler and identifies the significant transit improvements within the city for the near-term, mid-term and long-term. All of the various elements of the Plan, especially the bicycle, transit and pedestrian elements, recommend the development of a multi-modal transportation network, which is consistent with the implementation of HCT in the AAAA study area.
System Configuration Study (Ongoing)		
Valley Metro	The System Configuration Study is an ongoing effort by Valley Metro to plan for the full build-out of the region's light rail network. The prevailing configuration for the system would be a north/south line and an east/west line intersecting in downtown Phoenix. There is also the option of implementing an overlay service that could provide 6-minute frequency in core areas of the system that are yet to be confirmed. The Study also recommends the implementation of downtown track work to allow for operation during construction and flexibility.	Although the System Configuration Study does not address projects that are not in the RTP, the results of this study will affect the AAAA. After build-out of the current RTP, the light rail system will be configured generally with separate lines running north/south and east/west, interchanging at downtown Phoenix. There are also discussions to implement overlay service between the East Valley and Phoenix to provide 6-minute headways on the core segment of the line. This service may provide possible interlining opportunities for the AAAA corridor to connect into the existing system.

Fiesta-Downtown Chandler Transit Corridor Study (2017)		
Valley Metro/Chandler/Mesa	The Fiesta-Downtown Chandler Transit Corridor Study 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 – Mesa, Chandler, Gilbert and MAG − identified potential land use adjustments and transit investments, including local bus service and HCT appropriate in the short- (2020), mid- (2030) and long-term (2040) to meet the anticipated travel demand in the area.	The Study identified the need for increased transit service within the AAAA study area through comparison of the Dobson Road/Southern Avenue corridor to Country Club Road in Mesa. Specifically, the recommendation was for high capacity transit from Main Street along Dobson Road, Southern Avenue and Country Club Drive/Arizona Avenue to downtown Chandler. The Study also 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. These recommendations served as the basis for the AAAA.
Arizona Avenue High Capacity Transit Long Range Study (2012)		
Valley Metro/Chandler	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 viable for HCT service. In addition, this study provided a review of the necessary capital and operating costs that would be associated with HCT development in this corridor.	The Study recommended transit service enhancements along Arizona Avenue, which could include HCT. These results were based on analysis and land use scenarios that would enhance transit ridership. 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. All of these recommendations were carried forward in the FDCTCS for further analysis.

Southeast Valley Transit System Study (2015)		
Valley Metro/MAG	The Southeast Valley Transit System Study identified short-, mid- and long-term recommendations that would expand and improve the transit system throughout the Southeast Valley. The study included an evaluation of the existing transit conditions followed by an analysis of the transit needs for the area, including a review of existing services, an analysis of current and future travel demands, planning for future population growth and economic development, and community input. The final report presented these recommendations for optimizing transit services in the study area in the short term.	The Study included recommendations to improve and expand transit service in the FDCTCS study area, which overlays the AAAA study area. This included adjusting service frequency to at least 30-minute frequency for local bus service throughout the southeast valley, as well as consolidating LINK and local services along Main Street and Arizona Avenue into a higher frequency service that matches light rail headways. These service enhancements will support a future investment in HCT.
Southeast Corridor Major Investment Study (2012)		
MAG	The Southeast Corridor Major Investment Study was developed by MAG to explore transportation strategies influenced by the travel demand between the East Valley and Central Phoenix. The study highlighted the high concentrations of employment in the Southeast Corridor and the evolving needs for transportation services. The purpose of the study was to consider transportation options for the Southeast Corridor as well as expansion options for Interstate 10.	The results of this study produced transportation alternatives in the form of HCT on exclusive right-of-ways, interconnectivity with the existing light rail system, as well as possible commuter rail connection. The study area for the Southeast Corridor Major Investment study only incorporates a portion of the AAAA study area, and largely lies along the edge of the study area boundary, but is close enough to improve HCT potential within the AAAA study area.
Sustainable Transportation and Land Use Integration Study (2013)		
MAG	The purpose of this study was to highlight the potential to move the Phoenix metropolitan region towards greater use of sustainable transportation modes including transit, walking and biking. The study examined transit investments and services previously recommended for consideration, and supported the creation of transit-oriented communities.	Although this study does not include recommendations specific to the AAAA, it does outlines land use and station area planning guidelines that will assist in the development of the corridor, with a primary focus of maximizing residential and commercial opportunities to coincide with HCT investments. These guidelines will be utilized during AAAA station area planning exercises.

2.2 POPULATION AND EMPLOYMENT

A review of existing and projected future population and employment was conducted to understand the socioeconomic trends within the study area. MAG Transportation Analysis Zones (TAZs) data was used to determine the socioeconomic characteristics and trends within the study area. TAZ data, which is developed by MAG, provides projected growth figures for population and employment. The most recent existing year data in this dataset is 2015; 2040 was used as the projected year based on the expected date that the AAAA study area could see HCT investments.

2.2.1 Population

As of 2015, over 250,000 people reside within the AAAA study area (approximately 4,000 people per square mile), with a projected growth of 22 percent by the year 2040 to reach a population of 300,000. Similarly, the City of Chandler population is forecasted to grow by 23 percent, while the MAG region is forecasted to grow by 48 percent over that same timeframe. Although the region is projected to grow more than the study area, it should be noted that the AAAA study area is significantly denser than the region as a whole. Table 2 outlines the population growth for the study area, the City of Chandler and the region.

TABLE 2: POPULATION GROWTH

Location	Total Population		2015-2040 Growth		Population Density (per square mile)	
	2015	2040	Change	Percent	2015	2040
MAG-Region	4,000,000	6,000,000	2,000,000	50%	450	650
City of Chandler	250,000	300,000	60,000	20%	3,800	4,700
AAAA Study Area	260,000	320,000	60,000	23%	4,000	5000

Source: MAG TAZ, 2016

As shown in Appendix A, one of the most densely populated portions of the study area is located between Baseline Road and Warner Road, from Arizona Avenue on the west to Cooper Road on the east. Appendix B illustrates the projected population density in 2040. The corridor along Arizona Avenue within in the study area is projected to become denser, especially near the municipal airport.

2.2.2 Employment

As of 2015, the AAAA study area had about 145,000 employees (approximately 2,200 employees per square mile), with a projected employment growth of 46 percent by 2040 to 212,000. Similarly, Chandler employment is forecasted to grow by 43 percent, which is similar to the MAG region which is forecasted to grow 50 percent over that same timeframe. It is worth noting however, that the AAAA study area has more employees per square mile compared to the City of Chandler and the MAG region. Table 3 outlines the employment growth for the study area, city and region.

TABLE 3: EMPLOYMENT GROWTH

Location	Total Employment		2015-2040 Growth		Employment Density (per square mile)	
	2015	2040	Change	Percent	2015	2040
MAG Region	1,900,000	2,860,000	960,000	50%	200	300
City of Chandler	129,000	185,000	56,000	43%	1,980	2,800
AAAA Study Area	145,000	212,000	67,000	46%	2,200	3,300

Source: MAG TAZ, 2016

Appendix C illustrates 2015 employment density in the AAAA study area. Employment is pocketed throughout the study area, but one of the highest concentrations exists between Cooper Road and Arizona Avenue, south of Baseline Road to Elliot Road. As shown in Appendix D, the entire study area is projected to see an increase in employment density, with key areas displayed along the Arizona Avenue corridor and downtown Chandler.

2.3 LAND USE

A city's transportation system is reliant on the functionality of both its existing and future land use. Land use policies conducive with transit and transit-oriented development, like high density and or mixed-use development, promote the success of transit investments by emphasizing a live/work atmosphere combined with access to activity centers near stations or stops. This proximity provides greater opportunity for access and mobility, while at the same time, encouraging transit use by providing a fast and convenient alternative to personal automobile use.

The City of Chandler has a large percent of land dedicated to single-family residential housing, which is consistent with the region as a whole; this trend is also prevalent in the AAAA study area. However, compared to the MAG region, the AAAA study area and the City of Chandler have significantly less vacant land. In fact, only 5 percent or less of the land in both the study area and the City of Chandler is vacant, compared to the region's 20 percent.

Table 4 and Table 5 summarize the existing and planned land uses throughout the MAG region, Chandler and study area. Appendix E and Appendix F provide a graphical representation of the existing and future land use in the AAAA study area.

TABLE 4: EXISTING LAND USE

Land Use Sector	MAG Region		City of Chandler		AAAA Study Area	
	Acres	Percent	Acres	Percent	Acres	Percent
Agriculture	260,742	4%	1,798	4%	1,920	5%
Commercial	36,572	<1%	2,240	5%	2,515	6%
Industrial	34,510	<1%	2,931	7%	3,187	8%
Mixed Use	337	<1%	0	0%	0	0%
Multi-Family Residential	34,640	<1%	2,176	5%	2,598	6%
Office	9,123	0%	602	<1%	704	2%
Open Space	3,708,504	63%	4,134	10%	3,731	9%
Other Employment	114,997	2%	2,125	5%	2,374	6%
Single Family Residential	427,572	7%	20,698	50%	19,283	47%
Transportation	89,137	2%	2,842	7%	2,880	7%
Vacant	1,186,831	20%	1,894	5%	1,600	4%
Total	**5,902,964**	**100%**	**41,440**	**100%**	**40,794**	**100%**

Source: MAG Existing Land Use, 2016

TABLE 5: FUTURE LAND USE

Land Use Sector	MAG Region		City of Chandler		AAAA Study Area	
	Acres	Percent	Acres	Percent	Acres	Percent
Agriculture	37,426	<1%	0	0%	13	<1%
Commercial	68,076	1%	2,733	7%	3,066	8%
Industrial	64,519	1%	3,002	7%	3,264	8%
Mixed Use	271,297	5%	1,574	4%	1,466	4%
Multi-Family Residential	52,724	<1%	2,317	6%	2,669	7%
Office	11,961	<1%	1,165	3%	1,395	3%
Open Space	3,761,395	64%	4,506	11%	4,083	10%
Other Employment	169,069	3%	1,709	4%	1,856	5%
Single Family Residential	1,373,482	23%	21,376	52%	19,968	49%
Transportation	92,923	2%	2,963	7%	2,944	7%
Vacant	0	0%	0	0%	0	0%
Total	**5,902,872**	**100%**	41,344	100%	40,723	100%

Source: MAG Future Land Use, 2016

2.4 TRANSPORTATION

A review was conducted of the existing and future transportation network to understand the existing street network, pedestrian facilities, bicycle facilities, transit services and other transportation-related issues. Data from the City of Chandler, MAG and Valley Metro was used to determine the current characteristics and use of the transportation network in the AAAA study area, including all modes of transportation, existing service and facilities, and future transportation improvement projects.

2.4.1 Streets & Highways

The AAAA study area's street network is designed with all arterial streets consisting of multiple vehicular lanes, signalized intersections and sidewalks in each direction. The study area includes two highways, as well as AZ 87 (Arizona Avenue), which operates as an arterial street through the City of Chandler and moves an average of nearly 37,000 vehicles daily. This is the highest traffic volume of any street in the study area. Table 6 and Table 7 outline the major streets and highways within the study area, their classification, lane configuration, traffic volumes, and the presence of bike lanes and sidewalks. Appendix G shows the layout of the transportation system within the AAAA study area.

TABLE 6: AAAA STUDY AREA PRIMARY STREETS

Street	Classification	Average Daily Traffic Volume	Bike Lanes	Sidewalks
East/West				
Baseline Road	Collector	19,612	Yes	Yes
Guadalupe Road	Arterial	32,151	Yes	Yes
Elliot Road	Arterial	26,900	Yes	Yes
Warner Road	Arterial	36,500	Partial	Yes
Ray Road	Arterial	29,480	Partial	Yes
Chandler Blvd	Arterial	26,320	Yes	Yes
Pecos Road	Arterial	15,740	Yes	Yes
Germann Road	Arterial	16,180	Yes	Yes
Queen Creek Road	Arterial	17,740	Yes	Yes
Ocotillo Road	Arterial	16,400	Yes	Yes
North/South				
Dobson Road	Arterial	26,658	No	Yes
Alma School Road	Arterial	33,216	Partial	Yes
Arizona Avenue	Arterial	36,840	Partial	Yes
McQueen Road	Arterial	29,250	Partial	Yes
Cooper Road	Arterial	19,075	Yes	Yes
Gilbert Road	Arterial	27,360	Yes	Yes

Source: Gilbert, AZ, Chandler, AZ Mesa, AZ Traffic Counts GIS Map, 2015/16

TABLE 7: AAAA STUDY AREA HIGHWAYS

Highway	Average Daily Traffic Volume	Interchanges
Loop 202	129,884	Price Road, Dobson Road, Alma School Road, Arizona Avenue, McQueen Road, Cooper Road, Gilbert Road
US 60	200,613	Dobson Road, Alma School Road, Arizona Avenue, McQueen Road, Cooper Road

Source: ADOT HPMS Location Report for Year - 2016

2.4.2 Bike and Pedestrian

The AAAA study area exhibits standard pedestrian and bicycle facilities common to most Arizona cities. This includes sidewalks at least 4-feet wide, bike lanes on almost all arterial streets and crosswalks at major intersections. Various streetscape improvement projects have taken place or are currently in development to improve the pedestrian and bicycle environment in the AAAA study area.

FIGURE 2: PASEO TRAIL

Source: visitchandler.com

In 2009, the 10-foot-wide concrete multi-use pathway, featured in figure 2, known as the Paseo Trail finished construction. The trail is 6.5 miles long and connects the City of Chandler and the town of Gilbert. The trail begins at Galveston Street and continues to Riggs Road with the majority of the trail existing in the AAAA study area. The concrete pathway exists on the eastern side of the canal while the western side has both dirt and asphalt surfaces suitable for horseback riding and mountain biking. The City of Chandler also installed signal crossing at intersections with activation capabilities for pedestrians on foot and for those on horseback. Restroom facilities were installed along the trail to promote pedestrian use of the trail.

In 2014, the City of Chandler completed a bicycle and pedestrian bridge that spans over the Loop 101 on the Galveston Street alignment (between Ray Road and Chandler Boulevard). The bridge is 1,145 feet long and 10 feet wide. Figure 3 shows the bridge that spans both the freeway and the frontage roads. The bridge allows safe passage for residents to amenities on both sides of the freeway.

FIGURE 3: GALVESTON STREET BICYCLE AND PEDESTRIAN BRIDGE

Source: tylin.com

In 2018, the City of Chandler completed pedestrian and bicycle improvements to the downtown area, with special attention paid to Dakota Street, which is featured in Figure 4, and Commonwealth Avenue featured in figure 5. The Dakota Street extension project created several benefits that made the street more walkable and connective to downtown including:

FIGURE 4: DAKOTA STREET EXTENSION

Source: achen.com

- The establishment of a north and south connection into downtown Chandler from Dakota Street.
- The addition of bike lanes, construction of wide-shaded walkways and speed tables to slow traffic.
- Improved access to the San Marcos Resort.
- Allowed the reconstruction and revitalization of the historic Salt River Project open canal on Commonwealth Avenue.

FIGURE 5: COMMONWEALTH AVENUE RECONSTRUCTION PROJECT

Source: achen.com

Figure 5 displays the newly constructed pedestrian pathway along the canal on Commonwealth Avenue. The canal was an integral part of the design to incorporate safe pedestrian and bicycle travel while also maintaining aesthetically pleasant surroundings and expanding the west side of downtown Chandler. Artistic features were added to enhance the aesthetics of the canal pedestrian pathway by weaving panels throughout the path that make connections to the water.

In early 2018 the City of Chandler also made infrastructure upgrades to Arizona Avenue between Frye and Pecos Roads as part of an overall plan to develop a pedestrian-friendly entryway to the city's core. The project enhanced sidewalks, driveways, landscape and hardscape features as well as improving streetlights and signage along the half mile stretch of Arizona Avenue.

2.4.3 Existing and Planned Transit Services

This section provides a summary of existing and proposed transit services within the study area. Fixed route bus service and paratransit service is currently provided in the AAAA study area. Various proposed service improvements are identified within Valley Metro's Short Range Transit Program. Appendix G shows the layout of the existing transit system in the AAAA study area.

2.4.3.1 Existing Bus Service

Bus service within the study area is comprised of local bus, express bus and paratransit service.

Local Bus

The local bus routes within the study area provide transit service along the region's one-mile arterial street network. Bus stops are usually located 1/4 to 1/2 mile apart at arterial intersections and mid-block locations. Bus services vary with most routes offering service Monday through Saturday, and some offering Sunday service. Eleven local bus routes serve the study area. The service days, times and frequency are outlined in Table 8.

TABLE 8: EXISTING FIXED ROUTE BUS SERVICE WITHIN THE STUDY AREA

Route	Service Days	Weekday Service Times	Weekday Peak Frequency	Weekday Off-Peak Frequency
77 – Baseline	Mon. – Sun.	4:00 a.m. – 1:15 a.m.	30 minutes	30 minutes
96 – Dobson	Mon. – Sun.	4:30 a.m. – 11:15 p.m.	30 minutes	30 minutes
104 – Alma School	Mon. – Sun.	5:30 a.m. – 9:30 p.m.	30 minutes	30 minutes
108 – Elliot Road	Mon. – Sun.	5:00 a.m. – 12:15 a.m.	30 minutes	30 minutes
112 – Country Club/AZ Ave	Mon. – Sun.	4:45 a.m. – 11:30 p.m.	15 minutes	15 minutes
120 – Mesa Dr	Mon. – Sat.	8:45 a.m. – 9:00 p.m.	30 minutes	30 minutes
128 – Stapley	Mon. – Sat.	5:45 a.m. – 6:45 p.m.	30 minutes	30 minutes
136 – Gilbert Rd	Mon. – Sat.	4:30 a.m. – 7:30 p.m.	30 minutes	30 minutes
140 – Ray Road	Mon. – Sat.	5:00 a.m. – 9:15 p.m.	30 minutes	30 minutes
156 – Chandler Blvd/Williams	Mon. – Sun.	4:30 a.m. – 10:15 p.m.	30 minutes	30 minutes
541 – Chandler Express 1	Mon. – Fri.	5:00 a.m. – 5:10 p.m.	4 inbound / 4 outbound	n/a
542 – Chandler Express	Mon. – Fri.	5:55 a.m. – 5:20 p.m.	8 inbound / 8 outbound	n/a

Source: Valley Metro Transit Book, October 22, 2018

Express Bus

Express bus provides weekday peak-period commuter service to downtown Phoenix from central Chandler. Two express bus routes traverse through the study area, and make stops within the study area as well. Express Routes 541 and 542 originate in the study area. Express Route 541 picks up riders along Arizona Avenue Alma School Road, and Knox Road; Express Route 542 picks up riders at Chandler Park-and-Ride and travels through the study area via the Loop 202 freeway.

Paratransit

Valley Metro and its partner agencies offer ADA paratransit service to any location within 3/4 mile of any local bus route. The City of Chandler extends that service throughout the entire city, which includes a majority of the study area. This service is provided on-demand by making trip requests at least 24 hours in advance.

Table 9 summarizes annual boardings for bus routes that service the study area from FY2018. The data reflects boardings for the entirety of the route which include areas that exist outside the study area. The routes with the highest overall boardings include Southern Avenue (Route 61), Country Club/Arizona Ave (Route 112) and Chandler Blvd/Williams (Route 156), which each serve more than 250,000 riders per year. Route 61 runs outside of Chandler just within the boundary of the study area, and is one of the top ten routes in terms of total boardings in the entire Valley Metro network. Using boardings per mile, Routes 61, 77, 96,112,120 are the most productive local bus routes in the study area with an average over 1.8 boardings per mile.

TABLE 9: STUDY AREA LOCAL BUS PERFORMANCE

Route	Annual Boardings	Revenue Miles	Boardings per Mile*
Local Routes			
61 – Southern Avenue	1,321,308	725,385	1.8
77 – Baseline Road	698,915	420,256	1.7
96 – Dobson Road	424,494	261,752	1.6
104 – Alma School Road	211,071	187,278	1.1
108 – Elliot Road	267,003	416,978	0.6
112 – Country Club/Arizona Avenue	740,241	356,830	2.1
120 – Mesa Drive	87,452	53,526	1.6
128 – Stapley Drive	72,482	72,101	1,0
136 – Gilbert Road	214,681	219,031	1.0
140 – Ray Road	45,226	121,266	0.4
156 – Chandler Blvd	252,445	356,652	0.7
Express Routes			
531 – Mesa Gilbert Express	59,840	77,152	19.9
533 – Mesa Express	91,405	86,649	30.5
541 – Chandler/Mesa Express	35,025	53,152	17.5
542 – Chandler Express	107,044	97,425	35.7

*Note: Express Routes are reported as *Boardings per Trip*.
Source: Valley Metro Annual Ridership Report, FY2018.

In addition to the routes identified in Table 9, Table 10 identifies future improvements to existing routes within the study area between FY2018 and FY2020.

TABLE 10: FUTURE IMPROVEMENTS TO EXISTING BUS ROUTES WITHIN THE STUDY AREA

Route	Proposed Service Change
Local Routes	
61 – Southern Avenue	No proposed changes.
77 – Baseline Road	Extend route north on 75th Avenue to Vineyard Road. (FY2019) Begin PTF funding of Route 77 in Mesa. (FY2020) Extend to Gilbert Road in connection with Gilbert Road Extension and keep at current weekday level of service, remove existing end-of-line loop. Implement 30-minute Saturday and Sunday service. (FY2020) Extend to Power Road, and replace Route 108 service to Sunland Village East. Analyze infrastructure costs east of Val Vista. (FY2021)
96 – Dobson Road	Explore options to serve Price Corridor. (FY2019) Improve Peak weekday service to 15 minutes from Riverview to Elliot Rd. (FY2021) Improve weekday service in Chandler by extending current service to add one evening round trip. (FY2021)
104 – Alma School Road	Add Saturday service and some weekday evening trips. (FY2019) Begin PTF funding of route in Mesa. (FY2020)

Route	Proposed Service Change
	Add evening trips until 11:30 p.m. from Alma School Road to Baseline Road; improve weekend frequency to 30 minutes and extend evening service. (FY2020) Increase Peak frequency to 15 minutes from Mesa Riverview to Elliot Road. (FY2020)
108 – Elliot Road	No proposed changes.
112 – Country Club Drive/Arizona Avenue	Extend Route 112 to Hamilton High School. (FY2021)
120 – Mesa Drive	Extend to Warner Road in Gilbert. (FY2020) Connect to Baseline Road weekday service (both directions) starting at 5 a.m. and ending at 10 p.m. Improve Saturday service to match weekday service. Implement Sunday service from 6 a.m. to 9 p.m. at 30-minute frequency. Will go online when GRE is complete. (FY2020) Extend route to McKellips Road. (FY2021)
128 – Stapley	Weekday service (both directions) starting at 5 a.m. and ending at 10 p.m. Improve Saturday service to match weekday service. Implement Sunday service from 6 a.m. to 9 p.m. at 30-minute frequency. Will go online when GRE is complete. (FY2020) Extend Route 128 south to Galveston Street. (FY2021)
136 – Gilbert Road	Improve peak weekday frequency in Gilbert and Mesa (Main Street to Elliot Road), and add evening trips. Improve Saturday service in Mesa to 30 minutes and add Sunday service in Mesa and Gilbert at 30-minute frequency, and extend span of service by adding night trips. (FY2020) Analyze and streamline north end route deviation by either removing deviation or finding a better service connection for Boeing. (FY2022)
140 – Ray Road	Extend 140 from Gilbert Road to Power Road on Warner Road. Add Sunday service. (FY2022)
156 – Chandler Blvd/Williams	15-minute Peak frequency from Kyrene Road to Gilbert Road and one evening round trip in Chandler. (FY2022) 15-minute Peak from 48th Street to Val Vista Drive. (FY2022)
Express Routes	
541 – Chandler/Mesa Express	No proposed changes.
542 – Chandler Express	No proposed changes.

*Note: The Short Range Transit Program is currently being updated, anticipated for completion [April, 2019]. Service improvements listed in this table may change.
Source: Valley Metro Short Range Transit Program, FY2018-2022.

2.4.4 Transit-Dependent Populations

Transit dependency refers to portions of the population that rely on transit service to increase their overall mobility. The population within the AAAA study area is diverse and exhibits population groups with a propensity to use transit. Such groups include households with zero or one cars, those who commute using a mode other than a conventional vehicle, households with lower than average incomes and seniors. The transit-dependent characteristics evaluated for the study area, city of chandler and mag region are identified in table 11.

TABLE 11: TRANSIT-DEPENDENT POPULATION CHARACTERISTICS

Population Characteristic	MAG Region		City of Chandler		AAAA Study Area	
	Total	Percent	Total	Percent	Total	Percent
Commute (Transit, Bike, Walk)	81,124	5%	3,210	3%	3,785	3%
Population Below Poverty	457,885	32%	22,049	9%	25,717	10%
Over Age 65	513,536	13%	23,014	10%	23,298	9%
Zero & One Car Households	467,608	27%	31,558	37%	33,063	38%

Source: 2016 American Community Survey

Compared to the City of Chandler and MAG region, the AAAA study area has a larger percentage of zero and one car households. The absence of a vehicle is an indication of transit dependency, but the presence of one vehicle does not necessarily indicate the freedom of mobility for an entire household since household size is not indicated in the data. Residents in the study area are slightly less likely to use alternative modes of transportation to commute to work, compared to the region, and generally have a smaller percentage of people with lower incomes, but are less likely to own an automobile. The AAAA study area also has a lower percentage of seniors compared to the MAG region. Appendix I, Appendix J, Appendix, K and Appendix L illustrate the concentrations of transit dependent population characteristics throughout the AAAA study area.

Using a normal distribution of the data, each population characteristic summarized in table 11 was broken down into five value ranges representing individual varying levels of transit dependency by census block. The most transit-dependent range of each characteristic was rated a value of five, the second highest dependency was rated a four and so on through a value of one (least transit-dependent). Table 12 illustrates the levels of transit dependency for each population characteristic analyzed in the AAAA study area.

TABLE 12: TRANSIT DEPENDENT VALUE RANGES

Population Characteristic	Transit Dependent Population Score				
	5	4	3	2	1
Commute (Transit, Bike, Walk)	> 25%	10% - 25%	5% - 10%	1% - 5%	< 1%
Poverty	> 20%	10% - 20%	5% - 10%	1% - 5%	> 1%
Over Age 65	> 30%	15% - 30%	10% - 15%	5% - 10%	< 5%
Zero & One Car Households	> 60%	40% - 60%	30% - 40%	20% - 30%	< 20%

Within the AAAA study area, each Census block was assigned a value for each characteristic as shown in Table 12. The sum of those four population characteristic values determined an overall transit dependent value for each Census block within the study area. The result of that calculation is shown in Appendix L, which illustrates the sections of the AAAA study area that may have the greatest propensity to use transit.

Source: 2016 American Community Survey

Compared to the City of Chandler and MAG region, the AAAA study area has a larger percentage of zero and one car households. The absence of a vehicle is an indication of transit dependency, but the presence of one vehicle does not necessarily indicate the freedom of mobility for an entire household since household size is not indicated in the data. Residents in the study area are slightly less likely to use alternative modes of transportation to commute to work, compared to the region, and generally have a smaller percentage of people with lower incomes, but are less likely to own an automobile. The AAAA study area also has a lower percentage of seniors compared to the MAG region. Appendix I, Appendix J, Appendix, K and Appendix L illustrate the concentrations of transit dependent population characteristics throughout the AAAA study area.

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TABLE 12: TRANSIT DEPENDENT VALUE RANGES

Concern	Description
Drainage Facilities (Natural & Man-made)	
Consolidated Canal	Man-made drainage facility that runs southwest through the study area. The canal is fed from the South Canal, which in turn is fed from the Salt River at the Granite Reef Diversion Dam.
US 60 Channel	Man-made drainage channel located immediately north of the US 60 that runs east to west along the entire study area.
Floodplains	
Identified Floodplain Areas	There are two primary areas within the AAAA study area that are located in floodplains that require mandatory flood insurance: • Area 1: Generally located in the northwest corner of Banner Desert Medical Center, heading north along San Jose Street, Farmdale Avenue, Valencia Street, 8th Avenue and Roosevelt Street, including a small number of homes between the Tempe Canal and Roosevelt Street. • Area 2: The west side of Mesa Drive, east of the railroad track, north and south of Baseline Road, as well as parts of the golf course located between the railroad tracks and Mesa Drive/McQueen Road.

Concern	Description
Hazardous Materials Sites	
Water Quality Assurance Revolving Fund (WQARF) Site(s)	There is one WQARF Site in the AAAA study area: • Cooper Road and Commerce Avenue site, between Elliot Road and Guadalupe Road: Contaminants found in the water and the soil in 2004. Air sparging conducted from 2009 to 2014, groundwater pump and treat from 2010 to 2014, and soil vapor extract initiated in 20008 and is still operational. Clean up and remediation continues, 16 pounds of volatile organic compounds were removed in 2018.
Historic & Cultural Properties	
Properties	There are several historic and cultural properties in the AAAA study area, including properties that are listed on the National Register of Historic Properties and the Chandler Historical Society. Some significant properties in the study area include: • Chandler High School • Suhwaro Hotel • Various buildings in historic downtown Chandler • Individual homes • Arizona Railway Museum Properties that are listed are given additional protections to help maintain history and culture within the city.
Underground Storage Tanks	
Identified Underground Storage Tanks	Underground storage tanks have greater risks for environmental issues. Leaks from underground storage tanks can continue unnoticed and be difficult to fix. According to the Arizona Department of Environmental Quality, there are more than 400 identified underground storage tanks in the AAAA study area. Most of these are located adjacent to arterial streets and concentrated along Arizona Avenue.
Waters of the United States (WOTUS)	
Identified WOTUS	The Salt River is the only designated WOTUS in the vicinity of the AAAA study area, located roughly 3 miles north. There is the possibility that additional bodies of water near the Salt River may fall under the definition of WOTUS.
Wells	
Identified Wells	There are approximately 300 identified well sites in the AAAA study area. Of these, approximately 13% have been abandoned, destroyed or replaced by other wells.
Wetlands	
Identified Wetlands	According to the US Fish and Wildlife Service, there are dozens of identified wetlands in the AAAA study area. However, all of the wetlands identified are man-made. They consist mostly of canals, park lakes, retention basins and golf course water features.

2.5.2 Activity Centers

The AAAA study area consists of activity centers that are identified as local and regional destinations. Local areas of interest include retail, grocery, restaurants and employment centers. There are several key regional activity centers in the study area, such as downtown Chandler, the Chandler Municipal Airport and Fiesta District (inclusive of the former Fiesta Mall, Mesa Community College and Banner Desert Medical Complex).

FIGURE 6: DOWNTOWN CHANDLER - CITY HALL

Source: chandleraz.gov

From 2014 to 2019 the Fiesta District witnessed almost $600 million in capital investment from more than 20 different projects. Downtown Chandler added dozens of new restaurants and retailers proceeding the $70 million dollars invested in the redevelopment of city hall in 2010, featured in figure 6.

These regional activity centers attract thousands of visitors each year for special events, employment, shopping, entertainment and athletic events. Although not technically inside the AAAA study area, the Chandler Fashion Center mall is adjacent to the study area and features more than 200 retail shops and restaurants, as well as event space. The primary activity centers in the AAAA study area are listed in Table 14. Appendix M shows the locations of the activity centers within the AAAA study area.

TABLE 14: ACTIVITY CENTERS

Activity Center	Type	Description
Chandler		
Chandler Museum	Arts & Culture	Newly renovated 10,000 square foot facility with a shaded court yard that hosts special events and exhibits.
Chandler Center for the Arts	Arts & Culture	A cultural resource facility that focuses on advocating and advancing arts and culture in Chandler.
Chandler Municipal Court	Government	Home to the judicial branch of Chandler city government that oversees civil and criminal proceedings.
Chandler City Hall	Government	The primary government facilities housing the Chandler City Council and city staff.

Activity Center	Type	Description
Chandler		
Chandler Regional Hospital	Medical	General medical and surgical hospital that offers the community emergency care, intensive care, a family birthing center and a cancer clinic.
Chandler Municipal Airport	Travel	A base for charter, transport and sightseeing aircraft with more than 200,000 operations annually.
Chandler Senior Center	Recreation	A 50-plus community center that provides recreational, social and supportive services for mature adults and their family members.
Cross Roads Town Center	Shopping	Shopping center with 35 specialty and big box retailers, 28 dinging options and special event space.
Chandler Fashion Center	Shopping	The second largest mall in the metropolitan Phoenix area with over 180 different stores, restaurants and a 20-screen movie theater.
Chandler Park-and-Ride	Travel	A 460 space parking facility that features covered parking and allows connection to local and express route transit options.
Courtyard Phoenix – Chandler Fashion Center	Hospitality	156 room hotel with event and meeting space as well as on site dining.
Folley Pool	Recreation	Features a 25-yard pool with diving boards, water playground, water slide and a wading pool.
Department of Economic Security - Chandler	Government	State facility focused on developing the capacity of communities and providing temporary assistance for those in need with a variety of programs and initiatives.
Desert Oasis Aquatic Center	Recreation	Features a 25-meter pool with eight lanes, sand volleyball court, water playground and two water slides.
Hamilton High School	Education	Public High School with 3,900 enrolled students in grades 9-12.
Hamilton Aquatic Center	Recreation	Features an eight-lane pool, water playground, water vortex, three water slides and two diving boards.
Hamilton Library	Education	A public reading, learning, and cultural center for the Chandler community.
Chandler Community Center	Recreation	Recreational facility that hosts dozens of programs and events with various space for different types of occasions.
Primavera Technical Learning Center	Education	A non-profit organization that offers courses and programs in arts, social studies, mathematics, science and other languages.
Chandler-Gilbert Community College	Education	One of the fastest growing Maricopa Community colleges that offers 60 different degrees to more than 14,000 students.
Chandler High School	Education	One of the oldest high schools in Arizona, with more than 3,000 enrolled students in grades 9-12.
Overstreet	Entertainment	Shopping, dining, office and entertainment center.

Activity Center	Type	Description
Chandler		
New Square	Commercial	Multi-use commercial office development.
Tumbleweed Park	Recreation	Nearly 1 square mile of park land that features a 62,000 square foot recreation center.
Mesa		
Golfland Sunsplash	Recreation	Waterpark and amusement center with water slides, arcades, miniature golf and various other attractions.
Banner Desert Medical Center	Healthcare	General medical and surgical hospital. Includes Cardon Children's Medical Center for pediatric specialty care.
Mesa Community College	Arts & Culture	The largest community college in Maricopa County with more than 25,000 enrolled students and more than 1,100 staff.
Rio Salado College East Valley	Education	Public community college that offers associates degrees and certificate programs.
Mesa Grand Shopping Center	Shopping	Shopping center with 13 shops, 13 dining options and a 14 screen movie theatre.

3.0 CONCLUSION

The AAAA study area characteristics in terms of population, employment, major activity centers and transit services, summarized in this report, establishes a baseline for consideration of a potential future HCT corridor. Downtown Chandler and the Fiesta District are established regional activity centers in the AAAA study area that warrant further consideration for transit connection. Based on the data in this report, the socioeconomic characteristics of the area show emerging population and employment density, as well as future growth, which is projected to come from higher density and more intense development. The study provides multiple shopping, restaurant and arts/culture opportunities, as well as an abundance recreational space and the unique benefit of an airport facility.

The study area also boasts a vital education component by possessing two large higher education facilities in Mesa Community College and Chandler Gilbert Community College. Comprehensive local bus service, as well as various streetscape, multi-modal projects and other street improvements have been established in the study area; city and regional planning documents all support the development of HCT in the study area through appropriate land use and transportation policies.

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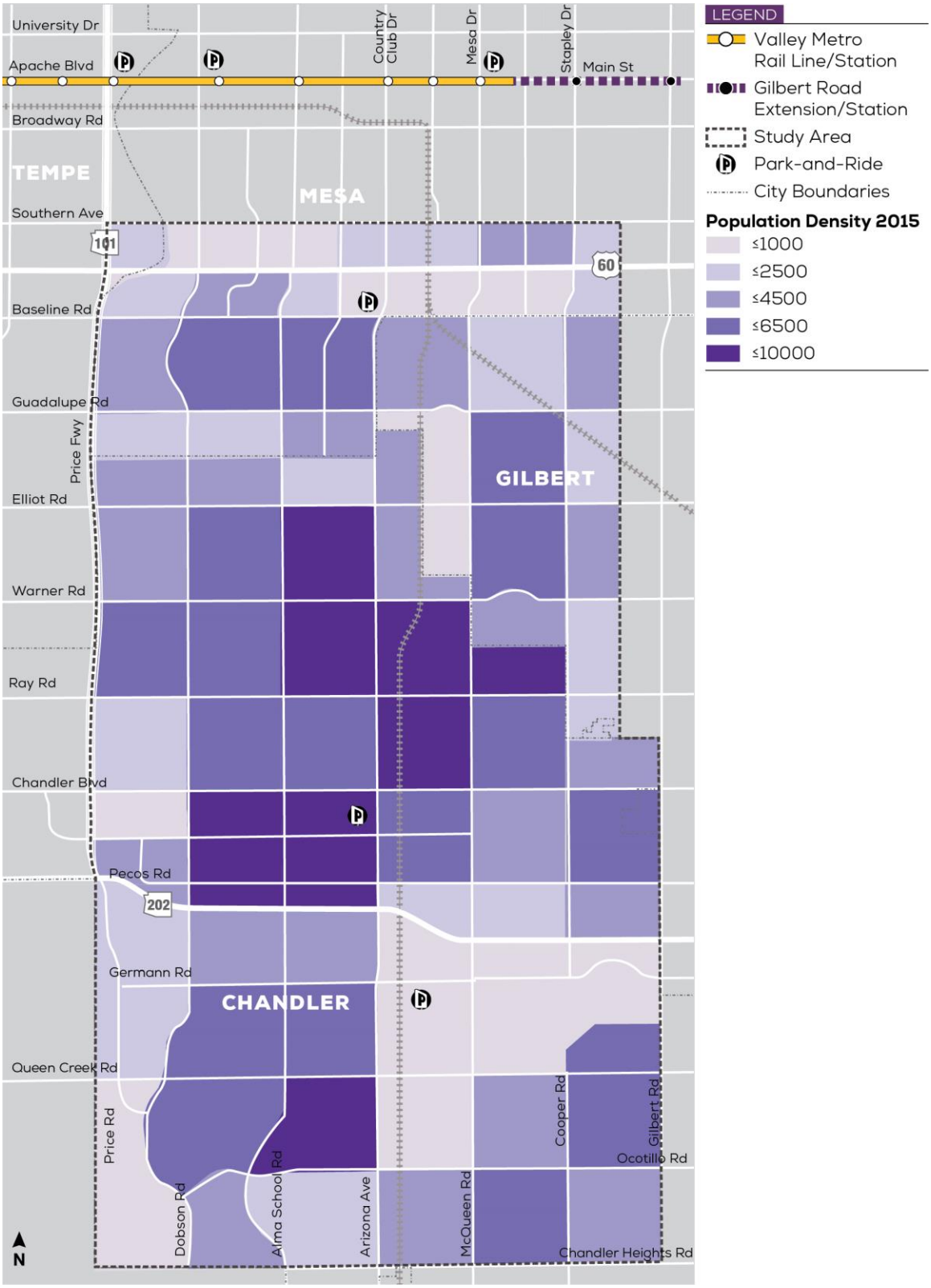
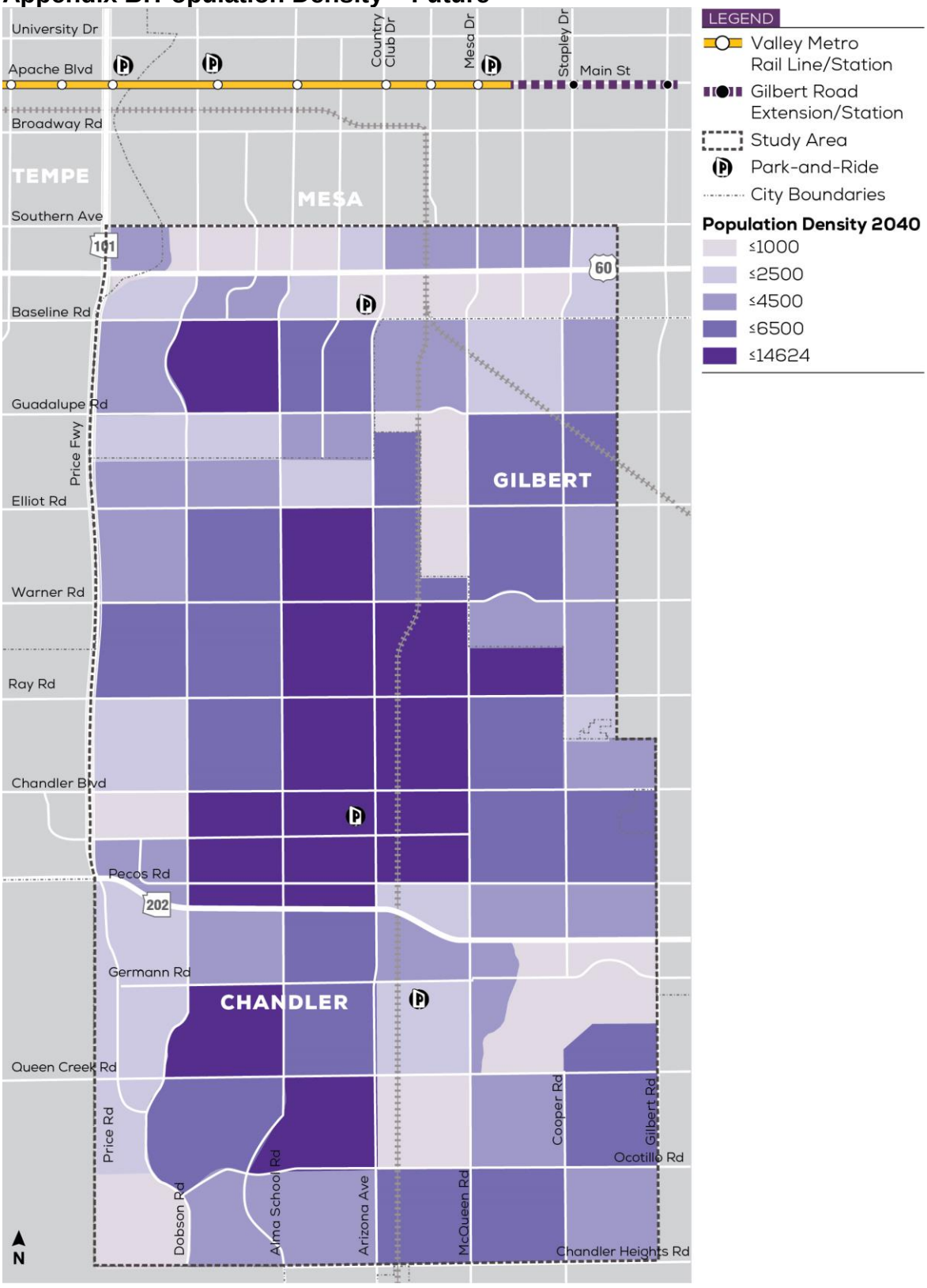
5.0 APPENDICES

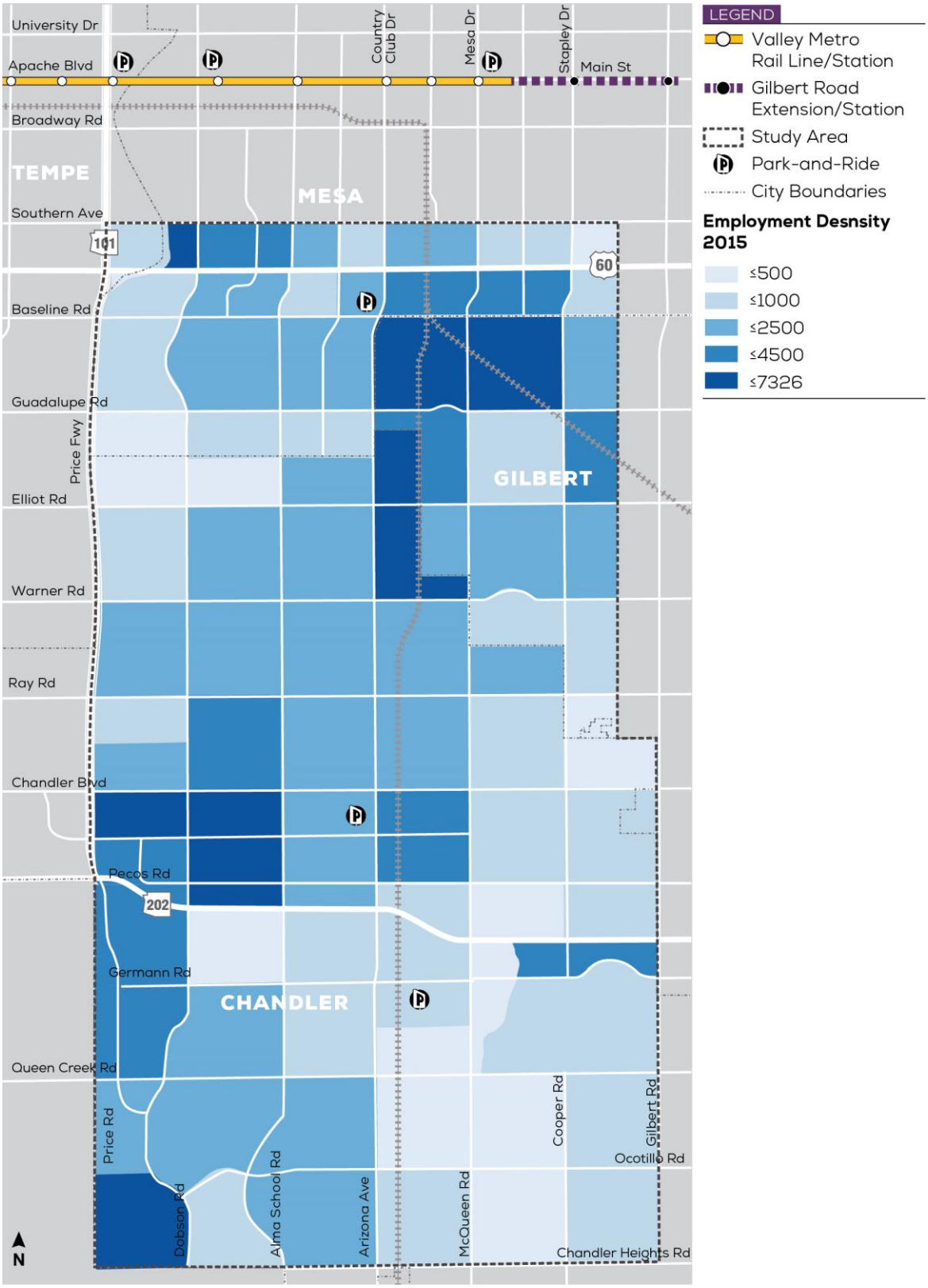
Appendix A: Population Density – Existing



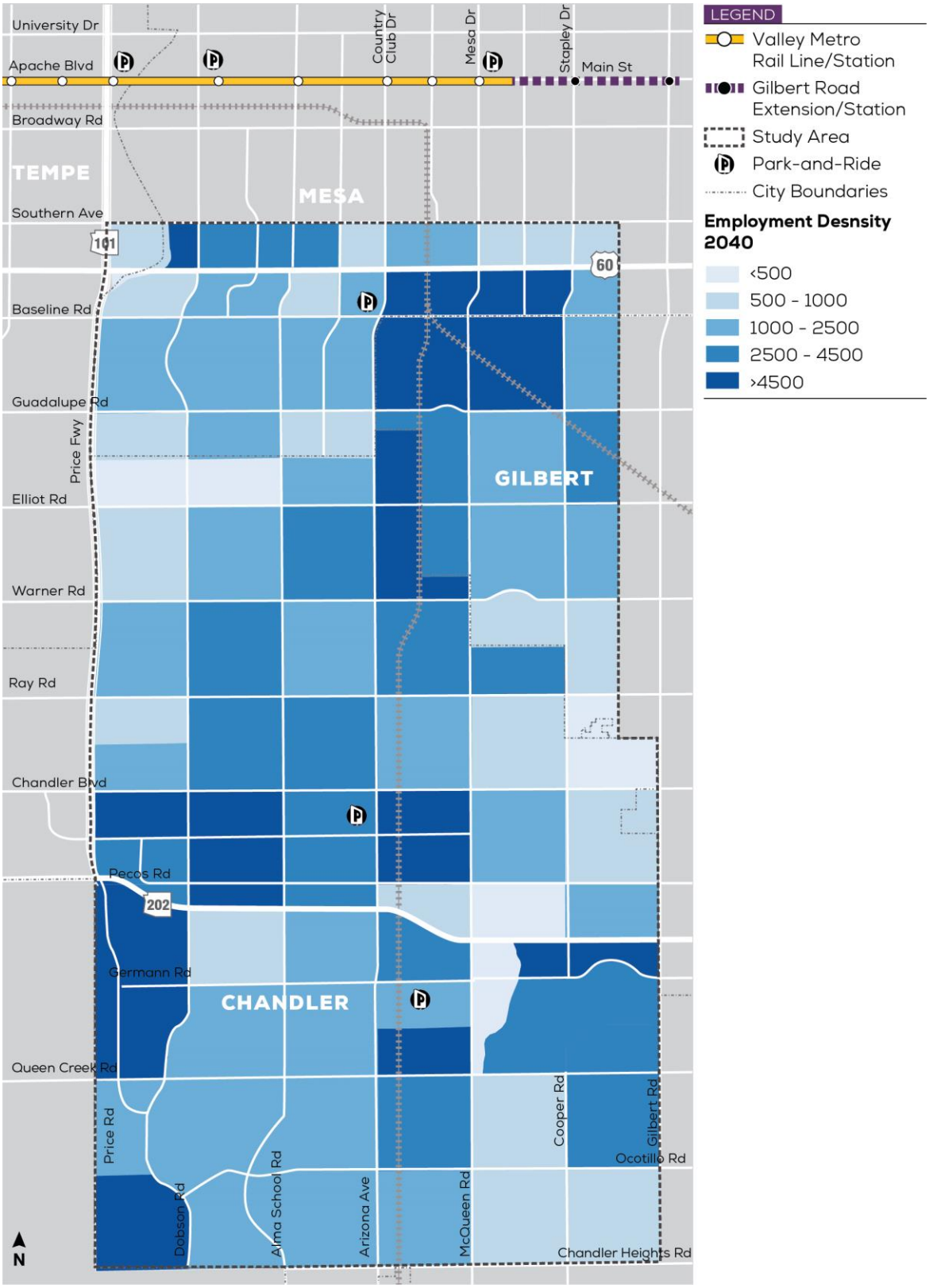
Appendix B: Population Density – Future



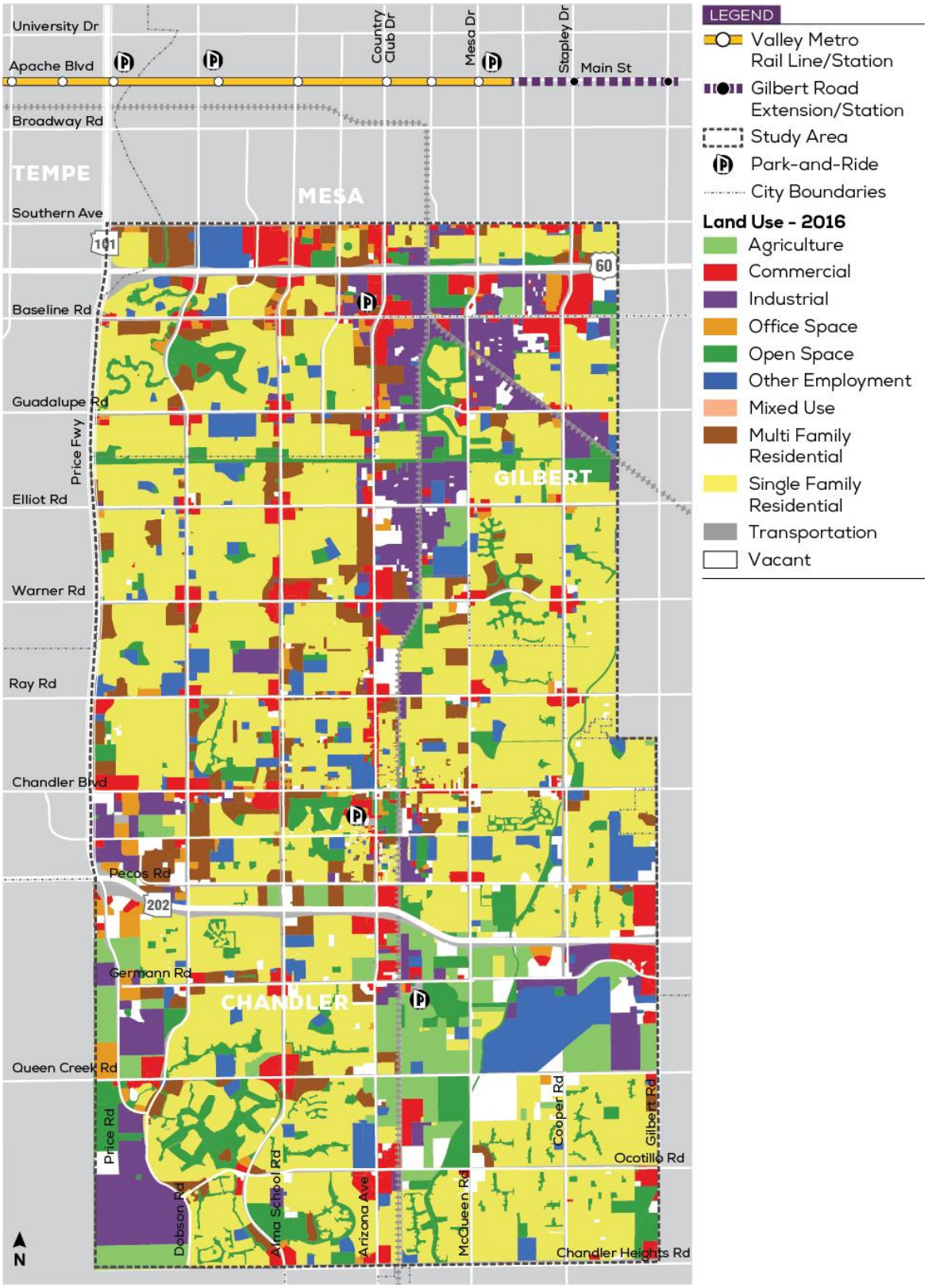
Appendix C: Employment Density – Existing



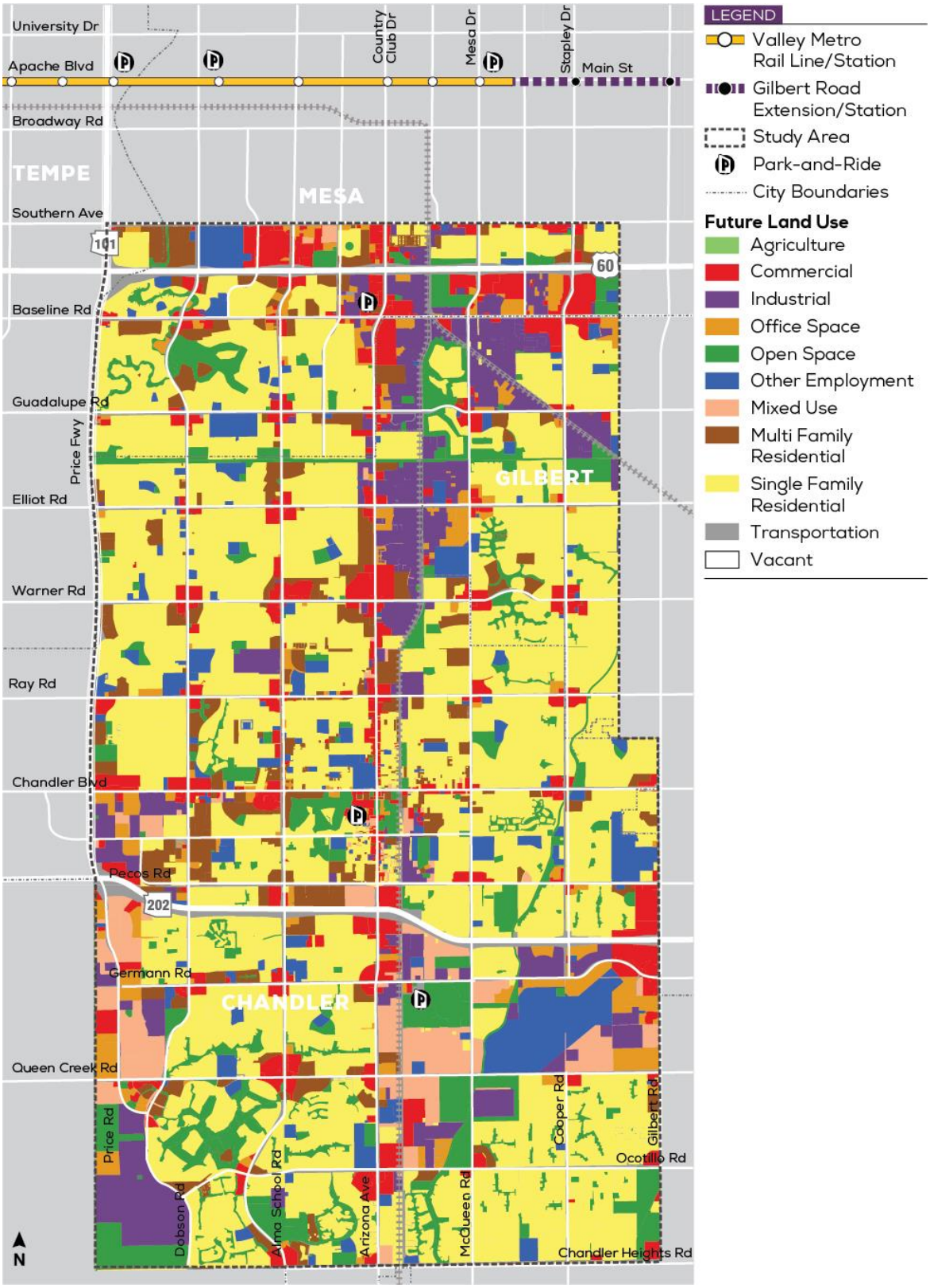
Appendix D: Employment Density – Future



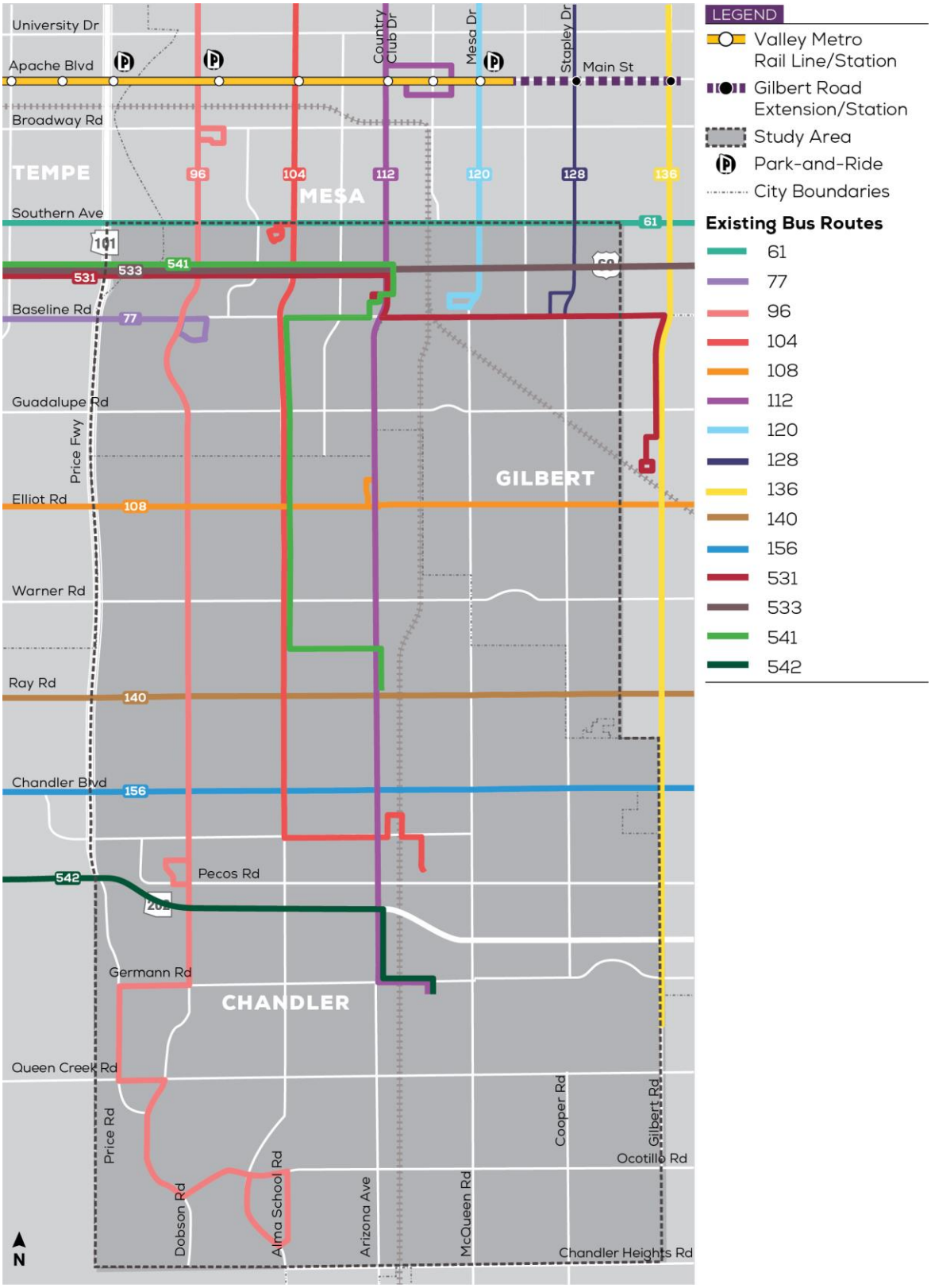
Appendix E: Land Use – Existing



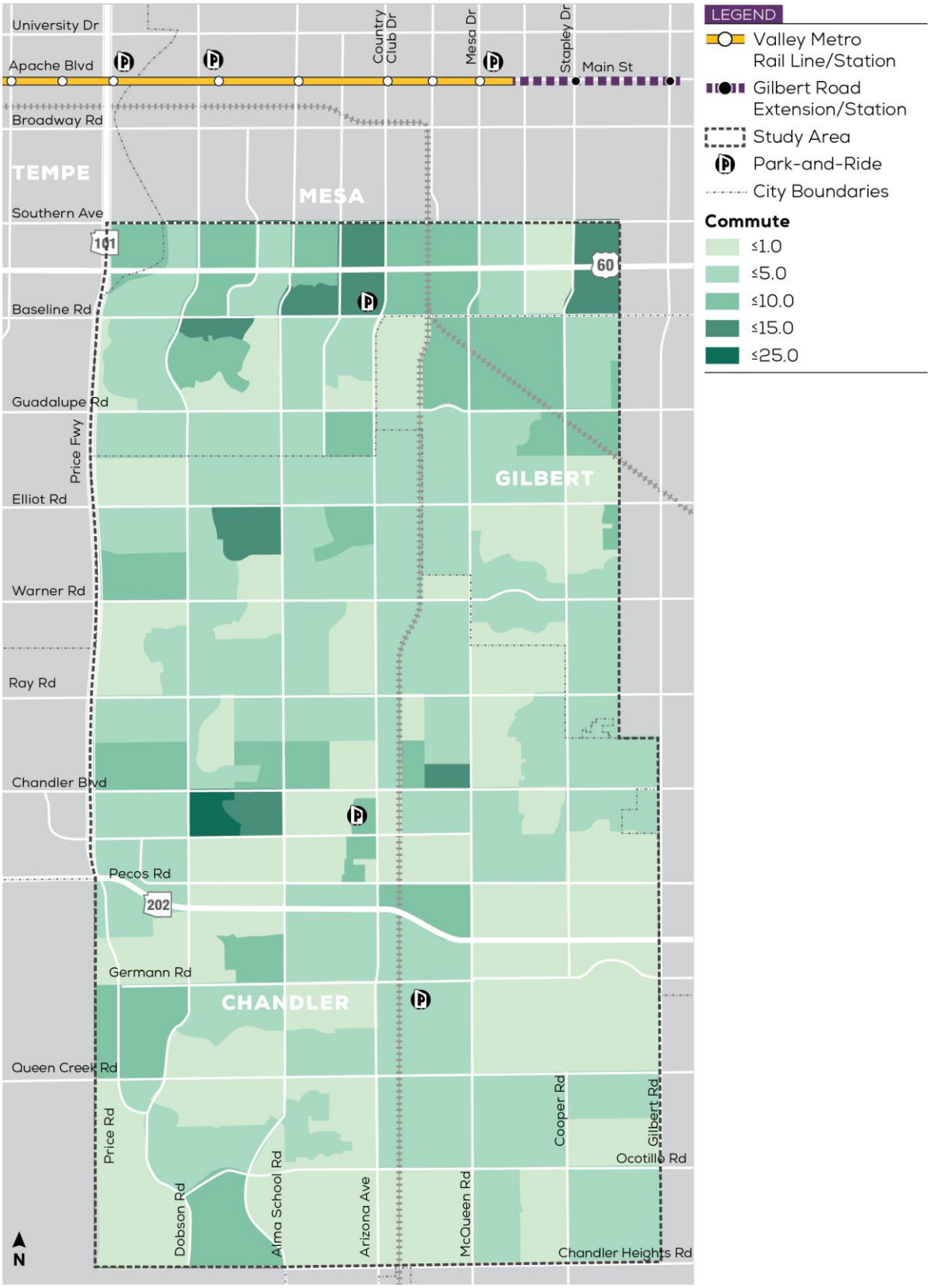
Appendix F: Land Use – Future



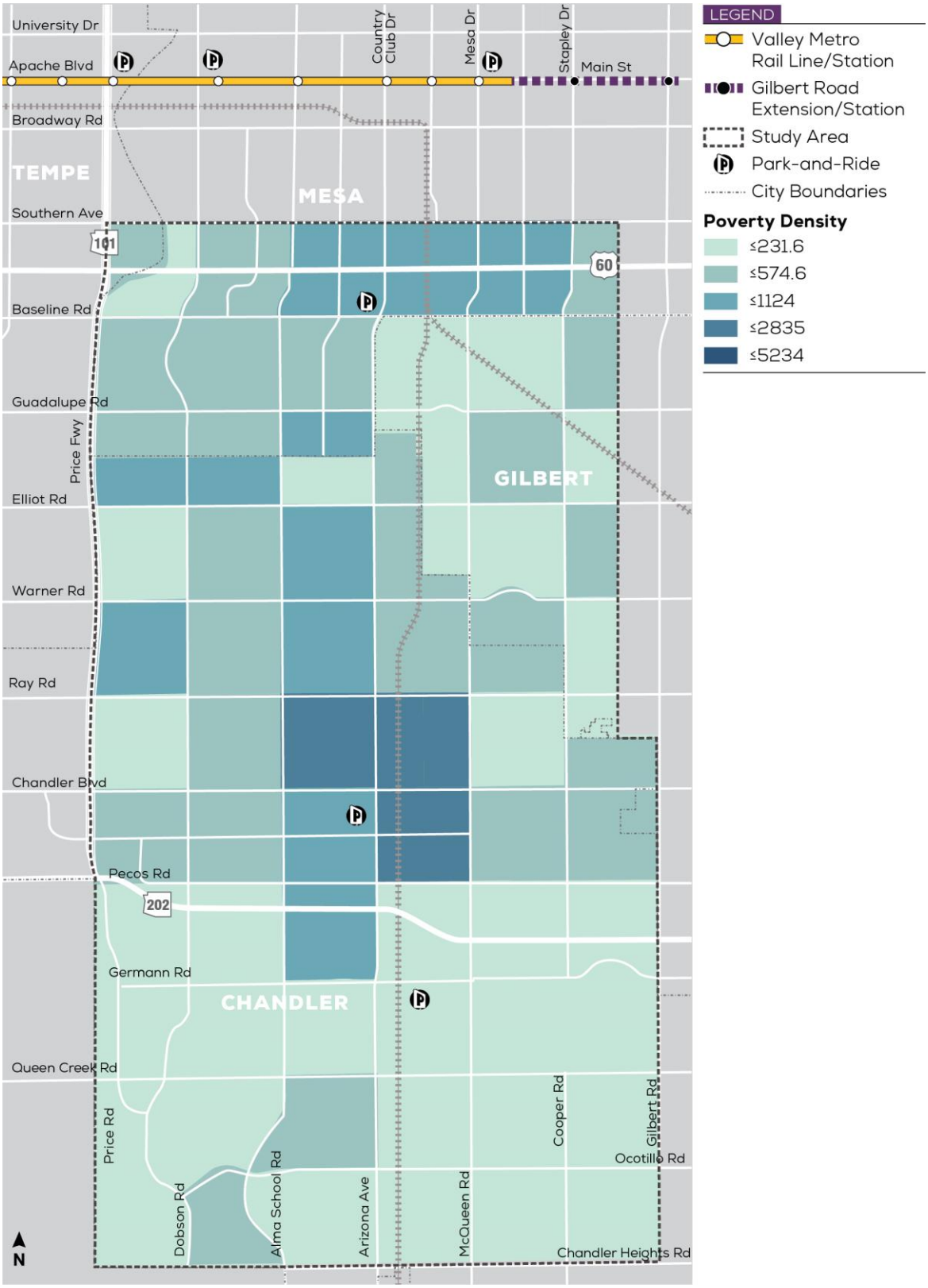
Appendix G: Existing Transit Network



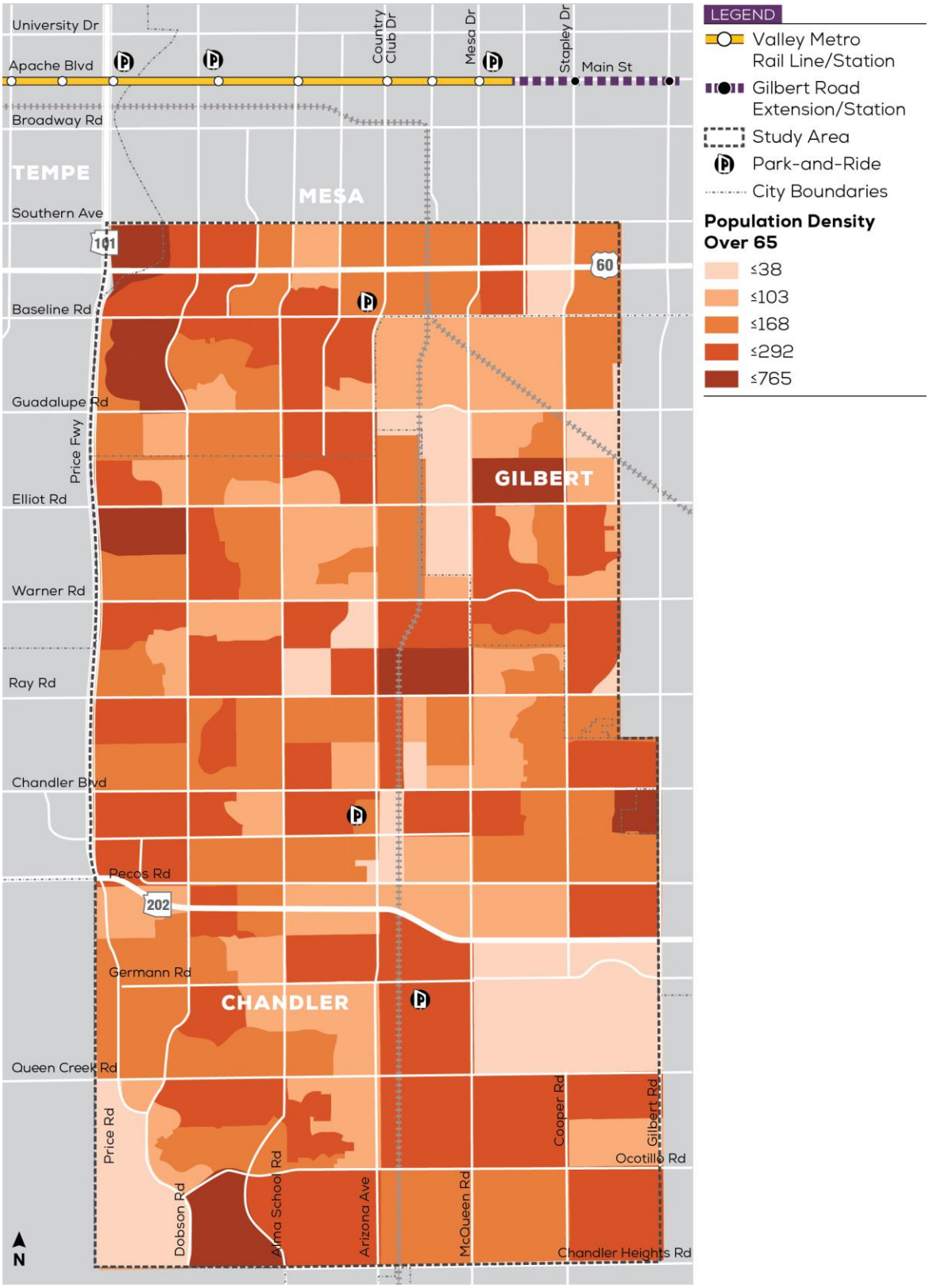
Appendix H: Commute (Transit, Bike, Walk)


University Dr
Apache Blvd
Broadway Rd
Southern Ave
Baseline Rd
Guadalupe Rd
Elliot Rd
Warner Rd
Ray Rd
Chandler Blvd
Pecos Rd
Germann Rd
Queen Creek Rd
Ocotillo Rd
Chandler Heights Rd
Country Club Dr
Mesa Dr
Stapley Dr
Main St
Price Fwy
Price Rd
Dobson Rd
Alma School Rd
Arizona Ave
McQueen Rd
Cooper Rd
Gilbert Rd
TEMPE
MESA
GILBERT
CHANDLER
101
60
202
N
LEGEND
Valley Metro Rail Line/Station
Gilbert Road Extension/Station
Study Area
Park-and-Ride
City Boundaries
Commute
≤1.0
≤5.0
≤10.0
≤15.0
≤25.0

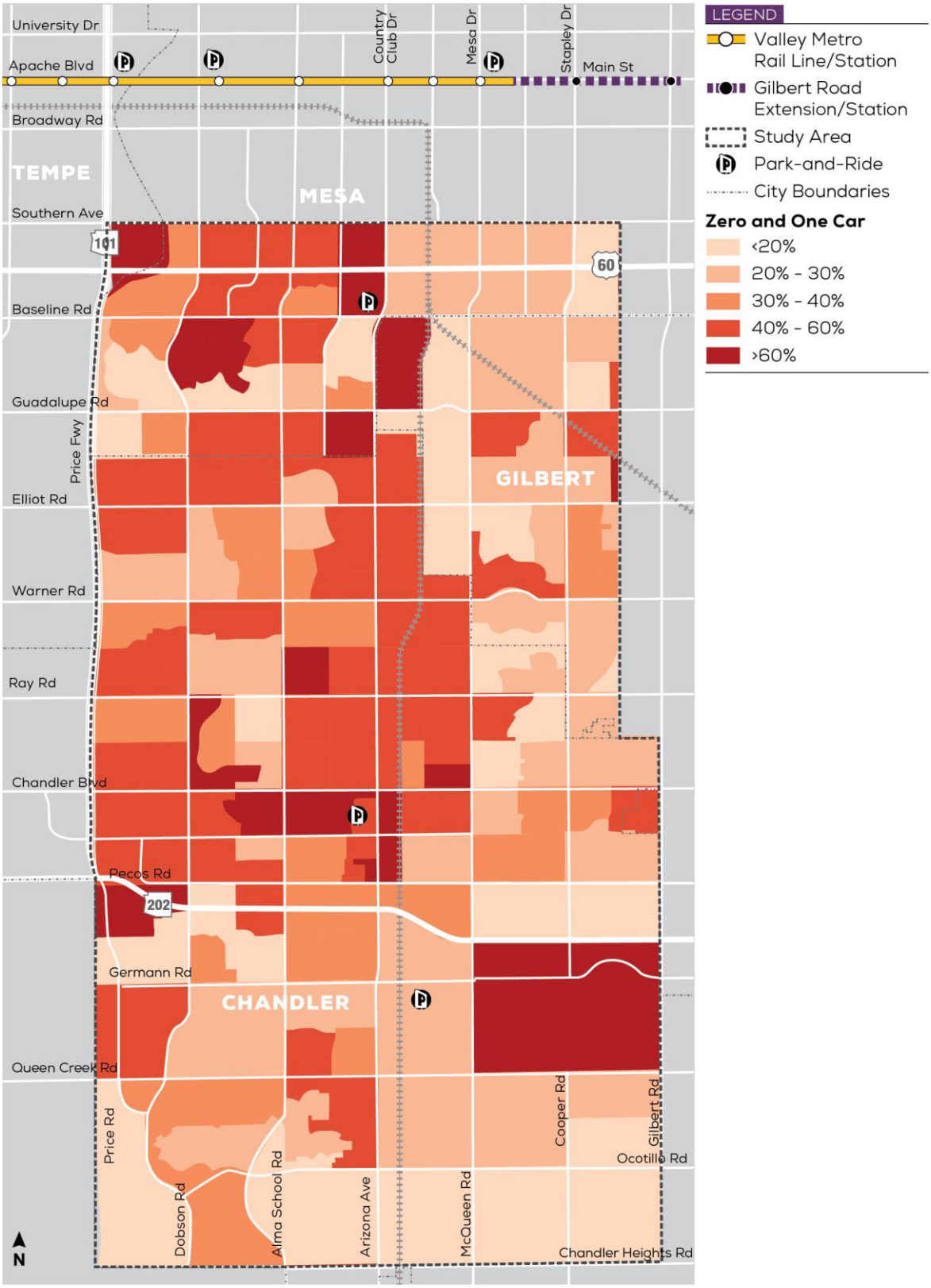
Appendix I: Poverty



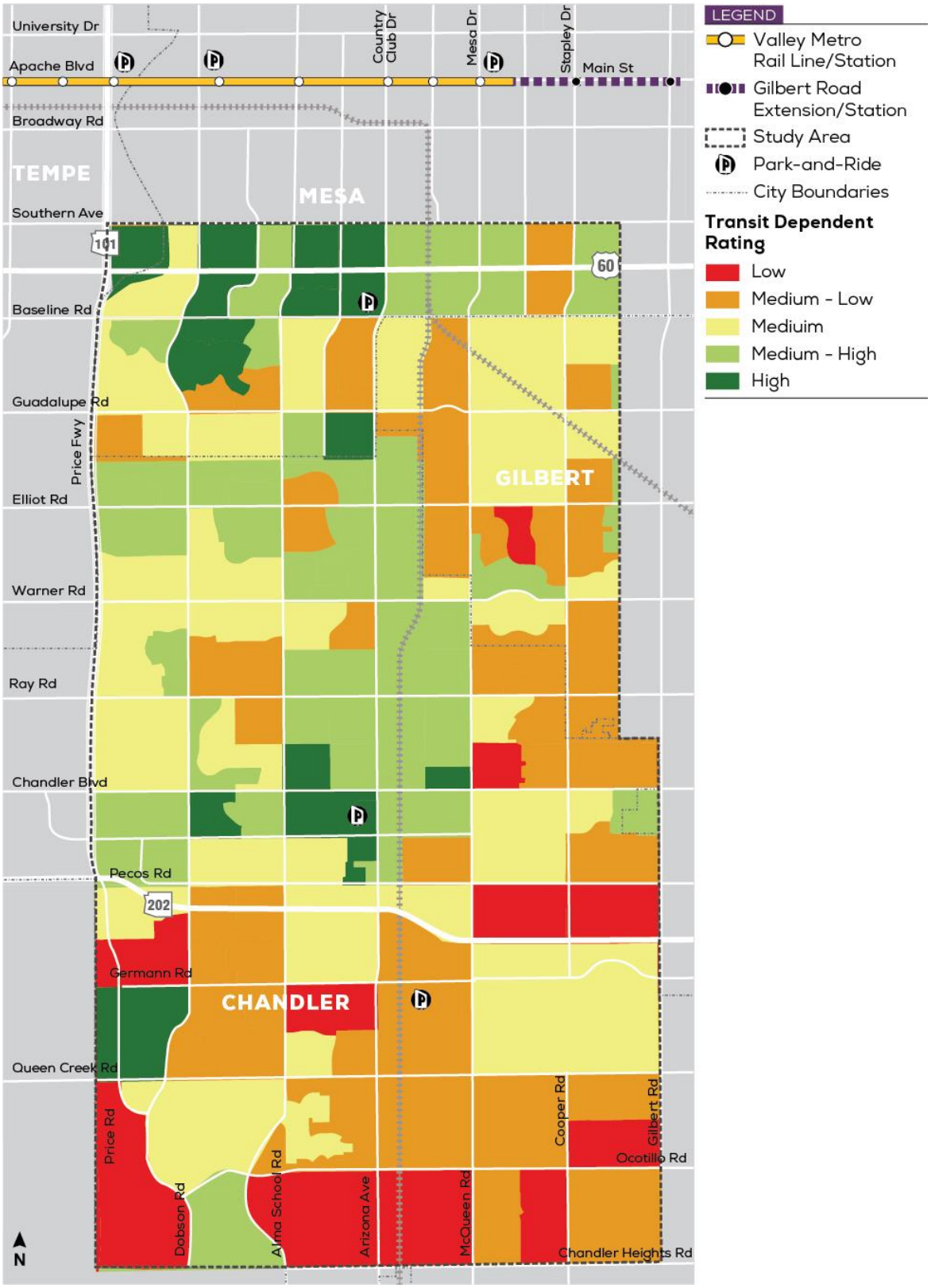
Appendix J: Age (Over 65)



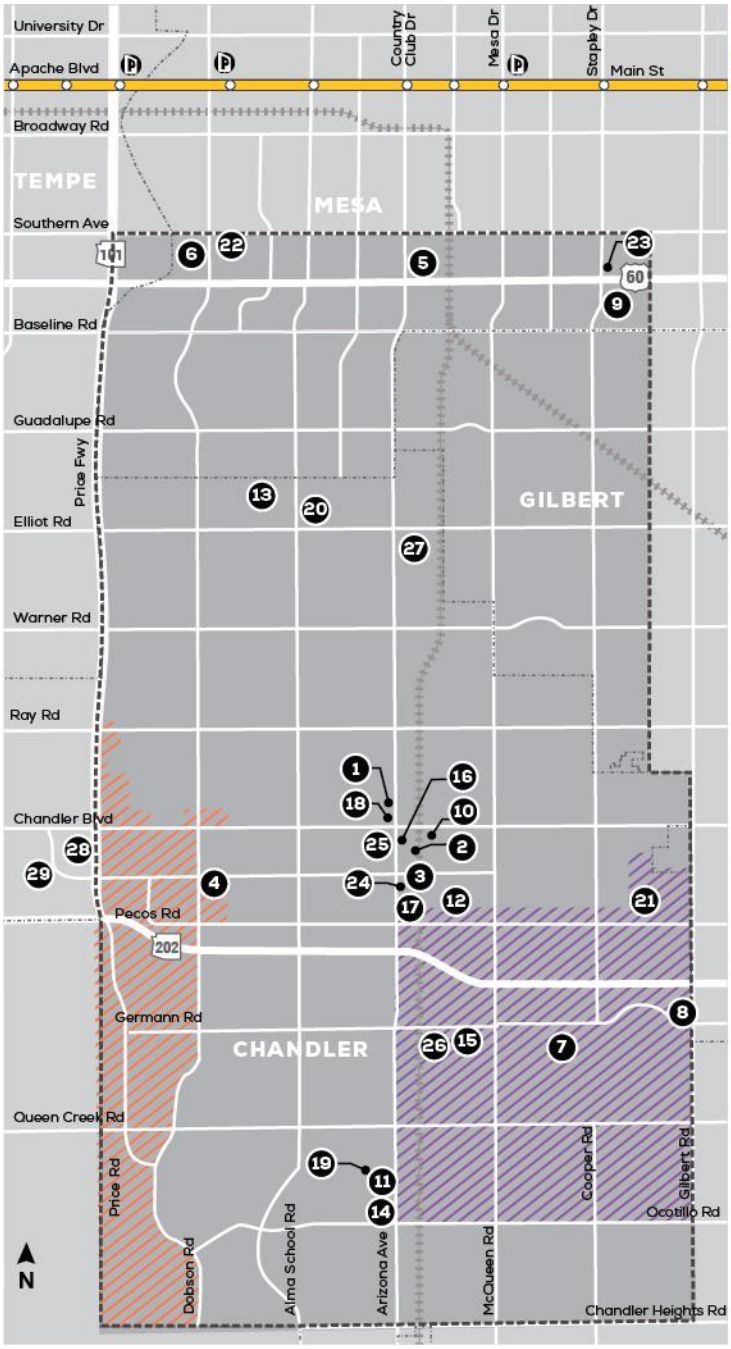
Appendix K: Zero and One Car Households



Appendix L: Transit-Dependency Rating



Appendix M:Activity Centers



LEGEND

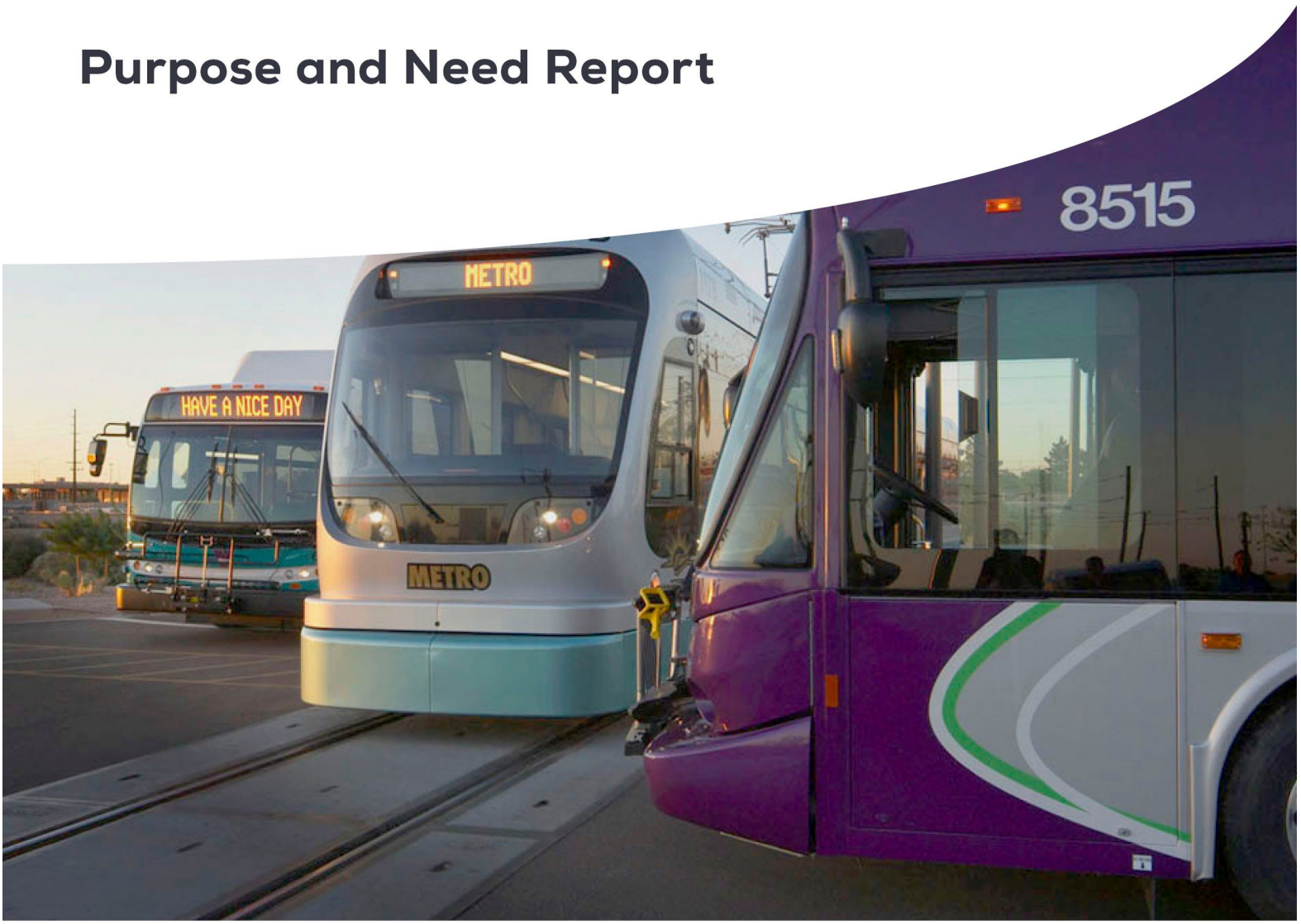
- Valley Metro Rail Line/Station
- Park-and-Ride
- Study Area
- City Boundaries
- Price Road Employment Corridor
- Chandler Airpark Area

Activity Centers

1. Chandler Center for the Arts
2. Chandler Municipal Court
3. Chandler City Hall
4. Chandler Regional Hospital
5. Golfland Sunsplash
6. Banner Desert Medical Center
7. Chandler Municipal Airport
8. Crossroads Town Center
9. Mesa Grand Shopping Center
10. Chandler Downtown Library
11. Hamilton Library
12. Folley Pool
13. Desert Oasis Aquatic Center
14. Hamilton Aquatic Center
15. Tumbleweed Recreation Center
16. Chandler Community Center
17. Chandler Senior Center
18. Chandler High School
19. Hamilton High School
20. Primavera Technical Learning Center
21. Chandler-Gilbert Community College
22. Mesa Community College
23. Rio Salado College
24. New Square Development
25. Overstreet Development
26. Chandler Park and Ride
27. Chandler Arizona Department of Economic Security
28. Chandler Fashion Center
29. Chandler Museum

ARIZONA AVENUE ALTERNATIVES ANALYSIS

Purpose and Need Report



MAY 2020

VALLEY METRO

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Appendix A: Existing and Future Environment Report

1.0 INTRODUCTION

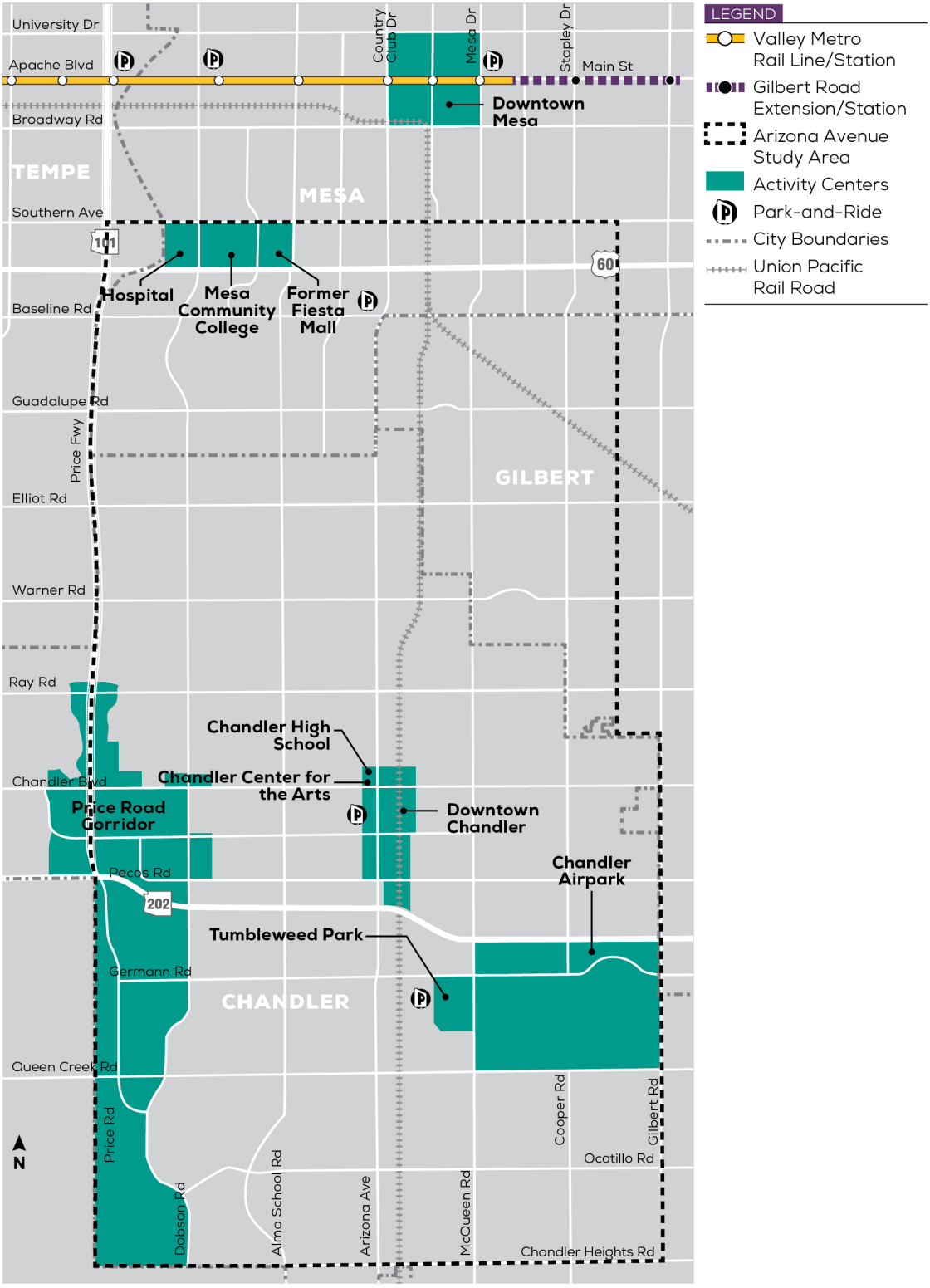
Over the past 30 years, Chandler has seen dramatic population growth and economic development. The City's population has almost tripled since 1990 and it is now home to major employers such as Intel, Wells Fargo, PayPal, NXP Semiconductors and Bank of America. This massive growth has led the City of Chandler to incorporate zoning and land use policies that encourage higher densities and pedestrian-orientation, especially in key employment centers like downtown Chandler, Price Road Corridor, and the Chandler Airpark district. Chandler is seen as a technological innovator in the transportation industry and is the home base of Waymo, a large autonomous vehicle testing facility.

All of these factors feed into a need for a multi-modal transportation network that serves all users. The City has increased bus service, added bike lanes and built other transportation infrastructure like wider sidewalks, raised medians, and new streetlights. However, current and future demand may necessitate investment in high-capacity transit (HCT) to address traffic congestion, mobility for transit-dependent populations and accessibility to employment opportunities. As such, the City and Valley Metro investigated the feasibility of implementing HCT in the Arizona Avenue corridor. The Fiesta-Downtown Chandler Transit Corridor Study, completed in 2017, demonstrated that HCT is feasible in this area; as such, the City and Valley Metro began the Arizona Avenue Alternatives Analysis (AAAA) to further study HCT in the corridor.

The AAAA study area (**Figure 1**) includes portions of Chandler, Mesa and Gilbert. It stretches from: Southern Avenue to Chandler Heights Boulevard to the south; the study area's western border follows the Loop 101/Price Road; and the eastern border generally follows Gilbert Road. It includes downtown Chandler, the Price Road Corridor and the Chandler Airpark District. This study will look at ways to improve mobility within the study area, especially for transit-dependent populations (38% who reside in zero and one car households in the study area).

The following sections focus on elements that will establish a purpose and need for this project, such as existing and potential travel patterns, passenger service availability and performance, congestion, travel time, population, employment, land use and economic development opportunities.

FIGURE 1: AAAA STUDY AREA MAP



2.0 OVERVIEW OF THE STUDY AREA

This section summarizes existing and future characteristics in the study area, as well as the potential need for HCT service. Specifically, Section 2.0 summarizes the socioeconomic characteristics, land use patterns, transit needs and transportation network conditions of the study area. **Appendix A: Existing and Future Environment Report** documents detailed information.

2.1 POPULATION AND EMPLOYMENT TRENDS

A review of existing and projected future population and employment was conducted to understand the socioeconomic trends within the study area. Transportation Analysis Zones (TAZs) from the Maricopa Association of Government (MAG), as well as Census Block Groups within the study area, are the basis for the analysis.

2.1.1 Population Growth

As of 2015, more than 250,000 people reside within the AAAA study area (approximately 4,000 people per square mile), with a projected growth of 22 percent by the year 2040 to reach a population of 300,000. One of the most densely populated portions of the study area is between Baseline Road and Warner Road, from Arizona Avenue on the west to Cooper Road on the east. The corridor along Arizona Avenue, near downtown Chandler, also exhibits high population densities and is projected to be denser by 2040. Table 1 outlines the population growth for the region, city and study area.

TABLE 1: POPULATION GROWTH

Location	Total Population		2015-2040 Growth		Population Density (per square mile)	
	2015	2040	Change	Percent	2015	2040
MAG-Region	4,000,000	6,000,000	2,000,000	50%	450	650
City of Chandler	250,000	300,000	60,000	20%	3,800	4,700
AAAA Study Area	260,000	320,000	60,000	23%	4,000	5000

Source: MAG TAZ, 2016

Population growth creates increased demand on the transportation network, causing congestion and travel delays. The AAAA study area has very little vacant land, which prompts population growth to be concentrated in areas where there is an increased density of redevelopment. Since most of the study area is fully built-out, reducing congestion and improving throughput by means of street expansion or the addition of vehicular traffic lanes would be impractical.

The addition of new bus routes or enhanced service on existing routes may provide additional capacity, but the buses would still operate in mixed traffic and incur significant traffic delays and reduced performance, especially during peak periods. The addition of HCT in an exclusive guideway in the study area would provide the capacity and performance needed to meet future population growth, both within the study area and across the Southeast Valley region.

2.1.2 Employment Growth

As of 2015, the AAAA study area had about 145,000 employees (approximately 2,200 per square mile), with a projected employment growth of 46 percent by 2040 to 212,000 employees. A high concentration of employment in the study area is established between Cooper Road and Arizona Avenue, south of Baseline Road to Elliot Road. The entire study area is projected to see an increase in employment density by 2040, with key areas along the Arizona Avenue corridor and downtown Chandler. Table 2 outlines the employment growth for the region, city and study area.

TABLE 1: EMPLOYMENT GROWTH

Location	Total Employment		2015-2040 Growth		Employment Density (per square mile)	
	2015	2040	Change	Percent	2015	2040
MAG Region	1,900,000	2,860,000	960,000	50%	200	300
City of Chandler	129,000	185,000	56,000	43%	1,980	2,800
AAAA Study Area	145,000	212,000	67,000	46%	2,200	3,300

Source: MAG TAZ, 2016

Employment growth would necessitate additional trips into the study area, especially in the morning peak period with an increase in outbound peak period traffic, further straining the future transportation network. Combined with projected population growth, the study area will experience high levels of traffic congestion and travel delays.

The addition of HCT in an exclusive guideway in the study area would increase capacity and reduce travel times. The benefits would be even greater if the HCT service can connect into the existing and planned regional light rail system. Additionally, the study area could benefit from a connection to HCT being considered in Mesa's Fiesta District Alternatives Analysis anticipated to conclude in spring 2020. This connection would provide links to population and employment centers throughout the region. The existing Valley Metro light rail currently connects more than 200,000 employees along the Central Avenue employment corridor, downtown Phoenix, downtown Tempe and downtown Mesa.

2.1.3 Transit Dependent Population

Transit-dependent populations are those that rely more heavily on transit services to maintain their overall mobility. Areas with these populations are more likely to utilize enhanced transit services, such as HCT, and have a greater need for improved transportation options. HCT provides transit-dependent populations with greater mobility, better access to jobs and an affordable means of transportation.

Four transit-dependent indicators were analyzed to understand the level of transit-dependency in the study area:

- Commute to work mode choice (transit, bike, walk)
- Population below poverty
- Age (over 65)
- Zero- and one-vehicle households

Each indicator captures populations that are more likely to utilize an HCT service. People who already utilize alternative modes to travel to work (transit, bike, walk) are more likely to adopt the higher service levels that HCT provides. People with lower incomes are more likely to ride transit in general, as it is a more affordable transportation option than owning a vehicle. Older populations are more likely to ride transit for various reasons, including health, affordability and personal choice. Lastly, households that have one or zero vehicles are more likely to ride transit. The transit-dependent characteristics for the AAAA study area, as well as a comparison to Chandler and the MAG region, are identified in **Table 3**.

TABLE 2: TRANSIT-DEPENDENT POPULATION CHARACTERISTICS

Population Characteristic	MAG Region		City of Chandler		AAAA Study Area	
	Total	Percent	Total	Percent	Total	Percent
Commute (transit, bike, walk)	81,124	5%	3,210	3%	3,785	3%
Population below poverty	457,885	32%	22,049	9%	25,717	10%
Over age 65	513,536	13%	23,014	10%	23,298	9%
Zero- and one-vehicle households	467,608	27%	31,558	37%	33,063	38%

Source: 2016 American Community Survey

As of 2016, there was a marginally higher percentage of people below the poverty level in the study area than in Chandler. The study area also has a higher percentage of residents with zero- and one-car households compared to the region as a whole. Lastly, the transit-dependent populations in the study area are focused around the Arizona Avenue corridor, one mile west to Alma School Road, and one mile east to McQueen Road between Frye Road and Southern Avenue.

2.2 LAND USE AND ECONOMIC DEVELOPMENT TRENDS

Land use contributes to the productivity of transit systems and is an integral part of this study. Generally, land uses that include dense residential characteristics, high employment concentrations, and major destinations are correlated with the potential for transit ridership. Land use policies that are compatible with transit and transit-oriented development may promote the success of HCT in the future.

2.2.1 Existing and Planned Land Use

The study area has a large percentage of its land dedicated to single-family residential zoning (47 percent of the total area), which is marginally less than Chandler as a whole. The slightly lower percentage of single-family residential zoning is supplemented by the larger percentage of multi-family residential zoning present in the study area. The study area is also marked by higher percentages of commercial, industrial and other employment related land uses. **Table 4** summarizes the existing and planned land uses throughout the MAG region, Chandler and study area.

TABLE 3: EXISTING LAND USE

Land Use Sector	MAG Region		City of Chandler		AAAA Study Area	
	Acres	Percent	Acres	Percent	Acres	Percent
Agriculture	260,742	4%	1,798	4%	1,920	5%
Commercial	36,572	<1%	2,240	5%	2,515	6%
Industrial	34,510	<1%	2,931	7%	3,187	8%
Mixed Use	337	<1%	0	0%	0	0%
Multi-Family Residential	34,640	<1%	2,176	5%	2,598	6%
Office	9,123	0%	602	<1%	704	2%
Open Space	3,708,504	63%	4,134	10%	3,731	9%
Other Employment	114,997	2%	2,125	5%	2,374	6%
Single Family Residential	427,572	7%	20,698	50%	19,283	47%
Transportation	89,137	2%	2,842	7%	2,880	7%
Vacant	1,186,831	20%	1,894	5%	1,600	4%
Total	**5,902,965**	**100%**	**41,440**	**100%**	**40,792**	**100%**

Source: MAG Existing Land Use, 2016

TABLE 4: FUTURE LAND USE

Land Use Sector	MAG Region		City of Chandler		AAAA Study Area	
	Acres	Percent	Acres	Percent	Acres	Percent
Agriculture	37,426	<1%	0	0%	13	<1%
Commercial	68,076	1%	2,733	7%	3,066	8%
Industrial	64,519	1%	3,002	7%	3,264	8%
Mixed Use	271,297	5%	1,574	4%	1,466	4%
Multi-Family Residential	52,724	<1%	2,317	6%	2,669	7%
Office	11,961	<1%	1,165	3%	1,395	3%
Open Space	3,761,395	64%	4,506	11%	4,083	10%
Other Employment	169,069	3%	1,709	4%	1,856	5%
Single Family Residential	1,373,482	23%	21,376	52%	19,968	49%
Transportation	92,923	2%	2,963	7%	2,944	7%
Vacant	0	0%	0	0%	0	0%
Total	**5,902,872**	**100%**	**41,345**	**100%**	**40,724**	**100%**

Source: MAG Future Land Use, 2016

2.2.2 Activity Centers

The AAAA study area has numerous employment clusters, entertainment sites and regional destinations. These activity centers generate and attract trips from within and outside the study area. Activity centers were identified through coordination with City staff; growing demand to activity centers could continue to strain the existing and future transportation system. HCT and improved transit service to the activity centers will strengthen the local economy, provide regional accessibility and support continued economic development like the $11 billion in new capital investment that occurred within 0.5 mile of light rail stations areas since construction began in 2005.

A partial listing of the study area's activity centers:

- **Fiesta District**
  - Former Fiesta Mall (Future Redevelopment Opportunity)
  - Mesa Community College
  - Banner Desert Medical Center
- **Downtown Chandler**
  - Chandler City Hall
  - Folley Memorial Pak
  - Chandler Downtown Library
  - Chandler Center for the Arts
- **Other**
  - Chandler-Gilbert Community College
  - Golfland Sunsplash
  - Chandler Airpark
  - Tumbleweed Park

3.0 TRANSPORTATION NEEDS

The AAAA HCT project would provide improved transit service that responds to regional travel patterns, increased travel demand, and changes in future traffic conditions and operations. This chapter identifies those transportation needs and conditions that an HCT investment could affect throughout the study area.

3.1 TRAVEL PATTERNS

An analysis of travel patterns was conducted to understand the geographic distribution of all person-trips within the AAAA study area, and between the study area and surrounding areas. To analyze travel characteristics, the MAG region was divided into several districts, nine of those districts are located in the study area. Using MAG 2017 regional travel forecasting model, travel market analysis was prepared using groups of traffic analysis zones (TAZ) delineated to reflect activity centers in and around the study area.

Figure 2 and **Figure 3** suggest key travel relationships in the study area by indicating the estimated daily home-based work (HBW) and non-work trips within the study area. The strongest pattern of all person-trips is indicated within the study area in a diagonal direction from southwest to northeast. An average daily 4,800 HBW trips and more than 22,654 non-work trips are estimated between the southwest district near Price Road/Queen Creek Road to the central district near Arizona Avenue/Chandler Boulevard. Additionally, a strong north-south pattern is indicated between the western district near Dobson Road/Warner Road and the southwest corridor near Price Road/Queen Creek Road with nearly 4,000 HBW trips and over 22,000 non-work trips.

Figure 4 and **Figure 5** suggest some of the key travel relationships between the study area and surrounding areas for HBW trips. The nine districts with which the study area has the highest number of trips are identified. HBW trips from the study area are largely destined to the west of the study area. The two largest HBW travel relationships had the same destination in the district located in east Tempe, which features a concentrated employment core. Examining all-person HBW trips from the study area indicated that daily, an average of 7,121 trips from the district near Dobson Road/Warner Road and 5,281 trips from the district near Price Road/Queen Creek Road, destined to the district in east Tempe.

Home-based work trips to the study area also indicate a westward travel pattern with the strongest patterns originating from districts east of the study area in Mesa and Gold Canyon. An average daily 8,441 all person HBW trips are estimated from the district near the Phoenix-Mesa Gateway airport.

Further northwest, a comparable travel pattern with an average daily 7,152 HBW trips to the study area is indicated in a district near the Superstition Freeway in Gold Canyon.

Finally, **Figure 6** and **Figure 7** suggest some of the key travel relationships to and from the study area for non-work trips. Non-work trips from and to the study area indicate a less defined pattern than HBW trips and instead suggest a relationship with districts along the edge of the study area in a radial arrangement. The strongest travel pattern of non-work trips from the study area originated in the district near Dobson Road/Warner Road and destined to east Tempe. With a daily estimated 22,037 trips. A reciprocal travel relationship is implied for this district as a daily estimated 20,034 trips originate from east Tempe as well. Similarly, the district near Price Road/Queen Creek Road in the study area suggested an estimated 14,614 trips to the same district in east Tempe. Non-work based trips to the study area exhibit a corresponding undefined radial arrangement as trips from the study area with strongest travel pattern exist between central Mesa and the district in the study area near Baseline Road/Cooper Road, with an estimated 23,565 trips.

FIGURE 2: HBW TRIPS WITHIN THESTUDY AREA

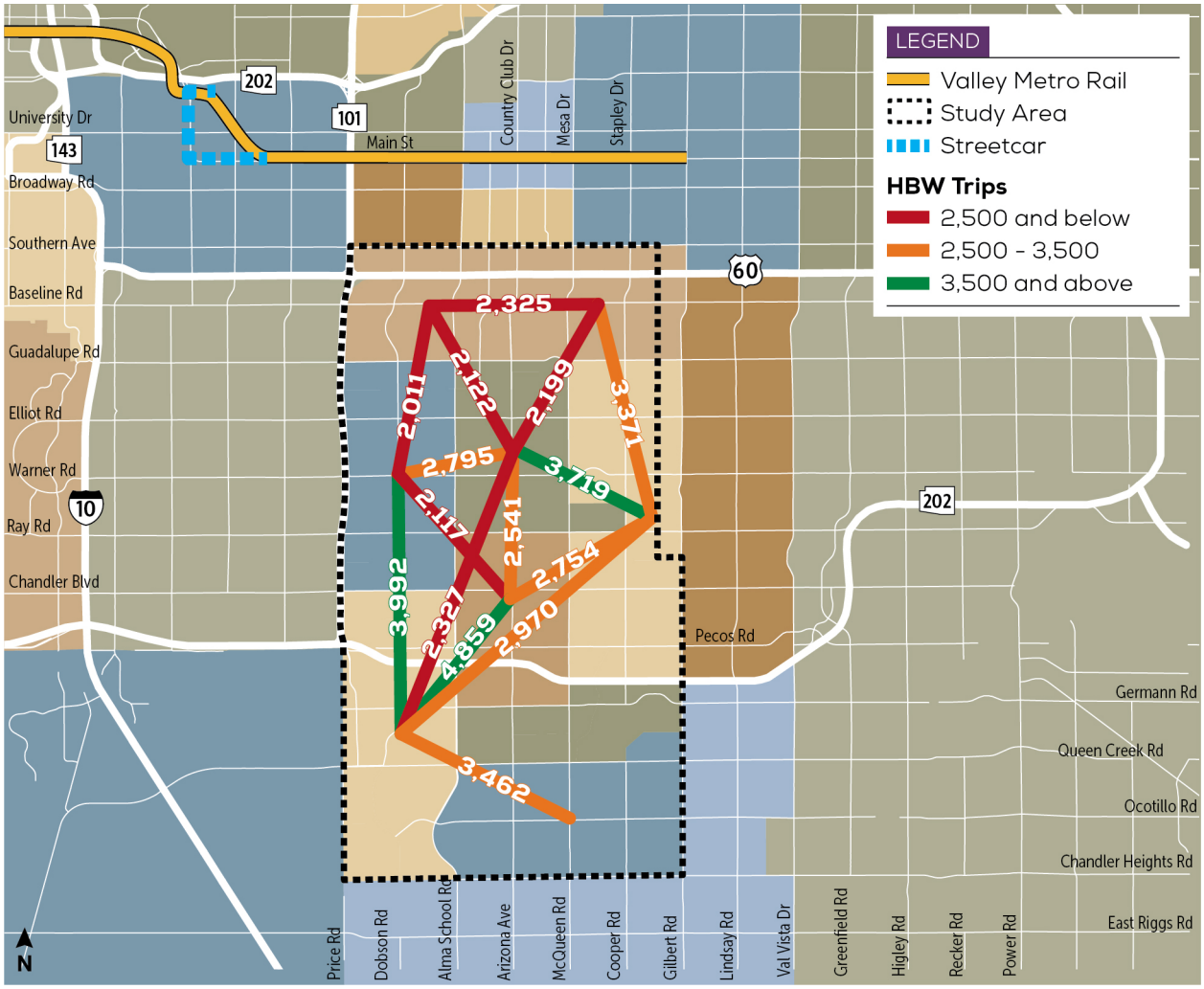


FIGURE 3: NON-WORK TRIPS WITHIN THE STUDY AREA

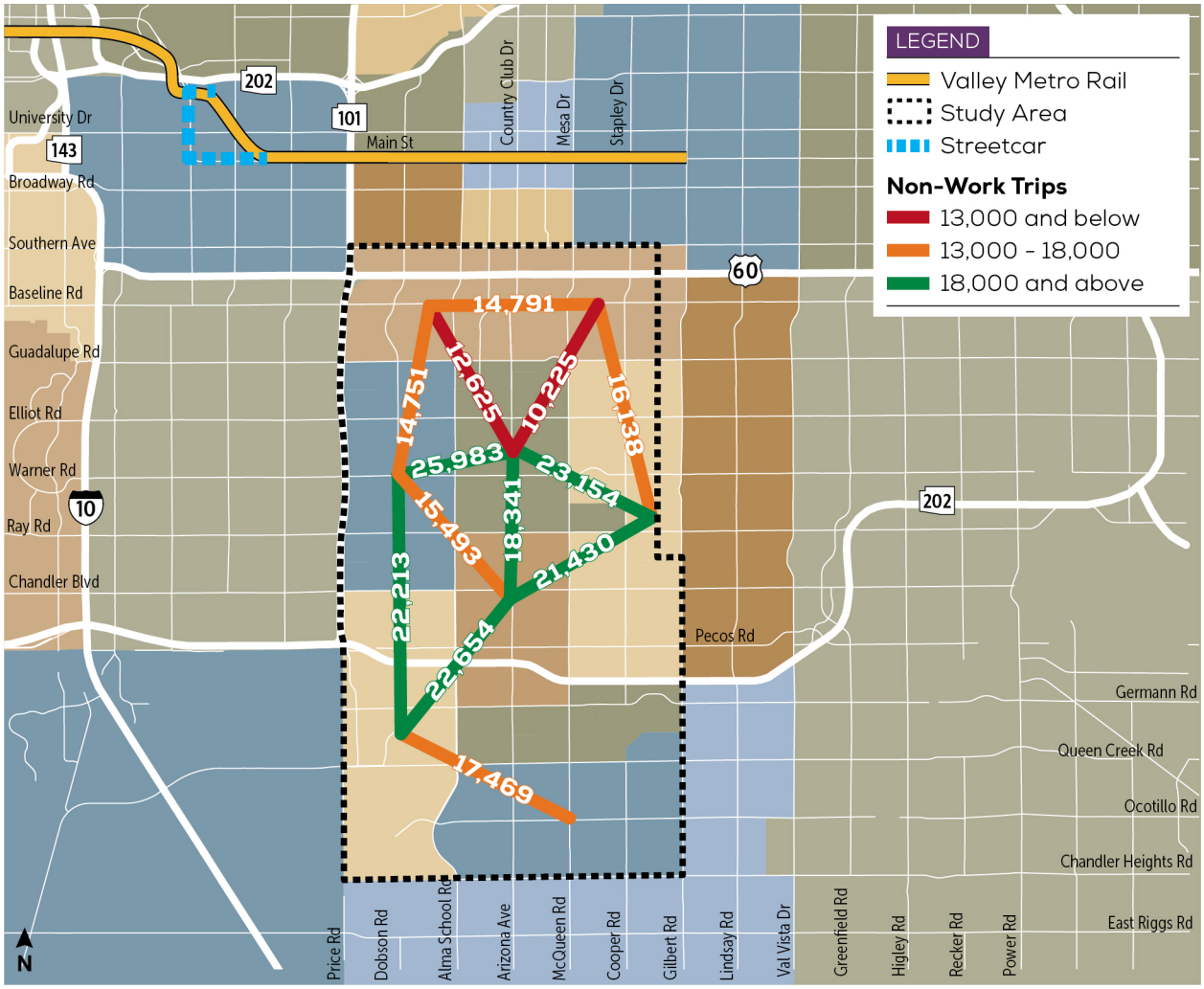


FIGURE 4: HBW TRIPS FROM STUDY AREA

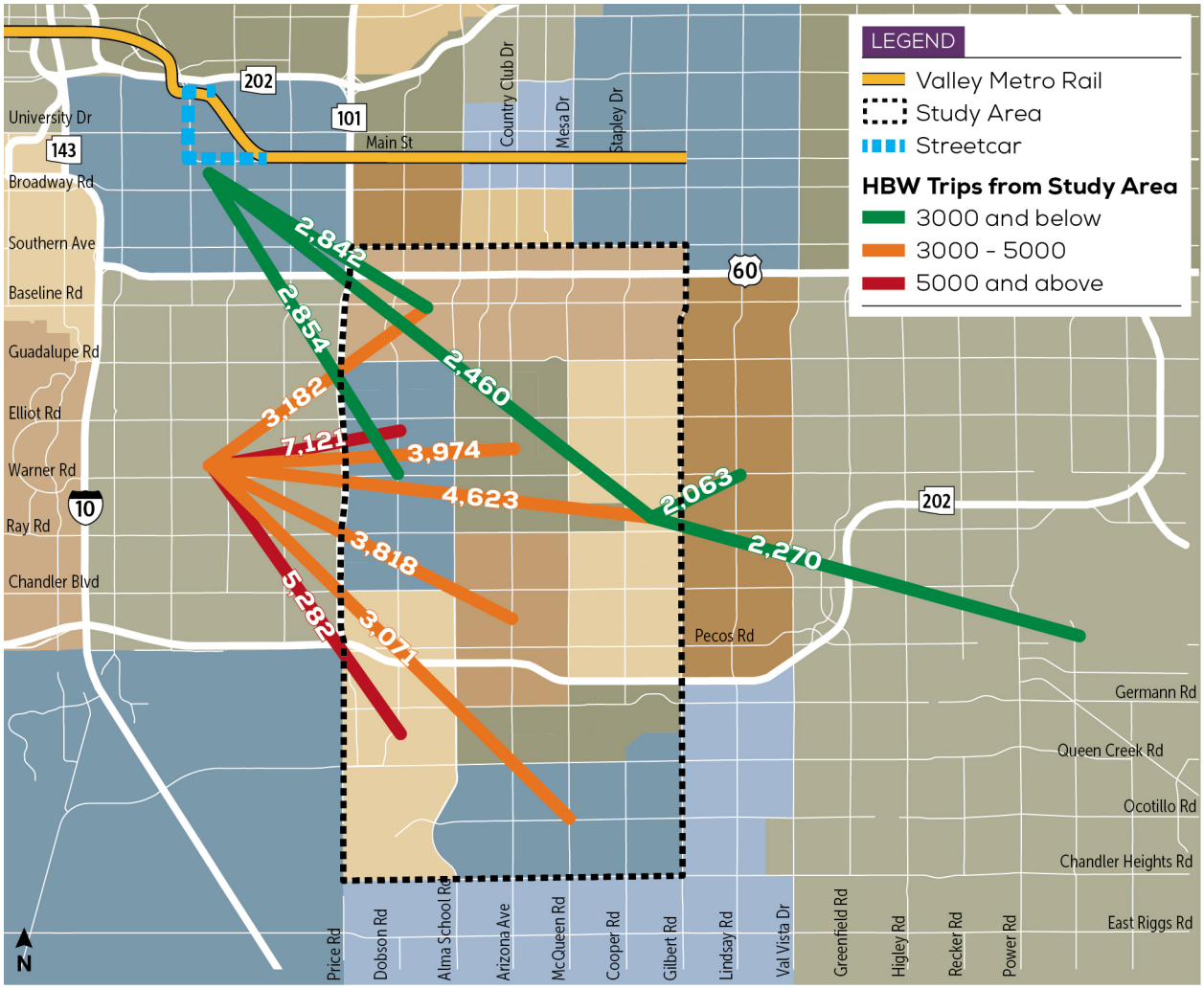


FIGURE 5: HBW TRIPS TO STUDY AREA

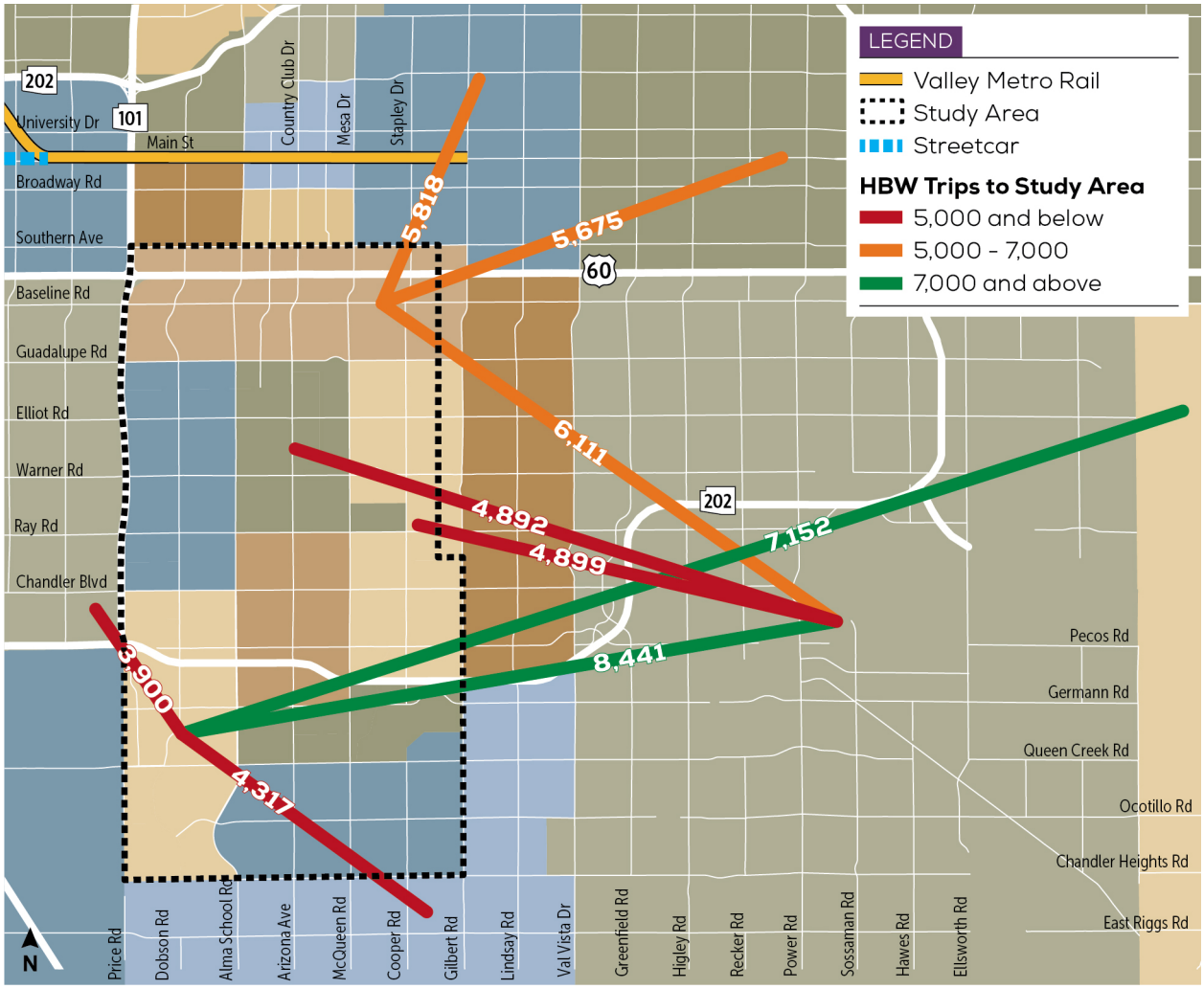


FIGURE 6: NON-WORK TRIPS FROM STUDY AREA

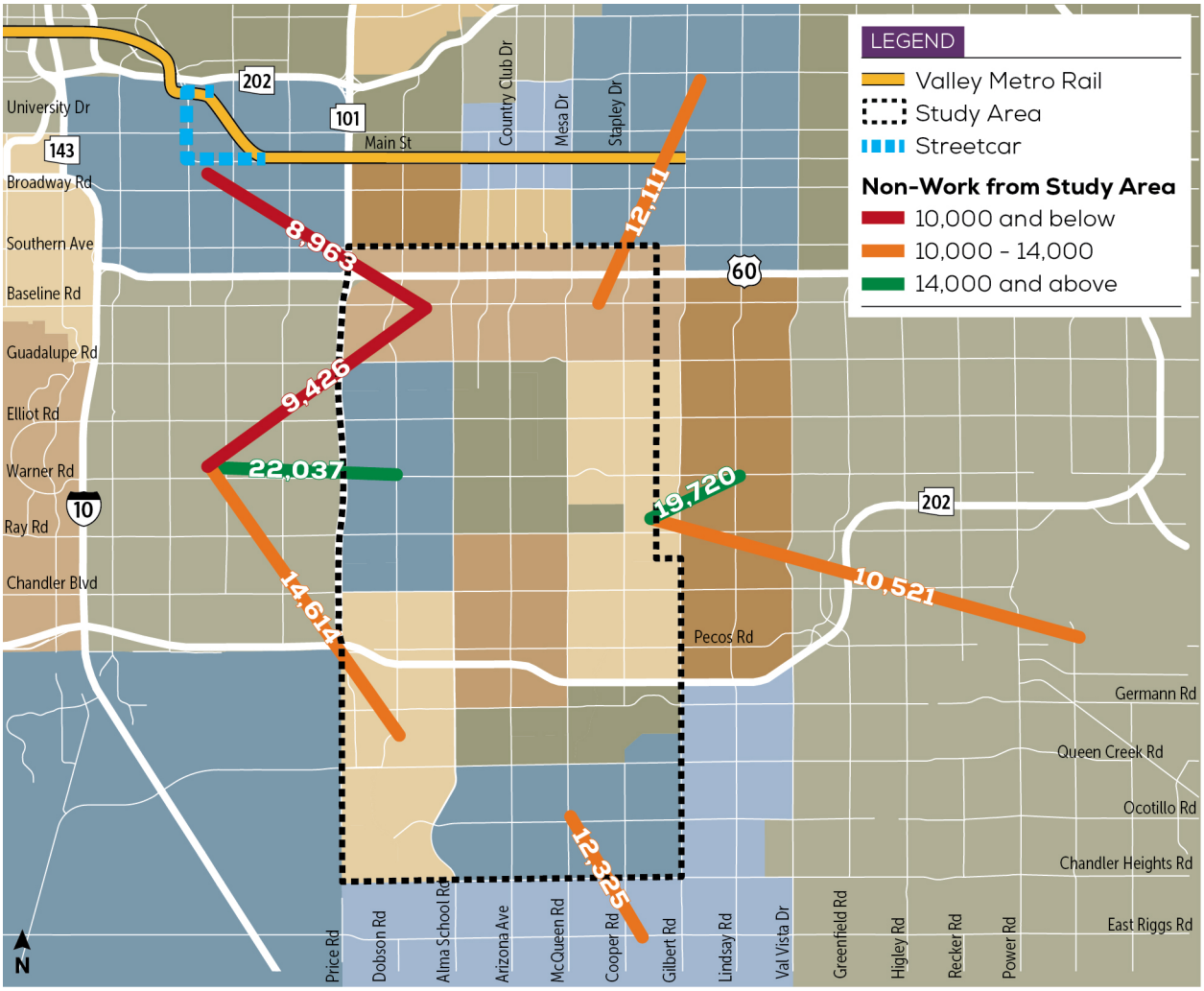
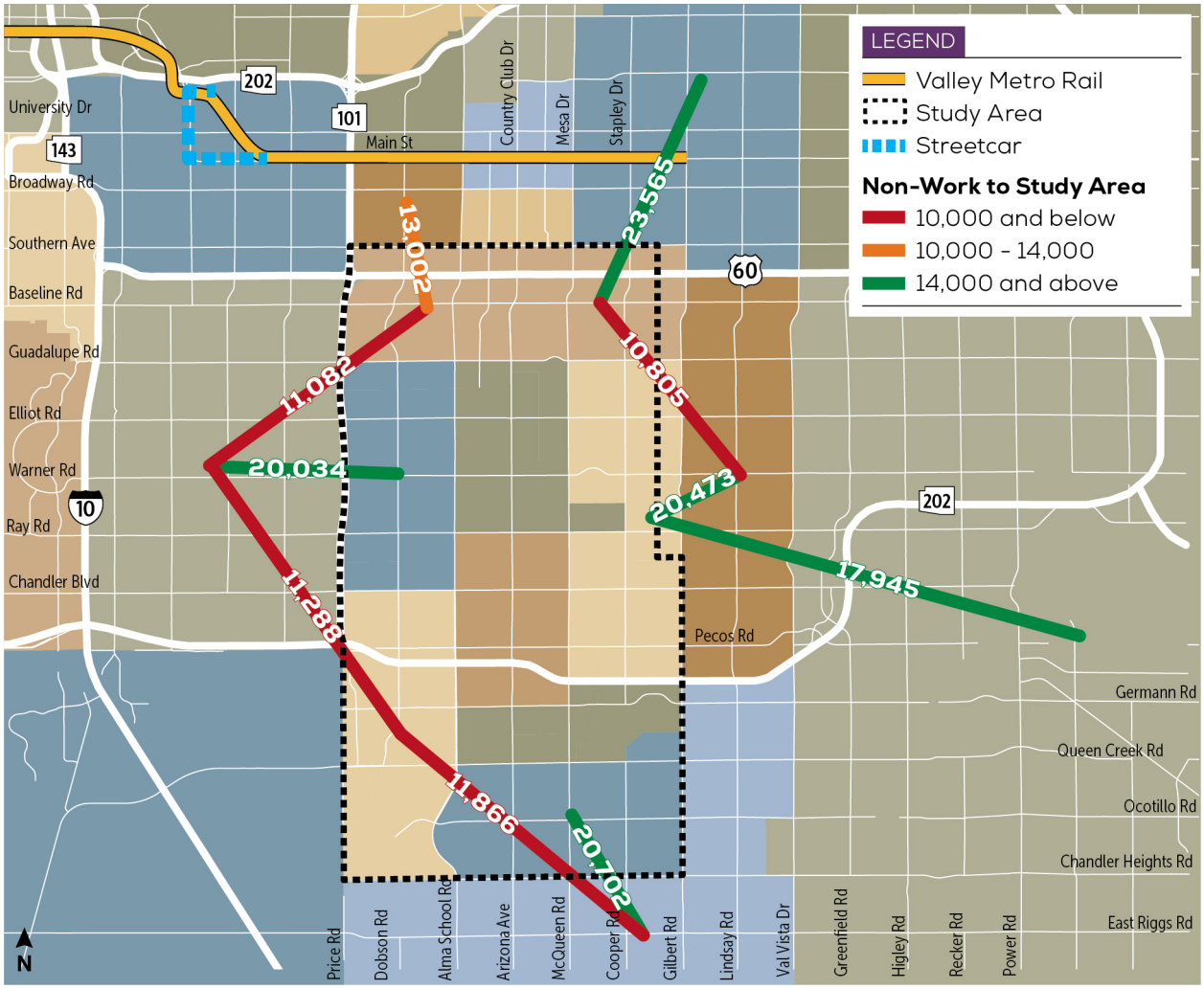


FIGURE 7: NON-WORK TRIPS TO STUDY AREA



3.2 TRAFFIC CONDITIONS

Understanding traffic conditions help determine the potential impacts and benefits of construction and operation of a HCT system in the study area. To provide a general indicator of congestion within the study area, daily level of service (LOS) values were compared under both the existing and future condition. A LOS indicates the amount of traffic congestion on a given section of road at a given time; LOS ratings range from level "A" (free flowing traffic) to "F" (traffic flow breakdown). **Figure 8** illustrates the LOS for roadways in the study area in 2017 and forecasted for 2040. All roadway segments in the study area are LOS "C" or below; segments of Alma School Road, McQueen Road, Ray Road and Price Road are forecasted to decrease to a LOS "F" in 2040.

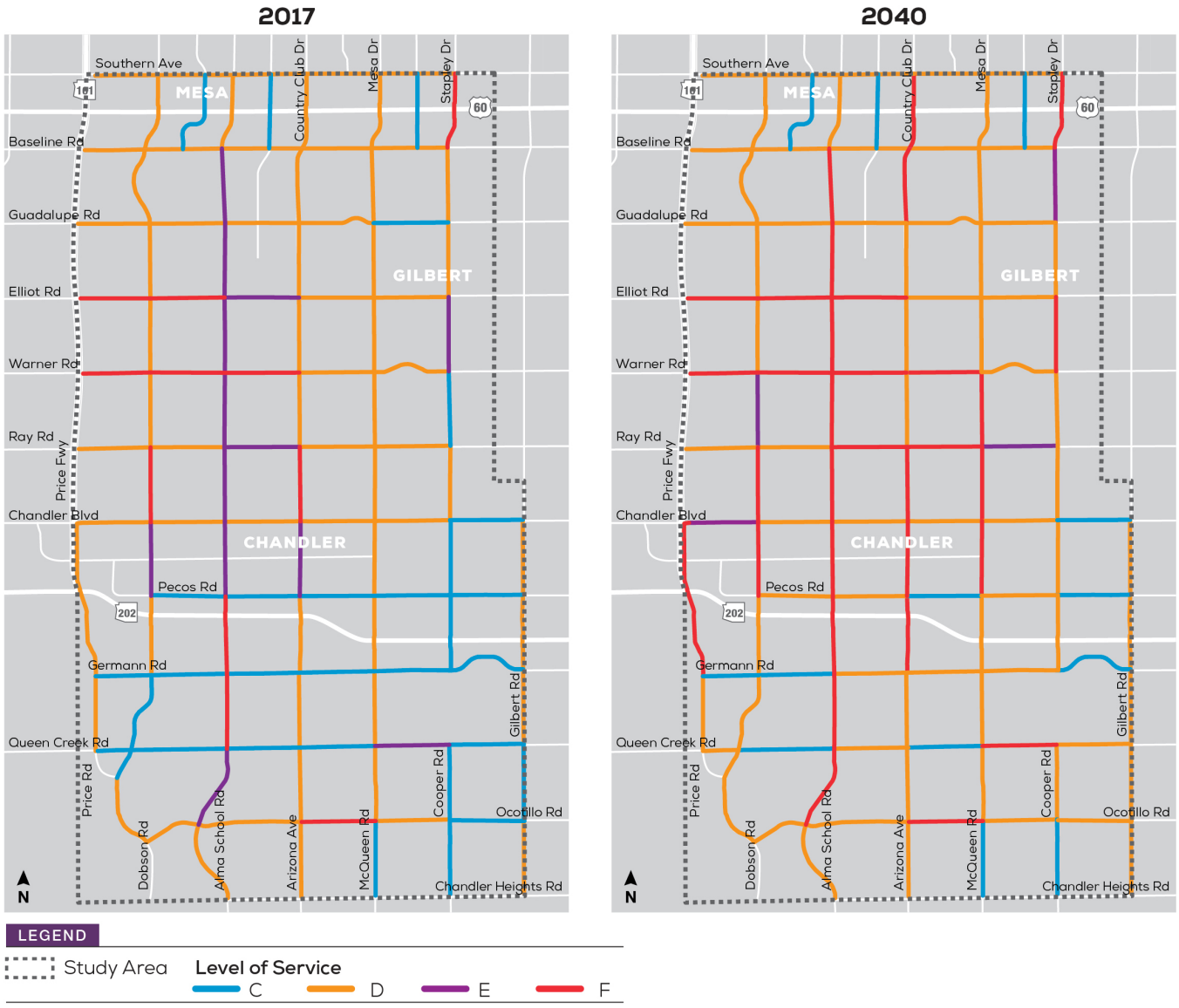
Another indicator of traffic conditions is travel time. **Table 6** indicates the travel times in minutes between key activity centers in the study area for both automobile and transit. The existing (2017) and future (2040) conditions are based on current planned facilities for automobiles and local buses. Generally, travel times between these key activity centers are expected to increase for both automobile and transit users by 20 minutes per week on average. This translates to an increase of 16 hours, the equivalent of 2 workdays, spent in congestion annually. Note that the travel times indicated are estimates from the MAG Regional Travel Forecast Model that allow comparison between existing and future horizon years.

TABLE 5: TRAVEL TIME

Origin	Destination	Existing Travel Time in Minutes (2017)		Future Travel Time in Minutes (2040)	
		Auto	Transit	Auto	Transit
Downtown Chandler	Downtown Mesa	27	44	30	48
Downtown Chandler	Chandler Municipal Airport	11	N/A	12	28
Downtown Chandler	Mesa Community College	23	39	25	40
Intel Campus	Chandler Fashion Center	17	31	19	30
Mesa Community College	Chandler Fashion Center	21	47	22	42

Source: MAG Regional Travel Forecast Model, 2018. Transit times are based on modeled abstract schedule.

FIGURE 8: LEVEL OF SERVICE



3.3 TRANSIT SERVICE AND RIDERSHIP

This section provides a summary of existing and planned transit within the study area. Fixed route bus service and paratransit service are currently provided in the study area (**Figure 9**). **Table 7** summarizes annual boardings in Chandler from FY2018 for existing transit routes that serve the study area. The routes with the highest overall boardings within the study area include Southern Avenue (Route 61), Country Club/Arizona Ave (Route 112) and Chandler Blvd/Williams (Route 156), which each serve more than 150,000 riders per year. Route 61 runs outside of Chandler, just within the boundary of the study area, and is one of the top ten routes in terms of total boardings in the entire Valley Metro network. Using boardings per mile, Route 61, Route 112, Route 96 and Route 120 are the most productive local bus routes in the study area with an average over 1.4 boardings per mile.

TABLE 6: STUDY AREA TRANSIT PERFORMANCE

Transit Service	Total Boardings	Peak Frequency	Revenue Miles	Boardings per Mile*
Local Routes				
61 – Southern Avenue	554,587	15 Min	284,280	2.0
77 – Baseline Road	22,213	30 Min	19,802	1.1
96 – Dobson Road	82,355	20 Min	117,072	0.7
104 – Alma School Road	57,249	30 Min	78,610	0.7
108 – Elliot Road	59,379	30 Min	59,316	1.0
112 – Country Club/Arizona Avenue	204,303	15 Min	165,369	1.2
120 – Mesa Drive	87,452	30 Min	49,244	1.8
128 – Stapley Drive	72,482	30 Min	66,333	1.1
136 – Gilbert Road	9,238	30 Min	21,873	0.4
140 – Ray Road	36,046	30 Min	100,862	0.4
156 – Chandler Boulevard	179,919	30 Min	173,149	1.0
Transit Service	**Total Boardings**	**Daily Trips**	**Revenue Miles**	**Boardings per Mile***
Express Routes				
531 – Mesa Gilbert Express	14,933	12	17,019.7	5.0
533 – Mesa Express	48,538	12	40,686.6	16.2
541 – Chandler/Mesa Express	6,391	8	9,205.5	3.2
542 – Chandler Express	54,920	14	38,432.2	18.3

*Note: Express Routes are reported as *Boardings per Trip*.
Source: Valley Metro Annual Ridership Report, FY2018.

FIGURE 9: EXISTING TRANSIT NETWORK

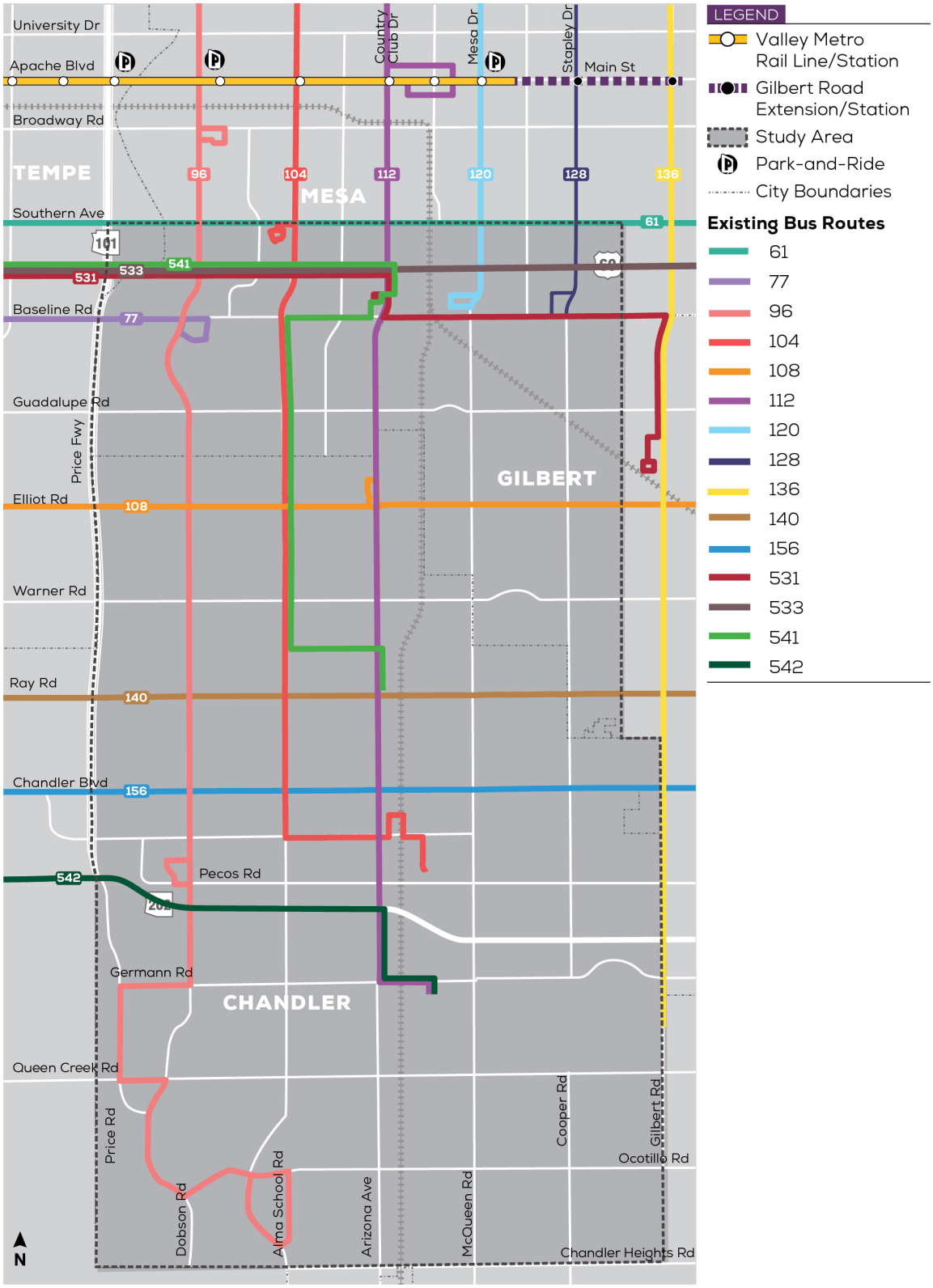


Table 8 identifies future improvements to existing routes within the study area between FY2019 and FY2022. Note, service improvements listed in this table may change.

TABLE 7: FUTURE IMRPOVEMENTS TO BUS ROUTES WITHIN THE STUDY AREA

Route	Proposed Service Change
Local Routes	
61 – Southern Avenue	No proposed changes.
77 – Baseline Road	Increase peak frequency to 15 minutes between 51st Ave and Dobson Rd. (FY2021) Extend to West Mesa Park-And-Ride. (FY2021)
96 – Dobson Road	Weekday, improve service in Chandler by extending current service to add one evening round trip. (FY2025) Improve peak weekday frequency to 15 minutes from Riverview to Elliot Rd. (FY2025)
104 – Alma School Road	Add Saturday service until 9pm in Chandler. (FY2024)
108 – Elliot Road	No proposed changes.
112 – Country Club Drive/Arizona Avenue	Extend Route 112 to Hamilton High School. (FY2024)
120 – Mesa Drive	Weekday service (both directions) from 5am to 10pm. (2024) Improve Saturday and Sunday service span to 6am-9pm and expand headways to 30 minutes. (FY2024) Extend route to McKellips Rd. (FY2022) Extend route to Warner Road in Gilbert. (FY 2024)
128 – Stapley	Weekday service (both directions) starting at 5am and ending at 10pm. Improve Saturday service to match weekday service. Implement Sunday service from 6am to 9pm at 30-minute frequency. (FY2021)
136 – Gilbert Road	Improve peak weekday frequency in Gilbert and Mesa (Main Street to Elliot Road). (FY2021) Extend evening service weekdays and Saturdays to Chandler. (FY2021) Improve peak weekday frequency in Gilbert and Mesa (Main to Elliot). (FY2021)
140 – Ray Road	Add Sunday service. (FY 2024) Extend 140 from Gilbert Rd. to Power Rd. on Warner. (FY 2025)
156 – Chandler Blvd/Williams	15-minute peak frequency from 40th St to Gilbert Road. (FY2021) 15-minute Peak in Chandler, starting at Gilbert Road. (FY2022)
Express Routes	
531 – Mesa/ Gilbert Express	No proposed changes.
533 – Mesa Express	No proposed changes.
541 – Chandler/ Mesa Express	No proposed changes.
542 – Chandler Express	Add one morning trip and one evening trip to service. (FY2024)

Source: Valley Metro Short Range Transit Program, FY2021-2025.

4.0 STATEMENT OF PROJECT PURPOSE AND NEED

The purpose of the AAAA is to recommend a locally preferred alternative for an HCT corridor in the study area. Transit improvements in the study area are needed to improve local and regional mobility by providing reliable, safe and efficient HCT service to employment clusters, activity centers, recreation facilities and residential housing along the Arizona Avenue corridor and other primary transit corridors in Chandler, Gilbert and Mesa. HCT improvements in the study area would:

- Connect local and regional activity centers in and around the study area, such as downtown Chandler and Sky Harbor International Airport.
- Support local transportation, economic development and land use planning goals and priorities.
- Build toward greater regional connectivity by interfacing with existing and future HCT projects in Mesa, Tempe and Phoenix.

Improved transit services in the study area will:

- Enhance connectivity in areas with high-use bus routes and projected population growth.
- Serve public facilities, residential areas and employment/retail clusters.
- Enhance the mobility of transit-dependent populations.
- Assist with travel demand in the study area and between regional destinations.

5.0 GOALS AND OBJECTIVES

Utilizing the *Existing and Future Environment Report* completed as part of Task 2.0 of this study, the project team developed goals and objectives for the implementation of HCT in the AAAA study area. Goals describe the desired outcome, while objectives measure the level of progress for completing a goal.

Goal 1: Improve access to businesses, cultural destinations, entertainment options, activity centers and education opportunities.

> Objective 1a: Serve key destinations within the study area, including downtown Chandler, the Price Road Corridor, Chandler Airpark, Fiesta District, Intel Ocotillo Campus, Fulton Ranch Towne Center, local schools and other activity centers.
>
> Objective 1b: Make transit investments that enhance the potential for economic, social and cultural activities, and are consistent with long-range plans and policies.

Goal 2: Connect people and places within the study area and the overall region, especially for transit-dependent populations.

> Objective 2a: Ensure future HCT in Chandler connects with the region's current HCT system.
>
> Objective 2b: Serve the study area's transit dependent populations.

Goal 3: Utilize HCT investment as a catalyst for economic development that is higher density, pedestrian oriented and supports a world-class economy.

> Objective 3a: Include the potential for new construction and redevelopment as a criterion for the evaluation of station locations.
>
> Objective 3b: Identify changes to land use planning policies, zoning codes and design guidelines that will encourage transit oriented development adjacent to any future HCT in Chandler.
>
> Objective 3e: Develop HCT alternatives that connect Chandler's identified growth areas and enhance the economic development opportunities in these areas.

Goal 4: Expand public transportation choices in anticipation of future population growth, travel demand and increased congestion.

> Objective 4a: Maximize potential ridership while maintaining an affordable and cost effective HCT project.
>
> Objective 4b: Attract new riders to the regional transit system.

Goal 5: Provide sustainable, healthy and multi-modal transportation alternatives.

Objective 5a: Incorporate a holistic approach to pedestrian, bike, automobile, and transit planning and infrastructure in any future HCT design.

Objective 5b: Support regional environmental goals, including air quality and congestion relief, by providing a fast, safe and affordable HCT alternative.

Goal 6: Frame HCT vision in context of Chandler's General Plan and the Transportation Master Plan 2019 Update.

Objective 6a: Utilize the recommendations from the Transportation Master Plan 2019 Update to ensure any future HCT alternative is consistent with the overall plan for future transit service.

6.0 CONCLUSIONS

The study area has a relatively high population density, demonstrates existing transit use and includes many economic development opportunities. The characteristics of the study area suggest strong future growth and travel demand that warrants a future investment in HCT and other transit services. The travel patterns analysis suggests a strong localized trip pattern within the study area that may be reasonably served through transit improvements, especially from southwest to northeast, as well as strong travel relationship between the study area and Mesa and Tempe.

In summary, the project is intended to:

- Enhance mobility by serving active travel patterns.
- Supply a reliable source of transportation for transit dependent populations.
- Connect the key regional destinations such as downtown Chandler, the Price Road Corridor, and the Chandler Airpark.
- Support future growth consistent with local economic and community development priorities and goals.

As alternative transit improvements are evaluated, an analysis will assess which options best meet the purpose and need for the project.

ARIZONA AVENUE ALTERNATIVES ANALYSIS

Identification of Alternatives Technical Memo

JUNE 2020

VALLEY METRO

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1.0 OVERVIEW

The purpose of this memorandum is to summarize the technical analysis results from Task 4.0 of the Arizona Avenue Alternatives Analysis (AAAA) scope of work. Task 4.0 included the following sub-tasks:

- Base Mapping
- Definition of Basic Alternatives Proposed for Evaluation
- Conceptual Definition of Alternatives
- Initial Screening of Alternatives

The original intended outcome of Task 4.0 was an initial list of alternatives to be evaluated, including the conceptual definition of those alternatives (i.e. alignment maps; station locations; park-and-ride locations and capacities; intermodal transfer stations including an end-of-line station and right-of-way requirements; and other impacts). These initial alternatives would then go through a high-level screening to determine how well they would meet the purpose and need of the project developed in Task 3.0. These alternatives would all be mapped on the base map developed during this task. After the initial screening, the remaining alternatives would be carried forward to Task 5.0 for a thorough analysis based on the Analysis Methodology created in Task 3.0.

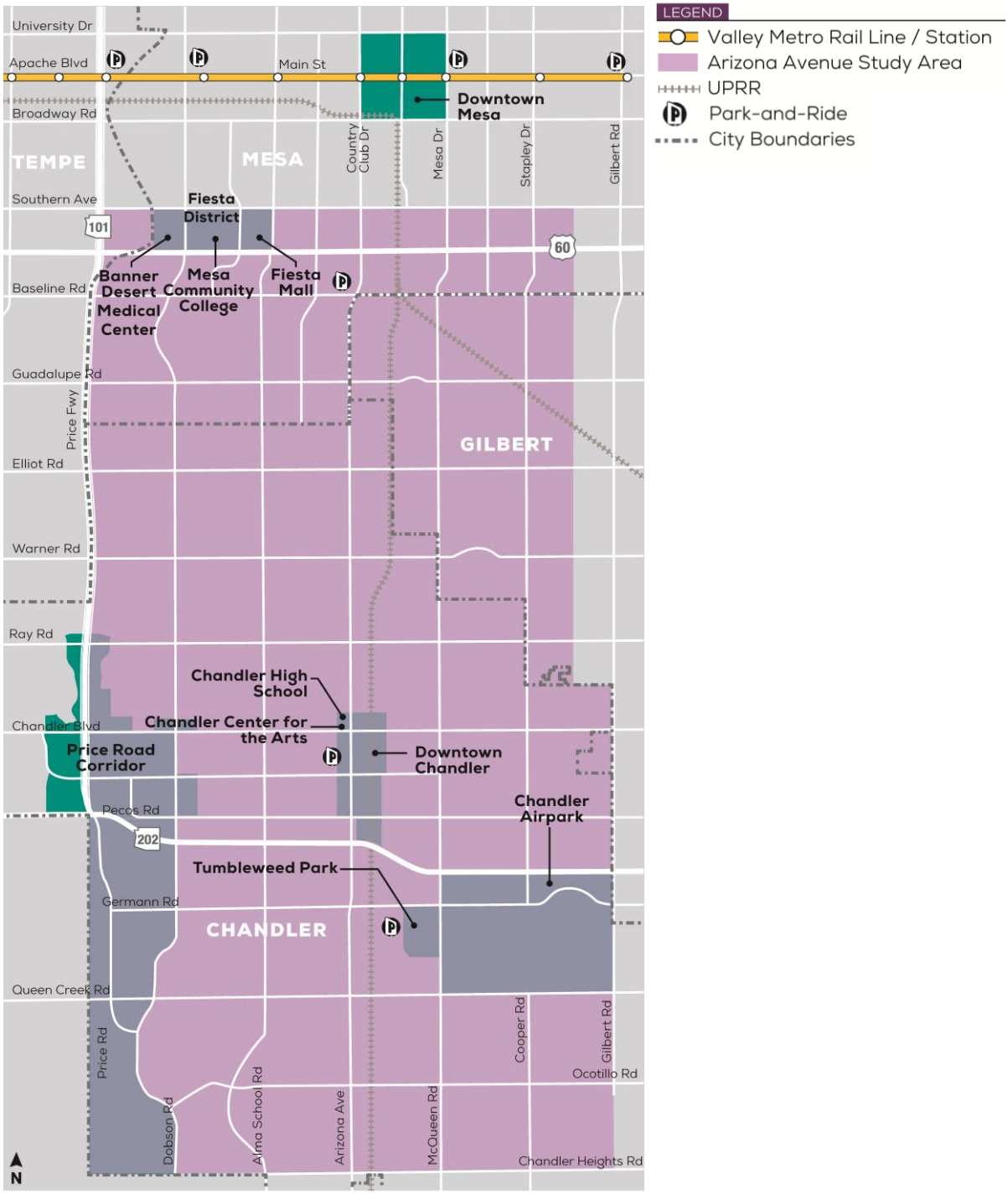
However, the project management team (PMT) agreed that the AAAA should utilize the high capacity transit (HCT) corridors recommended in the adopted 2019 Chandler Transportation Master Plan (TMP) Update. The PMT also requested to include the Price Corridor in south Chandler to determine the feasibility of HCT in this business district.

Therefore, the project team did not compile an initial list of alternatives and perform a high-level screening, as defined in the AAAA scope of work. The three alternatives were conceptually defined and an initial screening was completed.

2.0 BASE MAP

The AAAA base map is provided in Figure 1 below. The base map may be changed if data and analysis warrant refinement of the study area, in concurrence with the PMT.

FIGURE 1: AAAA BASE MAP



Source: Valley Metro, 2020

3.0 INITIAL SCREENING OF ALTERNATIVES

The Purpose and Need developed in Task 3.0 of the AAAA will be utilized to develop criteria for the initial screening of the Arizona Avenue, Chandler Boulevard, and Price Road Alternatives. The AAAA Purpose and Need is to improve local and regional mobility by providing reliable, safe and efficient HCT service to employment clusters, activity centers, recreation facilities and residential housing along the Arizona Avenue corridor and other primary transit corridors in Chandler, Gilbert and Mesa. HCT improvements in the study area would:

- Connect local and regional activity centers in and around the study area, such as downtown Chandler and Sky Harbor International Airport.
- Support local transportation, economic development and land use planning goals and priorities.
- Build toward greater regional connectivity by interfacing with existing and future HCT projects in Mesa, Tempe and Phoenix.

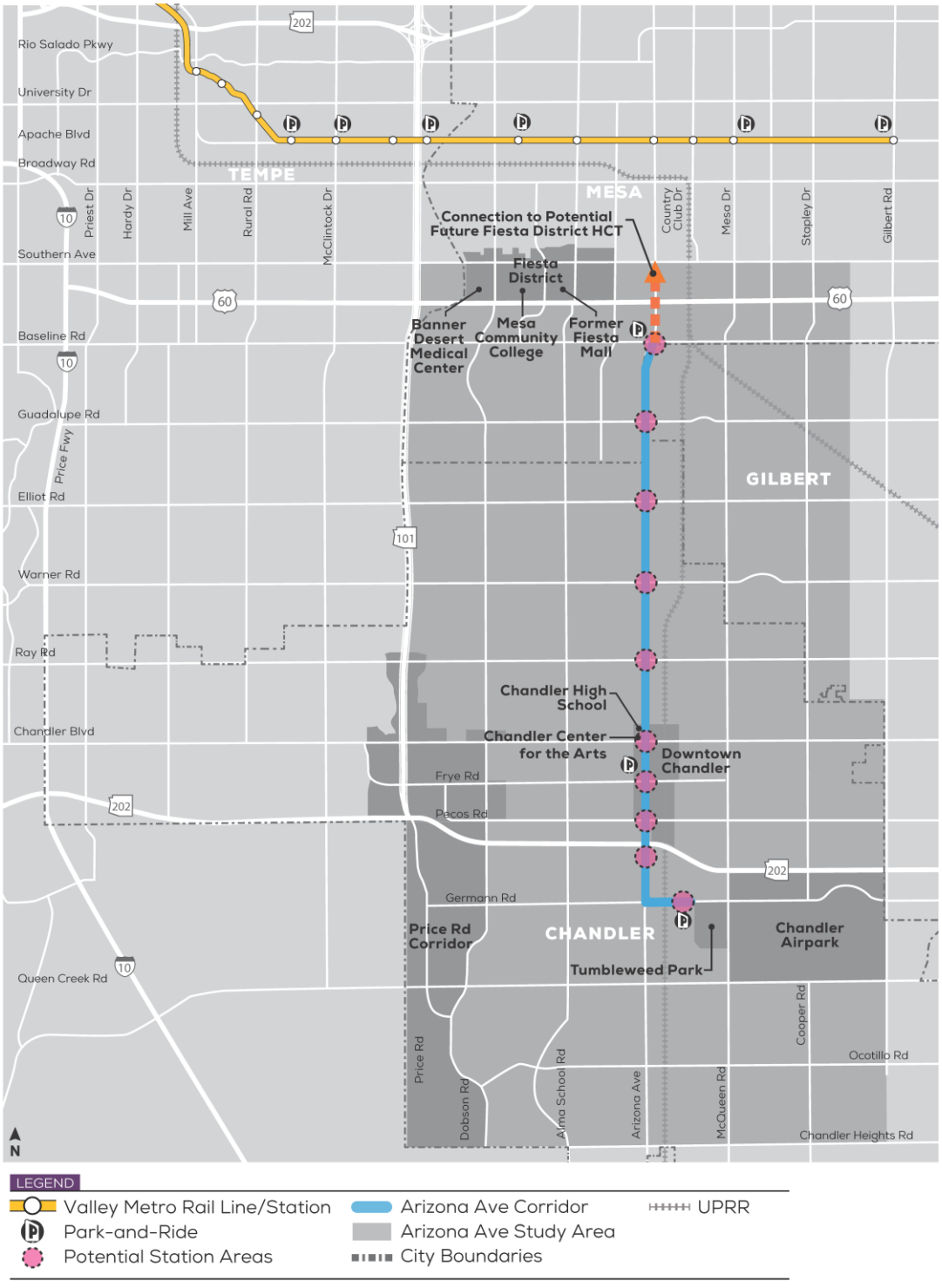
Improved transit services in the study area will:

- Enhance connectivity in areas with high-use bus routes and projected population growth.
- Serve public facilities, residential areas and employment/retail clusters.
- Enhance the mobility of transit-dependent populations.
- Assist with travel demand in the study area and between regional destinations

The Purpose and Need also includes six goals and twelve objectives to clarify the intended outcomes of a future HCT project. Each alternative includes a map defining the extent of the corridor and initial station areas, as well as a brief narrative analyzing to what extent the alternatives satisfies the Purpose and Need. Table 1 compares the alternatives against the Goals and Objectives identified in the Purpose and Need.

3.1 ARIZONA AVENUE ALTERNATIVE (BRT OR RAIL)

FIGURE 2: ARIZONA AVENUE ALTERNATIVE



Note: The Union Pacific Railroad (UPRR) corridor was not identified as an alternative based on previous concerns noted in the Fiesta-Downtown Chandler Transit Corridor Study regarding the feasibility of using railroad right-of-way for HCT.

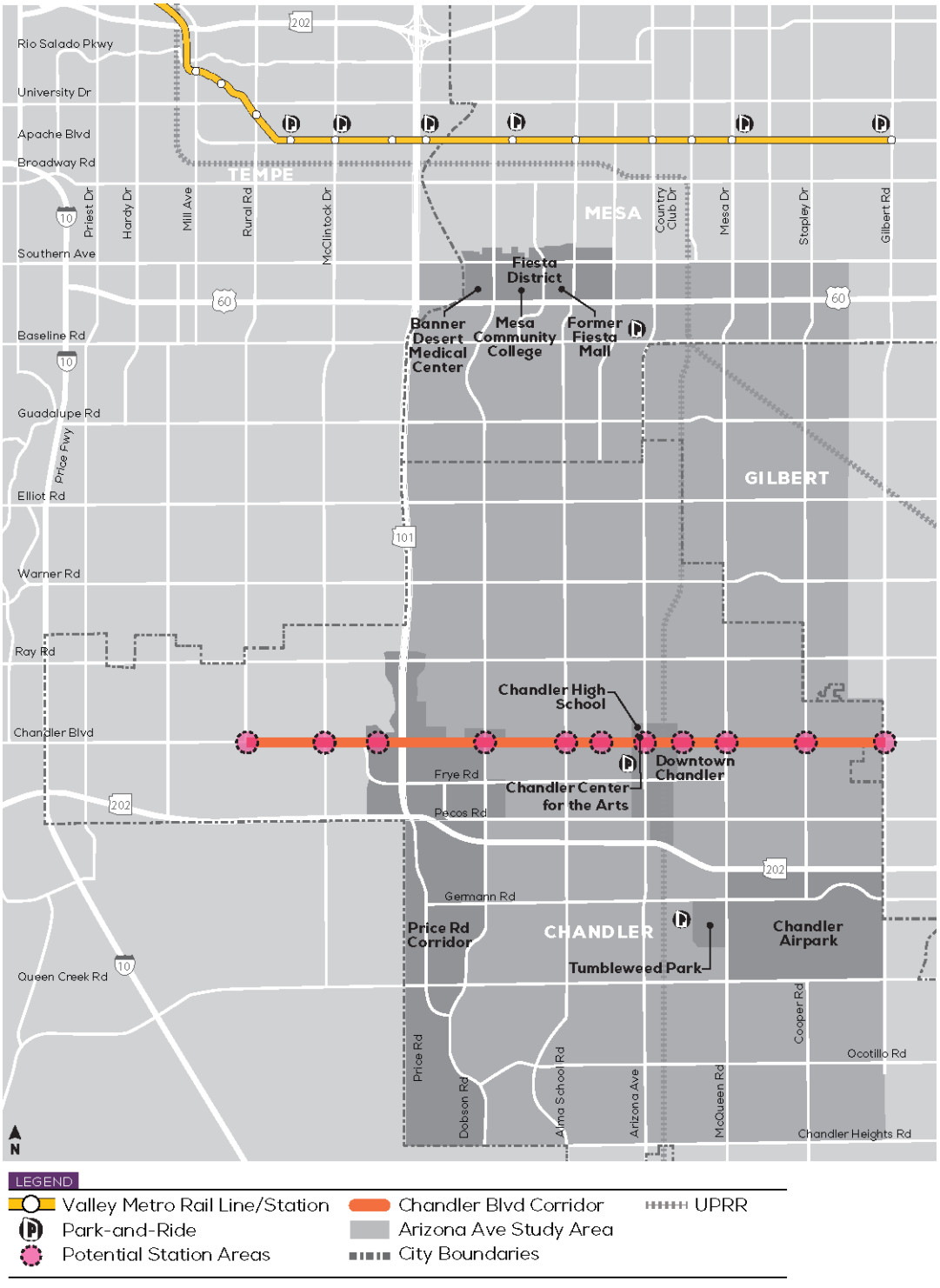
The Arizona Avenue Alternative meets most of the Purpose and Need elements summarized in Task 3.0. The route along Arizona Avenue follows an existing local bus route (Route 112) that has the highest ridership in Chandler and is the only alternative with a feasible direct connection to the existing light rail system. An HCT connection would connect Chandler to other regional activity centers, such as Sky Harbor International Airport, numerous university campuses, and downtown Mesa, Chandler, and Phoenix. Local activity centers, including downtown Chandler and its associated public, retail, and entertainment venues, would also be connected to north Chandler.

The alternative is also supported by Chandler's land use and transportation planning goals, as documented in the TMP and the 2016 General Plan. The TMP identifies Arizona Avenue as a future HCT line. The General Plan identifies three growth areas (North Arizona Avenue, Downtown Chandler, and Chandler Airpark) that could all be served by a future HCT along Arizona Avenue.

There is significant development opportunity along the Arizona Avenue corridor, especially in downtown Chandler. There are large amounts of vacant or underutilized properties along the corridor that are adjacent to already established residential and commercial areas. These neighborhoods are also made up of people who are more likely to be transit dependent. Lastly, Arizona Avenue is a congested street with the highest average daily traffic count of any arterial street in the study area. Thus, an HCT investment would provide a reliable transportation alternative.

3.2 CHANDLER BOULEVARD ALTERNATIVE (BRT OR RAIL)

FIGURE 3: CHANDLER BOULEVARD ALTERNATIVE



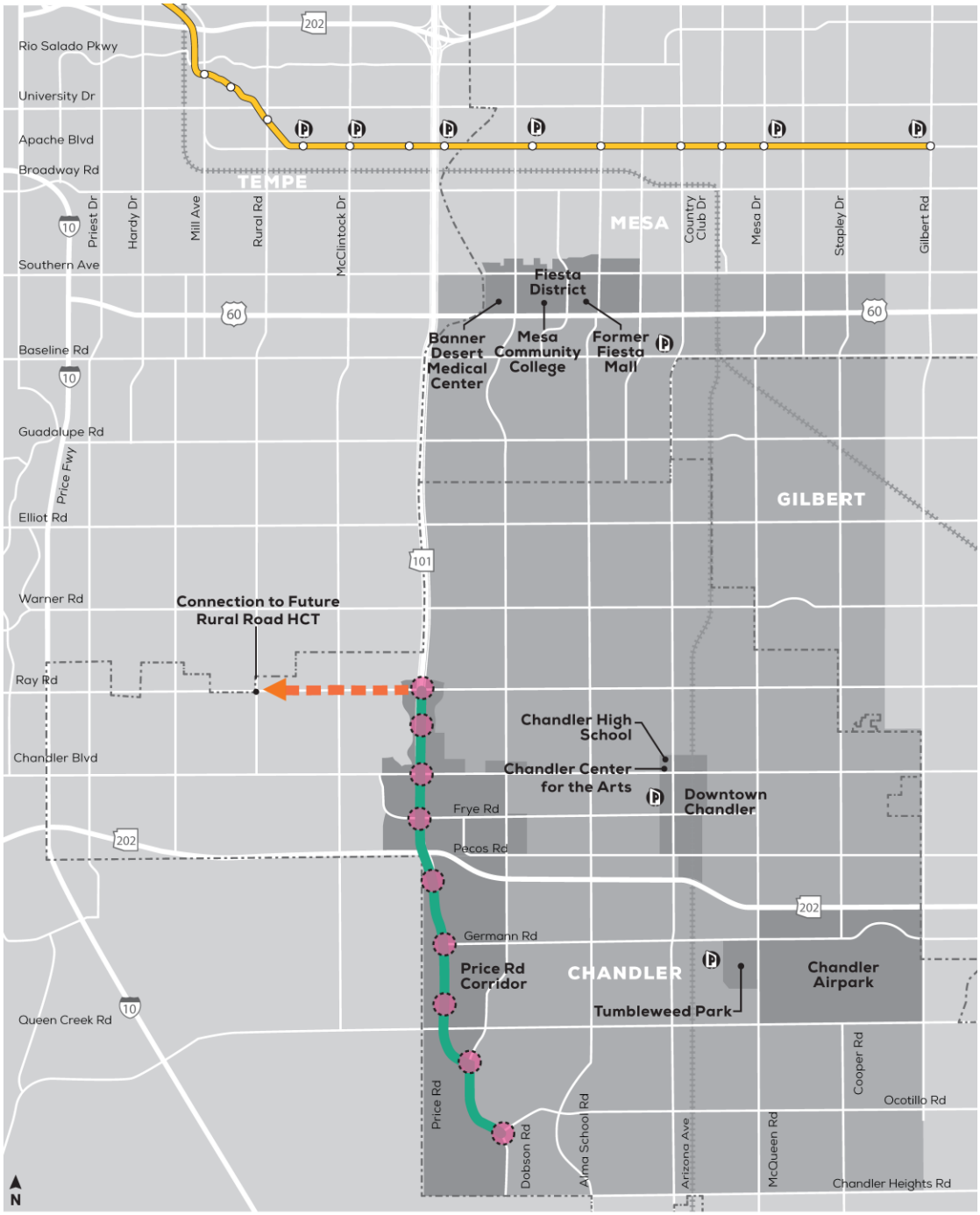
The Chandler Boulevard Alternative meets most of the Purpose and Need criteria. The route along Chandler Boulevard follows an existing local bus route (Route 156) that has the second highest ridership in Chandler. This alternative does provide numerous connections to local and regional activity centers, including downtown Chandler, Chandler Fashion Center, and the Price Road Corridor. Chandler Boulevard also provides long-term connections to Phoenix-Mesa Gateway Airport on the east end, and a future HCT corridor identified on Rural Road within Chandler's TMP. However, this route does not have a feasible direct connection to the existing light rail system.

The Chandler Boulevard Alternative is supported by Chandler's General Plan and TMP. Chandler Boulevard serves two Growth Areas identified in the General Plan: Downtown Chandler and Medical/Regional Retail (centered on north Price Road corridor). The TMP identified Chandler Boulevard as a future HCT route.

There are a number of sites with opportunities for economic development along Chandler Boulevard, although these are primarily underdeveloped sites instead of vacant parcels. These underdeveloped sites include low intensity uses with significant surface parking lots and large setbacks that provide opportunities for infill development or redevelopment. Other than areas at intersections or adjacent to the street, the corridor is primarily made up of built-out single-family housing. The corridor also has significant percentages of transit dependent populations, especially west of downtown Chandler. There is some opportunity to address traffic congestion by providing a transportation alternative on Chandler Boulevard, as average daily traffic counts indicate the street is somewhat congested, especially near downtown Chandler and Chandler Fashion Center.

3.3 PRICE ROAD ALTERNATIVE (BRT OR RAIL)

FIGURE 4: PRICE ROAD ALTERNATIVE



The Price Road Alternative fails to meet the criteria of several objectives for the AAAA Purpose and Need. The route along Price Road does not have any existing all-day transit service. Route 96 runs along the southern portion of Price Road during peak hours, but ridership is very low along this portion. There is also no feasible connection to the existing light rail system, which means there are only limited connections to large, regional activity centers in surrounding communities. Along the corridor there are a number of activity centers, including the Chandler Fashion Center, the Intel Campus, and other employment centers in the Price Road Corridor.

The Price Road Alternative is not identified in the Chandler TMP as a HCT corridor; instead, it is identified as a possible corridor for flexible transit services, such as a demand responsive service. Chandler's General Plan does include two Growth Areas that would be served by the Price Road Alternative: South Price Road Corridor and Medical/Regional Retail.

There is a significant amount of undeveloped land along Price Road, especially in the southern portion of the corridor, which creates a lot of opportunity for future economic development. However, a large portion of this vacant property falls within the Gila River Indian Community, and thus is outside Chandler's land use planning policies. The corridor has varying levels of transit dependence, with some areas very high and others very low.

There are two other important components to note about the Price Road area. First, the northern portion is centered on the Loop 101. Although a highway corridor can have positive influences on HCT (such as speed and right-of-way availability), it also presents challenges. The highway can create a barrier to pedestrian access and make transit oriented development more challenging. Placing HCT on frontage roads could have significant impacts on vehicles attempting to enter or exit the highway, especially during peak hours. Unlike other highway corridors in the region, there is no space in the median where an HCT alternative could be placed. The alternative to using the highway corridor and frontage roads would be winding HCT through residential neighborhoods. This presents its own challenges, likely including lack of public support and increased travel time.

Lastly, the Price Road area is built out with a suburban character, with large property setbacks, significant surface parking, and low density. Since HCT is primarily placed on arterial streets, this development pattern again makes it challenging for pedestrians and other non-automobile users to access the service.

TABLE 1: PURPOSE AND NEED INITIAL SCREENING

Objective	Description	Arizona Avenue Alternative	Chandler Boulevard Alternative	Price Road Alternative
Goal 1: Improve access to businesses, cultural destinations, entertainment options, activity centers and education opportunities.				
1a	Serve key destinations within the study area, including downtown Chandler, the Price Road Corridor, Chandler Airpark, Fiesta District, Intel Ocotillo Campus, Fulton Ranch Towne Center, local schools and other activity centers.	◐	●	◐
1b	Make transit investments that enhance the potential for economic, social and cultural activities, and are consistent with long-range plans and policies.	●	●	○
Goal 2: Connect people and places within the study area and the overall region, especially for transit-dependent populations.				
2a	Ensure future HCT in Chandler connects with the region's current HCT system.	●	○	○
2b	Serve the study area's transit dependent populations.	●	●	○
Goal 3: Utilize HCT investment as a catalyst for economic development that is higher density, pedestrian oriented and supports a world-class economy.				
3a	Include the potential for new construction and redevelopment as a criterion for the evaluation of station locations.	●	●	●
3b	Identify changes to land use planning policies, zoning codes and design guidelines that will encourage transit-oriented development adjacent to any future HCT in Chandler.	●	●	◐
3c	Develop HCT alternatives that connect Chandler's identified growth areas and enhance the economic development opportunities in these areas.	●	◐	◐
Goal 4: Expand public transportation choices in anticipation of future population growth, travel demand and increased congestion.				
4a	Maximize potential ridership while maintaining an affordable and cost effective HCT project.	●	●	◐
4b	Attract new riders to the regional transit system.	●	◐	◐
Goal 5: Provide sustainable, healthy and multi-modal transportation alternatives.				
5a	Incorporate a holistic approach to pedestrian, bike, automobile, and transit planning and infrastructure in any future HCT design.	●	●	○
5b	Support regional environmental goals, including air quality and congestion relief, by providing a fast, safe and affordable HCT alternative.	●	●	◐
Goal 6: Frame HCT vision in context of Chandler's General Plan and the Transportation Master Plan 2019 Update.				
6a	Utilize the recommendations from the Transportation Master Plan 2019 Update to ensure any future HCT alternative is consistent with the overall plan for future transit service.	●	●	○

Legend

- ● Meets the objective
- ◐ Meets part of the objective
- ○ Does not meet the objective

4.0 CONCLUSION

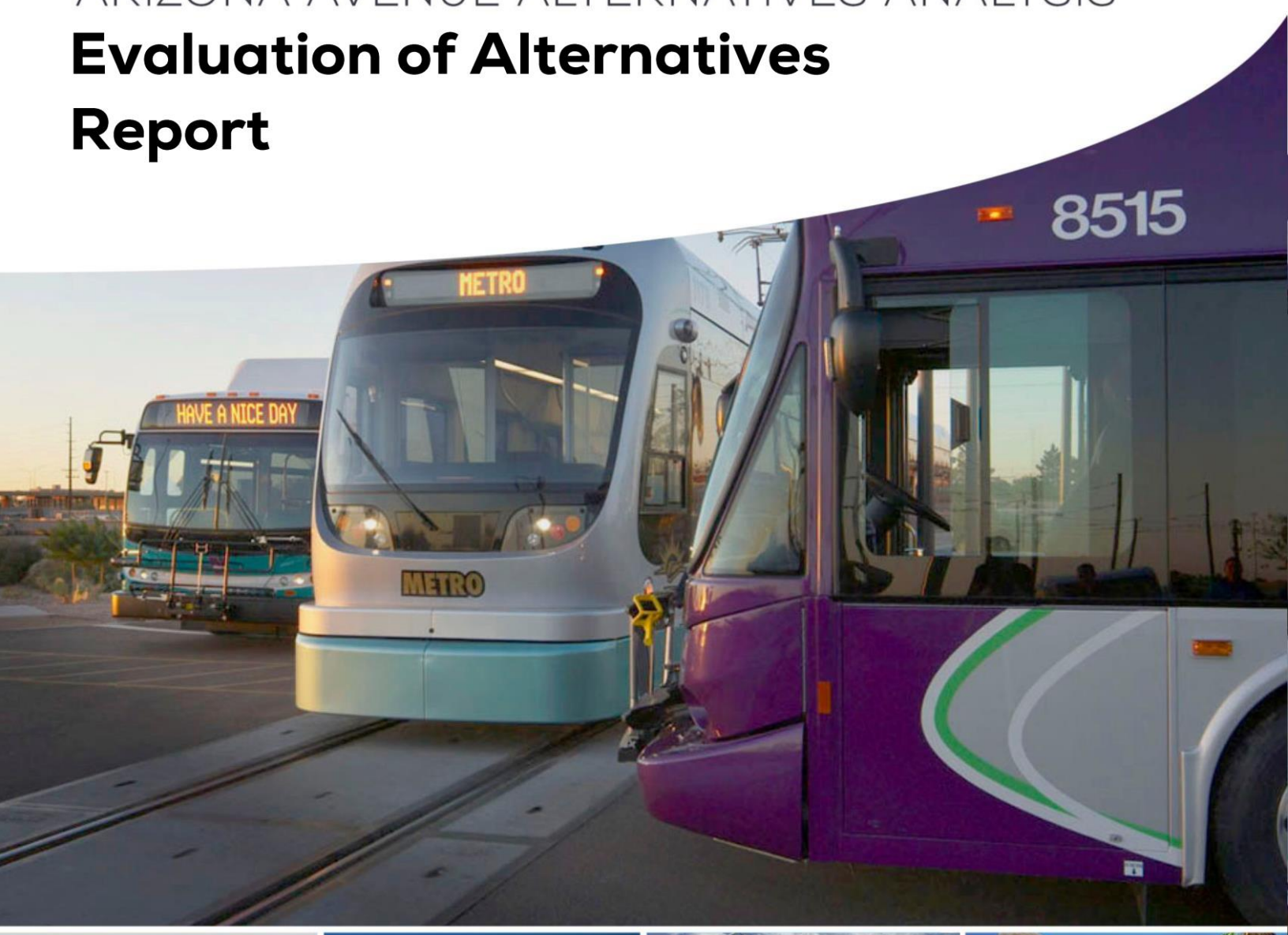
The purpose of this technical memorandum was to define the base map that would be used for the study, define the initial list of alternatives and complete an initial screening of the alternatives against the Purpose and Need. Based on the analysis summarized in section 3.0 of this memorandum, the Price Road Alternative has numerous challenges that would hinder the future development of HCT:

- Failure to meet most of the Goals and Objectives outlined in the Purpose and Need Report developed in Task 3.0 of this study
- Incompatibility with Chandler's TMP recommendations
- The barrier created by the Loop 101 highway that bisects the Price Road Corridor
- The low density, suburban character of existing development
- The challenge of connecting to the existing regional HCT system

The Project Management Team requested that the Price Road Alternative be brought forward into Task 5.0 for further analysis to validate the initial observations made in this memorandum. As such, the Arizona Avenue, Chandler Boulevard and Price Road Alternatives will be advanced to Task 5.0 for further refinement and analysis. Each alternative will be analyzed as a BRT and rail option, thus six total alternatives will be carried forward.

ARIZONA AVENUE ALTERNATIVES ANALYSIS

Evaluation of Alternatives Report



MAY 2021

VALLEY METRO

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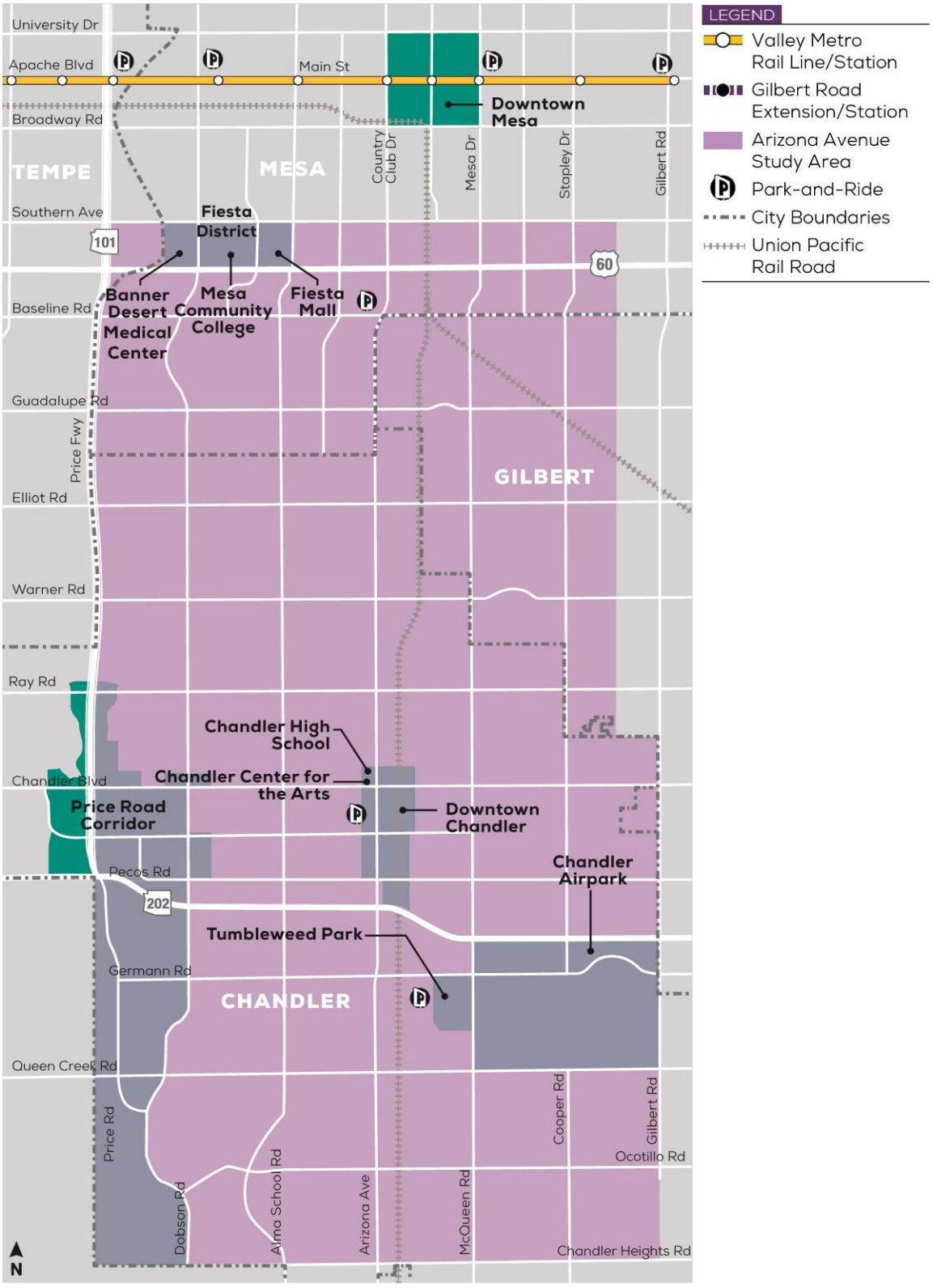
1.0 INTRODUCTION

Valley Metro and the City of Chandler in coordination with the Maricopa Association of Governments (MAG), are conducting the Arizona Avenue Alternatives Analysis (AAAA) to evaluate potential high-capacity transit (HCT) improvements in Chandler (**Figure 1**). The recommendations of this study will assist the City of Chandler in identifying a preferred future HCT corridor, describe guidance for transit improvements in the recommended corridor, and help to inform the city's decisions for future investment commitments. The results of this study will also inform potential future HCT investments for consideration in the region's new transportation plan that will inform the extension of Proposition 400.

This report summarizes the second tier of evaluation results, focused on quantitative analysis, and recommends an alignment for future HCT investments.

FIGURE 1: ARIZONA AVENUE STUDY AREA

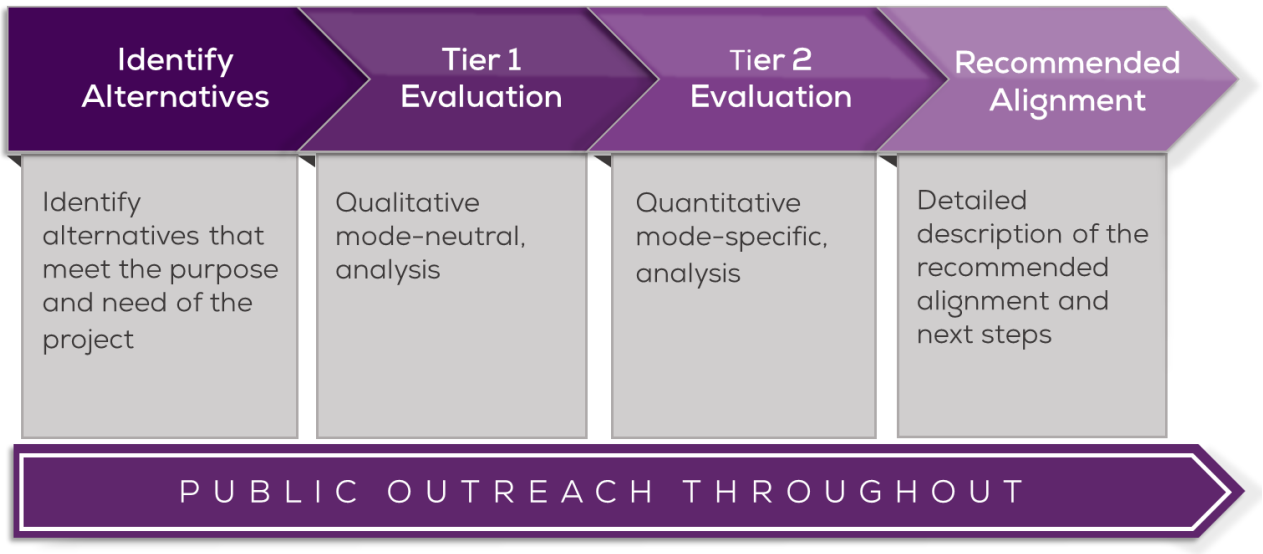


2.0 ALTERNATIVES ANALYSIS PROCESS

The alternatives analysis process is a two-tiered evaluation to assess the HCT alternatives identified to meet the Purpose and Need of the project (as described in the AAAA Purpose and Need Statement). **Figure 2** illustrates the overall structure of the analysis process.

Valley Metro and the City of Chandler collaborated throughout the evaluation process via regular meetings of the Project Management Team (PMT). In addition, public outreach and briefings to elected officials, standing committees and key business stakeholders occurred throughout the process to update interested parties and solicit feedback.

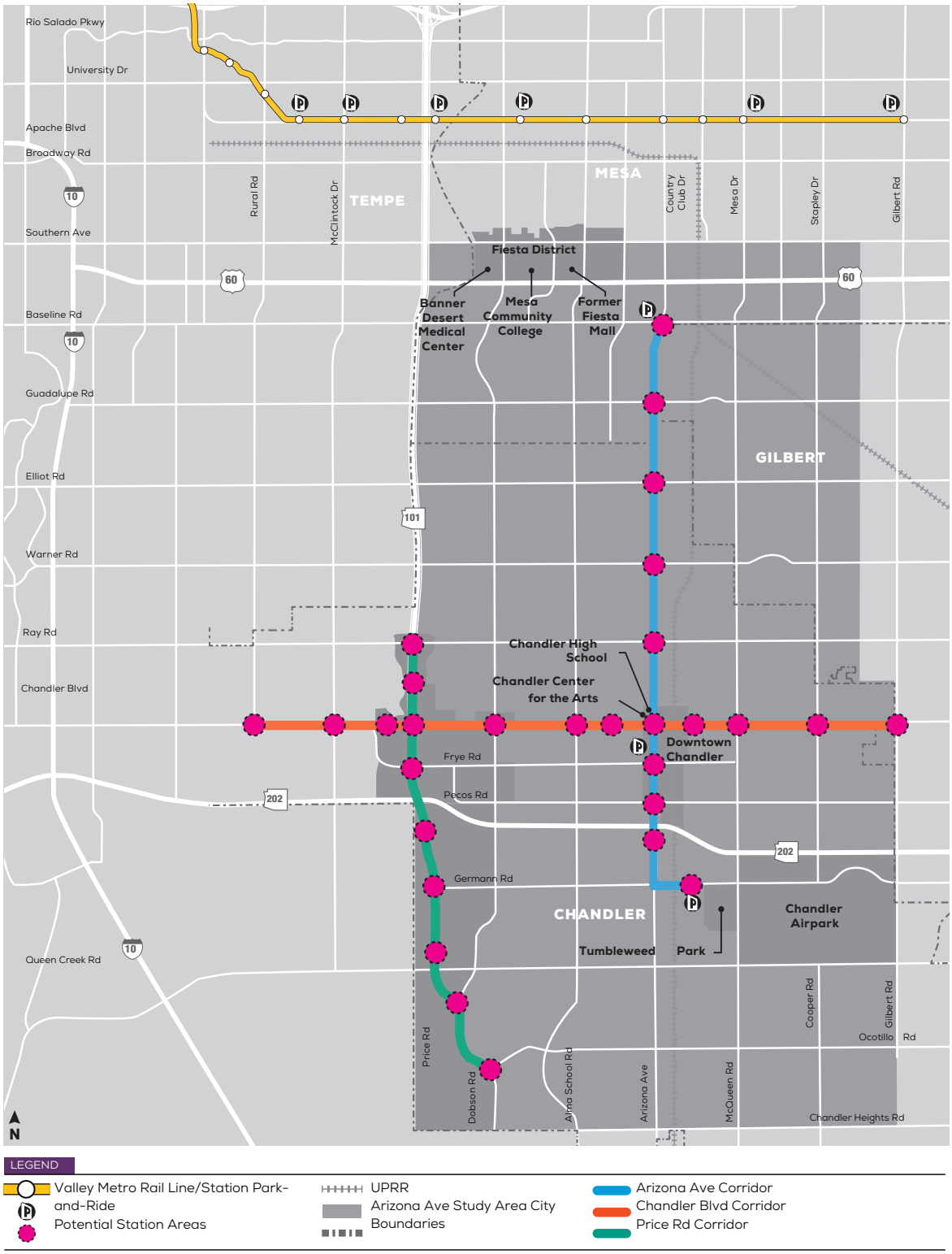
FIGURE 2: ALTERNATIVES ANALYSIS PROCESS



3.0 TIER 1 EVALUATION

A Tier 1 Evaluation is a qualitative, high-level review of potential HCT options within the study area. The assessment of potential alignments during the Tier 1 Evaluation is mode-neutral, assuming each alternative could accommodate either type of HCT mode under consideration, i.e. rail or bus rapid transit (BRT). Rather than performing a standard Tier 1 Evaluation, Chandler defined three HCT alternatives informed by the recently adopted Chandler Transportation Master Plan (TMP) update (2019). Two of the alternatives were recommended for HCT (Arizona Avenue and Chandler Boulevard), while the third is identified for enhanced transit services (Price Road Corridor) by the TMP. A map of the alternatives identified for further analysis: Arizona Avenue, Chandler Boulevard, and Price Road, is shown in **Figure 3.**

FIGURE 3: AAAA ALTERNATIVES ADVANCING TO TIER 2 ANALYSIS



4.0 DEFINITION OF TIER 2 ALTERNATIVES

4.1 TRANSIT TECHNOLOGY TYPES

Two types of HCT technologies were considered in the definition of alternatives, described in **Table 1**. The Rail mode is a hybrid option between streetcar and light rail. It is envisioned as a streetcar vehicle with streetcar stops that operates in an exclusive guideway for a large portion of the alignment. Once the streetcar enters the downtown area it would operate in mixed traffic. Bus Rapid Transit (BRT) considered for analysis operates with semi dedicated guideway in portions of the alignment.

TABLE 1: TRANSIT TECHNOLOGY TYPES

	RAIL	BRT
Purpose/Market Type	Moderate-speed, moderate-demand local and regional connectivity	Higher-speed, high-demand local or regional connectivity
Operating Environment	Primarily dedicated guideway, mixed traffic	Semi-dedicated guideway, mixed traffic
Spacing of Stops	1/2 to 1 mile	1/2 to 1 mile
Passenger Capacity per Vehicle	130 to 160	60 to 90
Relative Capital Cost	$$	$
Relative Operating Cost	$$$	$
		

For purposes of the analysis, high level BRT commitment was evaluated, however, BRT can be tiered to suit various levels of demand. BRT is defined by possessing several elements that distinguish the service from standard bus service including, dedicated lanes, unique branding, enhanced stations, advanced fare collection, customized buses, and spot transit improvements. The levels of BRT commitment are displayed in **Table 2**, and examples can be found in **Appendix B.**

TABLE 2: BRT LEVELS OF COMMITMENT

LEVEL	CAPITAL COST PER MILE ($2020)	BRT ELEMENTS	DEDICATED LANES		
			MINIMAL	PARTIAL	ENTIRE
1	$	✓			
2	$$	✓	✓		
3	$$$	✓		✓	
4	$$$	✓			✓

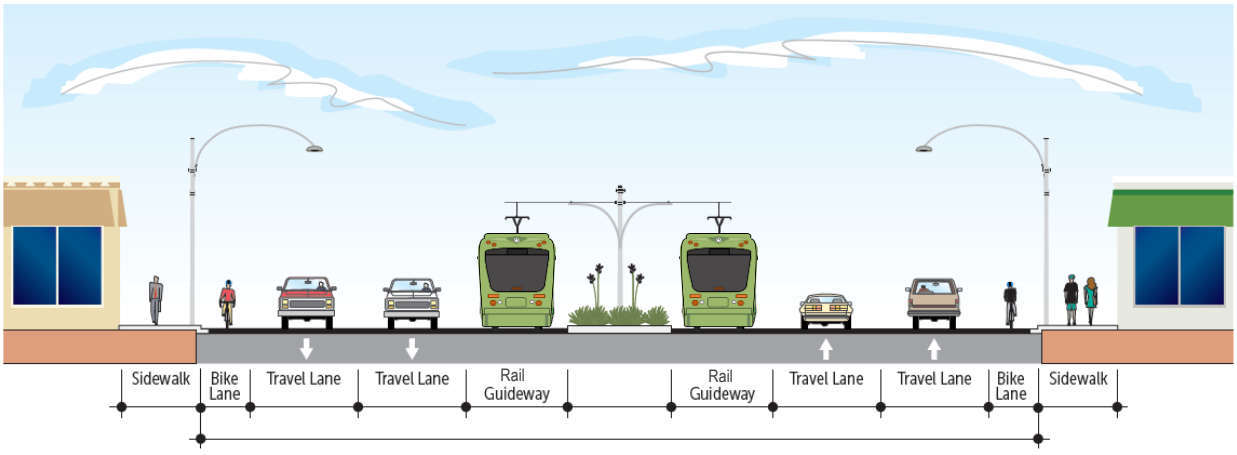
BRT ELEMENTS :
Dedicated Lanes, Unique Branding, Enhanced Stations, Advanced Fare Collection, Custom Buses, Transit Improvements

4.2 CONCEPTUAL DESIGN CROSS SECTIONS

For the Tier 2 alternatives, conceptual designs were developed to determine impacts to street and traffic lane configurations, right of way needs and potential station locations. The following cross sections demonstrate typical configurations for each HCT technology type at representative locations in the study area. The evaluation assumed these operational concepts for each alternative alignment and technology type.

Rail is assumed to operate in primarily exclusive, median-running guideway through most of the corridor, except in downtown areas where the rail operates in mixed traffic with left turns allowed in a separate center turn lane. The assumed guideway is at-grade, except in areas crossing over the Union Pacific Railroad. **Figure 4** illustrates the cross section with rail along Arizona Avenue.

FIGURE 4: CONCEPTUAL RAIL CROSS SECTION IN EXCLUSIVE GUIDEWAY



Two concepts for bus rapid transit were assumed. Both assumed guideways are at-grade. **Figure 5** shows the first concept operating in curb-running, semi-exclusive business access and transit (BAT) lanes that allow right turns at driveways and intersections. The second concept, featured in **Figure 6**, illustrates the cross section with bus rapid transit, assumed to operate in semi exclusive, median-running guideway.

FIGURE 5: CONCEPTUAL BUS RAPID TRANSIT CROSS SECTION IN BAT LANE

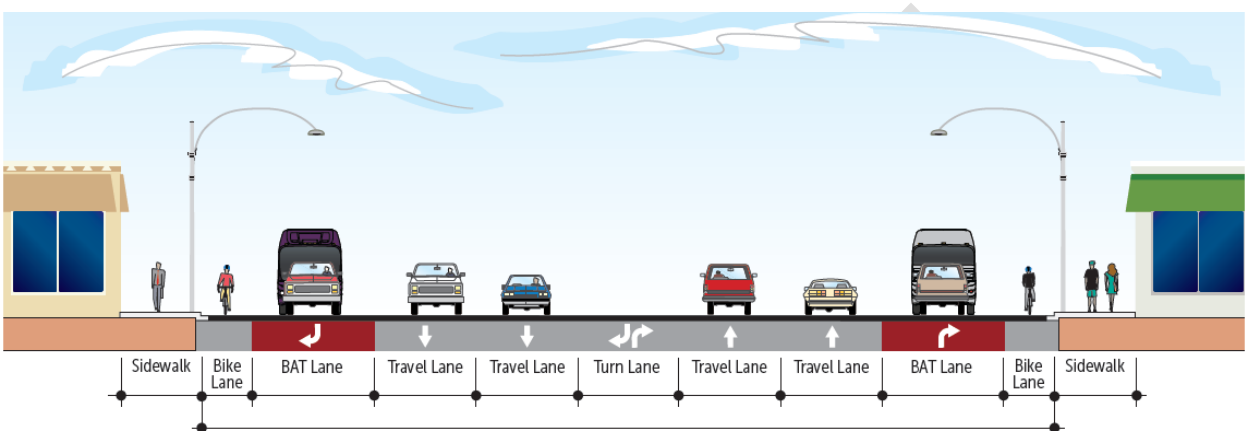
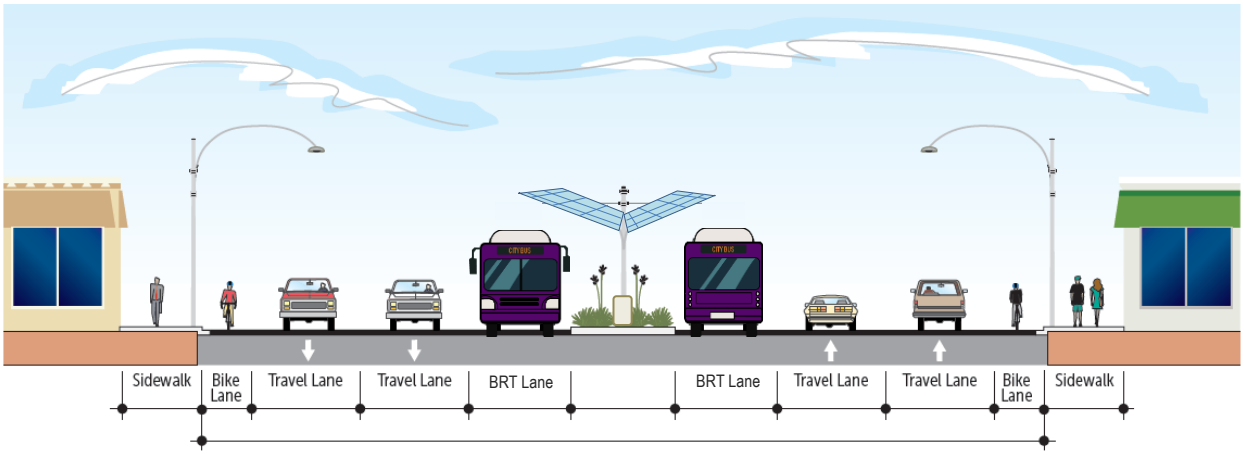


FIGURE 6: CONCEPTUAL BUS RAPID TRANSIT CROSS SECTION EXCLUSIVE GUIDEWAY



5.0 TIER 2 EVALUATION

5.1 EVALUATION CRITERIA

The Tier 2 Evaluation was the secondary screening of the potential alternatives for advancement; the recommended alternatives underwent a detailed, primarily quantitative analysis. **Table 3** identifies the Tier 2 Evaluation criteria and associated elements.

TABLE 3: TIER 2 EVALUATION CRITERIA

Criteria	Elements of Criteria	Description
Ridership Potential	Forecasted Daily Transit Trips per Mile	Forecasted daily boardings per mile on project. Assumed best case scenario with fastest travel speed/visibility (FTA STOPS Ridership Forecasting Model).
	Forecasted Percent Zero-Car Transit Trips	STOPS output for forecasted percent of trips on project by zero-car households.
	Daily Transit Trips per Mile On Existing Transit	Daily boardings per corridor mile of existing transit routes operating within each proposed corridor.
Transit Access	Population in Study Area	Population density (population per square mile) 1/2 mile around each station (MAG 2040 Population).
	Employment in Study Area	Employment density (employees per square mile) 1/2 mile around each station (MAG 2040 Employment).
	Publicly-Supported Housing in Study Area	Number of publicly-supported low income housing units within 1/2 mile of station areas (Data from Low-Income Housing Tax Credit and National Housing Preservation Database)
	Connections with Existing Transit Routes	Connections and distance to existing and planned/proposed transit services (transit routes and park-and-rides).
	Connections with Bikeways/Multi-Use Paths	Connections to and miles of bikeways and multi-use paths (parallel and intersecting 1/2-mile of station areas).
Physical & Engineering Constraints	Non-Transit Vehicle Lanes	Number of non-transit vehicle through lanes that conceptually are remaining after proposed repurposed HCT use.
	Right of Way (ROW) and Land Acquisition	Approximate square foot of ROW and building hits/relocations conceptually proposed for acquisition.
	Environmental Impacts	• Number of resources within 1/2 mile of alternative alignments (National Register of Historic Places). • Number of Section 4(f) resources within 1/4 mile of alternative alignments. • Environmental issues that may need mitigation (besides historic/cultural and section 4(f) along the alternative alignments.
	Utilities	Identification of distinct public or private utility issues along the alternative alignments.

Criteria	Elements of Criteria	Description
Land Use/ Economic Development	Consistency with Adopted Land Use Plans and Policies	Alternatives consistency with existing city and regional economic plans/policies (Chandler General Plan 2016, Transportation Master Plan 2019, MAG RTFSU, MAG RTP).
	Redevelopment/Transit-Oriented Development (TOD) Opportunities	Acres of land compatible for redevelopment (commercial, public, vacant) within 1/2 mile of station areas (Maricopa County Assessor 2019 parcel data and Chandler Transportation Master Plan 2019).
	Opportunity for Integration into Emerging Developments	Acres of land compatible for redevelopment (commercial, public, vacant) within 1/2 mile of station areas (City of Chandler Proposed Zoning Parcels)
Potential Costs	Capital Cost Estimate	Relative total rough order-of-magnitude cost of alternative. Assumes all FTA Standard Cost Category elements – vehicles, maintenance facility, etc. (2020 dollars).
	Operations and Maintenance (O&M) Cost Estimate	Annual gross O&M cost based on cost-per-revenue mile (FY2020 dollars).
	Cost Effectiveness	Annual cost-per-rider based on annualized capital and O&M divided by annual ridership.
Transportation Efficiencies	Operating Efficiency	Transit operational efficiencies including number of slow turns and end of line placement.
	Transit Speed and Reliability Impediments	Obvious transit speed and reliability impediments (signaled intersections, curb cuts/turning conflicts, special events).
	Scalability	Identify and list the alternative's ability to be split into phases.

The detailed analyses were conducted for several of these criteria elements, including travel forecasting and cost estimating. These detailed analyses are summarized in reports appended to this document (**Appendix C**: Travel Forecasting Report and **Appendix D**: Cost Estimating Report).

Three criteria were selected in collaboration with the PMT to have higher weights based on the Tier 2 criteria. Those criteria were selected because they aligned with the goals and objectives of the AAAA as well as the Purpose and Need of the HCT project.

The criteria with higher weights included:

- Ridership Potential
- Transit Access
- Potential Costs

5.2 RESULTS

The three alignment alternatives, combined with transit types, were compared to each other across all criteria and given a rating that indicated “high”(3), “medium”(2) or “low”(1) performance. The outcomes for each alternative were summarized (**Table 4**) and used to rank the alternatives.

TABLE 4: EVALUATION CRITERIA MATRIX

	Evaluation Criteria	Evaluation Criteria Weight	Alternative 1 Arizona Avenue | 8.5 miles		Alternative 2 Chandler Boulevard | 8 miles		Alternative 3 Price Road | 5.5 miles	
			RAIL Score	BRT Score	RAIL Score	BRT Score	RAIL Score	BRT Score
Ridership Potential	Forecasted Daily Transit Trips per Mile	5	3	2	3	1	1	1
	Forecasted Percent Zero-Car Transit Trips	1	1	1	2	2	3	2
	Daily Transit Trips per Mile	1	3	3	2	2	1	1
		Subtotal	19	14	19	9	9	8
Transit Access	Population Density in Stop Area	1	2	2	3	3	1	1
	Employment Density in Stop Area	2	1	1	2	2	3	3
	Publicly-Supported Housing in Study Area	1	2	2	3	3	2	1
	Connections with Existing Transit Routes	2	3	3	2	2	1	1
	Connections with Future HCT Routes	2	3	3	2	3	2	2
	Connections with Bikeways/ Multi-Use Paths	1	2	2	3	3	2	2
		Subtotal	20	20	21	21	16	16
Physical & Engineering Constraints	Non-Transit Vehicle Lanes	1	2	3	2	3	3	3
	Right of Way (ROW) and Land Acquisition	1	1	3	1	3	1	3
	Potential Environmental Impacts	1	2	3	2	3	3	3
	Utilities	1	2	3	2	3	1	3
		Subtotal	7	12	7	12	8	12
Land Use & Economic Development	Consistency with Adopted Land Use Plans and Policies	1	3	3	3	3	1	1
	Redevelopment/Transit-Oriented Development (TOD) Opportunities	1	3	3	2	2	2	2
	Opportunity for Integration into Emerging Developments/Districts	1	3	3	1	1	1	1
		Subtotal	9	9	6	6	4	4
Potential Costs	Capital Cost Estimate (millions)	1	2	3	1	3	1	3
	Operations and Maintenance (O&M) Cost Estimate	1	1	2	1	2	2	3
	Cost Effectiveness	1	3	3	3	3	1	1
		Subtotal	18	20	17	20	9	11
Transportation Efficiencies	Operating Efficiency	1	2	2	2	2	2	2
	Transit Speed and Reliability Impediments	1	2	2	2	2	3	3
	Scalability	1	2	2	2	2	1	2
		Subtotal	6	6	6	6	6	7
		Total	79	81	76	74	51	58
		Rank	2	1	3	4	6	5

Table 5 summarizes the Tier 2 Evaluation results. The full Tier 2 Evaluation Matrix is provided in **Appendix A**, which shows the full details and data for each criterion.

TABLE 5: TIER 2 EVALUATION RESULTS

Alternative		Ridership Potential	Transit Access	Physical & Engineering Constraints	Land Use & Economic Development	Potential Costs	Transportation Efficiencies	Rank
Arizona Avenue	Rail	●	●	▲	●	●	▲	2
	BRT	▲	●	●	●	●	▲	1
Chandler Boulevard	Rail	●	●	▲	▲	▲	▲	3
	BRT	◆	●	●	▲	●	▲	4
Price Road	Rail	◆	▲	▲	◆	◆	▲	6
	BRT	◆	▲	●	◆	◆	▲	5

● High Performance; ▲ Medium Performance; ◆ Low Performance

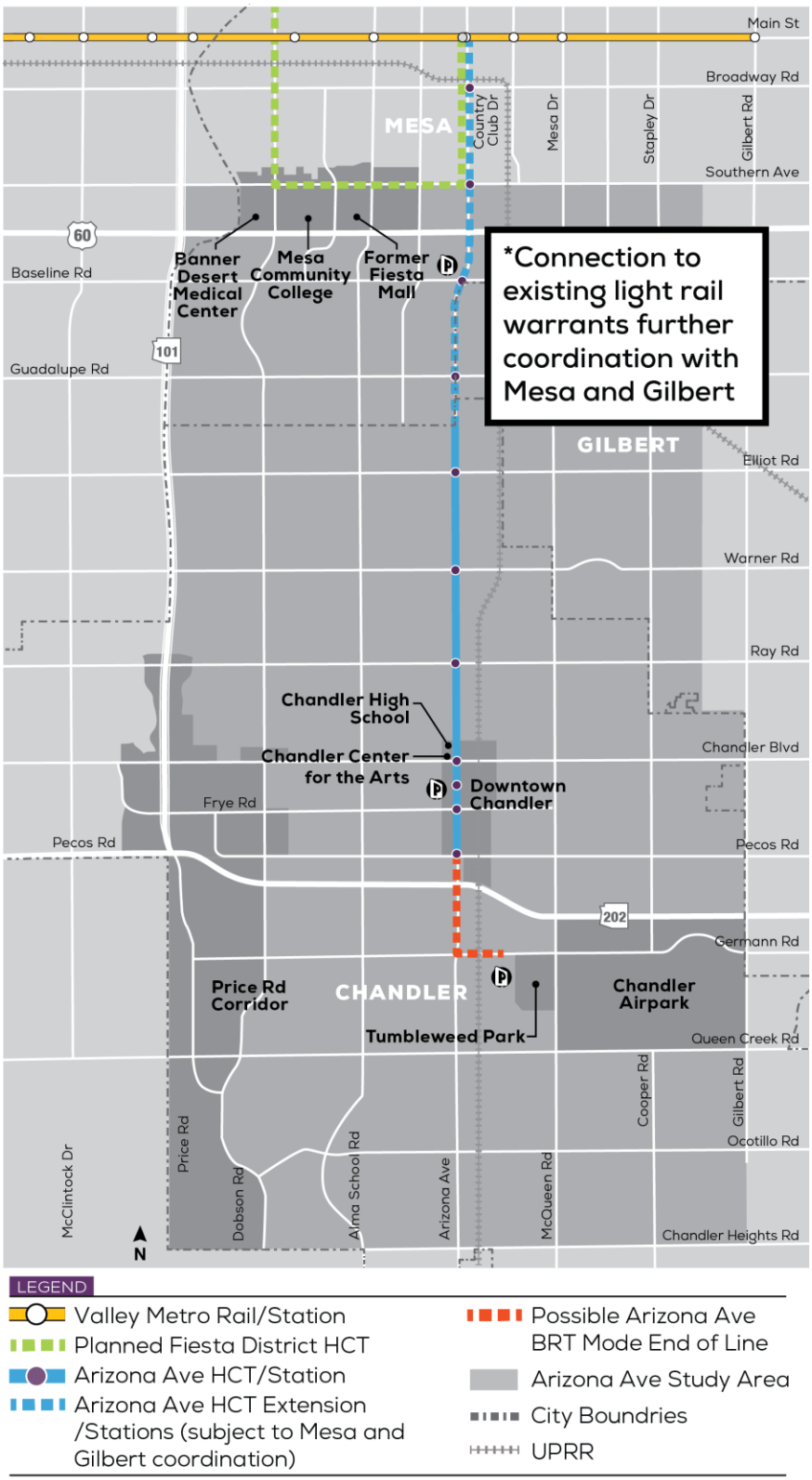
The top four ranking alternatives and transit technologies are:

1. Alternative 1 (Arizona Avenue), BRT
2. Alternative 1 (Arizona Avenue), Rail
3. Alternative 2 (Chandler Boulevard), Rail
4. Alternative 2 (Chandler Boulevard), BRT

The Tier 2 results indicate that Alternative 1 (**Figure 7**) should be selected for future evaluation for HCT in the AAAA study area. Compared to all other alternatives, Alternative 1 ranked highest in three of the four criteria categories (mobility improvements, land use/ economic development, and stakeholder support), with a rating in access opportunities on par with the highest scoring alternative.

To help discern Alternative 1's viability as a candidate for future HCT investment, the potential performance of BRT and Rail in the corridor was compared to the performance of similar corridors and modes in peer cities. **Appendix E** illustrates the boardings per mile by mode for peer cities selected, and the results of the travel forecast modeling.

FIGURE 7: ALTERNATIVE 1 ARIZONA AVENUE



The City of Chandler expressed the desire to have a responsive mode suitable for the continued growth and development of the city, as well as the ability to connect to future HCT projects in the region. The rail option evaluated for the corridor alternatives is a hybrid streetcar alignment, with a large portion of the project in a dedicated guideway operating like a light rail. This would allow the project to interline with future HCT streetcars projects and operate in mixed traffic where right-of-way is limited, such as Downtown Chandler.

5.3 END OF LINE ASSESSMENT: ALTERNATIVE 1

Alternative 1, (Arizona Avenue) assessed three different end-of-line options applied to both modes (Rail, BRT) to identify ideal end-of-line characteristics for each. The three end of line options were Pecos Road, Germann Road and the Chandler Park-and Ride.

Rail

A Rail mode on Arizona Avenue terminating on Pecos Road would be a suitable end-of-line option based on the surrounding development characteristics and ease of implementation.

Terminating rail on Germann Road is feasible. However, it would require travel under the 202 San Tan Freeway in order to provide increased service to approximately 200 projected additional riders. Based on projected ridership and the existing surrounding development characteristics on Germann Road that are less conducive to rail, it would be difficult to justify the potential increased capital costs required for design and construction with this end of line option.

Terminating at the Chandler Park-and-Ride would be beneficial for riders who use the park-and-ride, and there is potential for better transfers to the transit network. However, similar to the German Road end-of-line option, terminating rail at the Chandler Park-and-Ride has the same potential increased capital costs associated with travel under the 202 San Tan Freeway. This option would also require the construction of an elevated Rail track to run above the Union Pacific railroad to prevent disruption of commuter and freight train operation. An elevated rail line would also require the relocation or raising of power lines existing adjacent to the railroad near the park-and-ride.

BRT

A BRT mode with exclusive lane dedication terminating at Pecos Road would be a suitable end-of-line option based on the surrounding development characteristics and ease of implementation.

Terminating BRT with exclusive lane dedication at Germann Road or the Chandler Park-and-Ride, assuming a grade-separated guideway for the purposes of this study, would be less efficient because of the density demographics and surrounding development characteristics south of Pecos Road.

To extend service to Germann Road or the Chandler Park-and-Ride, the BRT dedication level could be reduced to a level one service after Pecos Road with no lane dedication and operate in mixed traffic like local bus service.

6.0 NEW STARTS EVALUATION

The AAAA applied FTA Capital Investment Grant (CIG) program criteria to the recommended alternative, Alternative 1 (Arizona Avenue), to demonstrate how that alternative, with an option of HCT technologies, might perform as a project seeking FTA CIG funding. For the purposes of this study, the New Stats Evaluation is only a preliminary analysis using the known CIG criteria as posted in 2020.

The CIG program has three funding categories (Core Capacity, New Starts and Small Starts), with the designation being dependent on project cost and magnitude. All alternatives were evaluated under the New Starts category, based on the assumed capital costs above $300 million (the threshold for New Starts). This provided an assessment of Alternative 1's potential performance and construction/operational feasibility against an accepted industry standard. It indicates how this alternative could perform considering mobility improvements and cost effectiveness.

Table 6 shows the preliminary results for each transit technology for Alternative 1 (Arizona Avenue) in the New Starts criteria.

TABLE 6: NEW STARTS ANALYSIS PRELIMINARY RESULTS FOR ALTERNATIVE 1

CRITERIA	**Rail** - Alternative 1	**BRT** – Alternative 1
Congestion Relief		
Cost Effectiveness		
Economic Development		
Environmental Benefits		
Land Use		
Mobility Improvements		
Summary Ranking		

 = Medium-Low

 = Low

The FTA requires a Medium rating or higher in the Project Justification analysis to be eligible for CIG funding. Based on current assumptions, Alternative 1 would rate as a Medium-Low for Project Justification analysis. The largest components of the analysis are cost and ridership: lowering costs and/or raising ridership will have positive impacts on several criteria, and thus the overall project rating. Local jurisdictions can also directly improve the project rating criteria results by enhancing transit-supportive features such as land use, economic development and mobility improvements. This can be achieved with measures that limit the amount of parking in the central business district (CBD), providing more affordable housing, enhancing local bus networks that feed into Arizona Avenue and adding more transit supportive development along the corridor.

7.0 COMMUNITY OUTREACH SUMMARY

Valley Metro and the City of Chandler conducted community outreach to present the AAAA results and gather general feedback on the Tier 2 Evaluation in a series of public and stakeholder meetings. The outreach began in January 2019 and continued throughout the project. Community outreach efforts were often combined with Chandler Transportation Master Plan (TMP) public meetings. Information presented at all AAAA meetings included a project overview, descriptions of the study area and the three alternative corridors.

Table 7 lists the community input opportunities stakeholders had to view study status and learn the latest information, ask study team members questions or submit comments.

TABLE 7: LIST OF STAKEHOLDER INPUT OPPORTUNITIES

Table 1. Community Input Opportunities	Dates
Study website	1/1/2019-Current
Chandler Transportation Master Plan Update, Public Meeting	1/23/2019
Chandler Transportation Master Plan Update, Public Meeting	1/28/2019
Chandler Transportation Master Plan Update, Public Meeting	1/30/2019
Chandler Transportation Master Plan, Stakeholder Workshop	10/17/2019
Chandler Transportation Master Plan Update, Public Meeting	10/24/2019
Chandler Transportation Commission Bimonthly Meeting, Virtual Presentation	6/23/2020

Discussion at the public meetings, workshop and Chandler Transportation Commission meeting presentation focused on understanding the study process and the future transit needs of the study area. Questions from stakeholders included regional and local destinations, desired transit services and input directly related to alternative corridors (Arizona Avenue, Chandler Boulevard and Price Road). Most responses expressed support for transit as stakeholders anticipate growth in Chandler.

8.0 NEXT STEPS

The alternative evaluation process provided insight to recommend an alternative that may be most suitable for future development as a HCT corridor.

The recommended alternative is Alternative 1 (**Figure 7**), which travels from Pecos Road, north on Arizona Avenue to Baseline Road in Mesa with opportunity for connection to the proposed Fiesta District HCT development. The HCT technology best suited for Alternative 1 will be identified in future analyses. The end-of-line for Alternative 1 in Chandler will be modified depending on HCT technology found to be best suited, to either terminate at Pecos Rd, Germann Road or Chandler Park-and-Ride.

Although Alternative 1 is the recommended alternative, the study results indicate that the corridor would warrant transit and land use supportive investments to compete for important federal discretionary funding to compliment local funds and potential regional support. These efforts should include:

- Continuing to invest in the existing transit services within the corridor by increasing frequency and improving travel speed and reliability to create an attractive mode of transportation.

- Engaging with future and potential developments along the corridor to implement TOD elements, such as building designs oriented towards the street, lower parking minimums and higher-density mixed-uses.

- Coordinating with all departments of the City of Chandler (e.g., economic development and public works) for buy-in to set policies for this corridor that would encourage TOD, create safe pedestrian and bicycling connections, and make decisions now that would be supportive to implement HCT later (e.g., the placement of new utility lines).

APPENDIX A:
TIER 2 EVALUATION MATRIX

Arizona Avenue Alternatives Analysis
Tier 2 Evaluation (Page 1 of 3)

SCORING
Key: 1 - 3 = substandard to strong performance

		Evaluation Criteria	Description (data and extent of criteria analysis)	Assumptions (breakpoint determination for scoring)	Evaluation Criteria Weight	Alternative 1 Arizona Avenue 8.5 miles				Alternative 2 Chandler Boulevard 8 miles				Alternative 3 Price Road 5.5 miles			
						RAIL		BRT		RAIL		BRT		RAIL		BRT	
						SCORE	DETAIL	SCORE	DETAIL	SCORE	DETAIL	SCORE	DETAIL	SCORE	DETAIL	SCORE	DETAIL
1	Ridership Potential	**Forecasted Daily Transit Trips per Mile**	STOPS Model output for forecasted daily boardings per mile.	Under 70 = 1; 71-120 = 2 ; Over 120 = 3	**5**	3	252	2	81	3	144	1	48	1	43	1	19
2		**Forecasted Percent Zero-Car Transit Trips**	STOPS Model output for percent of trips on project by zero-car households.	Under 30%; = 1; 31-54% = 2; Over 54% = 3	**1**	1	28%	1	18%	2	49%	2	53%	3	59%	2	54%
		Daily Transit Trips per Mile	Daily boardings per mile on existing transit.	Under 23 = 1; 23 - 38 = 2; Over 38 = 3	**1**	3	63	3	63	2	25	2	25	1	2	1	2
					Subtotal	**19**		**14**		**19**		**9**		**9**		**8**	
3	Transit Access	**Population Density in Stop Area**	Population per square mile within 1/2 mile of stations (MAG 2040 Population)	Under 3,100 = 1 3,101 - 5,100 = 2 over 5,100 = 3	**1**	2	3,942	2	3,942	3	5,316	3	5,316	1	2,980	1	2,980
4		**Employment Density in Stop Area**	Employment per square mile within 1/2 mile of stations (MAG 2040 Employment)	Under 3,070 = 1; 3,071 - 5,100 = 2; over 5,100 = 3	**2**	1	2,694	1	2	2	4,363	2	4,363	3	5,212	3	5,212
5		**Publicly-Supported Housing in Study Area**	Number of legally-binding, affordability restricted (LBAR) housing units within 1/2-mile of stations (data from D)	Under 50 = 1; 51 - 100 = 2; over 100 = 3	**1**	2	81	2	81	3	467	3	467	2	0	1	0
6		**Connections with Existing Transit Routes**	Connections with and distance to existing transit services (routes and PNRs)	Greatest diversity of transit modes =3; Average diversity of transit modes = 2; Minimal diversity of transit modes = 1	**2**	3	9	3	9	2	7	2	7	1	4	1	4
7		**Connections with Future HCT Routes**	Connections with potential future HCT routes consistent with MAG RTFSU and MAG BRT/commuter bus study recommendations	Greatest potential for connection = 3; All others = 2;	**2**	3	Possibility to connect to FDAA Corridor, TMSFS Corridor, and Chandler Blvd Corridor	3	Possibility to connect to FDAA Corridor, TMSFS Corridor, and Chandler Blvd Corridor	2	Possibility to connect to Rural Rd HCT, Price Rd Corridor, and Arizona Ave Corridor.	3	Possibility to connect to Rural Rd HCT, Price Rd Corridor, and Arizona Ave Corridor.	2	Possibility to connect to Chandler Rd Corridor and Price Rd Corridor.	2	Possibility to connect to Chandler Rd Corridor and Price Rd Corridor.
8		**Connections with Bikeways/Multi-Use Paths**	Connections to bikeways and miles of multi-use paths within 1/2-mile of station)	Greatest connection = 3; All others = 2;	**1**	2	15 Miles 20 Connections	2	15 Miles 20 Connections	3	33 Miles 28 Connections	3	33 Miles 28 Connections	2	23 Miles 15 Connections	2	23 Miles 15 Connections
					Subtotal	**20**		**20**		**21**		**21**		**16**		**16**	

Arizona Avenue Alternatives Analysis
Tier 2 Evaluation (Page 2 of 3)

SCORING
Key: 1 - 3 = substandard to strong performance

	Evaluation Criteria	Description (data and extent of criteria analysis)	Assumptions (breakpoint determination for scoring)	Evaluation Criteria Weight	Alternative 1 Arizona Avenue 8.5 miles				Alternative 2 Chandler Boulevard 8 miles				Alternative 3 Price Road 5.5 miles			
					RAIL		BRT		RAIL		BRT		RAIL		BRT	
					SCORE	DETAIL	SCORE	DETAIL	SCORE	DETAIL	SCORE	DETAIL	SCORE	DETAIL	SCORE	DETAIL
Physical & Engineering Constraints	**Non-Transit Vehicle Lanes**	Number of vehicular travel lanes (not turn lanes) remaining after repurposed for HCT	4+ lanes altered =1 2 lanes altered = 2 0 lanes altered = 3	**1**	2	4 lanes (6 to 4)	3	0	2	4 lanes (6 to 4)	3	0	3	4 lanes (4 to 4)	3	0
	Right of Way (ROW) and Land Acquisition	Approximate sq. ft. of take and building hits/relocations	Under 140,000 sq ft with and no building hits = 3; greater than 141,000 sq ft and no building hits = 2; any building hits (regardless of take size) =1	**1**	1	Approx 155,190 sq ft. 9 building hits	3	NO ROW Takes	1	Approx 279,239 sq ft. 3 building hits	3	No ROW Takes	1	Approx 120,361 sq ft. 1 building hits	3	No ROW Takes
	Potential Environmental Impacts	Historical and Cultural Resources	minimal environmental impact =3 moderate environmental impact = 2	**1**	2	5	3	0	2	4	3	0	3	1	3	0
		Section 4(f) Resources				6		0		7		0		1		0
		Environmental Impacts				Wells, Western Canal Xing Noise/Vibration		None		Wells, Eastern Canal Xing Noise/Vibration		None		Wells, Noise/Vibration		None
	Utilities	Identify distinct public or private utilities issues. Note relative magnitude and number of potential issues.	Less than 2 issues = 3 2+ issues = 2	**1**	2	RR Xing, move KV underground, HP Gas, Jet fuel line	3	None	2	RR Xing, Nitrogen Gas, HP Gas, move KV underground,	3	None	1	Underground KV, Nitrogen Gas, Freeway Constraints	3	No Issues
				Subtotal	7		12		7		12		8		12	
Land Use & Economic Development	**Consistency with Adopted Land Use Plans and Policies**	Alternative's consistency with existing city and regional economic plans/policies (Chandler General Plan 2016, Transportation Master Plan 2019, MAG RTFSU, MAG RTP)	Identified as strongest potential or other potential as HCT corridor = higher score Considered for efficient, expedited public transit service (BRT, LRT, Streetcar) = higher score	**1**	3	Arizona Ave, Chandler Blvd identified as HCT corridors	3	Arizona Ave, Chandler Blvd identified as HCT corridors	3	Arizona Ave, Chandler Blvd identified as HCT corridors	3	Arizona Ave, Chandler Blvd identified as HCT corridors	1	Arizona Ave, Chandler Blvd identified as HCT corridors	1	Arizona Ave, Chandler Blvd identified as HCT corridors
	Redevelopment/ Transit-Oriented Development (TOD) Opportunities	Acres of land compatible for redevelopment (commercial, public, vacant) within 1/2 mile of station areas. Current Maricopa County Assessor parcels and Chandler Transportation Master Plan 2019.	No major differences in potential for each of the alignments. (Scored 2)	**1**	3	294 Acres	3	294 Acres	2	281 Acres	2	281 Acres	2	288 Acres	2	288 Acres
	Opportunity for Integration into Emerging Developments/ Districts	Identify and list opportunities to integrate with existing and planned developments along alignment.	fewer than 8 = 1 more than 13 = 3	**1**	3	17 proposed or approved Dev Opp	3	17 proposed or approved Dev Opp	1	6 proposed or approved Dev Opp	1	6 proposed or approved Dev Opp	1	7 proposed or approved Dev Opp	1	7 proposed or approved Dev Opp
				Subtotal	**9**		**9**		**6**		**6**		**4**		**4**	

Arizona Avenue Alternatives Analysis
Tier 2 Evaluation (Page 3 of 3)

SCORING
Key: 1 - 3 = substandard to strong performance

	Evaluation Criteria	Description (data and extent of criteria analysis)	Assumptions (breakpoint determination for scoring)	Evaluation Criteria Weight	Alternative 1 Arizona Avenue 8.5 miles				Alternative 2 Chandler Boulevard 8 miles				Alternative 3 Price Road 5.5 miles			
					RAIL		BRT		RAIL		BRT		RAIL		BRT	
					SCORE	DETAIL	SCORE	DETAIL	SCORE	DETAIL	SCORE	DETAIL	SCORE	DETAIL	SCORE	DETAIL
Potential Costs	**Capital Cost Estimate (millions)**	Total rough order of magnitude cost of alternative. 2020 dollars; 30% contingency and all FTA SCC items (vehicles, O&M facility, etc.)	$ (under $600M) = 3; $$ ($600M - $1B) = 2; $$$ (over $1B) = 1	**1**	2	$$	3	$	1	$$$	3	$	1	$$$	3	$
Potential Costs	**Operations and Maintenance (O&M) Cost Estimate**	Annual Gross O&M cost (2020 dollars)	$ (under $8M) = 3; $$ ($8M - $14M) = 2; $$$ (over $14M) = 1	**1**	1	$$$	2	$$	1	$$$	2	$$	2	$$	3	$
Potential Costs	**Cost Effectiveness**	Annual cost per rider: annualized capital and O&M divided by annual ridership.	$ (under $200M) = 3; $$ ($201M - $300M) = 2; $$$ (over $300M) = 1	**5**	3	$	3	$	3	$	3	$	1	$$$	1	$$$
				Subtotal	**18**		**20**		**17**		**20**		**9**		**11**	
Transportation Efficiencies	**Operating Efficiency**	Transit operational efficiencies (turns, end of line placement)	Scored based on the combo of number of turns and EOL conditions. Fewer turns, higher score; Better EOL, higher score	**1**	2	One turn, Logical end-of-line locations (existing PNR) Tie in for FDAA/TMSFS corridor). Will slow down when entering downtown Chandler.	2	One turn, Logical end-of-line locations (existing PNR) Tie in for FDAA/TMSFS corridor). Will slow down when entering downtown Chandler.	2	Straight line. Both end-of-lines are logical, cross streets have good local bus service. Crosses UPSS RR tracks.	2	Straight line. Both end-of-lines are logical, cross streets have good local bus service. Crosses UPSS RR tracks.	2	Straight alignment, navigates through congested highway frontage roads. End -of-lines are logical. Existing bus service on Ray Rd and Intel on S. end.	2	Straight alignment, navigates through congested highway frontage roads. End -of-lines are logical. Existing bus service on Ray Rd and Intel on S. end.
Transportation Efficiencies	**Transit Speed and Reliability Impediments**	List obvious transit speed and reliability impediments (# of signaled intersections; Qualitative assessment of curb cuts/turning conflicts; special events)	Fewer signals and events, higher score; More signals/events, lower score.	**1**	2	23 signalized intersections: Events downtown	2	23 signalized intersections: Events downtown	2	26 signalized intersections	2	26 signalized intersections	3	16 signalized intersections	3	16 signalized intersections
Transportation Efficiencies	**Scalability**	Identify and list the alternative's ability to split into phases.	2+ phase opportunities = 2 1 phase opportunity = 1	**1**	2	AZ Ave has one logical place to be split, with Phase I ending at Pecos and Phase II ending at the PNR. There is also the possibility of future extensions to Chandler Airpark.	2	AZ Ave has one logical place to be split, with Phase I ending at Pecos and Phase II ending at the PNR. There is also the possibility of future extensions to Chandler Airpark.	2	Chandler Blvd has one logical place to be split, with Phase I going from Gilbert Rd to the Mall, and Phase II going to Rural Rd. There is also the possibility of future extensions to the Phoenix-Mesa Gateway Airport.	2	Chandler Blvd has one logical place to be split, with Phase I going from Gilbert Rd to the Mall, and Phase II going to Rural Rd. There is also the possibility of future extensions to the Phoenix-Mesa Gateway Airport.	1	Generally, Price Rd does not have a logical place to be split into Phases. There is a possibility of future extension north along the 101, of west towards a future Rural Rd HCT.	2	Generally, Price Rd does not have a logical place to be split into Phases. There is a possibility of future extension north along the 101, of west towards a future Rural Rd HCT.
				Subtotal	**6**		**6**		**6**		**6**		**6**		**7**	
				Total	**79**		**81**		**76**		**74**		**51**		**58**	
				Rank	**2**		**1**		**3**		**4**		**6**		**5**	

APPENDIX B:
BRT LEVELS OF COMMITMENT

National Association of City Transportation Officials

The National Association of City Transportation Officials (NACTO) Transit Street Design Guide is an illustrated, detailed reference for designing streets for high-quality transit, from local buses to Bus Rapid Transit (BRT), streetcar to light rail. Drawing on the expertise of peer network and case studies from across North America, the guide provides a link between transit planning, transportation engineerig, and street design. The book presents core principals, street typologies, and design strategies to inform comprehensive transit street design, lane design, design for stations and stops, intersection strategies, and city transit network development.

Transit Lanes & Transitways

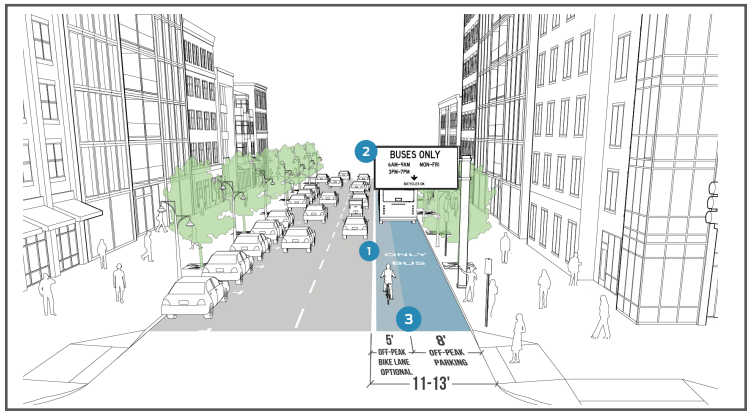
Transitways physically seperate a portion of the street for transit exclusive use, providng high-quality running way at all times. Transit lanes delineate space within the roadbed as exclusive, either full or part-time, and can generate transit benefits with relatively low implementation costs.

The following examples are subsections from the Transit Lanes chapter of the Transit Street Design Guide. The examples are referenced to illustrate the varying levels of bus enhancements in corridors conducive to BRT. The first level of BRT has no lane dedication and operates in mixed traffic.

BRT Level 2 (e.g., Peak-Only Bus Lane)

A peak-only bus lane that operates as a dedicated bus lane at peak travel periods and provides general curbside uses at other times. Can also be exclusive to buses at peak times, while permitting mixed traffic at other times. 12-13 feet is the desired width to accommodate parking or bike lane during non-peak hours.

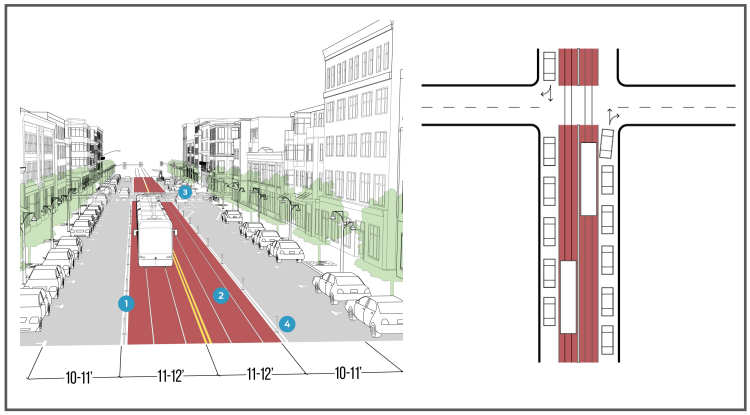
Pavement markings must indicate that the lane is dedicated to transit, including a solid white line and BUS ONLY stencil.



BRT Level 3 (e.g., Center Transit Lane)

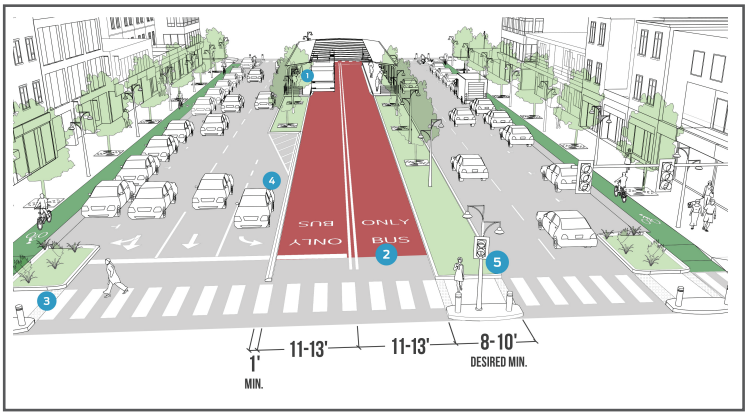
Center transit lanes are applicable to center-running streetcar, light rai lines or BRT and other bus improvements. 22-24 feet is the minimum desired width for center transit lanes. Center-running lanes should be designated using colot to emphasize the lane and deter drivers from entering.

Solid white lines or double white lines must be striped along the sides of the transit lane, along with BUS ONLY pavement markings.



BRT Level 4 (e.g., Center Transitway)

Center transitways seperated by medians provide strong protection from traffic-related delays, and allow the highest running speeds among on-street transit facilities, since pedestrians interact with vehicles only at stations and crosswalks.



Dedicated transit lanes require median boarding islands in the roadway at each stop and the widet of th emedian must be carefully determined based on the design vehicle's width and dyamic envelope.

The examples listed in this appendix do not represent the full range of possible transit lane configurations associated with levels of BRT dedication. The intention of these examples is to give a representative sample of varying level of BRT dedication.

All images used: NACTO- https://nacto.org/publication/transit-street-design-guide/

APPENDIX C:
TRAVEL FORECASTING REPORT

Memo

To: Project File

From: Michael Gorton, Valley Metro

Date: March 2021

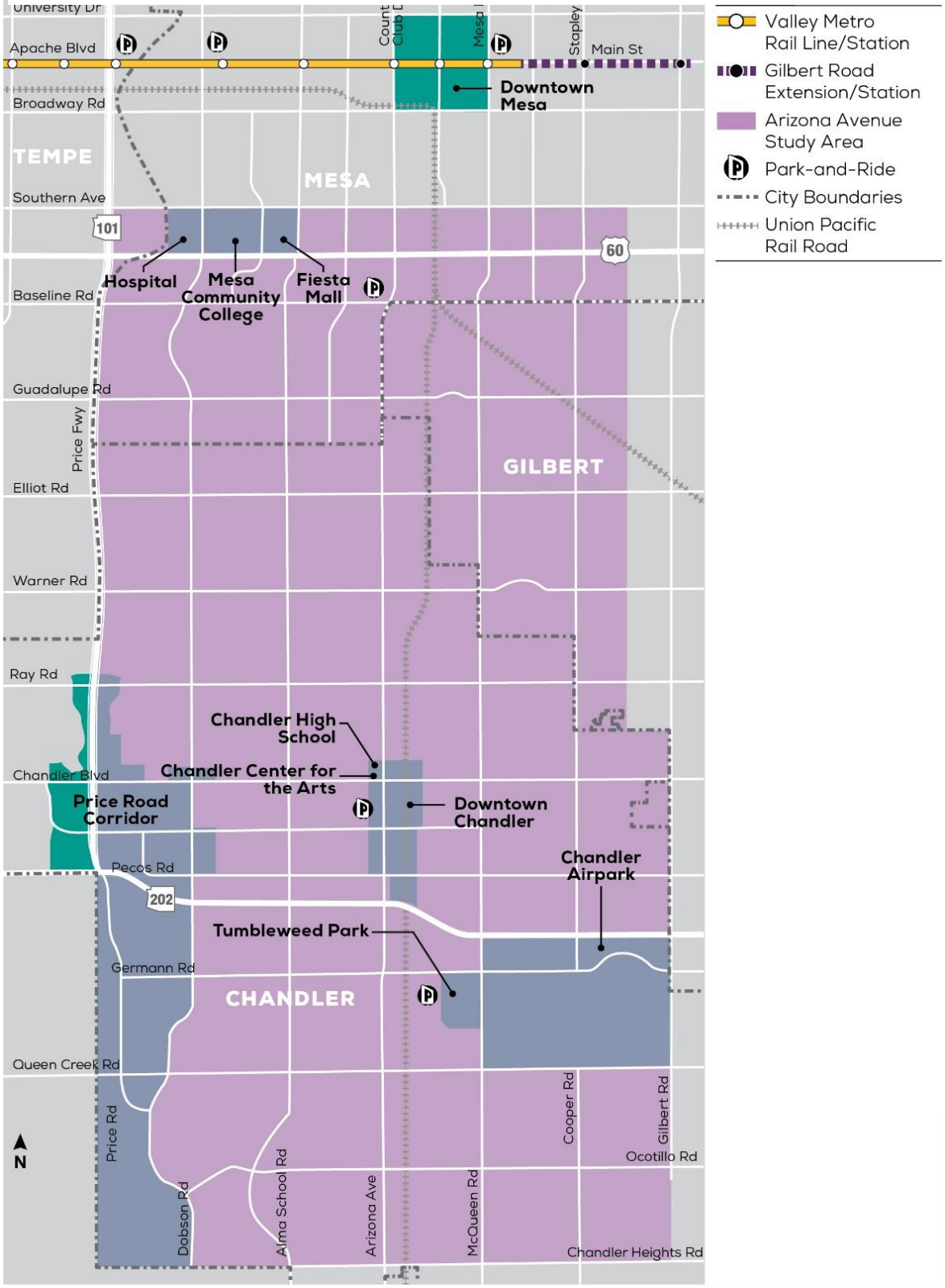
Re: Arizona Avenue Alternatives Analysis (AAAA) Travel Forecasting Memo

Background:

Valley Metro and the City of Chandler in coordination with the Maricopa Association of Governments (MAG), is conducting the Arizona Avenue Alternatives Analysis (AAAA) to evaluate potential high-capacity transit (HCT) improvements in Chandler **(Figure 1)**. The recommendations of this study will assist the City of Chandler in identifying a preferred HCT alignment and describe guidance for transit improvements in the recommended corridor. The results of the study will provide MAG with Chandler's priority corridor for future regional transit investments in long-range planning activities, specifically for consideration in the extension of Proposition 400.

This technical memorandum discusses the alternatives and ridership forecasts for the AAAA. Ridership was estimated using an existing Simplified Trips-On-Project Software (STOPS) application that was developed for the Valley Metro service area. The following sections will discuss the STOPS model used, the alternatives and ridership results.

Figure 1 : Arizona Avenue Study Area



STOPS Overview:

The ridership forecast for the AAAA was estimated using a travel modeling software called STOPS (Simplified Trips-on-Project Software). The STOPS application is a stand-alone ridership forecasting software package developed by the Federal Transit Administration (FTA). The software applies a set of travel models to predict detailed travel patterns on fixed-guideway systems. STOPS was specifically developed to support New Starts and Small Starts projects.

STOPS utilizes a modified four-step (trip generation, trip distribution, mode choice, and trip assignment) model structure to quantify total transit ridership by trip type, mode of access, and auto ownership. It also computes the change in person miles travelled (PMT) that is attributable to the proposed transit project. STOPS version 2.5 dated March 25, 2019, was used for estimating ridership for this study.

STOPS Inputs

Following the installation of STOPS, several inputs were required to successfully complete the model run. This section will provide detailed information on the following inputs:

- Census Data/On-Board Survey
- LRT/Bus Boarding Data
- Population and Employment Data
- Highway Skims
- Transit Agency Data
- Additional Inputs

Table 1 identifies the inputs that were used in STOPS for the Arizona Avenue Alternatives Analysis.

Table 1: STOPS Inputs

Inputs Used	Source	Source Year
GTFS Files	Valley Metro	2019 (April)
On-Board Survey Data	Valley Metro	2019 (April)
LRT Boarding Data	Valley Metro	2019 (April)
Bus Boarding Data	Valley Metro	2019 (April)
Population/Employment Data	MAG	2019, 2040
AM Peak Highway Skims	MAG	2019, 2040
GTFS Files	Valley Metro	2019 (April)

Census Data/ On-board Survey

STOPS can calibrate to year 2000 Journey-to-Work (JTW) trip flow data, year 2010 American Community Survey (ACS) trip flow data, or a recent on-board transit survey. In April 2019, Valley Metro completed an on-board survey and the transit trips from this survey (by trip purpose and household auto occupancy) were used as an input for calibration. Light rail and bus boarding data were provided from Valley Metro for April 2019.

LRT/Bus Boarding Data

Valley Metro April 2019 light rail and bus boarding data were used in the calibration process.

Population and Employment Data

Table 2 shows the MAG 2019 and 2040 population growth for Maricopa County and the study area. Study area population and employment is projected to grow at a slower rate than county population and employment.

Table 2: Population and Employment Growth

Area	MAG 2020	MAG 2040	Percent Change 2020-2040
Population			
Study Area	307,800	355,800	16
Maricopa County	4,893,000	6,332,000	29
Employment			
Study Area	146,400	199,700	36
Maricopa County	1,850,000	2,513,000	36

Highway Skims

Highway skims were prepared from the MAG travel model for the years 2020 and 2040 for estimated peak highway travel times.

Transit Agency Data

General Transit Feed Specification (GTFS) is a standardized format for public transportation schedules used by transit agencies throughout the world. GTFS is a collection of text files that, together, provide data necessary for trip planners, schedules and mobile phone applications. STOPS utilizes GTFS for estimating ridership in the existing, no-build, and build scenarios. GTFS files from April 2020 were provided by Valley Metro to be used as inputs into STOPS. These files were used for calibration and as a foundation for the no-build and build scenarios.

Additional Inputs

There are several inputs that are optional in STOPS. These include the following:

- Weekday Unlinked Transit Trips: 214,308
- Weekday Home-Based Work (HBW) Linked Transit Trips: 71,542

Table 3 shows the linked transit trips by household auto ownership used in STOPS for the Arizona Avenue Alternatives Analysis.

Table 3: Linked Transit Trips by Household Auto Ownership

Auto Ownership	HBW	HBO	NHB
0-Car HH	32,419	38,065	11,496
1-Car HH	23,804	18,416	4,314
2-Car HH	15,319	12,801	3,779
All-Car HH	71,542	69,282	19,589

Stops Service Scenarios

There are three service scenarios required by STOPS: Existing Transit, No Build, and Build. This section explains each of the scenarios and assumptions used for estimating ridership.

Existing Scenario

The existing transit scenario is a critical element of the ridership estimation process because it builds the foundation for all future model runs. This study uses an existing STOPS application that was previous developed for the Valley Metro region for all projects. The transit system (April 2019), district definition, and station boardings used for calibration were unchanged. The total daily unlinked trips used in calibration is 214,308.

No Build Scenario

In the No-Build scenario, the transit system was modified to reflect anticipated 2040 conditions. This includes the following:

- Light Rail: Metrocenter to Central Ave/Baseline Rd
- Light Rail: Central Station between Washington/Jefferson to Main St/Gilbert Rd
- Tempe Streetcar added
- Service reduced on Route 0 (Central Avenue)
- Baseline Express bus added between 27th Avenue to 24th Street
- Central South Mountain East/West RAPID service removed

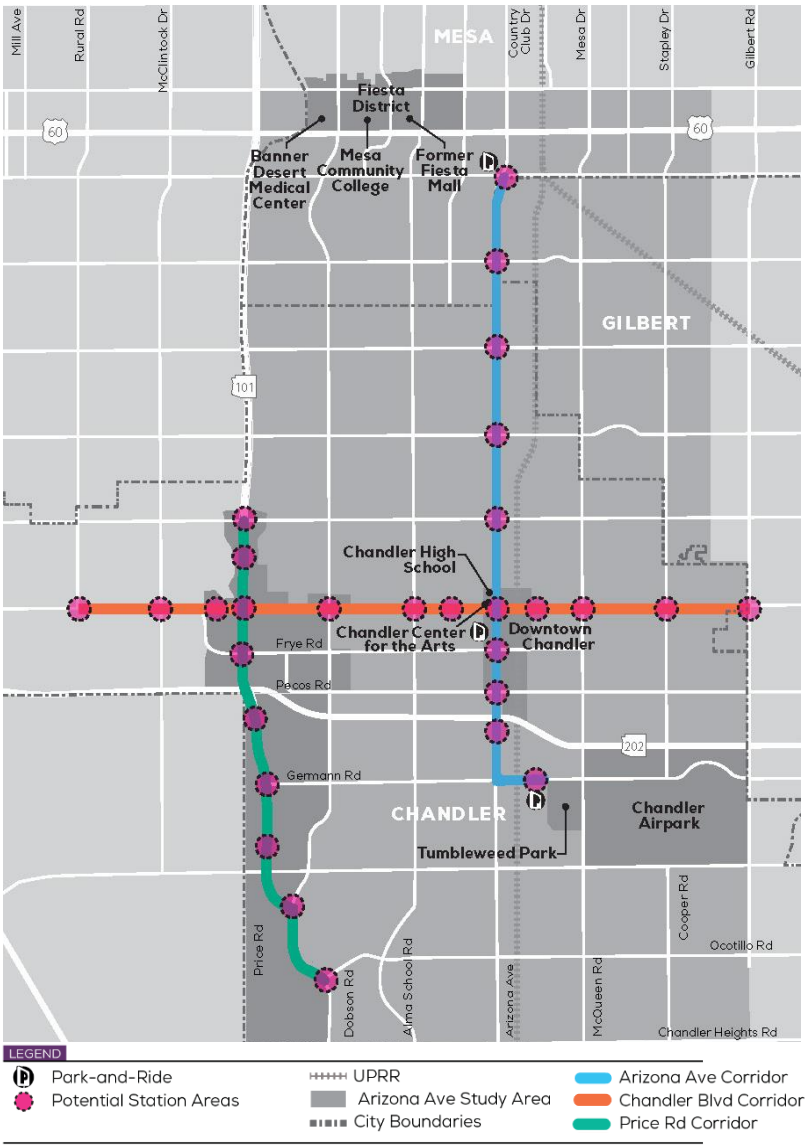
Build Scenarios

Each Build Scenario is comprised of the transit system used in the No Build Scenario, plus one of the three alternatives:

- **Chandler Blvd Alternative:** begins at Chandler Boulevard and Rural Road and travels east on Chandler Boulevard to Gilbert Road.
- **Price Road Alternative:** begins at Price Road and Ray Road and travels south on Price Road to Dobson Road.
- **Arizona Avenue Alternative:** begins at Arizona Avenue and Baseline Road and travels south to Germann Road where it travels east to the Chandler Park and Ride.

For each alternative, two modes were tested: bus rapid transit (BRT) and light rail (LRT). The number of stations for each corridor was same for each mode used. **Figure 2** shows the build alternative alignments and station locations.

Figure 2: AAAA Alternatives

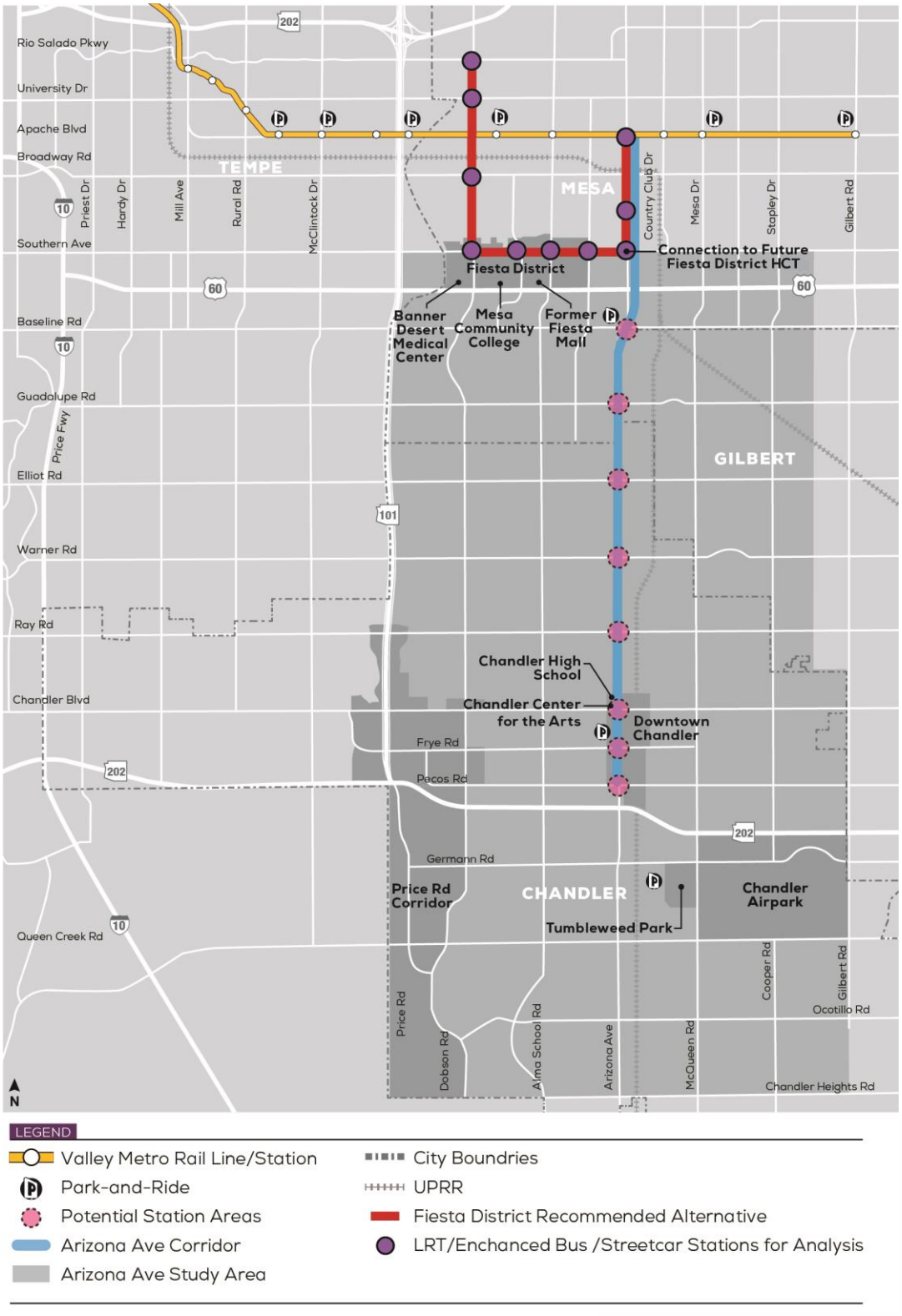


After conducting ridership estimations for the three alternatives identified in **Figure 2**, three additional scenarios were identified for the Arizona Avenue alternative. The additional build scenarios are as follows:

- **Arizona Avenue (BRT+Fiesta District):** begins at Arizona Avenue and Main Street and travels south on Arizona Avenue to Pecos Road using the BRT mode. Also, in this scenario, the Fiesta District Recommended Alternative was operated as BRT service in both the No Build and Build scenarios.
- **Arizona Avenue (STR+Fiesta District):** begins at Arizona Avenue and Main Street and travels south on Arizona Avenue to Pecos Road using the streetcar mode. Also, in this scenario, the Fiesta District Recommended Alternative was operated as streetcar service in both the No Build and Build scenarios.

Figure 3 shows the additional scenarios for the Arizona Avenue alternative.

Figure 3: Additional Arizona Avenue Scenarios



Travel Times

The travel times were calculated by using an average speed for the light rail and streetcar transit mode. Bus Rapid Transit speeds were calculated by determining the average speed of the underlying bus route with each corridor and increasing the speed by 20 percent. **Table 4** shows the mode and speed assumptions.

Table 4: Forecast Assumptions by Mode

Mode	Corridors	Speed (mph)	STOPS Visibility
Light Rail	Chandler Blvd Price Rd Arizona Ave	18.0	1 – Full benefit
Bus Rapid Transit	Chandler Blvd Price Rd Arizona Ave Arizona Ave (+FD)	18.0	0.1 – Proportional benefit
Streetcar	Arizona Ave (+FD)	12.0	0.5 – Proportional benefit

Service Span and Frequency

The service span and frequency used was the same of for all the alternatives and meant to match the current service span and frequency of light rail. The service span is approximately 19 hours with 10-minute frequency between 7:30 AM and 6:30 PM, and 20 minutes before 7:30 AM and after 6:30 PM. **Table 5** shows the service span and frequency that applies to all three alternatives.

Table 5: Service Span and Frequency

Time of Day	Start	End	Frequency (Min)
Early AM	4:40 AM	7:29 AM	20
AM/Midday/PM	7:30 AM	6:29 PM	10
Evening	6:30 PM	11:59 PM	20

The service span and frequency used for the additional Arizona Avenue scenarios was the same for all three scenarios and meant to match the service span and frequency of Tempe Streetcar. The service span is approximately 18 hours with 10-minute frequency until 7:00 PM, and 20 minutes after 7:00 PM. **Table 6** shows the service span and frequency that applies to the additional Arizona Avenue scenarios.

Table 3: Service Span and Frequency for Additional Arizona Avenue Scenarios

Time of Day	Start	End	Frequency (Min)
Early AM	6:00 AM	6:59 AM	10
AM/Midday/PM	7:00 AM	6:59 PM	10
Evening	7:00 PM	11:59 PM	20

Results

A key STOPS model output is weekday trips on project. **Table 7** shows the end-to-end travel time, the mode specific STOPS visibility factor, total trips on project for each alternative and mode, and average project trips per station. The ridership forecasts range from 100 to 2,470 average weekday trips on project depending on alternative and mode.

Table 8 to **Table 10** show 2040 station boarding forecasts by alternative and mode.

Table 4: 2040 Alternative Performance By Mode

Mode	End-to-End Travel Time	STOPS Visibility	Number of Stations	Total Trips on Project	Average Project Trips per Station
Chandler Boulevard					
Light Rail	26:48	Full	11	1,150	100
Bus Rapid Transit	26:42	0.1	11	390	40
Price Road					
Light Rail	18:54	Full	9	230	30
Bus Rapid Transit	18:54	0.1	9	100	10
Arizona Avenue					
Light Rail	25:32	Full	10	2,140	210
Bus Rapid Transit	25:37	0.1	10	690	70
Arizona Avenue (Additional Scenarios)					
Bus Rapid Transit (+FD)	28:29	0.1	8	2,660	330
Streetcar (+FD)	42:30	0.5	8	2,470	310

Table 5: Chandler Blvd-Year 2040 Station Boardings by Mode

Station	Light Rail	Bus Rapid Transit
Chandler Blvd & Rural Rd	120	30
Chandler Blvd & McClintock Dr	80	30
Chandler Blvd & Metro Blvd	90	60
Chandler Blvd & Dobson Rd	130	40
Chandler Blvd & Alma School Rd	70	10
Chandler Blvd & Hartford St	170	40
Chandler Blvd & Arizona Ave	110	40
Chandler Blvd & Hamilton St	150	50
Chandler Blvd & McQueen Rd	50	30
Chandler Blvd & Copper Rd	30	10
Chandler Blvd & Gilbert Rd	150	50
TOTAL	**1,150**	**390**
AVERAGE	**100**	**40**

Table 6: Price Rd-Year 2040 Station Boardings by Mode

Station	Light Rail	Bus Rapid Transit
Price Fwy & Ray Rd	90	30
Price Fwy & Galveston St	0	0
Price Fwy & Chandler Blvd	30	20
Price Fwy & Fyre Rd	0	0
Price Rd & Spectrum Blvd	10	0
Price Rd & Germann Rd	0	0
Price Rd & Innovation St	80	30
Price Rd & Dobson Rd	10	10
Dobson Rd & Ocotillo Rd	10	10
TOTAL	**230**	**100**
AVERAGE	**30**	**10**

Table 7: Arizona Ave-Year 2040 Station Boardings by Mode

Station	Light Rail	Bus Rapid Transit	Bus Rapid Transit (+FD)	Streetcar (+FD)
Arizona Ave & Baseline Rd	430	140	280	260
Arizona Ave & Guadalupe Rd	150	50	180	160
Arizona Ave & Elliot Rd	360	110	200	230
Arizona Ave & Warner Rd	120	30	80	80
Arizona Ave & Ray Rd	200	60	150	130
Arizona Ave & Chandler Blvd	110	40	150	100
Arizona Ave & Frye Rd	360	100	280	230
Arizona Ave & Pecos Rd	40	10	100	100
Arizona Ave & Willis Rd	200	70	N/A	N/A
Chandler PnR	170	80	N/A	N/A
TOTAL PROJECT TRIPS	**2,140**	**690**	**2,660***	**2,470***
AVERAGE BOARDINGS	**210**	**70**	**175**	**160**

*Boardings differ from project trips because three additional stations are shared with the Fiesta District Streetcar.

APPENDIX D:
COST ESTIMATING REPORT

Memo

To: Project File

From: Peter Valenzuela, Valley Metro

Date: March 2021

Re: Arizona Avenue Alternatives Analysis (AAAA) Capital Cost Estimates Memo

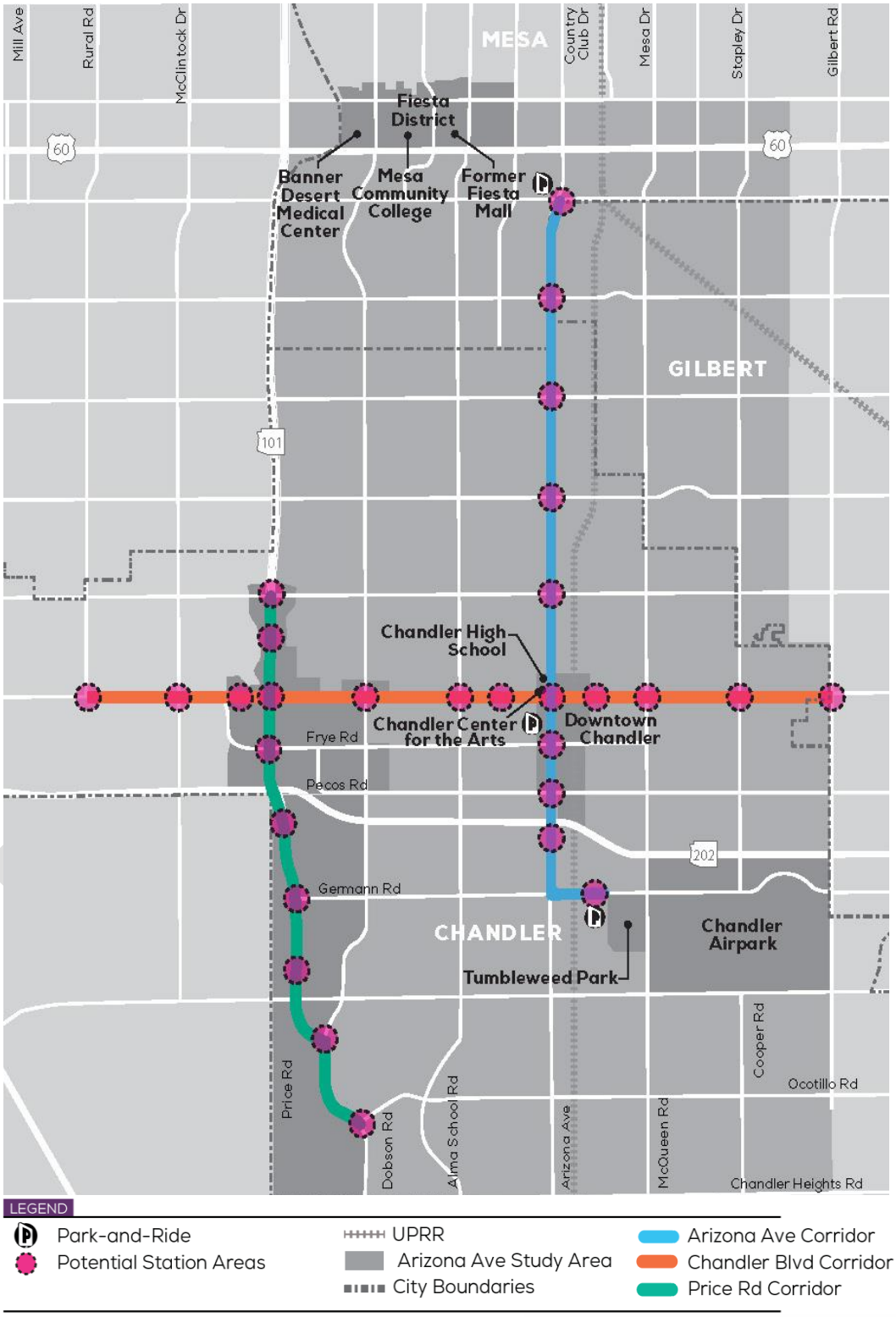
Background:

Valley Metro and the City of Chandler, in coordination with the Maricopa Association of Governments (MAG), is conducting the Arizona Avenue Alternatives Analysis (AAAA) to evaluate potential high-capacity transit (HCT) improvements in Chandler. The recommendations of this study will assist the City of Chandler in identifying a preferred HCT alignment and describe guidance for transit improvements in the recommended corridor.

The AAAA is currently in the second tier of a two-tier evaluation process to analyze potential high-capacity transit (HCT) corridors. The AAAA Tier 1 Evaluation assessed three alignment options based on City of Chandler recommendation and findings from the Chandler Transportation Master Plan 2019 Update. **Figure 1** shows the options being considered in the Tier 2 Evaluation.

As part of the Tier 2 Evaluation, the Project Team is developing preliminary capital costs for analytical purposes. These costs are developed at a high-level for purposes of this analysis and not for programming purposes. This memo summarizes cost estimates and the methodology used to develop the estimates.

Figure 1: AAAA Tier 2 Options



Capital Cost Estimates:

The capital costs were developed using a rough order-of-magnitude (ROM) approach.

First, base unit cost per mile were assumed for each HCT mode. These were developed based on similar projects currently under development or recently completed. They were adjusted with the understanding that the conceptual projects are located in Chandler, Arizona, and factored for local conditions.

Additionally, the costs are based on assuming Construction Manager at Risk (CMAR) project delivery method, which is consistent with recent Valley Metro HCT projects. The base cost per mile includes professional services, design, basic funding for operations and maintenance (O&M) facility and vehicles. Although a basic cost is included for O&M facility and vehicles, further analyses are required to understand the O&M facility needs and number of vehicles.

Table 1 summarizes the high contingency (wary forecast) base unit costs for each HCT mode.

Table 1: Assumed Base Unit Cost per Mile

High Capacity Transit Mode	Cost per mile *(Wary Forecast)*
Bus Rapid Transit (BRT)	
BRT Level 1	$10,360,000
BRT Level 2	$37,000,000
BRT Level 3	$66,000,000
BRT Level 4	$81,400,000
Hybrid Light Rail Transit (LRT)/Streetcar	$134,680,000
Light Rail	$193,436,000

Second, specific costs were developed for the elevated bridge and crossing structures planned for each option, where necessary. These costs are in addition to the base cost per mile. The costs assumed for each structure are listed in **Table 2**.

Table 2: Assumed Structure Costs

Structure	Added Cost to Project
Grade Separation over Union Pacific Railroad	$24,790,000
Price Road Bridge Over State Route 202	$52,355,000

Both cost assumptions were combined to develop a capital cost range for each option. The costs were estimated in current year (2020) dollars and did not account for inflation. Therefore, it should be expected that when the project is actually realized for construction, the assumed cost would be higher due to inflation.

Three costs were developed to create a range of costs:

1) The "Optimistic Forecast," 2) the "Likely Forecast," and 3) the "Wary Forecast."

- Optimistic Forecast represents a Selected Confidence "P value" of P50 (i.e., a 50% probability that the project will be constructed at or less than the cost/mile.)
- Likely Forecast represents a Selected Confidence "P value" of P65 (i.e., a 65% probability that the project will be constructed at or less than the cost/mile.)
- Wary Forecast represents a Selected Confidence "P value" of P80 (i.e., a 80% probability that the project will be constructed at or less than this cost/mile.)

Table 3 summarizes the total costs used for analysis for Likely and Wary Forecast options.

Table 3: Summary of Capital Costs Used for Analysis (2020 $)

Alternative (End-of-line and Route Length)	**Mode**	**Likely Forecast**	**Wary Forecast**
Option 1A Arizona Avenue (City Limit to Chandler Park-and-ride) 6.25 miles	BRT (Level 4)	$344,000,000	$ 509,000,000
	Rail (Hybrid)	$552,000,000	$879,000,000
	Rail (LRT)	$842,000,000	$1,246,000,000
Option 1B Arizona Avenue (City limit to Germann Road) 5.65 miles	BRT (Level 4)	$311,000,000	$460,000,000
	Rail (Hybrid)	$515,000,000	$761,000,000
	Rail (LRT)	$739,000,000	$1,093,000,000
Option 1C Arizona Avenue (City limit to Pecos Road) 4.65 miles	BRT (Level 4)	$256,000,000	$379,000,000
	Rail (Hybrid)	$424,000,000	$627,000,000
	Rail (LRT)	$608,000,000	$900,000,000

Option 2 **Chandler Boulevard** (Rural Road to Gilbert Road) 8.31 miles	BRT	$458,000,000	$677,000,000
	Rail (LRT)	$1,111,000,000	$1,645,000,000
Option 3 **Price Road** (Ray Road to Intel Ocotillo Campus) 5.85 miles	BRT	$322,000,000	$477,000,000
	Rail (LRT)	$817,000,000	$1,210,000,000

Reporting Capital Cost:

The capital costs developed for this project are rough order-of-magnitude estimates at a very early level of planning with no substantial design. At this level of planning, there is very high uncertainty and variability in the project scope. Because of this uncertainty, capital costs for this project will be reported in a single cost per mile range from low-to-high for all options using the optimistic forecast as the “low” cost and wary forecast as the “high” cost. To develop the cost per mile range, the total project costs used for analysis were divided by the length of the project route (**Table 3**). In addition to the cost per mile range, reports will note the various project elements in the project scope that could influence where within the range the project may cost.

Table 4 shows how capital cost may be reported using option 1A as an example.

Table 4: Illustration of Capital Cost Reporting (2020 $): Option 1A

Modes Considered
BRT Rail
Capital Cost Range per Mile (in 2020 dollars)
Low (Wary Forecast, BRT- Level 1) : $10,400,000 High (Wary Forecast, LRT) : $199,360,000
Project Elements That Could Impact Capital Cost
• Upgraded and relocated public and private utilities • New pavement, curb and gutter • New sidewalks and bicycle facilities • New traffic signal technology • New landscaping • Number of automobile lanes preserved • Right-of-way acquisition • Business or residence relocation • Environmental mitigation • Traction Power Substations

To reiterate, these cost forecasts and the established capital cost range per mile are rough order-of-magnitude estimates for the purposes of early planning and analyses for the AAAA. The total estimated costs depend on various factors, such as inflation, year of construction, street improvements, structure construction and changing scope of work.

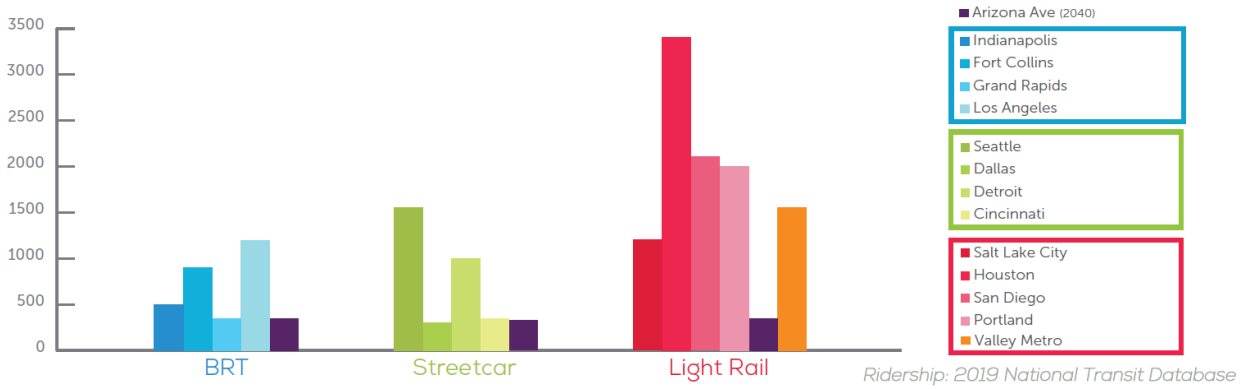
APPENDIX E:
PEER CITY PERFORMANCE COMPARISON

Table 1: Comparison of Projected Performance and Peer City Performance by Mode

Peer City	Mode	Corridor Miles	Boardings per Corridor Mile
Indianapolis, IN	Bus Rapid Transit	**13** (1 line)	501
Fort Collins, CO	Bus Rapid Transit	**5** (1 line)	919
Grand Rapids, MI	Bus Rapid Transit	**9.6** (1 line)	300
Los Angeles, CA	Bus Rapid Transit	**18** (1 line)	1,230
Seattle, WA	Streetcar	**3.8** (2 lines)	1,596
Dallas, TX	Streetcar	**2.5** (1 line)	266
Detroit, MI	Streetcar	**3.3** (1 line)	1,001
Cincinnati, OH	Streetcar	**3.6** (1 line)	329
Salt Lake City, UT	Light Rail	**43** (3 Lines)	1,300
Houston, TX	Light Rail	**23** (2 Lines)	3,346
San Diego, CA	Light Rail	**54** (3 Lines)	2,122
Portland, OR	Light Rail	**60** (5 Lines)	2,017
Local System LRT Performance (2019)			
Valley Metro	Light Rail	**28** (1 Line)	1,634
Projected Performance (2040 Horizon Year): Arizona Avenue (Alternative 1)			
Arizona Avenue	Bus Rapid Transit	**8.5** (1 Line)	**313**
Arizona Avenue	Rail[1]	**8.5** (1 Line)	**291**

National Transit Database: 2019, Average Weekday Boardings

Figure 1: Comparison of Projected Performance and Peer City Performance by Mode



To allow for a more accurate comparison between cities and projected trips on Arizona Avenue (2040), average weekday boardings were normalized to reflect trips per mile. Projected ridership for Arizona Avenue (2040) was modeled to reflect trips within the study area and account for a transfer from Rail or BRT to existing light rail and the planned Fiesta District Service in Mesa.

Comparison Findings

BRT projected ridership on Arizona Avenue was comparable, but underperformed when compared to peer cities average with some exclusive guideway[2]. It is important to note that peer city BRT corridors in the Los Angeles corridor is almost entirely excusive, Indianapolis and Fort Collins have some exclusive guideway, and Grand Rapids BRT corridor has no exclusive guideway.

Rail projected performance on Arizona Avenue achieved relatively similar boardings per mile when compared to peer cities, especially those with single line streetcar. This suggests connections between activity centers and existing and future HCT options reinforce Arizona Avenue as a competitive corridor for HCT as streetcar. Light rail comparison included full systems with multiple lines, and therefore Arizona Avenue projected rail option is shown as below average when compared to these peer cities.

[1] Rail on Arizona Avenue is considered a hybrid option between streetcar and light rail. It is envisioned as a streetcar vehicle with streetcar stops that would primarily operate in an exclusive guideway, except in the downtown Chandler area where it would operate in mixed traffic. This option interlines with the Fiesta District HCT corridor in Mesa and connects to the existing light rail system. The ridership shown is only for the boardings in Chandler.

[2] Some exclusive guideway was considered for BRT on Arizona Avenue. However, the travel forecast model provided a high-level assumption on BRT elements. Future analysis would be needed for more fined-tuned BRT ridership forecasting that is adjusted for different levels of exclusive guideway BRT.

APPENDIX F:
NEW STARTS ANALYSIS REPORT

Memo

To: Arizona Avenue AA Project File

From: Joshua Matthews

Date: March 5, 2021

Re: Task 8.0 New Starts Performance Evaluation – Arizona Ave BRT

The memorandum documents the results of the analysis performed for Task 8.0 New Starts Performance Evaluation as part of the Arizona Avenue Alternatives Analysis (AAAA). The Federal Transit Administration (FTA) offers federal funding opportunities for transit projects through the Capital Investment Grant (CIG) program, which was most recently authorized in the Fixing America's Surface Transportation (FAST) Act in 2015. To be eligible for federal funding through the CIG program, a project sponsor must follow the process laid out in the *Final Interim Policy Guidance* (link) issued in June 2016. One key component of this process is for the project to be evaluated based on two criteria: Project Justification and Local Financial Commitment. The Project Justification criterion, which was analyzed as part of Task 8.0, uses a series of "measures" to determine the likelihood the project will be successful. The Local Financial Commitment criterion determines whether the project has a reasonable financial plan and funding for capital and operating costs.

For the purposes of this Task, the Project Justification analysis was performed to determine if the preferred alternative for the AAAA would rate favorably in the FTA's existing CIG program. These results will also provide key policy areas where the City of Chandler and Valley Metro can work together to ensure the project's competitiveness for future federal funding.

Assumptions

For the purposes of this analysis, the following tools, datasets and assumptions were utilized:

- The project corridor was assumed for Arizona Ave, running from Pecos Rd to Main St in Mesa. The transit mode is assumed to be bus rapid transit (BRT) in a dedicated guideway. A portion of the corridor (from Main St to Southern Ave) is assumed to have been built as BRT as part of a future Fiesta District project.
- Stations were assumed at each arterial, as well as two additional mid-block stations in downtown Chandler (Boston St and Frye Rd). Appendix B provides an overview map showing the assumed corridor.
- The travel forecasting analysis was conducted with the Simplified Trips on Project (STOPS) model to estimate transit trips on the project. It was run using Maricopa Association of Governments (MAG) Transportation Area Zones (TAZ) for current and future (horizon year 2040) socioeconomic data (population, employment and dwelling units).

- Capital costs were assumed for the portion of the corridor south of Southern Ave (including a station at Southern Ave). How the funding is allocated and who pays for each portion is not applicable to this analysis.
- Operating costs were assumed for the entire portion of the corridor (from Pecos Rd to Main St). Because the project is interlining on an existing corridor and thus reaping the benefits through increased ridership, the project must carry its entire operating cost in the assessment. How the funding is allocated and who pays for each portion is not applicable to this analysis.

Project Justification Results
The guidance and breakpoints FTA uses to determine the ratings below are provided in Appendix A.

Congestion Relief

The Congestion Relief criterion is based on the number of new weekday linked transit trips as determined by the travel forecasting analysis.

New Weekday Linked Transit Trips	Rating
407	Low

Cost Effectiveness

The Cost Effectiveness criterion is based on the annual capital and operating cost per trip on the project. These figures are determined through the travel forecasting analysis and a project cost estimate. The project's annualized capital cost is assumed to be $16 million for 7 miles of new construction. The project's annual operating cost is an estimated $5.6 million for 8.5 miles of new operation. A graphic showing the cost effectiveness breakpoints is provided in Appendix C.

Value	Rating
$37.54	Low

Economic Development

The Economic Development criterion is the only part of the analysis that is based on qualitative assessments. The ratings below are based on current and future plans and policies that are or will be implemented in the corridor by the time a New Starts application would be made.

Growth Management	
Transit-Supportive Corridor Polices	
Supportive Zoning Near Transit	
Tools to Implement Transit-Supportive Plans and Policies	
Performance of Transit-Supportive Plans and Policies	
Potential Impact of Transit Project on Regional Development	
Plans and Policies to Maintain or Increase Affordable Housing in Corridor	
Rating:	Medium-Low

Environmental Benefits

The Environmental Benefits criterion is "based upon the dollar value of the anticipated direct and indirect benefits to human health, safety, energy, and the air quality environment scaled by the annualized capital and operating cost of the project. These benefits are computed based on the change in vehicle miles traveled (VMT) resulting from the implementation of the proposed project" (FTA CIG Policy Guidance, 2016). The VMT was derived from the travel forecasting analysis and was inputted into the New Starts template, which then calculates the rating. If the capital costs, operating costs or VMT change, the Environmental Benefits rating may change.

Value	Rating
-0.9%	Medium-Low

Land Use

The Land Use criterion is based on the analysis of four separate sub-criteria (population density, parking spaces per number of Central Business District (CBD) employees, parking cost and affordable housing) within each new station area and one sub-criteria (total employment) along all stations where a rider could take a no-transfer ride from any new station. Per FTA guidance, the population and employment figures are averages of the 2020 counts and 2040 projections. The station area is defined as a 1/2-mile buffer around each station. The parking analysis was performed on the CBD of Downtown Chandler.

	Value	Rating
Population Density	6,386	Medium
Employees	30,334	Low
Parking Spaces per Employee	2.89	Low
Parking Cost	$0.00	Low
LBAR Housing	1.08	Low
Rating	**Medium-Low**	

Mobility Improvements

The Mobility Improvements criterion is based off the annual number of linked trips using the proposed project (transit dependent person trips are given a weight of two). These values are derived from the travel forecasting analysis.

Annual Transit Linked Trips	Rating
791,175	Low

Conclusion
Based on current assumptions, the Arizona Avenue Streetcar project would rate as a Medium-Low in the Project Justification analysis as part of the FTA CIG Program:

Criteria	Rating (Value)
Congestion Relief	Low (2)
Cost Effectiveness	Low (1)
Economic Development	Medium-Low (2)
Environmental Benefits	Medium-Low (2)
Land Use	Medium-Low (2)
Mobility Improvements	Low (1)
Total:	Medium-Low (1.5)

Currently, FTA requires a Medium rating or higher in the Project Justification analysis to be eligible for CIG funding.

The largest components of this analysis are cost and ridership: lowering costs and/or raising ridership will have positive impacts on several criteria, and thus the overall project rating. Appendix C illustrates the breakpoints in cost and ridership that correspond to the rating for the Cost Effectiveness criterion.

There are also several areas that the local jurisdiction can directly impact the project rating:

- Economic Development criterion is directly impacted by plans and policies the city sets for future development.
- Land Use criterion can be improved by limiting the amount of parking in the CBD, raising parking costs and providing more affordable housing.
- Mobility Improvements criterion can be improved by enhancing the local bus network that feeds into the Arizona Avenue Streetcar project, as well as adding more transit supportive development and land uses to further build the transit market along the corridor.

Appendix A

Final Capital Investment Grant Program Interim Policy Guidance

Evaluation Criteria and Rating Process

EVALUATION CRITERIA AND RATING PROCESS

New Starts projects are evaluated and rated according to CIG criteria set forth in law. The project justification criteria outlined in law include: mobility improvements, environmental benefits, congestion relief, economic development effects, land use, and cost-effectiveness. The law also requires FTA to examine the following when evaluating and rating local financial commitment: availability of reasonable contingency amounts, availability of stable and dependable capital and operating funding sources, and availability of local resources to recapitalize, maintain, and operate the overall existing and proposed public transportation system without requiring a reduction in existing services. By law, each criterion is to be rated on a five point scale, from low to high. Summary project justification and local financial commitment ratings are prepared and combined to arrive at an overall project rating.

Guiding Principles

Below are some guiding principles FTA used when developing the evaluation criteria.

Establishing Breakpoints for Ratings

When possible, FTA established the breakpoints for ratings based on available research that recommended the values. When such research was not available for a particular criterion or measure, FTA established an initial set of breakpoints based on the performance measures available from projects previously and currently in the program. FTA will revisit the breakpoints as performance measures are accumulated from additional projects over time. Any changes in the breakpoints will be proposed in future policy guidance for public comment.

Time Horizons for Calculating Measures

FTA believes project evaluation based on existing conditions provides the most easily understood, most reliable, and most readily available information for decision-making. Thus, FTA requires all project sponsors to calculate the measures for the evaluation criteria based on current year inputs of population and employment and the opening year service plan of the proposed project. Use of current year data increases the reliability of the projected future performance of the proposed project by avoiding reliance on future population, employment, and transit service levels that are themselves forecasts. FTA defines “current year” as close to today as the data (including the American Community Survey) will permit.

FTA recognizes these projects are long term investments. Additionally, because some projects are designed to address and accommodate future growth more so than current congestion problems, they may not generate sufficient benefits to rate well based only on current year conditions. Thus, FTA allows project sponsors, at their option, to calculate the evaluation criteria using horizon year based forecasts as well as current year forecasts. FTA allows project sponsors to choose the horizon year they wish to use -- either 10 years in the future (2025) or 20 years in the future (2035).

Given the need to balance the enhanced reliability of short-term forecasts with the need to account for longer term benefits, when a project sponsor chooses to quantify the measures in both the current year and a horizon year, FTA computes each criterion rating as a weighted average that considers both years. FTA gives a weight of 50 percent for the current year information and a weight of 50 percent for the horizon year information.

Basis for Comparison

To simplify and streamline the process project sponsors go through to develop materials for submittal to FTA, where possible, FTA adopted measures that use absolute values rather than incremental values requiring a basis for comparison. However, in some cases, incremental measures remain necessary. When a basis for comparison is required because a measure is based on an incremental value, FTA will use the existing system as a point of comparison when developing current year information. When a project sponsor chooses to submit 10-year

horizon information, the no-build alternative (which includes the existing transportation system as well as those transportation investments committed in the Transportation Improvement Plan (TIP) pursuant to 23 CFR Part 450) will be the point of comparison. When a project sponsor choses to submit 20-year horizon information, the existing transportation network plus all projects identified in the Metropolitan Planning Organization's fiscally constrained long range plan (excluding the proposed build alternative) will serve as the point of comparison.

Use of Standard Factors Rather than Detailed Analysis

One of FTA's goals in the development of the Major Capital Investment Projects Final Rule and this Interim Policy Guidance was to establish measures that support streamlining of the New Starts process while maintaining an appropriate degree of analytic rigor as a basis on which to make CIG program funding decisions. Thus, some of the measures are calculated using simplified factoring approaches in order to eliminate undue burden on project sponsors. FTA based the factors on national data.

Simplified Estimation of Ridership and Vehicle Miles Traveled

FTA has made available to project sponsors a tool called Simplified Trips-on-Projects Software (STOPS) that can be used to estimate trips on the project. FTA believes this tool can significantly streamline the length of time required to generate ridership forecasts and vehicle miles traveled information for use in the evaluation measures. Use of STOPS is optional. Project sponsors may choose instead to continue to use their local travel forecasting model if they wish, with the understanding that FTA review of the forecasts and model will be necessary to ensure compliance with FTA policies and procedures. Project sponsors should contact FTA for assistance in obtaining and using STOPS.

If a sponsor chooses to use STOPS to calculate trips for the mobility, congestion relief, and cost effectiveness measures, the sponsor is expected to also use STOPS for calculating the VMT changes used in the environmental benefits measure. If a sponsor chooses instead to calculate trips for the mobility, congestion relief, and cost effectiveness measures using its local travel model, the sponsor is expected to also use its local travel model to calculate the change in VMT used in the environmental benefits measure. Should a project sponsor choose to use the local travel model, FTA expects to continue to review the validity of the model, as in past practice, to assure the validity of the results.

Project Justification

Land Use

Measures

The land use measure includes an examination of existing corridor and station area development; existing corridor and station area development character; existing station area pedestrian facilities, including access for persons with disabilities; existing corridor and station area parking supply; and the proportion of existing "legally binding affordability restricted" housing within ½ mile of station areas to the proportion of "legally binding affordability restricted" housing in the counties through which the project travels.

A legally binding affordability restriction is a lien, deed of trust or other legal instrument attached to a property and/or housing structure that restricts the cost of housing units to be affordable to households at specified income levels for a defined period of time and requires that households at these income levels occupy these units. This definition, includes, but is not limited to, state or federally supported public housing, and housing owned by organizations dedicated to providing affordable housing. For the land use measure looking at existing affordable housing, FTA is seeking legally binding affordability restricted units to renters with incomes below 60 percent of the area median income and/or owners with incomes below the area median that are within ½ mile of station areas and in the counties through which the project travels.

One reason FTA chose to include affordable housing in the land use criterion was to ensure that neighborhoods surrounding proposed transit stations have the fundamentals in place to ensure that as service is improved over

time there is a mix of housing options for existing and future residents. One measure of the readiness of a community to accept a new transit investment and avoid significant gentrification that can occur over time is the presence of "legally binding affordability restricted" units. These units have protections in place to ensure that they will continue to be available to low and moderate income households as changes in the corridor occur.

In this context FTA believes this to be a first step in developing a worthwhile measure that encourages project sponsors to locate projects where a higher share of "legally binding affordability restricted" housing exists in their area. The metric selected evaluates the proportional share of existing "legally binding affordability restricted" housing in the corridor compared to the share in the surrounding county or counties. FTA believes use of this ratio is appropriate to help normalize the results since we are not comparing projects to one another but rather to the circumstances in each local area where projects are proposed. However, FTA recognizes the use of a ratio for this measure can have some drawbacks, particularly where the surrounding county or counties are quite large in land area and/or have quite large amounts of "legally binding affordability restricted" housing. Therefore, FTA intends to boost the rating for this subfactor one level if the denominator shows the surrounding counties to have greater than a five percent share of "legally binding affordability restricted" housing.

Note that this metric is not intended in any way to serve as a "federally endorsed" definition of acceptable levels of legally binding affordability restricted or other types of affordable housing, and is unique to this CIG project evaluation process. FTA aims to improve and refine the measure as information is gathered from project sponsors on its application and its impacts are examined.

Calculation

FTA bases the rating primarily on quantitative measures, including station area population densities, total employment served by the project, and the proportion of "legally binding affordability restricted" housing within ½ mile of stations areas to the proportion of "legally binding affordability restricted" housing in the counties through which the project travels. Poor pedestrian accessibility may reduce the rating, as it reduces the effective amount of population and employment directly served by the system. Otherwise, the presence of high trip generators, a pedestrian-accessible and friendly station area environment, and limited availability of parking all serve to support the rating.

Project sponsors should obtain population and employment information from census data.

A station area encompasses a ½ mile radius of the station.

To develop information on "legally binding affordability restricted" housing located in the proposed corridor and the counties through which the project travels, project sponsors should consult with area housing agencies. For this purpose, FTA is seeking legally binding affordability restricted units to renters with incomes below 60 percent of the area median income and/or owners with incomes below the area median. Project sponsors should also obtain and submit to FTA signed certifications by the heads of the housing agencies or other entities from where the information was gathered attesting to the accuracy of the numbers provided.

While FTA believes contacting area housing authorities will provide the best and most comprehensive information on "legally binding affordability restricted housing", some statistics on affordable housing can be found in the National Housing Preservation Database (http://www.preservationdatabase.org/). This database includes an address-level inventory of federally assisted rental housing. It does not contain information on affordable units supported only by state and local programs. The amount of "legally binding affordability restricted" units in the corridor and the surrounding counties is then compared to total residential housing units in the corridor and the surrounding counties. Total residential housing units should come from the American Community Survey (ACS) five year forecasts at the County and Census Tract levels.

FTA assigns a value to this measure by comparing (a) the percent of total units in the transit corridor (defined as 1/2 mile around each proposed station) that are legally binding affordability restricted housing to (b) the percent

of total units in the counties in which the stations are located that are legally binding affordability restricted housing. FTA boosts the rating for this subfactor one level if the denominator shows the surrounding counties through which the project travels have greater than a five percent share of "legally binding affordability restricted" housing.

The measurement of housing affordability as part of the project evaluation criteria is something only recently added by FTA in 2013 after completion of an extensive public comment process. Since it is still a fairly new measure, project sponsors may submit additional information to supplement the calculation described above, that FTA may consider, on a case by case basis, in assigning a final rating for this metric.

Breakpoints

The breakpoints for station area population, employment density, and Central Business District parking are:

	Station Area Development		Parking Supply	
Rating	Employment served by system[2]	Avg. Population density (persons/square mile)[3]	CBD typical cost per day[4]	CBD spaces per employee[5]
High	> 220,000	> 15,000	> $16	< 0.2
Medium-High	140,000-219,999	9,600 - 15,000	$12 - $16	0.2 – 0.3
Medium	70,000-139,999	5,760 – 9,599	$8 - $12	0.3 – 0.4
Medium-Low	40,000-69,999	2,561 – 5,759	$4 - $8	0.4 – 0.5
Low	<40,000	< 2,560	< $4	> 0.5

The breakpoints for the proportion of "legally binding affordability restricted" housing in the corridor compared to the proportion of "legally binding affordability restricted" housing in the counties through which the project travels are shown in the table below.

Rating	Proportion of legally binding affordability restricted housing in the project corridor compared to the proportion in the counties through which the project travels
High	≥ 2.50
Medium-High	2.25 – 2.49
Medium	1.50 - 2.24
Medium-Low	1.10 - 1.49
Low	< 1.10

(For example, a low rating indicates the share of affordable housing units within the project corridor is lower than 110 percent of the share within the corresponding counties.)

Cost Effectiveness

Measures

FAST requires that the cost-effectiveness criterion for New Starts projects be based on a cost per trip measure. Therefore, the cost effectiveness measure for New Starts projects is the annual capital and operating and

[2] The employment breakpoints are based on the Institute for Transportation Engineer's document entitled "A Toolbox for Alleviating Traffic Congestion," which suggests minimum non-residential development concentrations of 20 million square feet for frequent local bus service and 35 million square feet for light rail service. At 500 square feet per employee, these figures are equivalent to 40,000 and 70,000 employees, respectively. The total employment served includes employment along the entire line on which a no-transfer ride from the proposed project's stations can be reached.

[3] The average population density breakpoints are based on the Institute for Transportation Engineer's document entitled "A Toolbox for Alleviating Traffic Congestion," which suggests light rail and frequent bus service requires a minimum of 9 to 15 dwelling units per acre. This data has been used to inform the medium breakpoint shown.

[4] CBD core (not fringe parking)

[5] Average across CBD

maintenance (O&M) cost per trip on the project. The number of trips on the project is not an incremental measure but simply total estimated trips on the project.

The cost part of the New Starts cost-effectiveness calculation is an incremental measure requiring a point of comparison. For current year calculations, the annualized capital and O&M cost for the proposed project is compared to the existing transit system. If a project sponsor also chooses to calculate the measure based on 10-year horizon forecasts, the annualized capital and O&M cost of the proposed project is compared to the no-build transit system (which includes the existing transportation system as well as those transportation investments committed in the Transportation Improvement Plan (TIP) pursuant to 23 CFR Part 450.) If a project sponsor chooses to calculate the measure based on 20-year horizon forecasts, the annual capital and O&M cost of the proposed project is compared to the annual capital and O&M cost of the projects identified in the Metropolitan Planning Organization's fiscally constrained long range plan (excluding the proposed build alternative.)

Calculation

For New Starts projects, the cost-effectiveness measure is computed as the annualized capital cost plus annual O&M cost of the project divided by the annual number of forecasted trips on the project. For calculation of this measure, the capital costs of scope elements considered "enrichments" are either reduced by an FTA defined percentage or eliminated entirely from the annualized capital cost calculation. "Enrichments" are improvements to the transit project that are desired by the project sponsor but are non-integral to the planned functioning of the project, and whose benefits are not captured in whole by the criteria. "Enrichments" are allowable expenses for reimbursement under a future New Starts construction grant. FAST includes a special rule related to "enrichments" that states FTA "shall not reduce or eliminate the capital costs of art and non-functional landscaping elements from the annualized capital cost calculation."

"Enrichments" are based on costs associated with certain Activity Line Items (ALIs) in the FTA Standard Cost Category worksheets. FTA, through its Project Management Oversight Contractors verifies "enrichments" claimed by project sponsors. FTA allows only the following "enrichments" to be excluded from the New Starts cost effectiveness calculation. This is a finite list that may be revisited through future proposed policy guidance:

- ALIs 20.01 through 20.04 and 30.01 through 30.04 Sustainable Building Design Features -- Up to 2.5 percent of the cost of facilities designed to achieve U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) or a comparable third-party certification (i.e., ENERGY STAR, BREEAM) may be removed from the cost effectiveness calculation. Projects that include buildings optimized to use less energy, consume less water and reduce greenhouse gas emissions may also claim the credit, even if the improvements do not lead directly to an official certification. Examples of eligible improvements include landscape and exterior site designs that improve water efficiency and management, and renewable and alternative energy technologies that support greenhouse gas emissions reduction. The 2.5 percent factor is based on studies completed in 2003 and 2004 by the General Services Administration (GSA) and State of California that estimated the average incremental construction cost associated with achieving LEED certification. FTA does not propose to credit the professional services cost of sustainable building design because the studies indicated that this is a very small fraction of a capital project's cost (0.1 to 0.3 percent).
- ALI 20.05 Joint Development – This ALI identifies items eligible for Federal participation per Section 5302(3)(A)(G) of Chapter 49 USC and FTA's Joint Development Circular found on the FTA website. All costs on this line item may be removed from the cost effectiveness calculation. Per FTA's Joint Development Circular, "Joint development is any income-producing activity with a transit nexus related to a real estate asset in which FTA has an interest. Joint development projects are commercial, residential, industrial, or mixed-use developments that are induced by or enhance the effectiveness of transit projects. . ." FTA hopes that the credit will encourage sponsors to undertake joint development efforts as part of New Starts projects; few to date have included joint development-related costs.
- ALI 40.06 Pedestrian/Bike Access and Accommodation and Functional Landscaping – All costs of this line item may be removed from the cost effectiveness calculation. All proposed bicycle and pedestrian improvements must be consistent with FTA's Bicycle and Pedestrian policy.

- ALI 70.04 Alternative Energy Bus Vehicles. Fifty percent of the purchase cost of "green" buses may be removed from the cost effectiveness calculation. Any type of clean fuel bus is eligible for the credit, including buses with compressed natural gas (CNG), hybrid, electric, or fuel cell propulsion. This allowance is based on a 2007 TCRP report, *Assessing and Comparing Environmental Performance of Major Transit Investment*, that found the average cost difference between a conventional diesel bus and a CNG or hybrid bus is approximately 50 percent.

If the project sponsor chooses to develop ridership forecasts for a horizon year in addition to the current year, the overall measure of cost effectiveness is a weighted average that considers both calculations. FTA weights each 50 percent.

Sources of Information

Annualized capital costs for New Starts projects are taken directly from the FTA Standard Cost Categories (SCC) workbook, specifically the "Build Annualized" worksheet.

- Capital costs are expressed in the current year's dollar value.
- The annualization worksheet of the SCC workbook converts the capital cost of individual scope items into their equivalent annual capital cost based on their economic lifetimes and a 2.0 percent discount rate. Enrichments are deducted from the annualized cost calculation automatically in the SCC "Build Annualized" sheet once the project sponsor indicates through simple yes or no answers the enrichments that are applicable and the amount of eligible base cost for each.

Annual operating and maintenance (O&M) costs for New Starts projects are taken directly from the O&M cost model(s) of current and proposed transit facilities and services.

- O&M costs from the model(s) for the current system in the current year are required to match the current O&M budget and reflect any changes anticipated in the existing transit system to integrate the project into the system, as documented in the transit service plan for the project.
- If the project sponsor chooses to calculate the measure in a horizon year as well, the O&M cost estimates are required to reflect the transit service plans for both the point of comparison and the project, including changes made to the point of comparison service plan needed to integrate the project into the system. Horizon-year O&M costs are expressed in the current year's dollars.

For the cost-effectiveness criterion, trips on the project are the number of linked trips using the project, with no extra weight given to trips by transit dependent persons. Trips may be calculated using either STOPS or the local travel model at the project sponsor's option.

Breakpoints

FTA examined data from projects currently in the New Starts process and developed the breakpoints below based on that information. FTA further compared the proposed New Starts breakpoints below to data contained on average annual capital and operating cost per trip of various modes in the National Transit Database and determined them to be reasonable and in line with expectations.

Cost Effectiveness Breakpoints

Rating	Range
High	< $4.00
Medium-High	Between $4.00 and $5.99
Medium	Between $6.00 and $9.99
Medium-Low	Between $10.00 and $14.99
Low	> $15.00

Mobility Improvements

Measures

FTA evaluates mobility improvements for New Starts projects as the total number of linked trips using the proposed project, with a weight of two given to trips that would be made on the project by transit dependent persons. Linked trips using the proposed project include all trips made on the project whether or not the rider boards or alights on the project or elsewhere in the transit system. If a project sponsor chooses to estimate trips using STOPS, then trips made by transit dependent persons are trips made by persons in households that do not own a car. If a project sponsor chooses to estimate trips using their local travel forecasting model, trips made by transit dependent persons are defined in local travel models generally in one of two ways: as trips made by persons in households having no cars or as trips made by persons living in households in the lowest income bracket as defined locally.

FTA assigned a weight of two to trips by transit dependent persons based on information from the 2009 National Household Transportation Survey, which indicates that 8.7 percent of U.S. Households own zero vehicles but make only 4.3 percent of the nation's person trips. If zero-car households had equal opportunity to make trips, i.e., if their mobility was not limited by the existing public transportation system, one could infer that these zero-car households would make more than 4.3 percent of the nation's person trips. To ensure that federal investments in major capital investment transit projects address the travel demand of zero car households equitably, FTA uses a factor of two for the number of trips made by transit dependent persons (8.7 percent ÷ 4.3 percent = 2.02).

If a project sponsor chooses to develop project trip forecasts based on inputs for a horizon year in addition to forecasts based on current year inputs, each is given 50 percent weight when establishing the overall mobility improvements rating. The trips measure is an absolute value rather than an incremental value, so a basis for comparison is not required.

Calculation

The mobility improvements measure is computed by adding together the estimated number of linked transit trips on the project taken by non-transit dependent persons and the number of linked transit trips taken by transit dependent persons multiplied by a factor of two, thereby giving extra weight to these trips.

Sources of Information

Number of Transit Trips Using the Project:

- The number of linked transit trips estimated on the project using current year inputs is generated either by STOPS (which uses census data and ridership experience on existing fixed guideway systems to estimate trips) or the local travel model at the project sponsor's option.
- If the project sponsor wishes to calculate a horizon year forecast of linked transit trips for consideration in the rating, the number of linked transit trips in the horizon year is based upon either STOPS or the local travel model at the project sponsor's option.
- If the project sponsor chooses to calculate a horizon year forecast in addition to a current year forecast, the mobility improvements rating is based on a weighted average that gives 50 percent weight to each.

Number of Trips by Transit Dependents Using the Project:

- The number of trips on the project made by transit dependent persons using current year inputs is generated either by STOPS or the local travel model at the project sponsor's option. Local travel models stratify trips taken in one of two ways – based on household income level or household auto ownership. STOPS uses auto ownership to stratify trips. Thus, trips made by transit dependent persons estimated by STOPS will be those made by households with no cars.

Breakpoints

Rating	Mobility Improvements: Estimated Annual Trips (Trips by Non-Transit Dependent Persons plus Trips by Transit Dependent Persons multiplied by 2)
High	≥ 30 Million
Medium-High	15 Million – 29.9 Million
Medium	5 Million – 14.9 Million
Medium-Low	2.5 Million – 4.9 Million
Low	< 2.5 Million

Congestion Relief

Measure

FTA evaluates congestion relief based on the number of new weekday linked transit trips resulting from implementation of the proposed project. FTA recognizes that this is an indirect measure of roadway congestion relief resulting from implementation of a transit project, but it serves as an indicator of potential cars taken off the road. Additionally, it keeps FTA from double counting the total transit trips evaluated under the mobility criterion or the vehicle miles traveled evaluated under the environmental benefits criterion. FTA believes its virtues are that it is simple to calculate, simple to explain to various decision-makers, and easily understood. Additionally, it continues to allow project sponsors the option of using FTA's simplified ridership forecasting tool entitled STOPS, which can save considerable time and expense.

Because the measure of new weekday linked transit trips is an incremental value, a basis for comparison is required. For forecasts prepared using current year inputs of population and employment, the proposed project is compared to the existing transit system. If a project sponsor also chooses to prepare 10-year horizon forecasts, the proposed project is compared to the no-build transit system (which includes the existing transportation system as well as those transportation investments committed in the Transportation Improvement Plan (TIP) pursuant to 23 CFR Part 450.) If a project sponsor chooses instead to prepare 20-year horizon forecasts, the proposed project is compared to a no-build transit system that includes the projects identified in the Metropolitan Planning Organization's fiscally constrained long range plan (excluding the proposed build alternative.)

If a project sponsor chooses to develop new weekday linked transit trips based on a horizon year in addition to current year, each is given 50 percent weight when establishing the overall congestion relief rating.

Calculation

New weekday linked transit trips are calculated by comparing total weekday linked transit trips for the no-build alternative with total weekday linked transit trips once the proposed project is implemented.

Breakpoints

Congestion Relief Breakpoints

Rating	New Weekday Linked Transit Trips
High	18,000 and above
Medium-High	10,000 to 17,999
Medium	2,500 to 9,999
Medium-Low	500 to 2,499
Low	0 to 499

Environmental Benefits

Measures

FTA evaluates and rates the environmental benefits criterion for New Starts projects based upon the dollar value of the anticipated direct and indirect benefits to human health, safety, energy, and the air quality environment scaled by the annualized capital and operating cost of the project. These benefits are computed based on the change in vehicle miles traveled (VMT) resulting from implementation of the proposed project. Because change in VMT is an incremental measure, a point of comparison is necessary to calculate environmental benefits. To calculate the measures for the current year, the point of comparison is the existing transit system. If the project sponsor also opts to calculate the measures based on 10-year horizon forecasts, the point of comparison is the no-build transit system (which includes the existing transportation system as well as those transportation investments committed in the Transportation Improvement Plan (TIP) pursuant to 23 CFR Part 450). If the project sponsor chooses to calculate the measures based on 20-year horizon forecasts, the point of comparison is the projects identified in the Metropolitan Planning Organization's fiscally constrained long range plan (excluding the proposed build alternative.) The estimated environmental benefits are monetized and compared to the same annualized capital and operating cost of the proposed New Starts project as used in the cost effectiveness calculation.

The standard factors that FTA uses for calculating environmental benefits and data sources are found in the tables below. (See the Appendix for the sources that FTA used to develop the factors.) FTA used data from the Transit Cooperative Research Program study on environmental benefits, "Assessing and Comparing Environmental Performance of Major Transit Investments", and other Federal government data sources to the greatest extent possible.

Calculation

- Environmental benefits include the following subfactors: change in air quality criteria pollutants, change in energy use, change in greenhouse gas emissions, and change in safety. Values for change in energy use and greenhouse gas emissions have been established so as to not double count. (Thus, the valuation of energy use reductions is based only on the economic cost of petroleum dependence identified in Paul N. Leiby, "Estimating the U.S. Oil Security Premium for the 2017-2025 Light -Duty Vehicle GHG/Fuel Economy Rule", Oak Ridge National Laboratory (ORNL), July 15, 2012.) The subfactors are calculated from forecasts of changes in automobile and transit vehicle miles traveled (VMT). All measures are converted from VMT into their native units (e.g., tons of emissions or total accidents) using national-level standard conversion factors. The native units are monetized based on standard dollar values. For air quality subfactors, weights are applied to reflect FTA judgment that higher priority be given to projects achieving reductions in nonattainment and maintenance areas. The monetized and weighted values of the various environmental benefits are summed and compared to the same annualized capital and operating cost of the proposed project as is used in the cost effectiveness calculation for New Starts projects.
- Forecasts of changes in VMT come from either the local travel model or the simplified national model developed by FTA (STOPS). The change in auto VMT is calculated based upon the change in the number of auto trips between the no-build and build alternatives, multiplied by the difference in auto travel distance between the no-build and build alternatives.
- If the project sponsor chooses to calculate a horizon year forecast in addition to a current year forecast, the environmental benefits rating is based on a weighted average that gives 50 percent weight to each.

Sources of Information

The New Starts templates include all of the conversion factors necessary to calculate changes in air quality, energy use, greenhouse gas emissions, and safety resulting from the changes in highway and transit VMT. The project sponsor is required only to input a few data points and the environmental benefits are automatically calculated in the templates. The factors used in the templates are shown below.

Change in Total Air Quality Criteria Pollutants – Carbon Monoxide (CO), Mono-Nitrogen Oxides (NOx), Particulate Matter (PM2.5), and Volatile Organic Compounds (VOC). For the change in air quality measure, FTA uses emission rates per VMT for automobiles (cars and light trucks) and transit vehicles including buses (diesel, hybrid-electric, and CNG), diesel commuter rail and diesel multiple unit vehicles (DMU), light rail transit vehicles, streetcars, electric commuter rail and electric multiple unit (EMU) vehicles, heavy rail vehicles, and electric buses. Because of the potential for double counting the value in reductions of PM2.5 and PM10, FTA includes only PM2.5 in the air quality measure.

Change in Air Quality Emissions Factors

	For Current Year Estimates				**For 10-year Horizon Estimates**				**For 20-year Horizon Estimates**			
	(grams/VMT)											
Mode	CO	NO_x	VOC	$PM_{2.5}$	CO	NO_x	VOC	$PM_{2.5}$	CO	NO_x	VOC	$PM_{2.5}$
Automobile	16.77	0.91	0.60	0.010	11.46	0.28	0.27	0.010	10.26	0.20	0.21	0.010
Bus - Diesel	5.83	8.67	0.73	0.48	3.26	2.08	0.24	0.09	2.89	1.14	0.16	0.03
Bus - Hybrid	5.83	8.67	0.73	0.480	3.26	2.08	0.24	0.09	2.89	1.14	0.16	0.03
Bus - CNG	39.62	3.84	1.46	0.010	20.30	3.41	1.15	0.010	17.16	3.35	1.11	0.010
Bus - Electric	6.45	5.83	0.12	0.378	5.39	4.39	0.10	0.313	5.04	3.98	0.10	0.299
Heavy Rail	7.06	6.38	0.13	0.413	6.85	5.58	0.13	0.398	6.73	5.32	0.13	0.399
Light Rail and Streetcar	10.51	9.50	0.19	0.615	10.20	8.31	0.19	0.593	10.01	7.91	0.20	0.593
Commuter Rail - Diesel locomotive (new) and DMU	16.80	13.20	0.55	0.190	16.80	13.20	0.55	0.190	16.80	13.20	0.55	0.190
Commuter Rail - Diesel locomotive (used) and DMU	16.80	93.00	4.36	4.600	16.80	43.00	1.26	1.330	16.80	20.90	0.44	0.470
Commuter Rail – Electric and EMU	12.81	11.57	0.24	0.750	12.43	10.12	0.23	0.722	12.19	9.64	0.24	0.723

Change in Air Quality Monetization Factors

	Year	CO	NOx – Mobile	NOx – EGU	VOC	PM2.5 - Mobile	PM2.5 - EGU
				$ / KG			
Attainment	Current Year	$0.08	$12.96	$18.36	$3.02	$680.40	$561.60
	10-Year Horizon	$0.08	$15.66	$22.95	$3.75	$861.30	$688.50
	20-Year Horizon	$0.08	$16.20	$23.76	$3.89	$896.40	$712.80
Nonattainment 1.5 times value of attainment	Current Year	$0.12	$19.44	$27.54	$4.53	$1,020.60	$842.40
	10-Year Horizon	$0.12	$23.49	$34.43	$5.63	$1,291.95	$1,032.75
	20-Year Horizon	$0.12	$24.30	$35.64	$5.84	$1,344.60	$1,069.20
Maintenance area 1.25 times value of attainment	Current Year	$0.10	$16.20	$22.95	$3.78	$850.50	$702.00
	10-Year Horizon	$0.10	$19.58	$28.69	$4.69	$1,076.63	$860.63
	20-Year Horizon	$0.10	$20.25	$29.70	$4.86	$1,120.50	$891.00

Change in Energy Use

A significant part of the benefits that come from reducing energy use is already accounted for by the resulting reduction in pollutant and greenhouse gas emissions. In this measure, FTA is attempting to capture the benefit coming from reduced reliance on foreign fuels. Thus, the change in energy use is only computed for modes that use petroleum fuel. The measure estimates the change in energy consumption rates for transit and automobile modes based on the forecasted change in VMT.

Change in Energy Use Factors

	Current Year	10-year Horizon	20-year Horizon
MODE	Btu/VMT		
Automobile	7,559	6,167	5,633
Bus – Diesel	41,436	35,635	33,978
Bus – Hybrid	33,149	28,508	27,182
Commuter Rail - Diesel (new) and DMU	96,138	96,138	96,138
Commuter Rail - Diesel (used)	96,138	96,138	96,138

FTA then monetizes the change in energy use based on the economic cost of dependence on imported petroleum for fuels. FTA uses a value of $0.20 per gallon of petroleum fuel (Leiby/ORNL 2012). To convert from Btu to gallons of petroleum fuel, FTA uses conversion factors (from the GREET model) of 116,090 Btu per gallon of gasoline and 128,450 Btu per gallon of diesel fuel. Therefore, the monetization factors are $1.72 per million Btu for gasoline and $1.56 per million Btu for diesel fuel. Gasoline is assumed to be the sole fuel for changes in automobile VMT for simplicity in the computation.

Change in Greenhouse Gas Emissions

The calculation of the proposed unit rates for GHG emissions includes the application of emissions factors by fuel type.

Change in Greenhouse Gas (CO2e) Emissions Factors

	Current Year	10-year Horizon	20-year Horizon
Mode	(g CO2e/VMT)		
Automobile	532	434	397
Bus – Diesel	3319	2854	2721
Bus – Hybrid	2655	2283	2177
Bus – CNG	2935	2524	2406
Bus - Electric	2934	2441	2303
Heavy Rail	3211	3106	3073
Light Rail and Streetcar	4779	4623	4574
Commuter Rail - Diesel (new) and DMU	7970	7970	7970
Commuter Rail - Diesel (used)	7970	7970	7970
Commuter Rail - Electric and EMU	5821	5632	5572

NOTE: The factor is CO2 equivalents (CO2e). This means that other greenhouse gas emissions (other than CO2) that have different rates of affecting global warming are converted into CO2 terms because that is the most prevalent greenhouse gas emission.

To capture the monetary value of change in GHG emissions, FTA uses the $38 midrange estimate of the social cost of carbon obtained from the Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866 (May 2013), which is a document developed and updated periodically by an Interagency Working Group comprised of a number of Federal agencies. The $38 value is the 2015 midrange

estimate based on a 3 percent discount rate. FTA will update the value based on the latest information available from the Interagency Working Group or other Federal government sources, as appropriate.

Change in Safety
To measure change in safety, FTA uses the change in VMT to calculate changes in disabling injuries and fatalities for automobiles and transit. FTA does not attempt to capture the changes in pedestrian or bicyclist accidents or injuries resulting from changes in VMT because of the difficulty in accounting for such changes using readily available national data.

Change in Safety Factor

Mode	Current Year		10-year Horizon		20-year Horizon	
	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries
	(per million VMT)					
Automobile	0.013	0.195	0.013	0.195	0.013	0.195
Bus – Diesel	0.004	1.824	0.004	1.824	0.004	1.824
Bus – Hybrid	0.004	1.824	0.004	1.824	0.004	1.824
Bus – CNG	0.004	1.824	0.004	1.824	0.004	1.824
Bus - Electric	0.004	1.458	0.004	1.458	0.004	1.458
Heavy Rail	0.007	0.155	0.007	0.155	0.007	0.155
Light Rail and Streetcar	0.009	1.696	0.009	1.696	0.009	1.696
Commuter Rail - Diesel (new) and DMU	0.012	1.746	0.012	1.746	0.012	1.746
Commuter Rail - Diesel (used)	0.012	1.746	0.012	1.746	0.012	1.746
Commuter Rail - Electric and EMU	0.012	1.746	0.012	1.746	0.012	1.746

To monetize the estimated changes in safety, FTA uses U.S. DOT guidance on the value of a statistical life and injuries. According to the most recent guidance, published in 2014, the current U.S. DOT value of a statistical life is $9.2 million. The value FTA uses for a disabling injury for both transit and automobiles is $490,000, which is 5.39 percent of the U.S. DOT value of a statistical life, based on the KABCO scale in the 2009 Highway Safety Manual published by the American Association of State Highway and Transportation Officials in coordination with the Federal Highway Administration. FTA plans to update these figures whenever U.S. DOT publishes revised values.

Breakpoints

The environmental benefits measure for New Starts projects is the sum of the monetized value of the benefits resulting from the changes in air quality and GHG emissions, energy use, and safety divided by the same annualized capital and operating cost of the project as used in the cost effectiveness measure. FTA multiplies the resulting ratio by 100 and expresses the environmental benefit measure as a percentage.

Rating	Range
High	> 10%
Medium-High	5 to 10%
Medium	0 to 5%
Low-Medium	0 to -10%
Low	< -10%

Economic Development

Measures

The measure of economic development effects is the extent to which a proposed project is likely to induce additional, transit-supportive development in the future based on a qualitative examination of the existing local plans and policies to support economic development proximate to the project.

Calculation

- FTA evaluates transit supportive plans and policies, the demonstrated performance of those plans and policies, and the policies and tools in place to preserve or increase the amount of affordable housing in the project corridor. FTA also reports the project sponsor's estimate of the number of U.S. jobs related to design, construction, operation and maintenance of the project although this is not used in developing the rating.
- At the project sponsor's option, an additional quantitative analysis (scenario based estimate) may be undertaken that considers:
    - The extent to which the proposed project would produce changes in development patterns around the transit investment and the resulting magnitude of changes in population and employment, considering:
        - the economic conditions in the project corridor;
        - the mechanisms by which the project would improve those conditions;
        - the availability of land in station areas for development and redevelopment;
        - an evaluation of policies that enable or inhibit housing in transit-supportive development; and
        - a pro forma assessment of the feasibility of specific development scenarios.
    - The estimated change in VMT attributable to the estimated changes in development patterns.
    - The estimated environmental benefits that would come from the VMT change attributable to the estimated change in development patterns. Note that these benefits are counted in the economic development criterion and not added to the benefits assessed in the environmental benefits criterion. These benefits are above and beyond the benefits that come from changes in mode choice that are addressed in the environmental benefits criterion.

The environmental benefits derived from the optional quantitative economic development scenario analysis are then monetized and compared to the same annualized capital and operating cost of the proposed project as used in the cost-effectiveness calculation. FTA multiplies the resulting ratio by 100 and expresses the environmental benefits derived from the optional quantitative economic development scenario as a percentage.

Sources of information

- Transit Supportive Plans and Policies
    - Growth Management;
    - Transit Supportive Corridor Policies;
    - Supportive Zoning Regulations Near Transit Stations; and
    - Tools to Implement Land Use Policies.
- Performance and Impacts of Policies:
    - Performance of Land Use Policies; and
    - Potential Impact of Transit Project on Regional Land Use.
- Tools to maintain or increase the share of affordable housing in the project corridor:
    - Evaluation of Corridor-Specific Affordable Housing Needs and Supply including an examination of local plans or policies that enable or inhibit housing development in the area
    - Plans and Policies to Preserve and Increase Affordable Housing such as:
        - Inclusionary zoning and/or density bonuses for affordable housing
        - Employer assisted housing policies
        - Voluntary or mandatory inclusionary housing policies

        - Rent controls or condominium conversion controls
        - Zoning to promote housing diversity
        - Affordability covenants
    - Adopted Financing Tools and Strategies to Preserve and Increase Affordable Housing such as:
        - Target property acquisition, rehabilitation, and development funding for low-income housing within the corridor, including:
            - Low Income Housing Tax Credits
            - Ongoing affordable housing operating subsidies
            - Weatherization and utilities support program
            - Local tax abatements for low-income or senior housing
            - Local of State programs that provide mortgage or other home ownership assistance for lower income and senior households
        - Established land banking programs or transfer tax programs
        - Local or regional affordable housing trust funds
        - Targeted tax increment financing or other value-capture strategies for low-income housing
    - Developer Activity to Preserve and Increase Affordable Housing

The optional scenario analysis could include, but is not required to include, information such as change in regional work force access to transit:

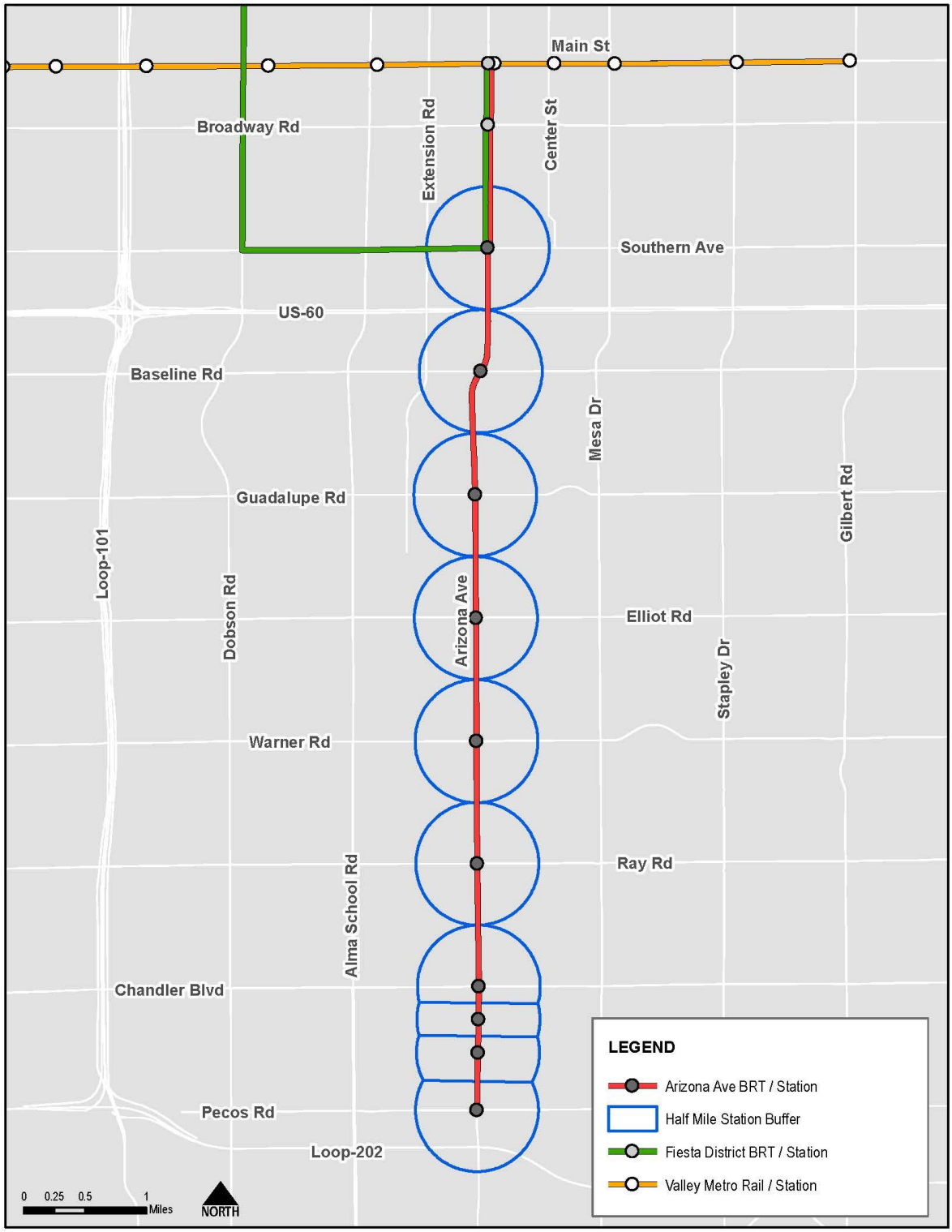
- U.S. Census data analyzed with a Geographic Information System to estimate the work-force population within a 40 minute transit commute of the proposed station locations.

Breakpoints

Below is a brief, high level summary of the breakpoints that will be used in evaluating the plans and policies in place. For more detailed information that further clarifies exactly how FTA establishes the ratings, please see our "Guidelines for Land Use and Economic Development Effects for New and Small Starts Projects" on the FTA website.

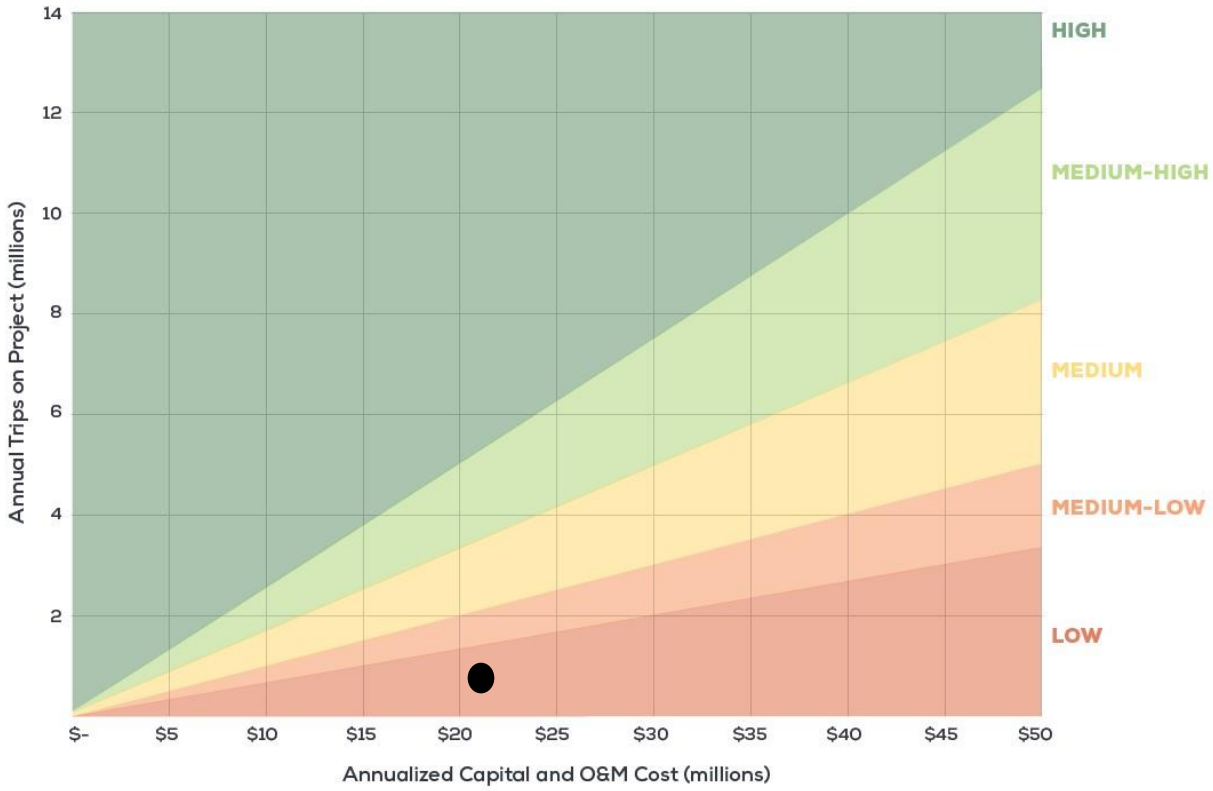
Appendix B

Arizona Ave Alternative Map



Appendix C

Cost Effectiveness Rating Breakpoints Graph



● *indicates where the AAAA project currently rates in Cost Effectiveness*

Memo

To: Arizona Avenue AA Project File

From: Joshua Matthews

Date: January 12, 2021

Re: Task 8.0 New Starts Performance Evaluation – Arizona Ave Rail

The memorandum documents the results of the analysis performed for Task 8.0 New Starts Performance Evaluation as part of the Arizona Avenue Alternatives Analysis (AAAA). The Federal Transit Administration (FTA) offers federal funding opportunities for transit projects through the Capital Investment Grant (CIG) program, which was most recently authorized in the Fixing America's Surface Transportation (FAST) Act in 2015. To be eligible for federal funding through the CIG program, a project sponsor must follow the process laid out in the *Final Interim Policy Guidance* (link) issued in June 2016. One key component of this process is for the project to be evaluated based on two criteria: Project Justification and Local Financial Commitment. The Project Justification criterion, which was analyzed as part of Task 8.0, uses a series of "measures" to determine the likelihood the project will be successful. The Local Financial Commitment criterion determines whether the project has a reasonable financial plan and funding for capital and operating costs.

For the purposes of this Task, the Project Justification analysis was performed to determine if the preferred alternative for the AAAA would rate favorably in the FTA's existing CIG program. These results will also provide key policy areas where the City of Chandler and Valley Metro can work together to ensure the project's competitiveness for future federal funding.

Assumptions

For the purposes of this analysis, the following tools, datasets and assumptions were utilized:

- The project corridor was assumed for Arizona Ave, running from Pecos Rd to Main St in Mesa. The transit mode is assumed to be hybrid rail, with the portion north of downtown Chandler in a dedicated guideway operating with a streetcar vehicle. A portion of the corridor (from Main St to Southern Ave) is assumed to have been built as streetcar as part of a future Fiesta District project.
- Stations were assumed at each arterial, as well as two additional mid-block stations in downtown Chandler (Boston St and Frye Rd). Appendix B provides an overview map showing the assumed corridor.
- The travel forecasting analysis was conducted with the Simplified Trips on Project (STOPS) model to estimate transit trips on the project. It was run using Maricopa Association of Governments (MAG) Transportation Area Zones (TAZ) for current and

future (horizon year 2040) socioeconomic data (population, employment and dwelling units).

- Capital costs were assumed for the portion of the corridor south of Southern Ave (including a station at Southern Ave). How the funding is allocated and who pays for each portion is not applicable to this analysis.
- Operating costs were assumed for the entire portion of the corridor (from Pecos Rd to Main St). Because the project is interlining on an existing corridor and thus reaping the benefits through increased ridership, the project must carry its entire operating cost in the assessment. How the funding is allocated and who pays for each portion is not applicable to this analysis.

Project Justification Results

The guidance and breakpoints FTA uses to determine the ratings below are provided in Appendix A.

Congestion Relief

The Congestion Relief criterion is based on the number of new weekday linked transit trips as determined by the travel forecasting analysis.

New Weekday Linked Transit Trips	Rating
523	Medium-Low

Cost Effectiveness

The Cost Effectiveness criterion is based on the annual capital and operating cost per trip on the project. These figures are determined through the travel forecasting analysis and a project cost estimate. The project's annualized capital cost is assumed to be $27 million for 7 miles of new construction. The project's annual operating cost is an estimated $16,698,599 for 8.5 miles of new operation. A graphic showing the cost effectiveness breakpoints is provided in Appendix C.

Value	Rating
$63.65	Low

Economic Development

The Economic Development criterion is the only part of the analysis that is based on qualitative assessments. The ratings below are based on current and future plans and policies that are or will be implemented in the corridor by the time a New Starts application would be made.

Growth Management	
Transit-Supportive Corridor Polices	
Supportive Zoning Near Transit	
Tools to Implement Transit-Supportive Plans and Policies	
Performance of Transit-Supportive Plans and Policies	
Potential Impact of Transit Project on Regional Development	
Plans and Policies to Maintain or Increase Affordable Housing in Corridor	
Rating:	Medium-Low

Environmental Benefits

The Environmental Benefits criterion is "based upon the dollar value of the anticipated direct and indirect benefits to human health, safety, energy, and the air quality environment scaled by the annualized capital and operating cost of the project. These benefits are computed based on the change in vehicle miles traveled (VMT) resulting from the implementation of the proposed project" (FTA CIG Policy Guidance, 2016). The VMT was derived from the travel forecasting analysis and was inputted into the New Starts template, which then calculates the rating. If the capital costs, operating costs or VMT change, the Environmental Benefits rating may change.

Value	Rating
-1.0%	Medium-Low

Land Use

The Land Use criterion is based on the analysis of four separate sub-criteria (population density, parking spaces per number of Central Business District (CBD) employees, parking cost and affordable housing) within each new station area and one sub-criteria (total employment) along all stations where a rider could take a no-transfer ride from any new station. Per FTA guidance, the population and employment figures are averages of the 2020 counts and 2040 projections. The station area is defined as a 1/2-mile buffer around each station. The parking analysis was performed on the CBD of Downtown Chandler.

	Value	Rating
Population Density	6,386	Medium
Employees	30,334	Low
Parking Spaces per Employee	2.89	Low
Parking Cost	$0.00	Low
LBAR Housing	1.08	Low
Rating	**Medium-Low**	

Mobility Improvements

The Mobility Improvements criterion is based off the annual number of linked trips using the proposed project (transit dependent person trips are given a weight of two). These values are derived from the travel forecasting analysis.

Annual Transit Linked Trips	Rating
957,495	Low

Conclusion
Based on current assumptions, the Arizona Avenue Streetcar project would rate as a Medium-Low in the Project Justification analysis as part of the FTA CIG Program:

Criteria	Rating (Value)
Congestion Relief	Medium-Low (2)
Cost Effectiveness	Low (1)
Economic Development	Medium-Low (2)
Environmental Benefits	Medium-Low (2)
Land Use	Medium-Low (2)
Mobility Improvements	Low (1)
Total:	Medium-Low (1.7)

Currently, FTA requires a Medium rating or higher in the Project Justification analysis to be eligible for CIG funding.

The largest components of this analysis are cost and ridership: lowering costs and/or raising ridership will have positive impacts on several criteria, and thus the overall project rating. Appendix C illustrates the breakpoints in cost and ridership that correspond to the rating for the Cost Effectiveness criterion.

There are also several areas that the local jurisdiction can directly impact the project rating:

- Economic Development criterion is directly impacted by plans and policies the city sets for future development.
- Land Use criterion can be improved by limiting the amount of parking in the CBD, raising parking costs and providing more affordable housing.
- Mobility Improvements criterion can be improved by enhancing the local bus network that feeds into the Arizona Avenue Streetcar project, as well as adding more transit supportive development and land uses to further build the transit market along the corridor.

Appendix A

Final Capital Investment Grant Program Interim Policy Guidance

Evaluation Criteria and Rating Process

EVALUATION CRITERIA AND RATING PROCESS

New Starts projects are evaluated and rated according to CIG criteria set forth in law. The project justification criteria outlined in law include: mobility improvements, environmental benefits, congestion relief, economic development effects, land use, and cost-effectiveness. The law also requires FTA to examine the following when evaluating and rating local financial commitment: availability of reasonable contingency amounts, availability of stable and dependable capital and operating funding sources, and availability of local resources to recapitalize, maintain, and operate the overall existing and proposed public transportation system without requiring a reduction in existing services. By law, each criterion is to be rated on a five point scale, from low to high. Summary project justification and local financial commitment ratings are prepared and combined to arrive at an overall project rating.

Guiding Principles

Below are some guiding principles FTA used when developing the evaluation criteria.

Establishing Breakpoints for Ratings

When possible, FTA established the breakpoints for ratings based on available research that recommended the values. When such research was not available for a particular criterion or measure, FTA established an initial set of breakpoints based on the performance measures available from projects previously and currently in the program. FTA will revisit the breakpoints as performance measures are accumulated from additional projects over time. Any changes in the breakpoints will be proposed in future policy guidance for public comment.

Time Horizons for Calculating Measures

FTA believes project evaluation based on existing conditions provides the most easily understood, most reliable, and most readily available information for decision-making. Thus, FTA requires all project sponsors to calculate the measures for the evaluation criteria based on current year inputs of population and employment and the opening year service plan of the proposed project. Use of current year data increases the reliability of the projected future performance of the proposed project by avoiding reliance on future population, employment, and transit service levels that are themselves forecasts. FTA defines “current year” as close to today as the data (including the American Community Survey) will permit.

FTA recognizes these projects are long term investments. Additionally, because some projects are designed to address and accommodate future growth more so than current congestion problems, they may not generate sufficient benefits to rate well based only on current year conditions. Thus, FTA allows project sponsors, at their option, to calculate the evaluation criteria using horizon year based forecasts as well as current year forecasts. FTA allows project sponsors to choose the horizon year they wish to use -- either 10 years in the future (2025) or 20 years in the future (2035).

Given the need to balance the enhanced reliability of short-term forecasts with the need to account for longer term benefits, when a project sponsor chooses to quantify the measures in both the current year and a horizon year, FTA computes each criterion rating as a weighted average that considers both years. FTA gives a weight of 50 percent for the current year information and a weight of 50 percent for the horizon year information.

Basis for Comparison

To simplify and streamline the process project sponsors go through to develop materials for submittal to FTA, where possible, FTA adopted measures that use absolute values rather than incremental values requiring a basis for comparison. However, in some cases, incremental measures remain necessary. When a basis for comparison is required because a measure is based on an incremental value, FTA will use the existing system as a point of comparison when developing current year information. When a project sponsor chooses to submit 10-year

horizon information, the no-build alternative (which includes the existing transportation system as well as those transportation investments committed in the Transportation Improvement Plan (TIP) pursuant to 23 CFR Part 450) will be the point of comparison. When a project sponsor choses to submit 20-year horizon information, the existing transportation network plus all projects identified in the Metropolitan Planning Organization's fiscally constrained long range plan (excluding the proposed build alternative) will serve as the point of comparison.

Use of Standard Factors Rather than Detailed Analysis

One of FTA's goals in the development of the Major Capital Investment Projects Final Rule and this Interim Policy Guidance was to establish measures that support streamlining of the New Starts process while maintaining an appropriate degree of analytic rigor as a basis on which to make CIG program funding decisions. Thus, some of the measures are calculated using simplified factoring approaches in order to eliminate undue burden on project sponsors. FTA based the factors on national data.

Simplified Estimation of Ridership and Vehicle Miles Traveled

FTA has made available to project sponsors a tool called Simplified Trips-on-Projects Software (STOPS) that can be used to estimate trips on the project. FTA believes this tool can significantly streamline the length of time required to generate ridership forecasts and vehicle miles traveled information for use in the evaluation measures. Use of STOPS is optional. Project sponsors may choose instead to continue to use their local travel forecasting model if they wish, with the understanding that FTA review of the forecasts and model will be necessary to ensure compliance with FTA policies and procedures. Project sponsors should contact FTA for assistance in obtaining and using STOPS.

If a sponsor chooses to use STOPS to calculate trips for the mobility, congestion relief, and cost effectiveness measures, the sponsor is expected to also use STOPS for calculating the VMT changes used in the environmental benefits measure. If a sponsor chooses instead to calculate trips for the mobility, congestion relief, and cost effectiveness measures using its local travel model, the sponsor is expected to also use its local travel model to calculate the change in VMT used in the environmental benefits measure. Should a project sponsor choose to use the local travel model, FTA expects to continue to review the validity of the model, as in past practice, to assure the validity of the results.

Project Justification

Land Use

Measures

The land use measure includes an examination of existing corridor and station area development; existing corridor and station area development character; existing station area pedestrian facilities, including access for persons with disabilities; existing corridor and station area parking supply; and the proportion of existing "legally binding affordability restricted" housing within ½ mile of station areas to the proportion of "legally binding affordability restricted" housing in the counties through which the project travels.

A legally binding affordability restriction is a lien, deed of trust or other legal instrument attached to a property and/or housing structure that restricts the cost of housing units to be affordable to households at specified income levels for a defined period of time and requires that households at these income levels occupy these units. This definition, includes, but is not limited to, state or federally supported public housing, and housing owned by organizations dedicated to providing affordable housing. For the land use measure looking at existing affordable housing, FTA is seeking legally binding affordability restricted units to renters with incomes below 60 percent of the area median income and/or owners with incomes below the area median that are within ½ mile of station areas and in the counties through which the project travels.

One reason FTA chose to include affordable housing in the land use criterion was to ensure that neighborhoods surrounding proposed transit stations have the fundamentals in place to ensure that as service is improved over

time there is a mix of housing options for existing and future residents. One measure of the readiness of a community to accept a new transit investment and avoid significant gentrification that can occur over time is the presence of "legally binding affordability restricted" units. These units have protections in place to ensure that they will continue to be available to low and moderate income households as changes in the corridor occur.

In this context FTA believes this to be a first step in developing a worthwhile measure that encourages project sponsors to locate projects where a higher share of "legally binding affordability restricted" housing exists in their area. The metric selected evaluates the proportional share of existing "legally binding affordability restricted" housing in the corridor compared to the share in the surrounding county or counties. FTA believes use of this ratio is appropriate to help normalize the results since we are not comparing projects to one another but rather to the circumstances in each local area where projects are proposed. However, FTA recognizes the use of a ratio for this measure can have some drawbacks, particularly where the surrounding county or counties are quite large in land area and/or have quite large amounts of "legally binding affordability restricted" housing. Therefore, FTA intends to boost the rating for this subfactor one level if the denominator shows the surrounding counties to have greater than a five percent share of "legally binding affordability restricted" housing.

Note that this metric is not intended in any way to serve as a "federally endorsed" definition of acceptable levels of legally binding affordability restricted or other types of affordable housing, and is unique to this CIG project evaluation process. FTA aims to improve and refine the measure as information is gathered from project sponsors on its application and its impacts are examined.

Calculation

FTA bases the rating primarily on quantitative measures, including station area population densities, total employment served by the project, and the proportion of "legally binding affordability restricted" housing within ½ mile of stations areas to the proportion of "legally binding affordability restricted" housing in the counties through which the project travels. Poor pedestrian accessibility may reduce the rating, as it reduces the effective amount of population and employment directly served by the system. Otherwise, the presence of high trip generators, a pedestrian-accessible and friendly station area environment, and limited availability of parking all serve to support the rating.

Project sponsors should obtain population and employment information from census data.

A station area encompasses a ½ mile radius of the station.

To develop information on "legally binding affordability restricted" housing located in the proposed corridor and the counties through which the project travels, project sponsors should consult with area housing agencies. For this purpose, FTA is seeking legally binding affordability restricted units to renters with incomes below 60 percent of the area median income and/or owners with incomes below the area median. Project sponsors should also obtain and submit to FTA signed certifications by the heads of the housing agencies or other entities from where the information was gathered attesting to the accuracy of the numbers provided.

While FTA believes contacting area housing authorities will provide the best and most comprehensive information on "legally binding affordability restricted housing", some statistics on affordable housing can be found in the National Housing Preservation Database (http://www.preservationdatabase.org/). This database includes an address-level inventory of federally assisted rental housing. It does not contain information on affordable units supported only by state and local programs. The amount of "legally binding affordability restricted" units in the corridor and the surrounding counties is then compared to total residential housing units in the corridor and the surrounding counties. Total residential housing units should come from the American Community Survey (ACS) five year forecasts at the County and Census Tract levels.

FTA assigns a value to this measure by comparing (a) the percent of total units in the transit corridor (defined as 1/2 mile around each proposed station) that are legally binding affordability restricted housing to (b) the percent

of total units in the counties in which the stations are located that are legally binding affordability restricted housing. FTA boosts the rating for this subfactor one level if the denominator shows the surrounding counties through which the project travels have greater than a five percent share of "legally binding affordability restricted" housing.

The measurement of housing affordability as part of the project evaluation criteria is something only recently added by FTA in 2013 after completion of an extensive public comment process. Since it is still a fairly new measure, project sponsors may submit additional information to supplement the calculation described above, that FTA may consider, on a case by case basis, in assigning a final rating for this metric.

Breakpoints

The breakpoints for station area population, employment density, and Central Business District parking are:

	Station Area Development		Parking Supply	
Rating	Employment served by system[2]	Avg. Population density (persons/square mile)[3]	CBD typical cost per day[4]	CBD spaces per employee[5]
High	> 220,000	> 15,000	> $16	< 0.2
Medium-High	140,000-219,999	9,600 - 15,000	$12 - $16	0.2 – 0.3
Medium	70,000-139,999	5,760 – 9,599	$8 - $12	0.3 – 0.4
Medium-Low	40,000-69,999	2,561 – 5,759	$4 - $8	0.4 – 0.5
Low	<40,000	< 2,560	< $4	> 0.5

The breakpoints for the proportion of "legally binding affordability restricted" housing in the corridor compared to the proportion of "legally binding affordability restricted" housing in the counties through which the project travels are shown in the table below.

Rating	Proportion of legally binding affordability restricted housing in the project corridor compared to the proportion in the counties through which the project travels
High	≥ 2.50
Medium-High	2.25 – 2.49
Medium	1.50 - 2.24
Medium-Low	1.10 - 1.49
Low	< 1.10

(For example, a low rating indicates the share of affordable housing units within the project corridor is lower than 110 percent of the share within the corresponding counties.)

Cost Effectiveness

Measures

FAST requires that the cost-effectiveness criterion for New Starts projects be based on a cost per trip measure. Therefore, the cost effectiveness measure for New Starts projects is the annual capital and operating and

[2] The employment breakpoints are based on the Institute for Transportation Engineer's document entitled "A Toolbox for Alleviating Traffic Congestion," which suggests minimum non-residential development concentrations of 20 million square feet for frequent local bus service and 35 million square feet for light rail service. At 500 square feet per employee, these figures are equivalent to 40,000 and 70,000 employees, respectively. The total employment served includes employment along the entire line on which a no-transfer ride from the proposed project's stations can be reached.

[3] The average population density breakpoints are based on the Institute for Transportation Engineer's document entitled "A Toolbox for Alleviating Traffic Congestion," which suggests light rail and frequent bus service requires a minimum of 9 to 15 dwelling units per acre. This data has been used to inform the medium breakpoint shown.

[4] CBD core (not fringe parking)

[5] Average across CBD

maintenance (O&M) cost per trip on the project. The number of trips on the project is not an incremental measure but simply total estimated trips on the project.

The cost part of the New Starts cost-effectiveness calculation is an incremental measure requiring a point of comparison. For current year calculations, the annualized capital and O&M cost for the proposed project is compared to the existing transit system. If a project sponsor also chooses to calculate the measure based on 10-year horizon forecasts, the annualized capital and O&M cost of the proposed project is compared to the no-build transit system (which includes the existing transportation system as well as those transportation investments committed in the Transportation Improvement Plan (TIP) pursuant to 23 CFR Part 450.) If a project sponsor chooses to calculate the measure based on 20-year horizon forecasts, the annual capital and O&M cost of the proposed project is compared to the annual capital and O&M cost of the projects identified in the Metropolitan Planning Organization's fiscally constrained long range plan (excluding the proposed build alternative.)

Calculation

For New Starts projects, the cost-effectiveness measure is computed as the annualized capital cost plus annual O&M cost of the project divided by the annual number of forecasted trips on the project. For calculation of this measure, the capital costs of scope elements considered "enrichments" are either reduced by an FTA defined percentage or eliminated entirely from the annualized capital cost calculation. "Enrichments" are improvements to the transit project that are desired by the project sponsor but are non-integral to the planned functioning of the project, and whose benefits are not captured in whole by the criteria. "Enrichments" are allowable expenses for reimbursement under a future New Starts construction grant. FAST includes a special rule related to "enrichments" that states FTA "shall not reduce or eliminate the capital costs of art and non-functional landscaping elements from the annualized capital cost calculation."

"Enrichments" are based on costs associated with certain Activity Line Items (ALIs) in the FTA Standard Cost Category worksheets. FTA, through its Project Management Oversight Contractors verifies "enrichments" claimed by project sponsors. FTA allows only the following "enrichments" to be excluded from the New Starts cost effectiveness calculation. This is a finite list that may be revisited through future proposed policy guidance:

- ALIs 20.01 through 20.04 and 30.01 through 30.04 Sustainable Building Design Features -- Up to 2.5 percent of the cost of facilities designed to achieve U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) or a comparable third-party certification (i.e., ENERGY STAR, BREEAM) may be removed from the cost effectiveness calculation. Projects that include buildings optimized to use less energy, consume less water and reduce greenhouse gas emissions may also claim the credit, even if the improvements do not lead directly to an official certification. Examples of eligible improvements include landscape and exterior site designs that improve water efficiency and management, and renewable and alternative energy technologies that support greenhouse gas emissions reduction. The 2.5 percent factor is based on studies completed in 2003 and 2004 by the General Services Administration (GSA) and State of California that estimated the average incremental construction cost associated with achieving LEED certification. FTA does not propose to credit the professional services cost of sustainable building design because the studies indicated that this is a very small fraction of a capital project's cost (0.1 to 0.3 percent).
- ALI 20.05 Joint Development – This ALI identifies items eligible for Federal participation per Section 5302(3)(A)(G) of Chapter 49 USC and FTA's Joint Development Circular found on the FTA website. All costs on this line item may be removed from the cost effectiveness calculation. Per FTA's Joint Development Circular, "Joint development is any income-producing activity with a transit nexus related to a real estate asset in which FTA has an interest. Joint development projects are commercial, residential, industrial, or mixed-use developments that are induced by or enhance the effectiveness of transit projects. . ." FTA hopes that the credit will encourage sponsors to undertake joint development efforts as part of New Starts projects; few to date have included joint development-related costs.
- ALI 40.06 Pedestrian/Bike Access and Accommodation and Functional Landscaping – All costs of this line item may be removed from the cost effectiveness calculation. All proposed bicycle and pedestrian improvements must be consistent with FTA's Bicycle and Pedestrian policy.

- ALI 70.04 Alternative Energy Bus Vehicles. Fifty percent of the purchase cost of "green" buses may be removed from the cost effectiveness calculation. Any type of clean fuel bus is eligible for the credit, including buses with compressed natural gas (CNG), hybrid, electric, or fuel cell propulsion. This allowance is based on a 2007 TCRP report, *Assessing and Comparing Environmental Performance of Major Transit Investment*, that found the average cost difference between a conventional diesel bus and a CNG or hybrid bus is approximately 50 percent.

If the project sponsor chooses to develop ridership forecasts for a horizon year in addition to the current year, the overall measure of cost effectiveness is a weighted average that considers both calculations. FTA weights each 50 percent.

Sources of Information

Annualized capital costs for New Starts projects are taken directly from the FTA Standard Cost Categories (SCC) workbook, specifically the "Build Annualized" worksheet.

- Capital costs are expressed in the current year's dollar value.
- The annualization worksheet of the SCC workbook converts the capital cost of individual scope items into their equivalent annual capital cost based on their economic lifetimes and a 2.0 percent discount rate. Enrichments are deducted from the annualized cost calculation automatically in the SCC "Build Annualized" sheet once the project sponsor indicates through simple yes or no answers the enrichments that are applicable and the amount of eligible base cost for each.

Annual operating and maintenance (O&M) costs for New Starts projects are taken directly from the O&M cost model(s) of current and proposed transit facilities and services.

- O&M costs from the model(s) for the current system in the current year are required to match the current O&M budget and reflect any changes anticipated in the existing transit system to integrate the project into the system, as documented in the transit service plan for the project.
- If the project sponsor chooses to calculate the measure in a horizon year as well, the O&M cost estimates are required to reflect the transit service plans for both the point of comparison and the project, including changes made to the point of comparison service plan needed to integrate the project into the system. Horizon-year O&M costs are expressed in the current year's dollars.

For the cost-effectiveness criterion, trips on the project are the number of linked trips using the project, with no extra weight given to trips by transit dependent persons. Trips may be calculated using either STOPS or the local travel model at the project sponsor's option.

Breakpoints

FTA examined data from projects currently in the New Starts process and developed the breakpoints below based on that information. FTA further compared the proposed New Starts breakpoints below to data contained on average annual capital and operating cost per trip of various modes in the National Transit Database and determined them to be reasonable and in line with expectations.

Cost Effectiveness Breakpoints

Rating	Range
High	< $4.00
Medium-High	Between $4.00 and $5.99
Medium	Between $6.00 and $9.99
Medium-Low	Between $10.00 and $14.99
Low	> $15.00

Mobility Improvements

Measures

FTA evaluates mobility improvements for New Starts projects as the total number of linked trips using the proposed project, with a weight of two given to trips that would be made on the project by transit dependent persons. Linked trips using the proposed project include all trips made on the project whether or not the rider boards or alights on the project or elsewhere in the transit system. If a project sponsor chooses to estimate trips using STOPS, then trips made by transit dependent persons are trips made by persons in households that do not own a car. If a project sponsor chooses to estimate trips using their local travel forecasting model, trips made by transit dependent persons are defined in local travel models generally in one of two ways: as trips made by persons in households having no cars or as trips made by persons living in households in the lowest income bracket as defined locally.

FTA assigned a weight of two to trips by transit dependent persons based on information from the 2009 National Household Transportation Survey, which indicates that 8.7 percent of U.S. Households own zero vehicles but make only 4.3 percent of the nation's person trips. If zero-car households had equal opportunity to make trips, i.e., if their mobility was not limited by the existing public transportation system, one could infer that these zero-car households would make more than 4.3 percent of the nation's person trips. To ensure that federal investments in major capital investment transit projects address the travel demand of zero car households equitably, FTA uses a factor of two for the number of trips made by transit dependent persons (8.7 percent ÷ 4.3 percent = 2.02).

If a project sponsor chooses to develop project trip forecasts based on inputs for a horizon year in addition to forecasts based on current year inputs, each is given 50 percent weight when establishing the overall mobility improvements rating. The trips measure is an absolute value rather than an incremental value, so a basis for comparison is not required.

Calculation

The mobility improvements measure is computed by adding together the estimated number of linked transit trips on the project taken by non-transit dependent persons and the number of linked transit trips taken by transit dependent persons multiplied by a factor of two, thereby giving extra weight to these trips.

Sources of Information

Number of Transit Trips Using the Project:

- The number of linked transit trips estimated on the project using current year inputs is generated either by STOPS (which uses census data and ridership experience on existing fixed guideway systems to estimate trips) or the local travel model at the project sponsor's option.
- If the project sponsor wishes to calculate a horizon year forecast of linked transit trips for consideration in the rating, the number of linked transit trips in the horizon year is based upon either STOPS or the local travel model at the project sponsor's option.
- If the project sponsor chooses to calculate a horizon year forecast in addition to a current year forecast, the mobility improvements rating is based on a weighted average that gives 50 percent weight to each.

Number of Trips by Transit Dependents Using the Project:

- The number of trips on the project made by transit dependent persons using current year inputs is generated either by STOPS or the local travel model at the project sponsor's option. Local travel models stratify trips taken in one of two ways – based on household income level or household auto ownership. STOPS uses auto ownership to stratify trips. Thus, trips made by transit dependent persons estimated by STOPS will be those made by households with no cars.

Breakpoints

Rating	Mobility Improvements: Estimated Annual Trips (Trips by Non-Transit Dependent Persons plus Trips by Transit Dependent Persons multiplied by 2)
High	≥ 30 Million
Medium-High	15 Million – 29.9 Million
Medium	5 Million – 14.9 Million
Medium-Low	2.5 Million – 4.9 Million
Low	< 2.5 Million

Congestion Relief

Measure

FTA evaluates congestion relief based on the number of new weekday linked transit trips resulting from implementation of the proposed project. FTA recognizes that this is an indirect measure of roadway congestion relief resulting from implementation of a transit project, but it serves as an indicator of potential cars taken off the road. Additionally, it keeps FTA from double counting the total transit trips evaluated under the mobility criterion or the vehicle miles traveled evaluated under the environmental benefits criterion. FTA believes its virtues are that it is simple to calculate, simple to explain to various decision-makers, and easily understood. Additionally, it continues to allow project sponsors the option of using FTA's simplified ridership forecasting tool entitled STOPS, which can save considerable time and expense.

Because the measure of new weekday linked transit trips is an incremental value, a basis for comparison is required. For forecasts prepared using current year inputs of population and employment, the proposed project is compared to the existing transit system. If a project sponsor also chooses to prepare 10-year horizon forecasts, the proposed project is compared to the no-build transit system (which includes the existing transportation system as well as those transportation investments committed in the Transportation Improvement Plan (TIP) pursuant to 23 CFR Part 450.) If a project sponsor chooses instead to prepare 20-year horizon forecasts, the proposed project is compared to a no-build transit system that includes the projects identified in the Metropolitan Planning Organization's fiscally constrained long range plan (excluding the proposed build alternative.)

If a project sponsor chooses to develop new weekday linked transit trips based on a horizon year in addition to current year, each is given 50 percent weight when establishing the overall congestion relief rating.

Calculation

New weekday linked transit trips are calculated by comparing total weekday linked transit trips for the no-build alternative with total weekday linked transit trips once the proposed project is implemented.

Breakpoints

Congestion Relief Breakpoints

Rating	New Weekday Linked Transit Trips
High	18,000 and above
Medium-High	10,000 to 17,999
Medium	2,500 to 9,999
Medium-Low	500 to 2,499
Low	0 to 499

Environmental Benefits

Measures

FTA evaluates and rates the environmental benefits criterion for New Starts projects based upon the dollar value of the anticipated direct and indirect benefits to human health, safety, energy, and the air quality environment scaled by the annualized capital and operating cost of the project. These benefits are computed based on the change in vehicle miles traveled (VMT) resulting from implementation of the proposed project. Because change in VMT is an incremental measure, a point of comparison is necessary to calculate environmental benefits. To calculate the measures for the current year, the point of comparison is the existing transit system. If the project sponsor also opts to calculate the measures based on 10-year horizon forecasts, the point of comparison is the no-build transit system (which includes the existing transportation system as well as those transportation investments committed in the Transportation Improvement Plan (TIP) pursuant to 23 CFR Part 450). If the project sponsor chooses to calculate the measures based on 20-year horizon forecasts, the point of comparison is the projects identified in the Metropolitan Planning Organization's fiscally constrained long range plan (excluding the proposed build alternative.) The estimated environmental benefits are monetized and compared to the same annualized capital and operating cost of the proposed New Starts project as used in the cost effectiveness calculation.

The standard factors that FTA uses for calculating environmental benefits and data sources are found in the tables below. (See the Appendix for the sources that FTA used to develop the factors.) FTA used data from the Transit Cooperative Research Program study on environmental benefits, "Assessing and Comparing Environmental Performance of Major Transit Investments", and other Federal government data sources to the greatest extent possible.

Calculation

- Environmental benefits include the following subfactors: change in air quality criteria pollutants, change in energy use, change in greenhouse gas emissions, and change in safety. Values for change in energy use and greenhouse gas emissions have been established so as to not double count. (Thus, the valuation of energy use reductions is based only on the economic cost of petroleum dependence identified in Paul N. Leiby, "Estimating the U.S. Oil Security Premium for the 2017-2025 Light -Duty Vehicle GHG/Fuel Economy Rule", Oak Ridge National Laboratory (ORNL), July 15, 2012.) The subfactors are calculated from forecasts of changes in automobile and transit vehicle miles traveled (VMT). All measures are converted from VMT into their native units (e.g., tons of emissions or total accidents) using national-level standard conversion factors. The native units are monetized based on standard dollar values. For air quality subfactors, weights are applied to reflect FTA judgment that higher priority be given to projects achieving reductions in nonattainment and maintenance areas. The monetized and weighted values of the various environmental benefits are summed and compared to the same annualized capital and operating cost of the proposed project as is used in the cost effectiveness calculation for New Starts projects.
- Forecasts of changes in VMT come from either the local travel model or the simplified national model developed by FTA (STOPS). The change in auto VMT is calculated based upon the change in the number of auto trips between the no-build and build alternatives, multiplied by the difference in auto travel distance between the no-build and build alternatives.
- If the project sponsor chooses to calculate a horizon year forecast in addition to a current year forecast, the environmental benefits rating is based on a weighted average that gives 50 percent weight to each.

Sources of Information

The New Starts templates include all of the conversion factors necessary to calculate changes in air quality, energy use, greenhouse gas emissions, and safety resulting from the changes in highway and transit VMT. The project sponsor is required only to input a few data points and the environmental benefits are automatically calculated in the templates. The factors used in the templates are shown below.

Change in Total Air Quality Criteria Pollutants – Carbon Monoxide (CO), Mono-Nitrogen Oxides (NOx), Particulate Matter (PM2.5), and Volatile Organic Compounds (VOC). For the change in air quality measure, FTA uses emission rates per VMT for automobiles (cars and light trucks) and transit vehicles including buses (diesel, hybrid-electric, and CNG), diesel commuter rail and diesel multiple unit vehicles (DMU), light rail transit vehicles, streetcars, electric commuter rail and electric multiple unit (EMU) vehicles, heavy rail vehicles, and electric buses. Because of the potential for double counting the value in reductions of PM2.5 and PM10, FTA includes only PM2.5 in the air quality measure.

Change in Air Quality Emissions Factors

	For Current Year Estimates				**For 10-year Horizon Estimates**				**For 20-year Horizon Estimates**			
	(grams/VMT)											
Mode	CO	NO_x	VOC	$PM_{2.5}$	CO	NO_x	VOC	$PM_{2.5}$	CO	NO_x	VOC	$PM_{2.5}$
Automobile	16.77	0.91	0.60	0.010	11.46	0.28	0.27	0.010	10.26	0.20	0.21	0.010
Bus - Diesel	5.83	8.67	0.73	0.48	3.26	2.08	0.24	0.09	2.89	1.14	0.16	0.03
Bus - Hybrid	5.83	8.67	0.73	0.480	3.26	2.08	0.24	0.09	2.89	1.14	0.16	0.03
Bus - CNG	39.62	3.84	1.46	0.010	20.30	3.41	1.15	0.010	17.16	3.35	1.11	0.010
Bus - Electric	6.45	5.83	0.12	0.378	5.39	4.39	0.10	0.313	5.04	3.98	0.10	0.299
Heavy Rail	7.06	6.38	0.13	0.413	6.85	5.58	0.13	0.398	6.73	5.32	0.13	0.399
Light Rail and Streetcar	10.51	9.50	0.19	0.615	10.20	8.31	0.19	0.593	10.01	7.91	0.20	0.593
Commuter Rail - Diesel locomotive (new) and DMU	16.80	13.20	0.55	0.190	16.80	13.20	0.55	0.190	16.80	13.20	0.55	0.190
Commuter Rail - Diesel locomotive (used) and DMU	16.80	93.00	4.36	4.600	16.80	43.00	1.26	1.330	16.80	20.90	0.44	0.470
Commuter Rail – Electric and EMU	12.81	11.57	0.24	0.750	12.43	10.12	0.23	0.722	12.19	9.64	0.24	0.723

Change in Air Quality Monetization Factors

	Year	CO	NOx – Mobile	NOx – EGU	VOC	PM2.5 - Mobile	PM2.5 - EGU
				$ / KG			
Attainment	Current Year	$0.08	$12.96	$18.36	$3.02	$680.40	$561.60
	10-Year Horizon	$0.08	$15.66	$22.95	$3.75	$861.30	$688.50
	20-Year Horizon	$0.08	$16.20	$23.76	$3.89	$896.40	$712.80
Nonattainment 1.5 times value of attainment	Current Year	$0.12	$19.44	$27.54	$4.53	$1,020.60	$842.40
	10-Year Horizon	$0.12	$23.49	$34.43	$5.63	$1,291.95	$1,032.75
	20-Year Horizon	$0.12	$24.30	$35.64	$5.84	$1,344.60	$1,069.20
Maintenance area 1.25 times value of attainment	Current Year	$0.10	$16.20	$22.95	$3.78	$850.50	$702.00
	10-Year Horizon	$0.10	$19.58	$28.69	$4.69	$1,076.63	$860.63
	20-Year Horizon	$0.10	$20.25	$29.70	$4.86	$1,120.50	$891.00

Change in Energy Use

A significant part of the benefits that come from reducing energy use is already accounted for by the resulting reduction in pollutant and greenhouse gas emissions. In this measure, FTA is attempting to capture the benefit coming from reduced reliance on foreign fuels. Thus, the change in energy use is only computed for modes that use petroleum fuel. The measure estimates the change in energy consumption rates for transit and automobile modes based on the forecasted change in VMT.

Change in Energy Use Factors

	Current Year	10-year Horizon	20-year Horizon
MODE	Btu/VMT		
Automobile	7,559	6,167	5,633
Bus – Diesel	41,436	35,635	33,978
Bus – Hybrid	33,149	28,508	27,182
Commuter Rail - Diesel (new) and DMU	96,138	96,138	96,138
Commuter Rail - Diesel (used)	96,138	96,138	96,138

FTA then monetizes the change in energy use based on the economic cost of dependence on imported petroleum for fuels. FTA uses a value of $0.20 per gallon of petroleum fuel (Leiby/ORNL 2012). To convert from Btu to gallons of petroleum fuel, FTA uses conversion factors (from the GREET model) of 116,090 Btu per gallon of gasoline and 128,450 Btu per gallon of diesel fuel. Therefore, the monetization factors are $1.72 per million Btu for gasoline and $1.56 per million Btu for diesel fuel. Gasoline is assumed to be the sole fuel for changes in automobile VMT for simplicity in the computation.

Change in Greenhouse Gas Emissions

The calculation of the proposed unit rates for GHG emissions includes the application of emissions factors by fuel type.

Change in Greenhouse Gas (CO2e) Emissions Factors

	Current Year	10-year Horizon	20-year Horizon
Mode	(g CO2e/VMT)		
Automobile	532	434	397
Bus – Diesel	3319	2854	2721
Bus – Hybrid	2655	2283	2177
Bus – CNG	2935	2524	2406
Bus - Electric	2934	2441	2303
Heavy Rail	3211	3106	3073
Light Rail and Streetcar	4779	4623	4574
Commuter Rail - Diesel (new) and DMU	7970	7970	7970
Commuter Rail - Diesel (used)	7970	7970	7970
Commuter Rail - Electric and EMU	5821	5632	5572

NOTE: The factor is CO2 equivalents (CO2e). This means that other greenhouse gas emissions (other than CO2) that have different rates of affecting global warming are converted into CO2 terms because that is the most prevalent greenhouse gas emission.

To capture the monetary value of change in GHG emissions, FTA uses the $38 midrange estimate of the social cost of carbon obtained from the Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866 (May 2013), which is a document developed and updated periodically by an Interagency Working Group comprised of a number of Federal agencies. The $38 value is the 2015 midrange

estimate based on a 3 percent discount rate. FTA will update the value based on the latest information available from the Interagency Working Group or other Federal government sources, as appropriate.

Change in Safety
To measure change in safety, FTA uses the change in VMT to calculate changes in disabling injuries and fatalities for automobiles and transit. FTA does not attempt to capture the changes in pedestrian or bicyclist accidents or injuries resulting from changes in VMT because of the difficulty in accounting for such changes using readily available national data.

Change in Safety Factor

Mode	Current Year		10-year Horizon		20-year Horizon	
	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries
	(per million VMT)					
Automobile	0.013	0.195	0.013	0.195	0.013	0.195
Bus – Diesel	0.004	1.824	0.004	1.824	0.004	1.824
Bus – Hybrid	0.004	1.824	0.004	1.824	0.004	1.824
Bus – CNG	0.004	1.824	0.004	1.824	0.004	1.824
Bus - Electric	0.004	1.458	0.004	1.458	0.004	1.458
Heavy Rail	0.007	0.155	0.007	0.155	0.007	0.155
Light Rail and Streetcar	0.009	1.696	0.009	1.696	0.009	1.696
Commuter Rail - Diesel (new) and DMU	0.012	1.746	0.012	1.746	0.012	1.746
Commuter Rail - Diesel (used)	0.012	1.746	0.012	1.746	0.012	1.746
Commuter Rail - Electric and EMU	0.012	1.746	0.012	1.746	0.012	1.746

To monetize the estimated changes in safety, FTA uses U.S. DOT guidance on the value of a statistical life and injuries. According to the most recent guidance, published in 2014, the current U.S. DOT value of a statistical life is $9.2 million. The value FTA uses for a disabling injury for both transit and automobiles is $490,000, which is 5.39 percent of the U.S. DOT value of a statistical life, based on the KABCO scale in the 2009 Highway Safety Manual published by the American Association of State Highway and Transportation Officials in coordination with the Federal Highway Administration. FTA plans to update these figures whenever U.S. DOT publishes revised values.

Breakpoints

The environmental benefits measure for New Starts projects is the sum of the monetized value of the benefits resulting from the changes in air quality and GHG emissions, energy use, and safety divided by the same annualized capital and operating cost of the project as used in the cost effectiveness measure. FTA multiplies the resulting ratio by 100 and expresses the environmental benefit measure as a percentage.

Rating	Range
High	> 10%
Medium-High	5 to 10%
Medium	0 to 5%
Low-Medium	0 to -10%
Low	< -10%

Economic Development

Measures

The measure of economic development effects is the extent to which a proposed project is likely to induce additional, transit-supportive development in the future based on a qualitative examination of the existing local plans and policies to support economic development proximate to the project.

Calculation

- FTA evaluates transit supportive plans and policies, the demonstrated performance of those plans and policies, and the policies and tools in place to preserve or increase the amount of affordable housing in the project corridor. FTA also reports the project sponsor's estimate of the number of U.S. jobs related to design, construction, operation and maintenance of the project although this is not used in developing the rating.
- At the project sponsor's option, an additional quantitative analysis (scenario based estimate) may be undertaken that considers:
    - The extent to which the proposed project would produce changes in development patterns around the transit investment and the resulting magnitude of changes in population and employment, considering:
        - the economic conditions in the project corridor;
        - the mechanisms by which the project would improve those conditions;
        - the availability of land in station areas for development and redevelopment;
        - an evaluation of policies that enable or inhibit housing in transit-supportive development; and
        - a pro forma assessment of the feasibility of specific development scenarios.
    - The estimated change in VMT attributable to the estimated changes in development patterns.
    - The estimated environmental benefits that would come from the VMT change attributable to the estimated change in development patterns. Note that these benefits are counted in the economic development criterion and not added to the benefits assessed in the environmental benefits criterion. These benefits are above and beyond the benefits that come from changes in mode choice that are addressed in the environmental benefits criterion.

The environmental benefits derived from the optional quantitative economic development scenario analysis are then monetized and compared to the same annualized capital and operating cost of the proposed project as used in the cost-effectiveness calculation. FTA multiplies the resulting ratio by 100 and expresses the environmental benefits derived from the optional quantitative economic development scenario as a percentage.

Sources of information

- Transit Supportive Plans and Policies
    - Growth Management;
    - Transit Supportive Corridor Policies;
    - Supportive Zoning Regulations Near Transit Stations; and
    - Tools to Implement Land Use Policies.
- Performance and Impacts of Policies:
    - Performance of Land Use Policies; and
    - Potential Impact of Transit Project on Regional Land Use.
- Tools to maintain or increase the share of affordable housing in the project corridor:
    - Evaluation of Corridor-Specific Affordable Housing Needs and Supply including an examination of local plans or policies that enable or inhibit housing development in the area
    - Plans and Policies to Preserve and Increase Affordable Housing such as:
        - Inclusionary zoning and/or density bonuses for affordable housing
        - Employer assisted housing policies
        - Voluntary or mandatory inclusionary housing policies

        - Rent controls or condominium conversion controls
        - Zoning to promote housing diversity
        - Affordability covenants
    - Adopted Financing Tools and Strategies to Preserve and Increase Affordable Housing such as:
        - Target property acquisition, rehabilitation, and development funding for low-income housing within the corridor, including:
            - Low Income Housing Tax Credits
            - Ongoing affordable housing operating subsidies
            - Weatherization and utilities support program
            - Local tax abatements for low-income or senior housing
            - Local of State programs that provide mortgage or other home ownership assistance for lower income and senior households
        - Established land banking programs or transfer tax programs
        - Local or regional affordable housing trust funds
        - Targeted tax increment financing or other value-capture strategies for low-income housing
    - Developer Activity to Preserve and Increase Affordable Housing

The optional scenario analysis could include, but is not required to include, information such as change in regional work force access to transit:

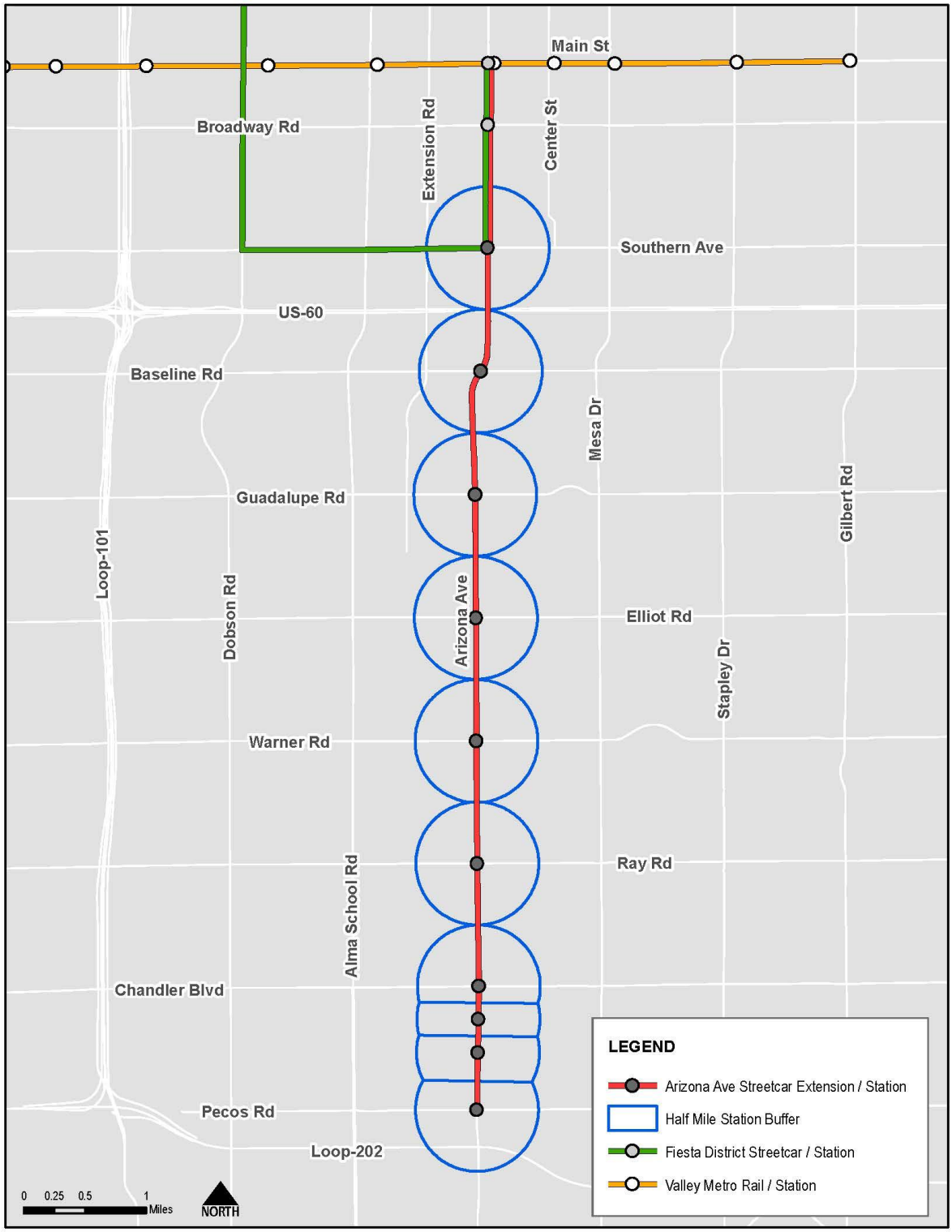
- U.S. Census data analyzed with a Geographic Information System to estimate the work-force population within a 40 minute transit commute of the proposed station locations.

Breakpoints

Below is a brief, high level summary of the breakpoints that will be used in evaluating the plans and policies in place. For more detailed information that further clarifies exactly how FTA establishes the ratings, please see our "Guidelines for Land Use and Economic Development Effects for New and Small Starts Projects" on the FTA website.

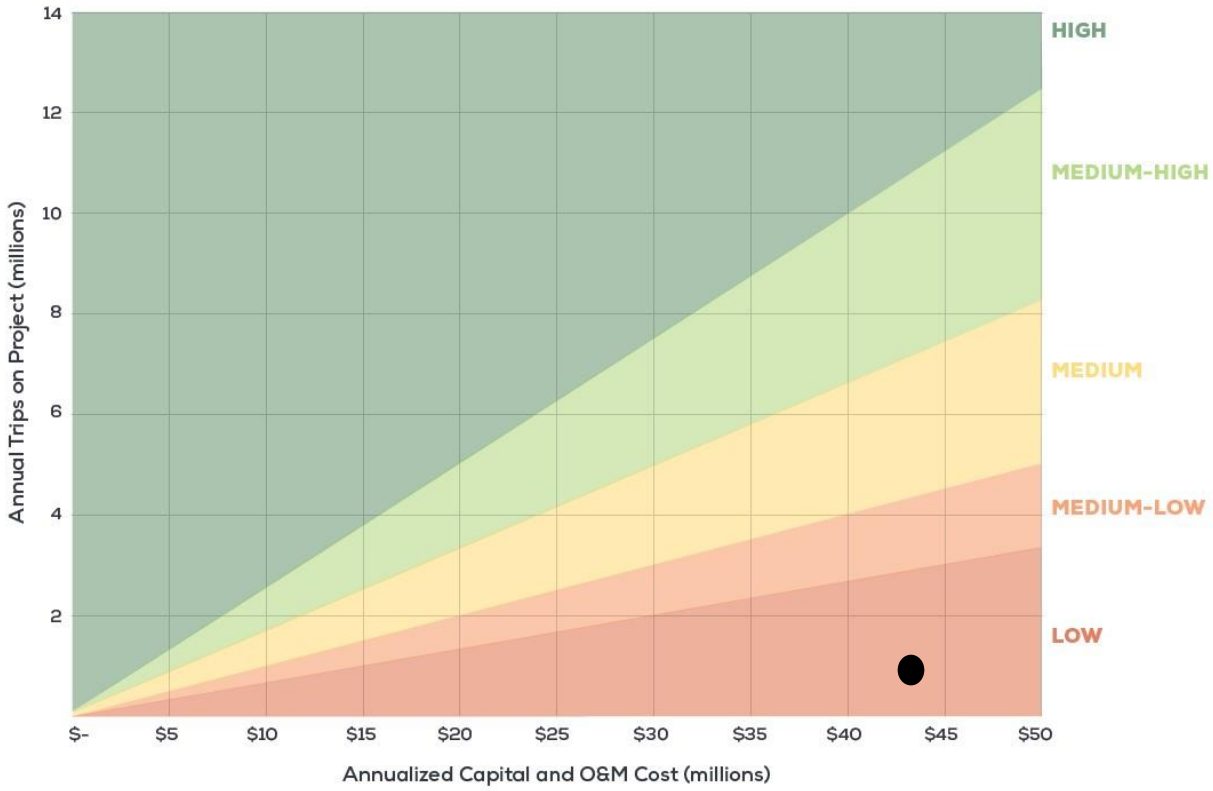
Appendix B

Arizona Ave Alternative Map



Appendix C

Cost Effectiveness Rating Breakpoints Graph



● *indicates where the AAAA project currently rates in Cost Effectiveness*

nc3d

Chandler AAAA Station Planning - DRAFT

S Arizona Ave and W Pecos Rd

ARIZONA AVENUE ALTERNATIVES ANALYSIS

Scenario Planning Technical Memorandum

JANUARY 2021

PREPARED BY AECOM

VALLEY METRO

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Introduction

Scenario modeling allows planners, decision-makers and other key stakeholders to understand the potential impacts of a range of interrelated decisions. The future has unlimited possibilities and scenario planning helps make choices amid long-range uncertainty. It is intended to explore high-level "what if?" questions, such as "what if the population increases beyond forecasted levels?" or "what if all bus routes increased their frequencies?" Outcomes can then be compared between different scenarios and to a baseline, or "Business-As-Usual" scenario, to analyze potential changes.

In addition to these more traditional categories of assumptions, transportation is on the verge of a series of profound revolutions based on a number of emerging technologies and evolving behavioral trends and preferences. These changes, such as automated vehicles (AVs), ride-hailing services and the rise of the shared economy all have the potential to impact how people interact with transportation. Changing travel behaviors and new transportation options are likely to impact transit ridership and where people choose to live and work. Scenario planning allows planners, decision-makers and other key stakeholders to understand the potential impacts of a range of interrelated decisions.

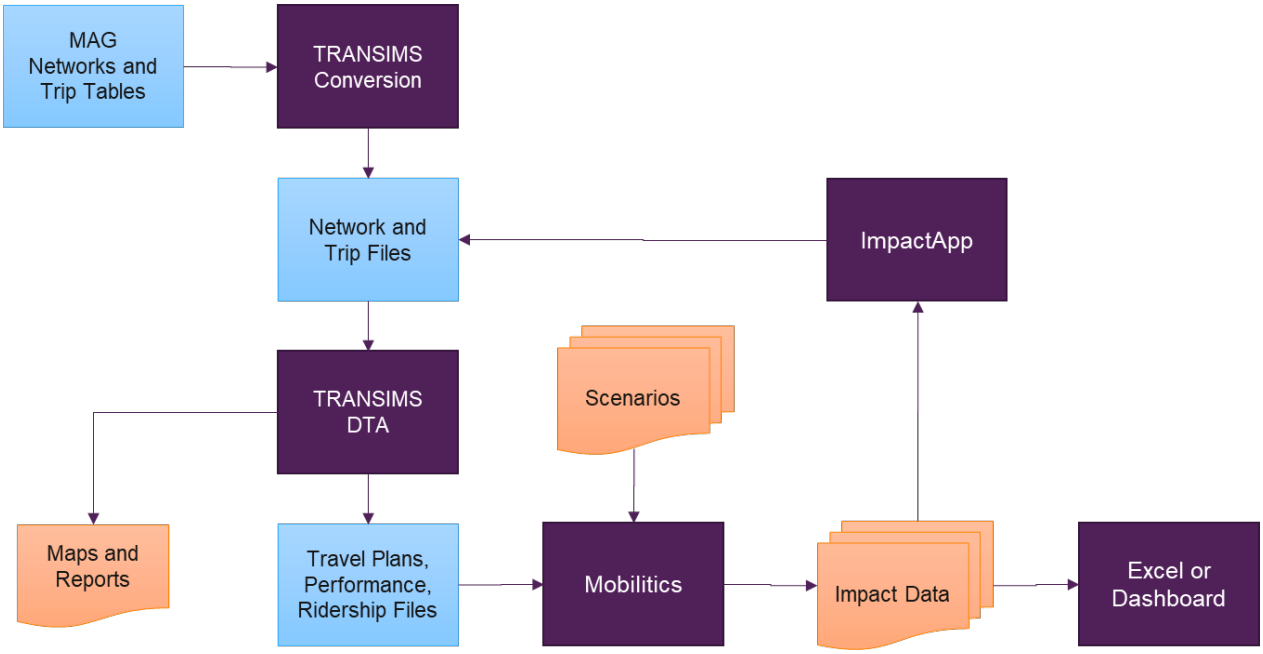
For this project, three alternative transportation futures were developed. These alternatives included input from the Project Management Team (PMT) and City of Chandler staff on the region's interests and priorities. In total, four scenarios were analyzed including the baseline scenario, using outputs from the Maricopa Association of Government (MAG) regional travel demand model and the Mobilitics™ tool to understand changes to the performance of the transportation system. The following sections describe the transportation scenarios, performance metrics and final outcomes for the scenario planning analysis.

It is important to note that scenario planning is not intended to predict the future, but instead it provides an understanding of potential future outcomes to aid in current planning decisions. The value comes in comparing the magnitude or direction of change for different outcomes and acts as a linkage between performance measures and the planning process. The three scenarios analyzed do not attempt to represent all possible futures for Chandler, Arizona and the surrounding region. Nor does this study attempt to identify what future scenario is the most likely to occur. This exercise study identified three potential futures that explore a range of possible conditions for the future of AVs and other technologies.

The Mobilitics Application Process

Mobilitics™ is a modeling tool developed by AECOM to understand the impacts of emerging technologies on transportation systems. It uses land use, networks and travel patterns from the MAG regional travel model to establish the baseline conditions to which future scenarios are applied. For this analysis, regional transportation networks and trip tables for 2020 and 2040 were provided by MAG. These data were imported into the Mobilitics modeling process outlined in Figure 1.

FIGURE 1: MOBILITICS MODELING PROCESS



As depicted in Figure 1, several TRANSIMS modeling tools are used to prepare the inputs for Mobilitics and assign the outputs for detailed network analysis. TRANSIMS is an open-source suite of disaggregate modeling tools originally developed for the Federal Highway Administration (FHWA). AECOM has subsequently enhanced the software to support Mobilitics and a variety of other advanced applications.

Trip tables from the MAG model were converted to individual tours by time of day using diurnal distribution curves. The trips were then assigned to the network using the TRANSIMS multi-model dynamic assignment process that results in 15-minute volumes on links and 15-minute ridership data on transit routes. The assignment results were then summarized by travel market for input to Mobilitics. Mobilitics applies the scenario definitions to the model outputs to generate a wide variety of performance measures for each year between 2020 and 2070. These measures are read into Excel workbooks to produce charts and summary tables. Optionally, the impact data can be processed using the ImpactApp tool to update the TRANSIMS networks and travel data for an additional application of the multi-modal dynamic assignment process.

The MAG regional transportation networks for 2020 and 2040 were used to define the baseline travel patterns for the analysis. Once the network and travel tours are prepared, the TRANSIMS Router is applied. The Router is a multi-modal analytical dynamic assignment tool that iteratively builds time-dependent paths for each traveler until the change in travel time from one iteration to the next is minimized for each traveler and the change in vehicle hours of travel on each link for each 15-minute time period is stabilized. The output of this process is a Plan file that contains the path and travel characteristics of each traveler, a Performance file that contains the link volumes and travel times for

each 15-minute time period and a Ridership file that contains the boarding and alighting information for each transit route, run and stop for each 15-minute time period. Several Mobilitics utilities are applied to this data to create summaries of network performance for each traffic analysis zone. These summaries include origin and destination zone travel time and distance skims by trip purpose (work and non-work), vehicle type (car, transit, truck) and time period (peak and off-peak). The network performance summaries include person and vehicle miles of travel, hours of travel and hours of delay by zone, vehicle type, facility type (freeway, major and minor arterials) and time period. The ridership summaries include riders, person and vehicle miles of travel by zone, mode (bus and rail) and time period.

Mobilitics takes the regional data summarized by zone and aggregates the data into markets or analysis districts using a zone equivalence file. In order to focus the analysis on the trips that are more likely to affect the City of Chandler, a subarea was defined for the primary analysis of impacts. This subarea includes the cities of Chandler, Mesa and Tempe, and the towns of Gilbert and Queen Creek. Figure 2 shows the roadway links included in the study area and Figure 3 shows the MAG zone centroids color coded by jurisdiction. The figure also highlights the location of Arizona Avenue in red and the existing light rail line through Tempe and Mesa in green. Table 1 summarizes the population and employment forecasts included in the MAG regional model for the Mobilitics subarea.

FIGURE 2: MOBILITICS SUBAREA ROADWAY NETWORK

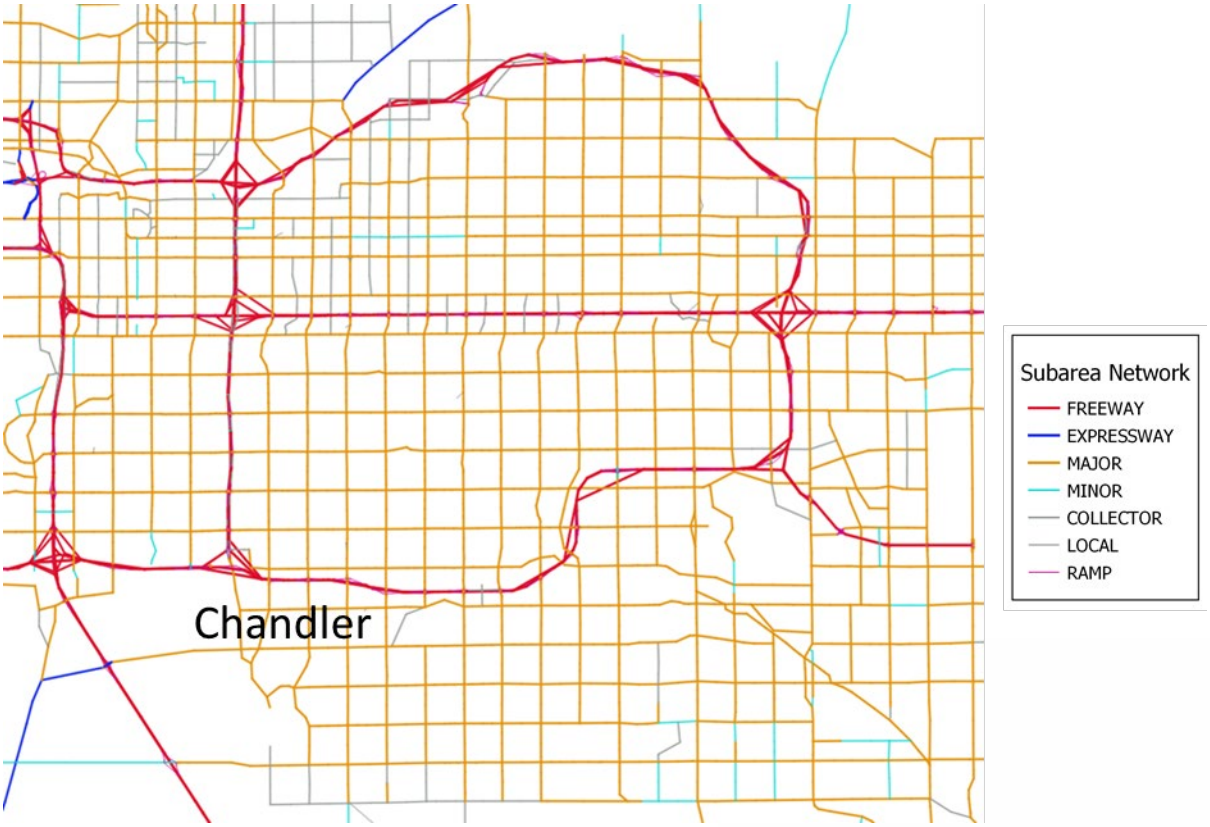


FIGURE 3: MOBILITICS SUBAREA ZONE CENTROIDS BY JURISDICTION

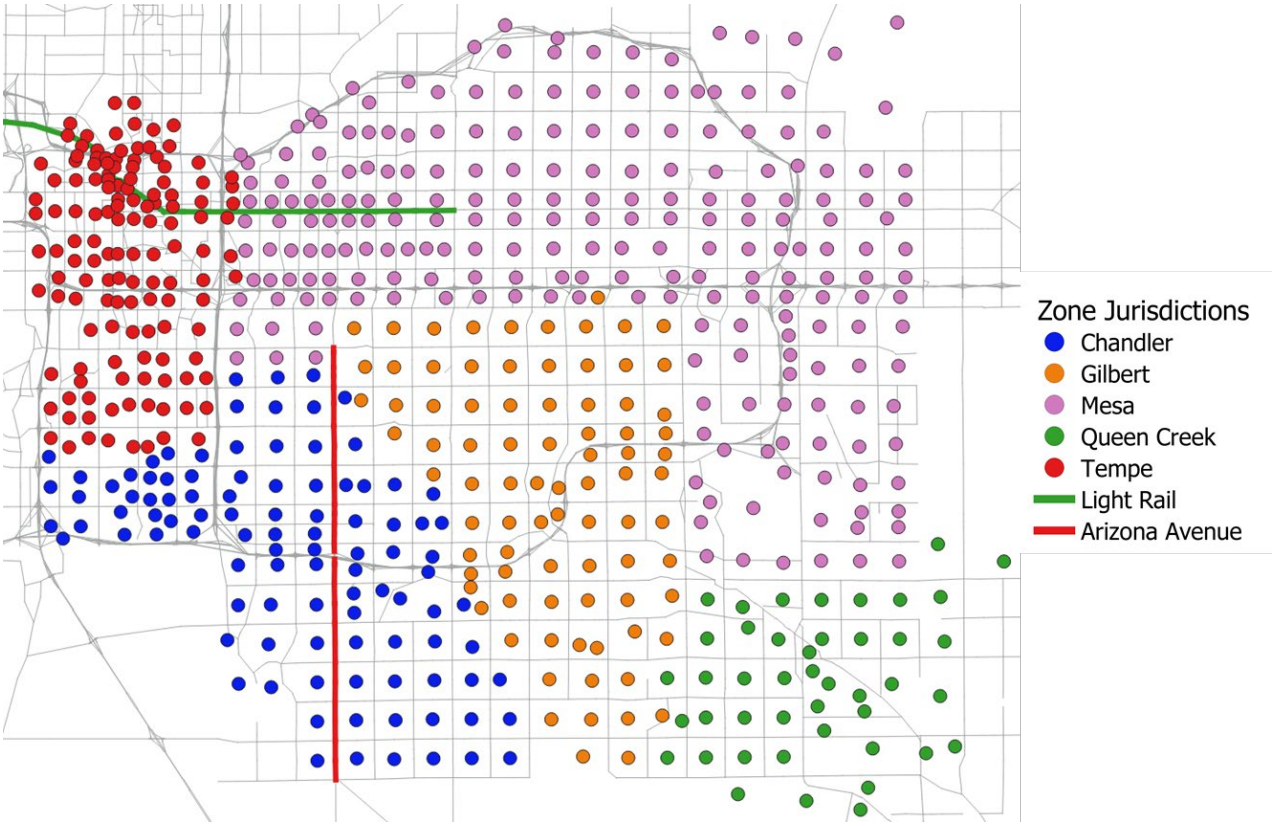


TABLE 1: SUBAREA DEMOGRAPHIC FORECASTS

	2020	2040	Change
Households	507,822	614,635	21.0%
Population	1,361,965	1,644,970	20.8%
Employment	500,862	633,154	26.4%

Vehicle Fleet Evolution

Mobilitics estimates changes to the baseline forecasts extracted from the MAG model using a series of time-based events that impact various components of travel demand, behavior and network performance. These events are defined by the scenario attributes or assumptions. The impacts of these events are influenced by the latest national and international research. The first category of events that are modeled within Mobilitics relate to the distribution of vehicles by connected and automated vehicle (CAV) types. Mobilitics considers three primary vehicle types with three sub-vehicle types. These types include:

- Car – Owned, Shared and Ride Service

- Transit – Bus, Rail, Micro Transit
- Truck – Delivery, Hauling, Tractor Trailer

These vehicles are subdivided into area types (downtown, urban, suburban business district, suburban residential and rural), CAV types and fuel types (gas, hybrid and electric). CAV Types are defined as follows:

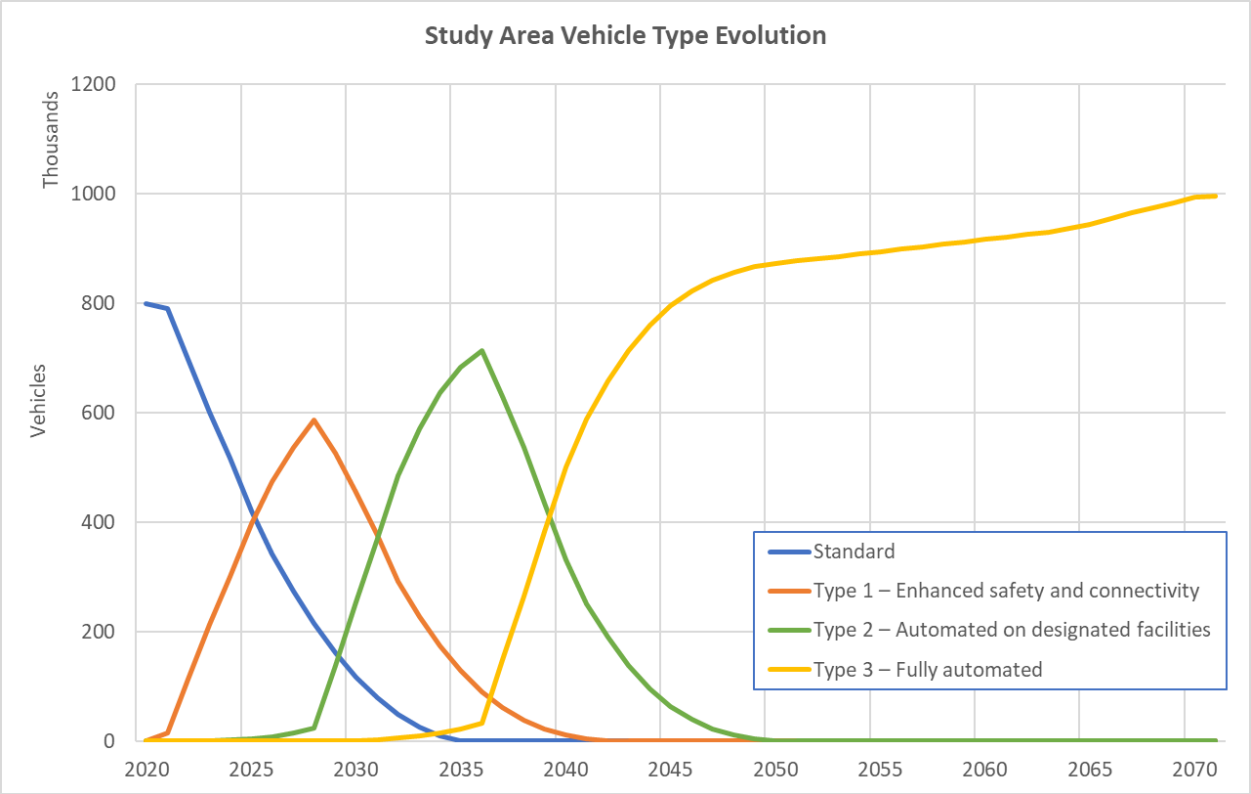
- Standard
- Type 1 – Enhanced safety features and connectivity
- Type 2 – Driver assistance and automation on specified facilities
- Type 3 – Fully automated

The evolution of vehicle types is based on the following scenario attributes:

- Available for purchase
- Years to acceptance
- Pre-acceptance buy rate
- Price difference
- Years of higher price
- Operating cost difference
- Replacement age
- Maximum vehicle age
- Electric vehicle rate

The various combinations of assumptions related to the vehicle fleet are primarily based on national expectations of technology development and market availability. The net result of these expectations is the vehicle fleet evolution shown in Figure 4. This chart shows that standard vehicles are phased out by 2035. Type 1 vehicles with enhanced safety features and connectivity options replace standard vehicles through 2028 when Type 2 vehicles are the primary new car purchase. These vehicles require a driver on most streets but can be switched to fully automated driving on specified facilities or dedicated lanes. Type 3 vehicles become available for general purchase in 2037 and are expected to represent 100 percent of the vehicles in operation by 2050. These vehicles are fully automated and do not permit driver control. One thing to note is that this chart represents all categories of cars, transit and trucks.

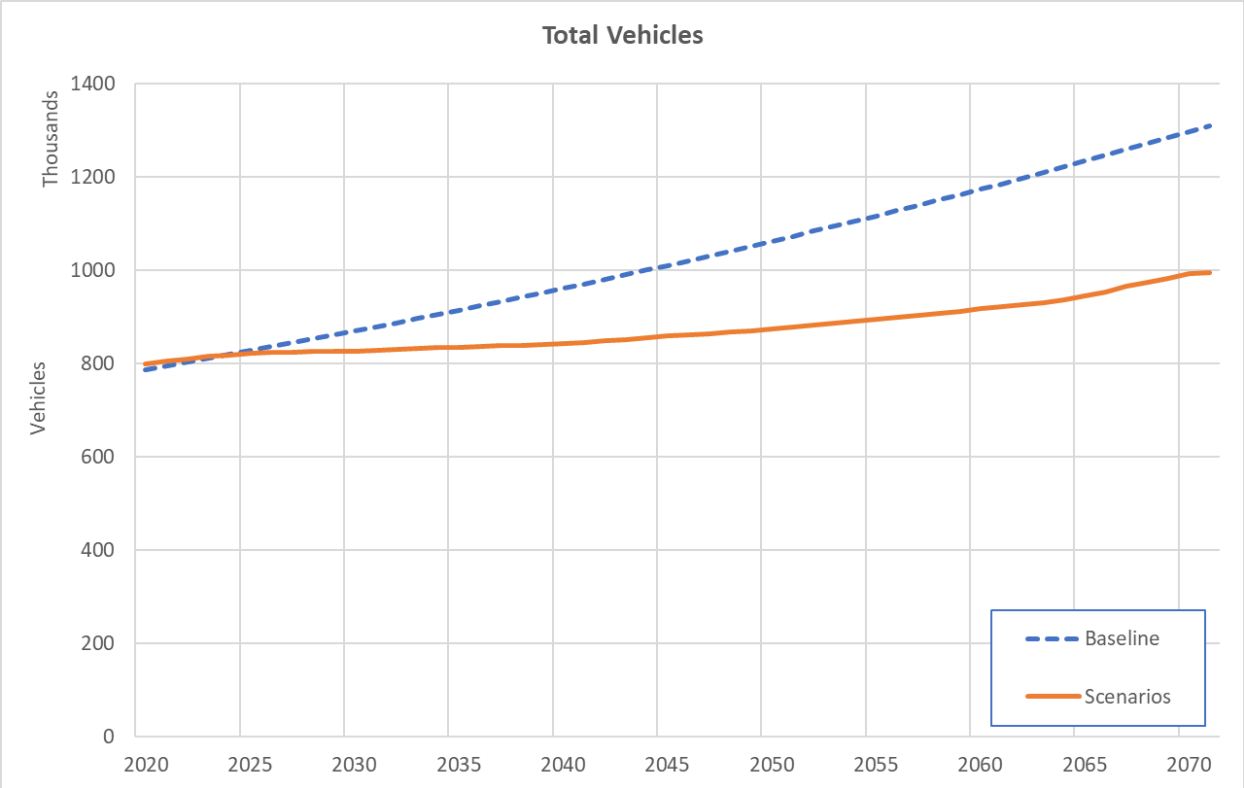
FIGURE 4: EVOLUTION OF CONNECTED AND AUTOMATED VEHICLE TYPES



The other aspect of vehicle evolution to automated technologies is how it impact household vehicle ownership. A ride service vehicle, for example, can replace the need for several household vehicles depending on the area type or the density of development. In dense urban areas a ride service vehicle can typically replace the need for 6 to 8 household-owned vehicles. Automated vehicles can also serve the travel needs of multiple household members. Rather than have a vehicle parked at work all day, an automated vehicle can drop off the worker and return home to serve other household travel needs. This plus greater dependence on ride services for some household trips can reduce the need for owning a second or third car. Households in dense urban areas can often depend on ride services for all of their travel needs and thereby forgo the cost and hassle of auto ownership.

For this study, the baseline growth in the number of vehicles is assumed to be consistent with the growth in the number of households. The net result of automated vehicles and increased dependence on ride services is a reduction in the total vehicle fleet as shown in Figure 5. This represents a 12.5 percent reduction in total vehicles in 2040. This includes a 21.8 percent reduction in household-owned vehicles and a 147 percent increase in ride service vehicles. In 2060, the total vehicle reduction increases to 21.9 percent with a 31.9 percent reduction in household-owned vehicles and a 138 percent increase in ride service vehicles.

FIGURE 5: CHANGE IN TOTAL VEHICLE FLEET IN THE STUDY AREA



Overview: Transportation Scenarios

Three future scenarios were development for this study in consultation with the City of Chandler and Valley Metro. These scenarios focused on the deployment and implementation of connected and automated vehicle (CAV) technologies and associated impacts to the public transportation system, traffic operations and congestion. The three scenarios were defined in terms of the technology penetration rate and the public transit system and are defined below.

SCENARIO 1: HOUSEHOLD OWNED AUTOMATED VEHICLES

Scenario 1 is the most aggressive scenario in terms of personal AV ownership, with the highest ownership rate of the three scenarios. This scenario emphasizes personal AV travel that allowed zero-occupancy vehicle miles traveled (VMT) (i.e., vehicles traveling without passengers). Ride services such as Uber or Lyft and ridesharing usage is lowest of the three scenarios.

An automated vehicle that does not require a licensed driver can also provide new freedoms for the elderly, mobility impaired and children, increasing the opportunity for additional trips. This scenario assumes underage children and elderly or mobility impaired people are permitted to travel in an automated vehicle without other adults present.

This scenario assumes there is no future expansion or service improvements to the existing Valley Metro transit system. Therefore, light rail along Arizona Ave is not included in this scenario. It also assumes no

new pricing strategies or parking restrictions are implemented. It does, however, assume a moderate increase in long term telework and e-commerce activity related to COVID-19 behavioral changes.

SCENARIO 2: MICRO TRANSIT AND FREEWAY AUTOMATION

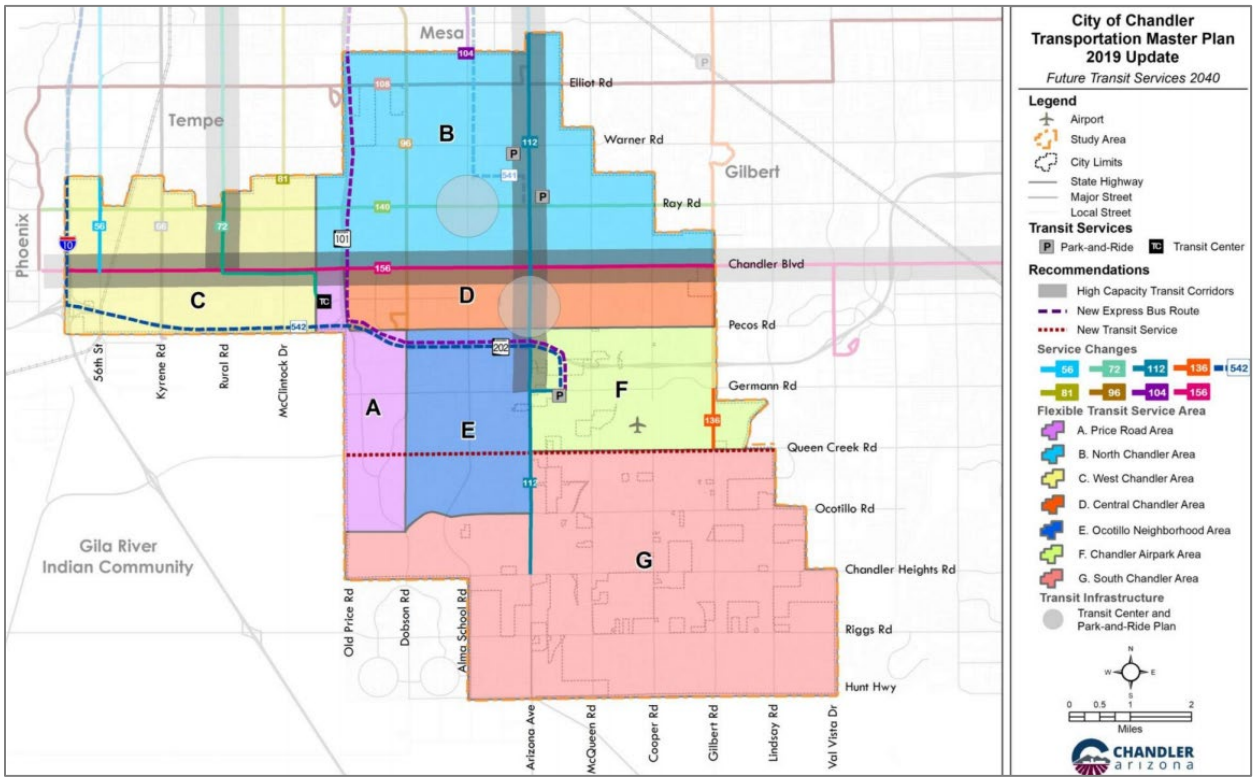
Scenario 2 includes a mix of personally owned and shared fleet AVs, with more emphasis on shared fleets than in Scenario 1. Lanes on freeways are dedicated to automated vehicles and fees are charged to automated vehicles that travel without passengers (i.e., zero-occupancy VMT fees). Freeway-only automation was selected for this scenario to represent a conservative approach to technology development; it is anticipated that automated travel will be permitted on freeways before it is permitted on arterial streets. Ride services and ridesharing usage is higher than Scenario 1 with first/last mile connections to transit.

This scenario retains the existing light rail system with no plans for future expansion on Arizona Avenue. It does, however, include service improvements to the existing bus system. Bus routes within area A: Price Road and area G: South Chandler Area, as indicated in the City of Chandler's 2019 Transportation Plan Update (see Figure 6) will be replaced with Micro Transit services. This makes the service more demand-responsive with reduced wait times and fewer transfers. As a result, this scenario eliminates the following bus routes:

- Route 81 (Hayden Rd/McClintock Drive);
- Route 96 (Dobson Road) south of Pecos Road only; and
- 104 (Alma School Road).

Unaccompanied children are not permitted to use automated ride services. This scenario assumes no parking management and the same long term telework and e-commerce activities as Scenario 1.

FIGURE 6: 2019 MICRO TRANSIT AREA REFERENCE



Source: City of Chandler's 2019 Transportation Plan Update, page 143

SCENARIO 3: PROMOTE TRANSIT

Scenario 3 is a mix of personally owned and shared fleet AVs, with more emphasis on shared fleets than in Scenario 2. This scenario includes zero occupancy VMT fees and permits children, the elderly and mobility impaired to travel without an accompanying adult in automated ride services.

For the transit system, this scenario uses this Micro Transit system from Scenario 2 and converts the following bus routes to AV buses:

- Route 96 (Dobson Road) north of Pecos Road only;
- Route 108 (Elliot Road/48th Street); and
- Route 140 (Ray Road)

This scenario also increases transit frequencies on existing routes by 50 percent. Transportation Network Companies (TNC) (e.g., Uber and Lyft) are utilized for first/last mile connections, with the highest participation rate of all the scenarios. A light rail transit guideway is assumed on Arizona Avenue within the City of Chandler.

Lanes on freeways and most major arterials are dedicated to connected and automated vehicles. In addition, select general-purpose lanes on the region's major roadways will be converted to HOV lanes to

promote carpooling, ridesharing and transit usage. If a roadway identified already has an HOV lane, a second lane is added for this scenario. Roadways identified include:

- McQueen Road
- Ray Road
- SR 202 from I-10 to Val Vista Drive
- I-10 from SR202 to 3rd Street
- US 60 from Gilbert Road to I-10

SCENARIO PARAMETER COMPARISON

The following table is a quick reference for the scenario parameters.

TABLE 2: SCENARIO REFERENCE

	Scenario 1: Household Owned AVs	Scenario 2: Micro Transit and Freeway Automation	Scenario 3: Promote Transit
Transit	Existing transit system with no plans for expansion	Replace some bus routes with Micro Transit, add some first/last mile services and reduce wait times	Add Light Rail on Arizona Avenue, expand first/last mile services, add AV bus routes with a 50% more frequent service and expand Micro Transit services
Vehicle Ownership	Predominately personally owned	Mix of personally owned and shared	Mix of personally owned and shared
Dedicated AV lanes	N/A	On Freeways	On Freeways and Major Arterials
Ride Services	Low	Medium	High
Road Usage	Existing Conditions	Existing Conditions	Add HOV lanes to major facilities
Pricing	N/A	Zero-Occupancy VMT fees	Zero-Occupancy VMT fees
Parking Management	N/A	N/A	N/A
Induced Demand	Children, elder and mobility impaired are permitted to ride solo	Children must be accompanied by an adult	Children, elder and mobility impaired are permitted to ride solo
Telework and E-commerce	Moderate long-term increase	Moderate long-term increase	Moderate long-term increase

Performance Metrics

Mobilitics™ interpolates and extrapolates performance data derived from the MAG regional model for 2020 and 2040 to establish baseline conditions. The model then considers the detailed scenario definitions and uses the latest in national and international research to quantify the potential performance impacts. The results of the scenario analysis are compared to the standard MAG forecasts to highlight the differences between the potential outcomes and the forecasts that planners are using to make planning decisions. This level of uncertainty in the outcomes means that continual observation and careful consideration will be needed in the coming years as new technologies and business models

are introduced to ensure that public policy is steering towards the desired outcomes and benefits. Where a trend is visible in all AV Scenarios, this study indicates that the trend is likely to occur. That does not mean there is no chance for the results to deviate from what is shown. New technologies that have yet to be invented, innovative marketing strategies and business models and even political, economic, societal and cultural shifts could alter these three different futures and their impacts on the City.

Mobilitics estimates each performance measure over the next fifty years (i.e., 2020 through 2070). Comparison tables of individual performance measures can also be prepared for specified future horizon years. For this analysis, statistics for 2020, 2040 and 2060 will be extracted to summarize the impacts. Since full automation is not expected before 2050, the 2040 and 2060 data provide a range of impacts based on partial and full automation. These summarizes will first be calculated for the subarea selected for this study and then focused on the City of Chandler. The subarea performance measures provide a broader view of the area wide impacts while the City of Chandler summaries are much more narrowly focused.

VEHICLE MILES OF TRAVEL

The first performance measure of interest is vehicle miles of travel (VMT). The general expectation is that VMT tends to increase with vehicle automation due to zero occupancy vehicle repositioning, longer trip lengths and mode shifts from transit or carpool to ride services. Repositioning for household-owned automated vehicles could be for parking the car at satellite parking facilities or having it return home to serve trips for other household members. Longer trip lengths are typically related to reduced values of time. Since the traveler is not driving the automated vehicle, they can engage in other activities while being driven to their destination. This could enable people to live further away from work to take advantage of cheaper or more spacious housing options. At the right price point and service level, ride services can be an attractive alternative to taking transit and thus increase vehicle miles of travel.

Figure 7 shows the estimated VMT impacts for the three scenarios and baseline conditions. The chart shows a slight drop in VMT through about 2037 when automated vehicles become the primary new car purchase. At this point VMT increases for all scenarios with the greatest increase in Scenario 1 – Household Owned AVs. Figure 8 provides a breakdown of the vehicle miles of travel for the three car types. The change in VMT for household-owned cars increases significantly between 2040 and 2060.

FIGURE 7: SUBAREA VEHICLE MILES OF TRAVEL

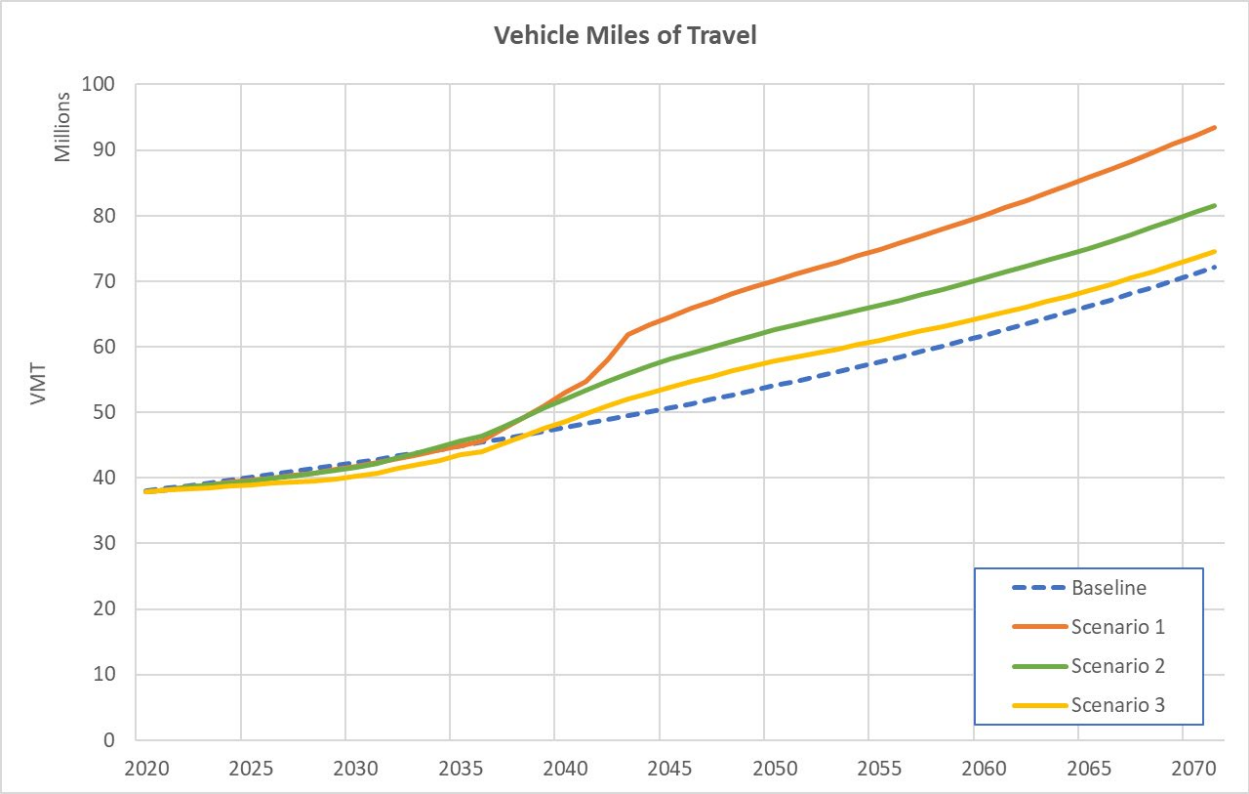
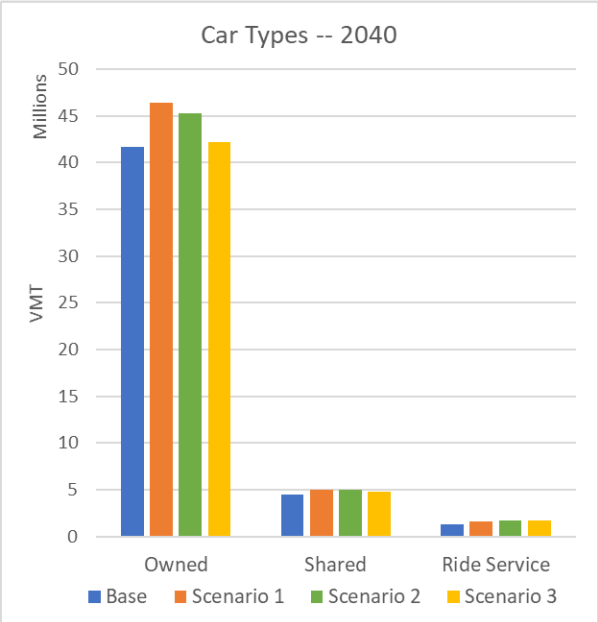


FIGURE 8: SUBAREA VMT BY CAR TYPES



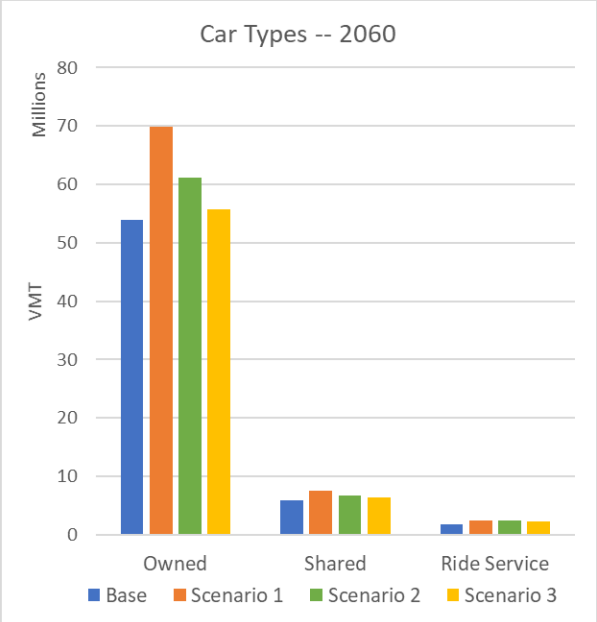
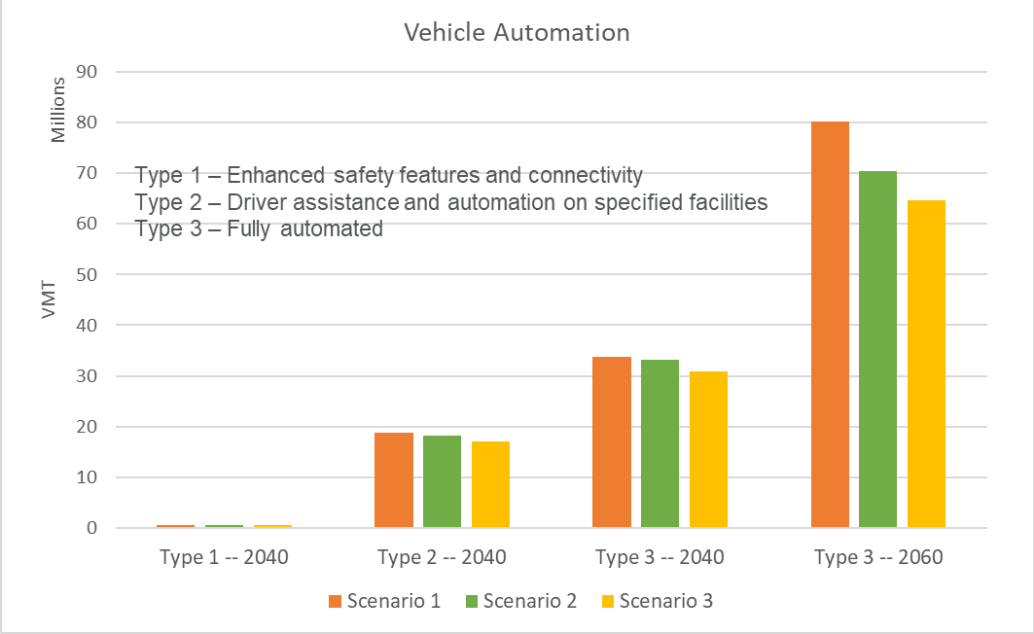


Figure 10 provides an additional breakdown of subarea VMT. This figure shows the share of VMT by automated vehicle type in 2040 and 2060. Very little of the 2040 VMT is made by Type 1 vehicles that only have enhanced safety and connectivity features. About a third of the VMT is from Type 2 vehicles that provide driver assistance and automation on specified facilities. The major of VMT is fully automated. By 2060 all of the VMT is fully automated.

FIGURE 9: SUBAREA DISTRIBUTION OF AUTOMATED VEHICLE TYPES



TRAVEL TIME

Changes in travel time are an important performance consideration for most transportation studies. Vehicle hours of travel and vehicle hours of delay are typical performance measures. Dividing vehicle miles of travel by vehicle hours of travel is average speed which is a useful measure for normalizing growth in travel. Vehicle hours of delay (VHD) is the difference between loaded or congested travel time and free flow travel time. From the perspective of connected and automated vehicles, VMT typically increases but VHD typically decreases. This is largely due to reduced gaps between vehicles, greater coordination that smooths flows and minimizes shock waves (i.e., stop and go traffic) and improved safety that tends to eliminate non-recurring congestion generated by traffic accidents. The net result is increased capacity or throughput and more reliable travel speeds.

Figure 10 shows the impact of connected and automated vehicles of roadway capacity by facility types. Note that capacities decrease as connected and automated vehicles start entering the market. This is due to the safety features built into these vehicles that cause them to obey traffic laws like speed limits and safe following distances. The improved capacity benefits don't emerge before most vehicles are

automated. At that point the freeways are estimated to experience a 60 percent increase is throughput. The improvements on arterials are 10 to 15 percent.

Figure 11 and Figure 12 show the net effects of increased automated VMT on VHT and VHD. All scenarios show a significant reduction in delay. The impact on hours of travel is mixed with Scenario 1 – Household-Owned AV showing an increase in the total hours of travel while the transit-related alternatives show a reduction. When these impacts are normalized, the peak period speeds shown in Figure 13 result in improved speeds for all scenarios.

FIGURE 10: CAPACITY ADJUSTMENT FACTORS BY FACILITY TYPE

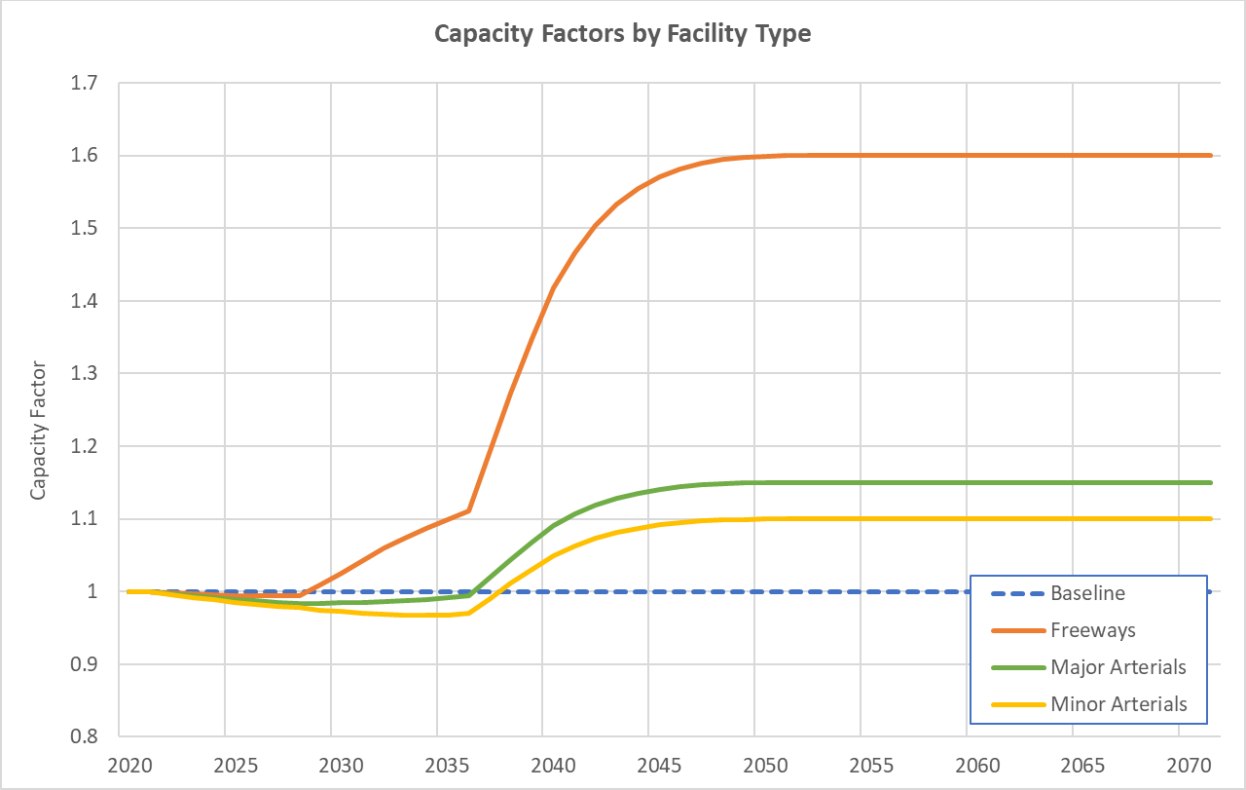


FIGURE 11: SUBAREA VEHICLE HOURS OF TRAVEL

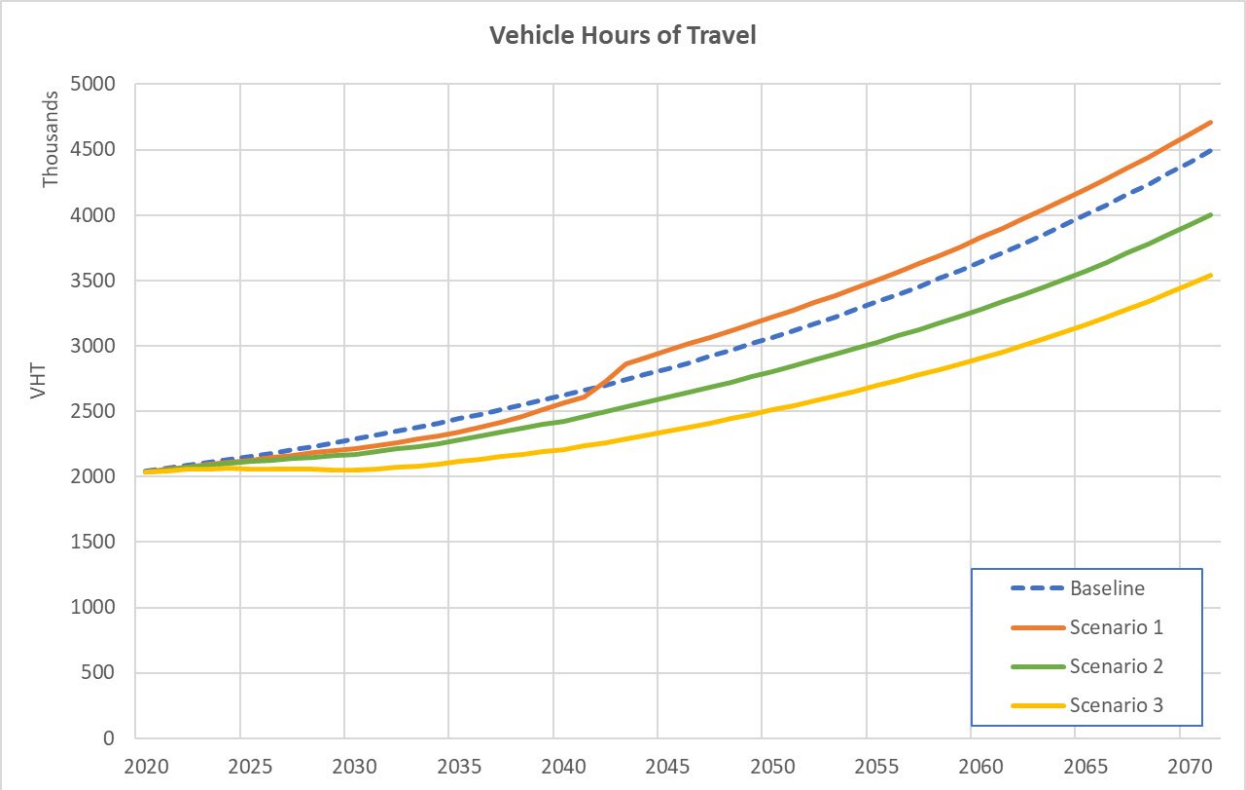


FIGURE 12: SUBAREA VEHICLE HOURS OF DELAY

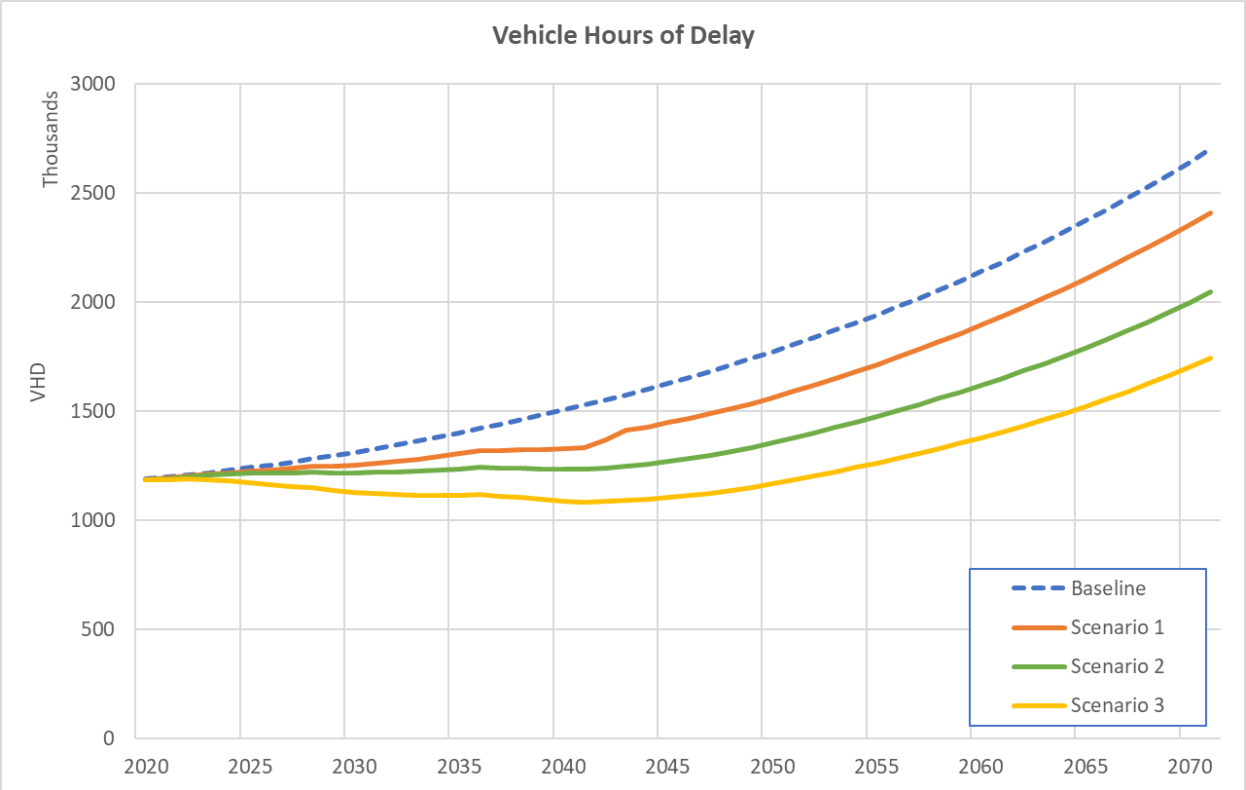
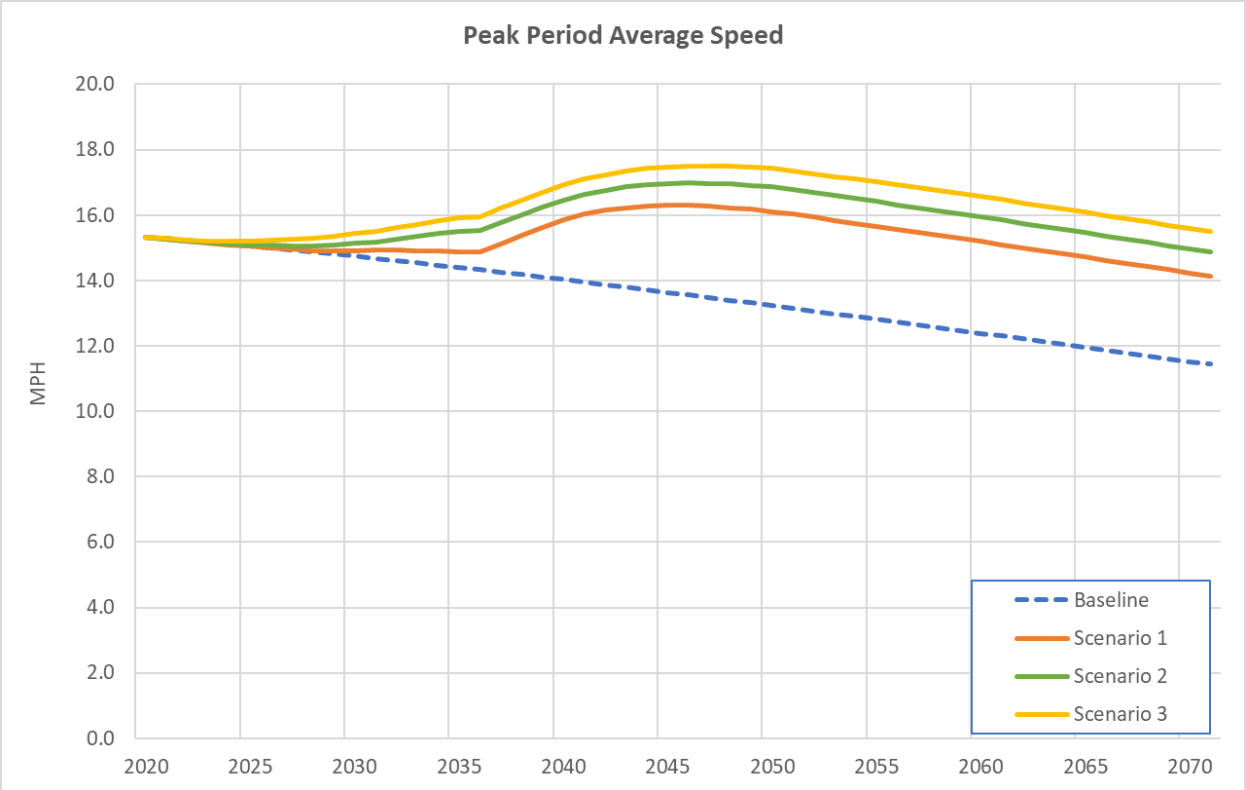


FIGURE 13: AVERAGE PEAK PERIOD SPEED IN THE SUBAREA AREA

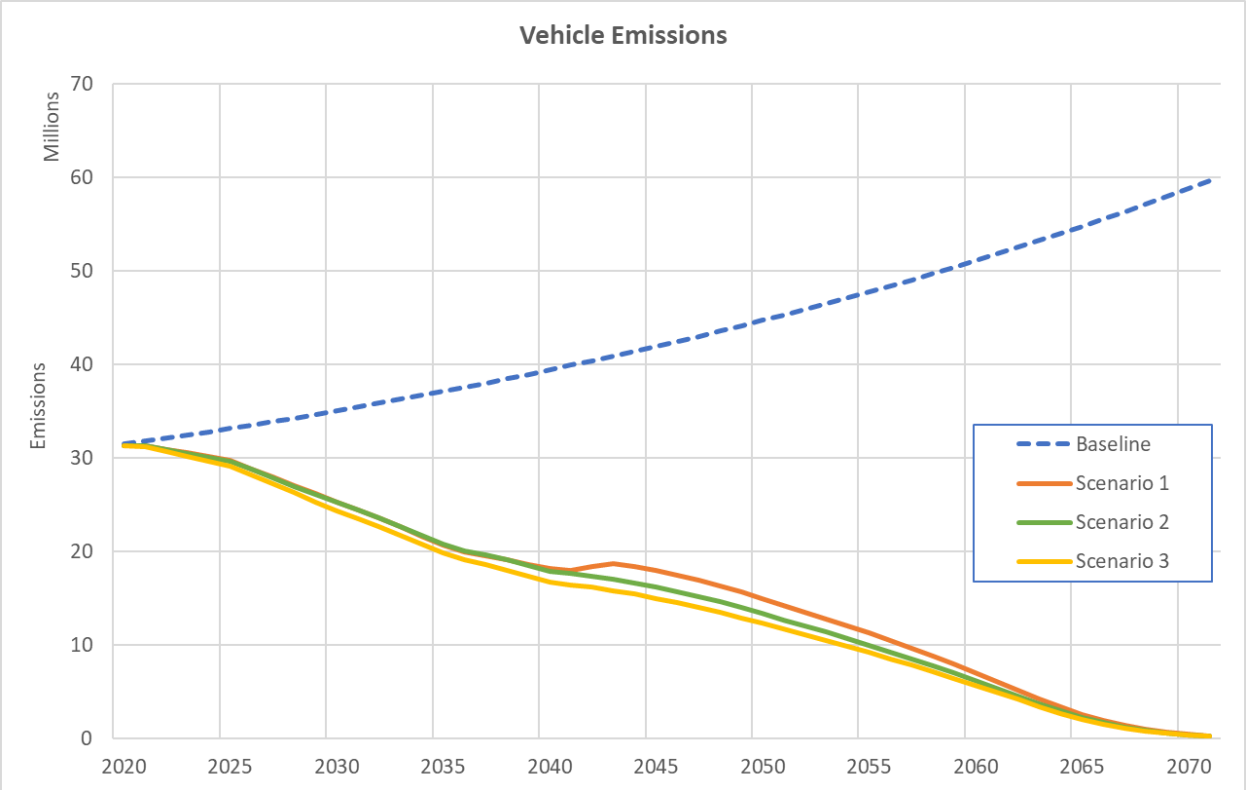


EMISSIONS

One of the more significant concerns about increasing VMT is the impact on air quality. Vehicle emissions are directly related to vehicle miles of travel at various speeds. In general, emissions increase with low speeds (especially stop-and-go traffic) and very high speeds. As such, automated vehicles will typically reduce the rate of pollution per vehicle mile by moderating and smoothing speed profiles. The other major factor in future emission rates is the likelihood that electric vehicles will replace gasoline engines over the next fifty years. Ride service vehicles and other commercial vehicles may transition to electric vehicles more quickly than household-owned vehicles. This is largely due to the need for charging stations. Corporate fleets can centralize charging stations while charging stations accessible to the general public will take time to develop.

For this study, a steady transition to electric vehicles was assumed. This results in the emission estimates shown in Figure 14. This estimate shows a 50 percent reduction in vehicle emission over the estimated baseline conditions by 2040 and zero emissions by 2070.

FIGURE 14: SUBAREA VEHICLE EMISSION ESTIMATES



TRANSIT

The impact of connected and automated vehicle on transit service and ridership is somewhat complicated. In dense urban areas with significant roadway congestion, transit can be an attractive alternative to driving. Transit also enables people without driver licenses, who cannot afford to own a car or are mobility impaired a way to get around. Emerging technologies may have positive and negative impacts of both types of transit users. Ride services and shared ride incentives can be an attractive and cost-effective alternative to a fixed-route transit service. They provide on-demand, point-to-point service that can save considerable travel time and inconvenience. On the other hand, ride services can also provide improved first mile/last mile access to line-haul transit services that provide an express option to heavily congested roadway alternatives. But transit can also adapt to connected and automated technologies and provide more attractive services to riders. For example, replacing traditional buses with automated buses can reduce operating cost that could enable the transit system to offer more frequent service and additional service hours. Larger buses could also be replaced by smaller buses serving more locations. The transit system could also decide to eliminate or subcontract less productive routes or service areas to ride service companies. Alternatively, automated Micro Transit services could be introduced to provide a public option with on-demand, point-to-point shared ride services.

Two of the scenarios defined for this study include a number of aggressive transit improvements that take advantage of connected and automated technologies in combination with enhanced ride services. The potential impacts of these scenarios on transit ridership are shown in Figure 15. The net result of the automated transit services is increased transit riders over the baseline forecast. Scenario 1 – Household Owned AV does not favor transit and as a result shows and overall reduction in ridership. Figure 16 breaks down these estimates by travel mode in 2040 and 2060. These charts show the significant benefit of Micro Transit in maintaining and increasing transit ridership.

FIGURE 15: SUBAREA TRANSIT RIDERSHIP

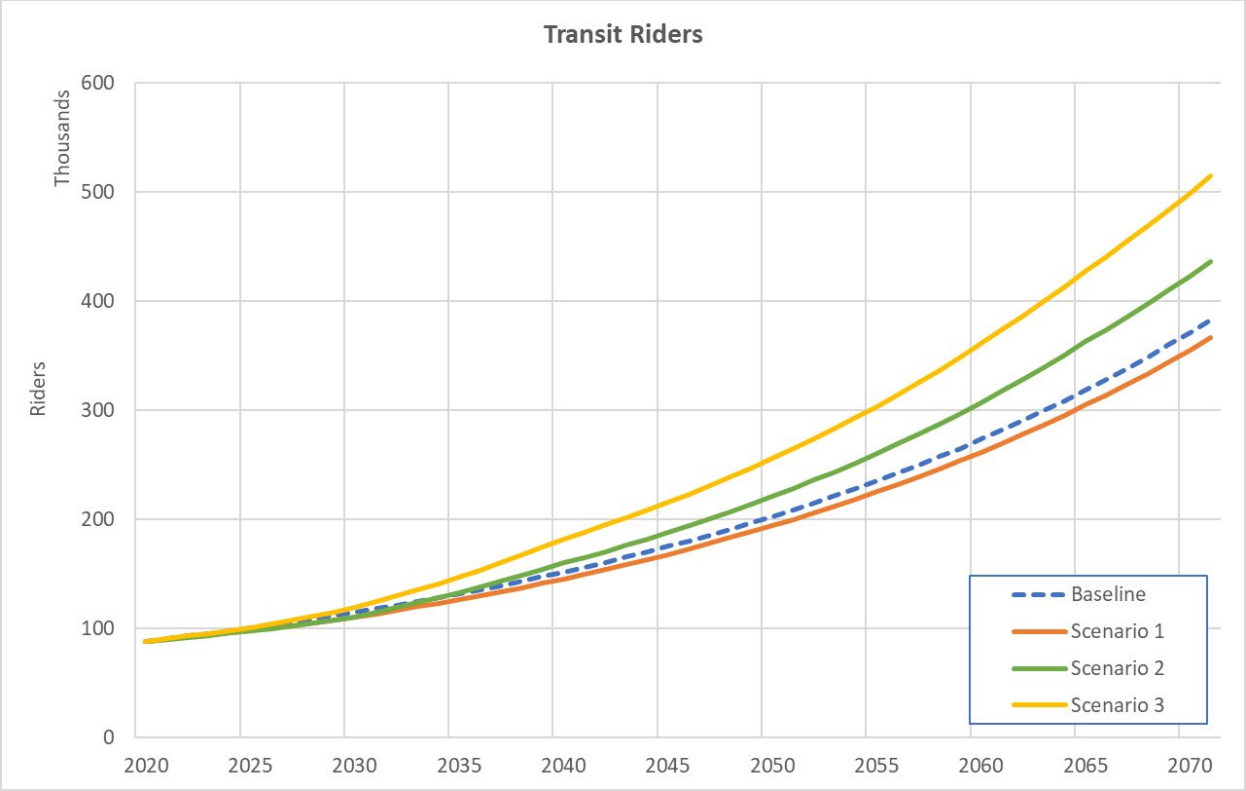
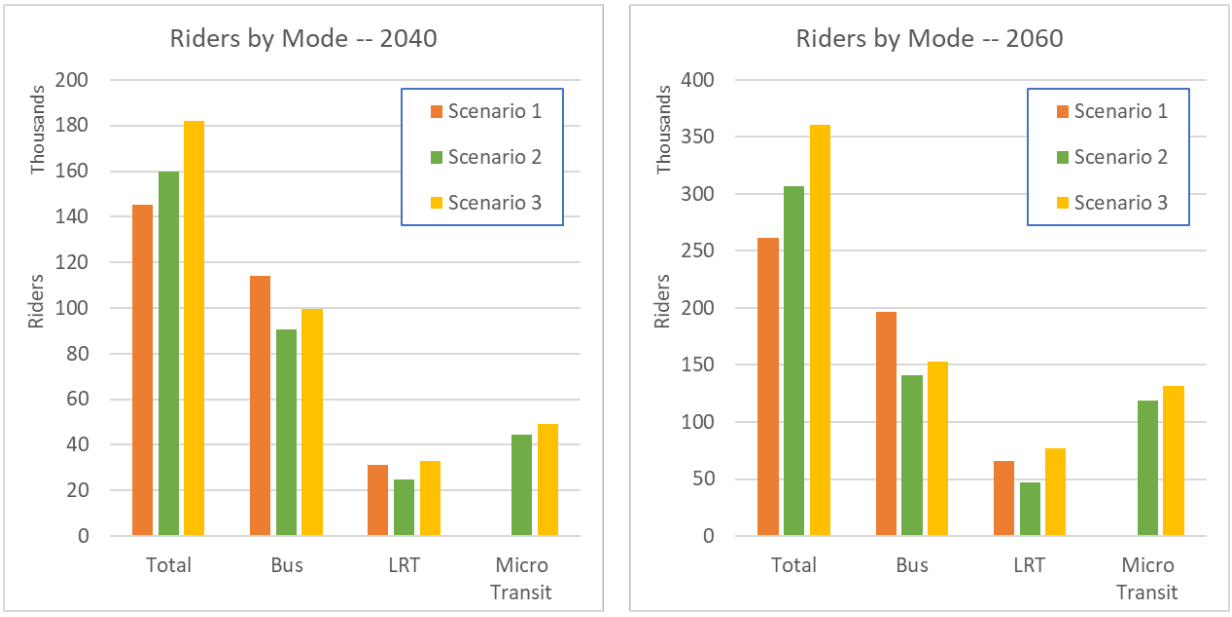


FIGURE 16: SUBAREA RIDERSHIP BY MODE IN 2040 AND 2060



SUMMARY OF SUBAREA ESTIMATES

Table 3 summarizes the overall growth assumptions for the study subarea between 2020, 2040 and 2060. Note the 2020 and 2040 values are derived from the MAG regional travel model and the 2060 values are extrapolated using the growth rate between 2020 and 2040. No attempt was made to constrain the future growth based on build-out land-use plans. The CAV Vehicles row is estimate by Mobilitics based on the evolving technology inputs. It highlights a slower growth in the vehicle fleet compared to the baseline estimates.

TABLE 3: GROWTH IN SUBAREA POPULATION AND EMPLOYMENT

	2020	2040	Percent Change	2060	Percent Change
Households	507,822	614,635	21%	743,916	46%
Population	1,361,965	1,644,970	21%	1,986,780	46%
Employment	500,862	633,154	26%	800,387	60%
Base Vehicles	787,680	961,747	22%	1,174,333	49%
CAV Vehicles	800,334	842,248	5%	917,285	15%

The change in key performance measures between each scenario and the estimated baseline conditions for 2040 and 2060 are summarized in Table 4. It shows an increase in vehicle miles of travel between 2 and 11 percent in 2040 that increases to between 4 and 30 percent by 2060. The largest increases are

for Scenario 1 – Household-Owned AV and the smallest increase is for Scenario 3 – Promote Transit. Vehicle Hours of Travel and Hours of Delay are reduced for all scenarios and time periods except Scenario 1 in 2060 where a 5 percent increase in hours of travel is estimated. In most cases the percent reduction in delay is twice as large as the change in hours of travel. This implies a reduction in congestion and an increase in speeds. Improvements in peak period average speeds are in the range of 13 to 34 percent. The 2060 speeds are higher than the 2040 speeds due to a fully automated vehicle fleet. The speeds are also higher for the scenarios with more transit investments. Transit ridership is reduced by Scenario 1 – Household-Owned AV but increases with increasing transit investments. A major component of the ridership increase for Scenario 3 – Promote Transit is the introduction of the light rail line on Arizona Avenue. Light rail in combination with complementary investments in first mile / last mile services, reduced wait times, Micro Transit and AV bus routes results in significant ridership increases.

TABLE 4: SUBAREA PERFORMANCE MEASURES FOR 2040 AND 2060

	Performance Measure				
	Vehicle Miles of Travel	Vehicle Hours of Travel	Vehicle Hours of Delay	Peak Period Speed (mph)	Transit Riders
2040					
Baseline	47,650,164	2,622,324	1,509,602	14.0	151,597
Scenario 1	53,063,440	2,562,995	1,330,665	15.9	145,332
Percent Change	11%	-2%	-12%	13%	-4%
Scenario 2	52,049,524	2,426,589	1,234,562	16.5	159,968
Percent Change	9%	-7%	-18%	17%	6%
Scenario 3	48,668,345	2,205,926	1,088,514	16.9	182,108
Percent Change	2%	-16%	-28%	21%	20%
2060					
Baseline	61,770,015	3,644,762	2,140,501	12.4	273,363
Scenario 1	80,104,780	3,826,987	1,895,416	15.2	261,647
Percent Change	30%	5%	-11%	23%	-4%
Scenario 2	70,464,179	3,282,541	1,620,187	15.9	307,032
Percent Change	14%	-10%	-24%	29%	12%
Scenario 3	64,546,701	2,907,152	1,377,797	16.6	361,024
Percent Change	4%	-20%	-36%	34%	32%

Scenario 1 -- Household-Owned AV; Scenario 2 – Micro Transit and Freeway Automation; Scenario 3 – Promote Transit

City of Chandler

Mobilitics also provides the option of generating statistics and charts for more localized combinations of zones. In this case, the City of Chandler was extracted as a separate summary to generate additional insights. Figure 17 shows the VMT profile for Chandler which represents about 19 percent of the overall subarea VMT shown in Figure 7 for the year 2020. The rate of increase is slightly greater and overall VMT increases generated by each scenario are slightly less than the subarea estimates. The vehicle hours of travel in Chandler (Figure 18) is about 16 percent of the overall subarea, but the rate of increase is much more significant, and the scenarios have less impact on VHT. A similar finding is shown for vehicle hours of delay (Figure 19). The delay is about 14 percent of the subarea estimate and the scenarios don't reduce the delay as much. This results in the peak speed changes shown in Figure 20. For the subarea estimates (Figure 13), the scenarios generated speed increases in the range of 22 to 28 percent in 2045. For the City of Chandler, the speed increases between 14 and 17 percent. The average peak period speed is slightly higher than the subarea in general, but the benefits significantly diminish over time. In other words, the congestion in Chandler is ultimately greater than the overall subarea. Transit ridership in Chandler (Figure 21) is 9 percent of the overall subarea in 2020. The rate of increase is greater which ultimately increases the Chandler share to 10 percent by 2060. The transit ridership generated by Scenario 3 – Promote Transit is double the current ridership in 2040. Figure 22 shows the breakdown of Chandler ridership by mode. Scenario 3 shows the greatest total ridership, but much of the bus ridership is replaced by light rail and Micro Transit services. Note that the Arizona Avenue light rail ridership is significantly less than previous forecasts due to competition from other highway and transit automation options.

FIGURE 17: VEHICLE MILES OF TRAVEL WITHIN THE CITY OF CHANDLER

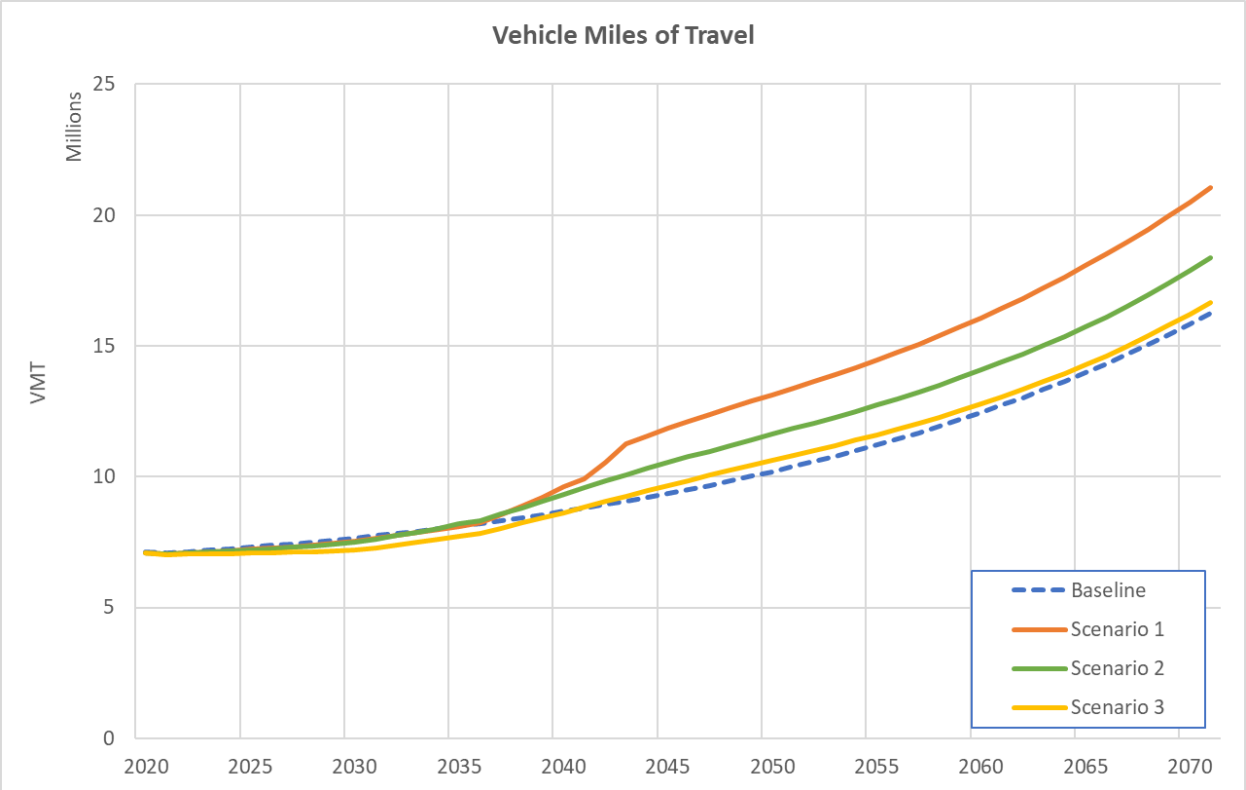


FIGURE 18: VEHICLE HOURS OF TRAVEL WITHIN THE CITY OF CHANDLER

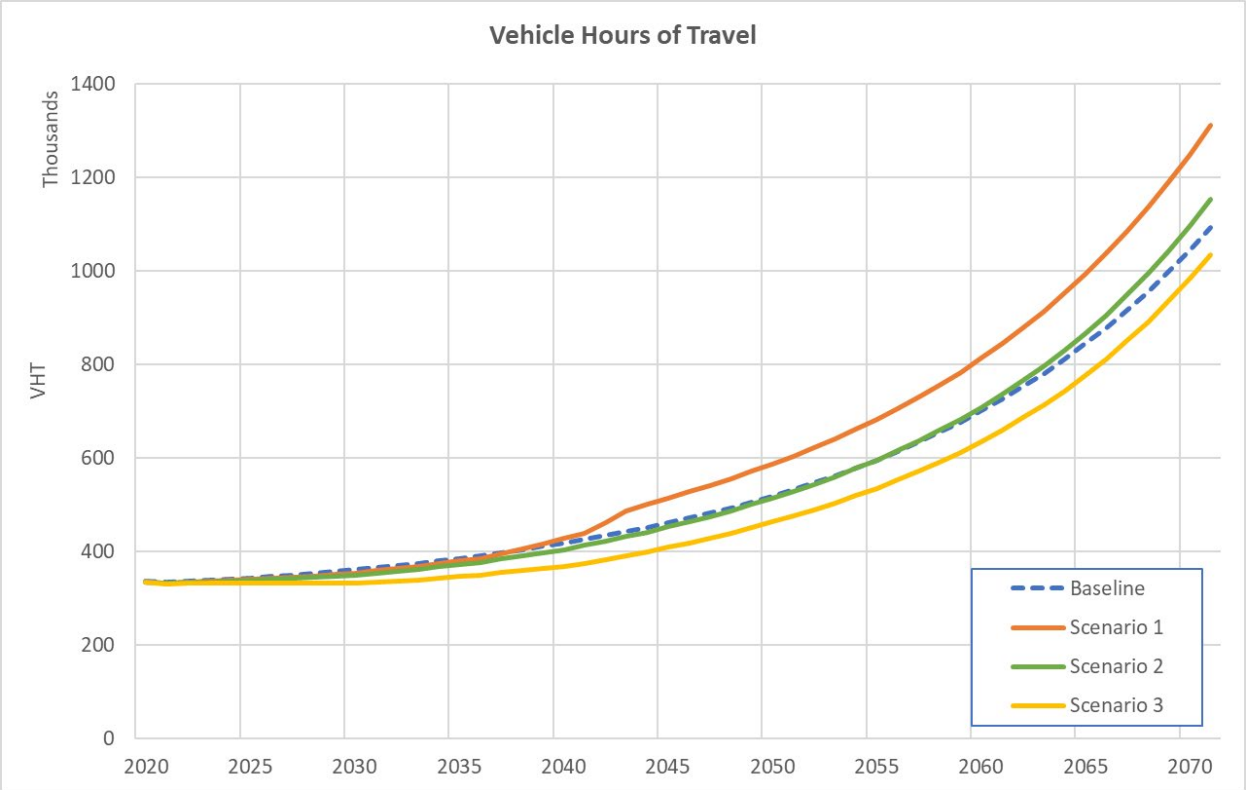


FIGURE 19: VEHICLE HOURS OF DELAY WITHIN THE CITY OF CHANDLER

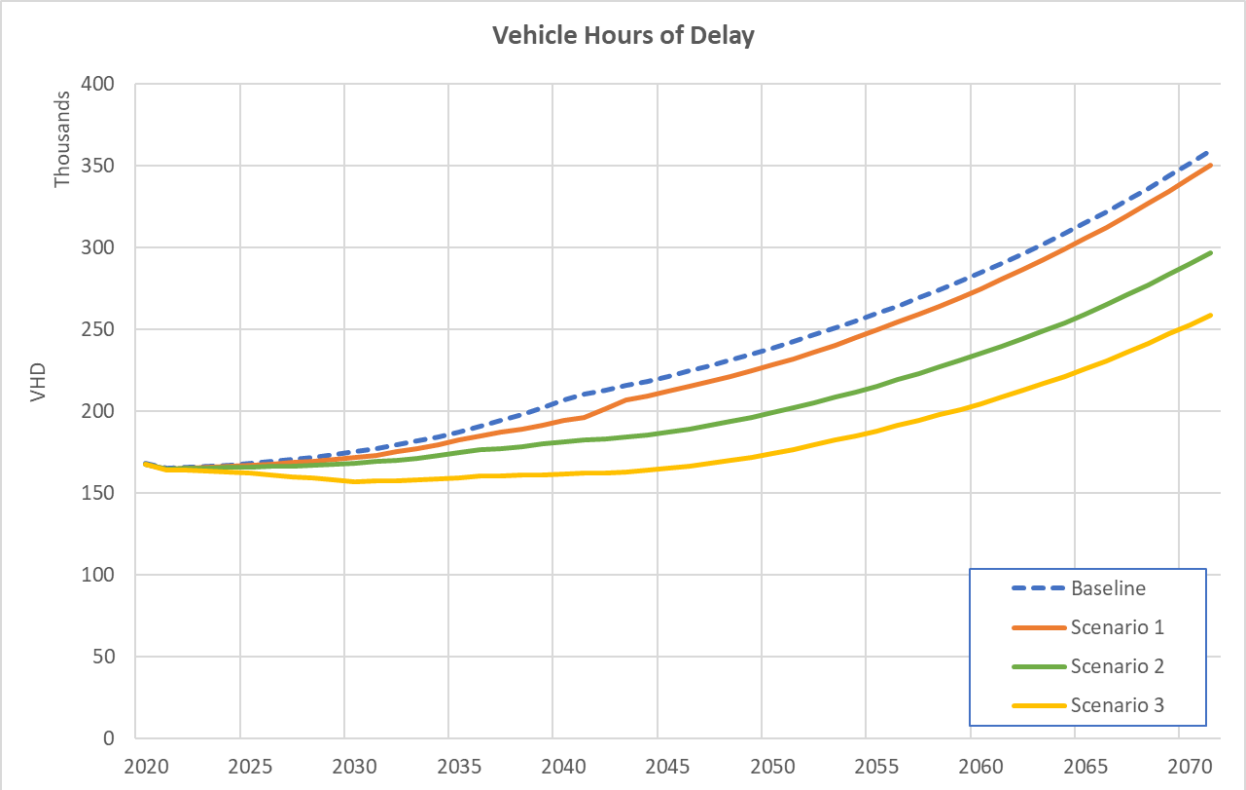


FIGURE 20: PEAK PERIOD SPEED WITHIN THE CITY OF CHANDLER

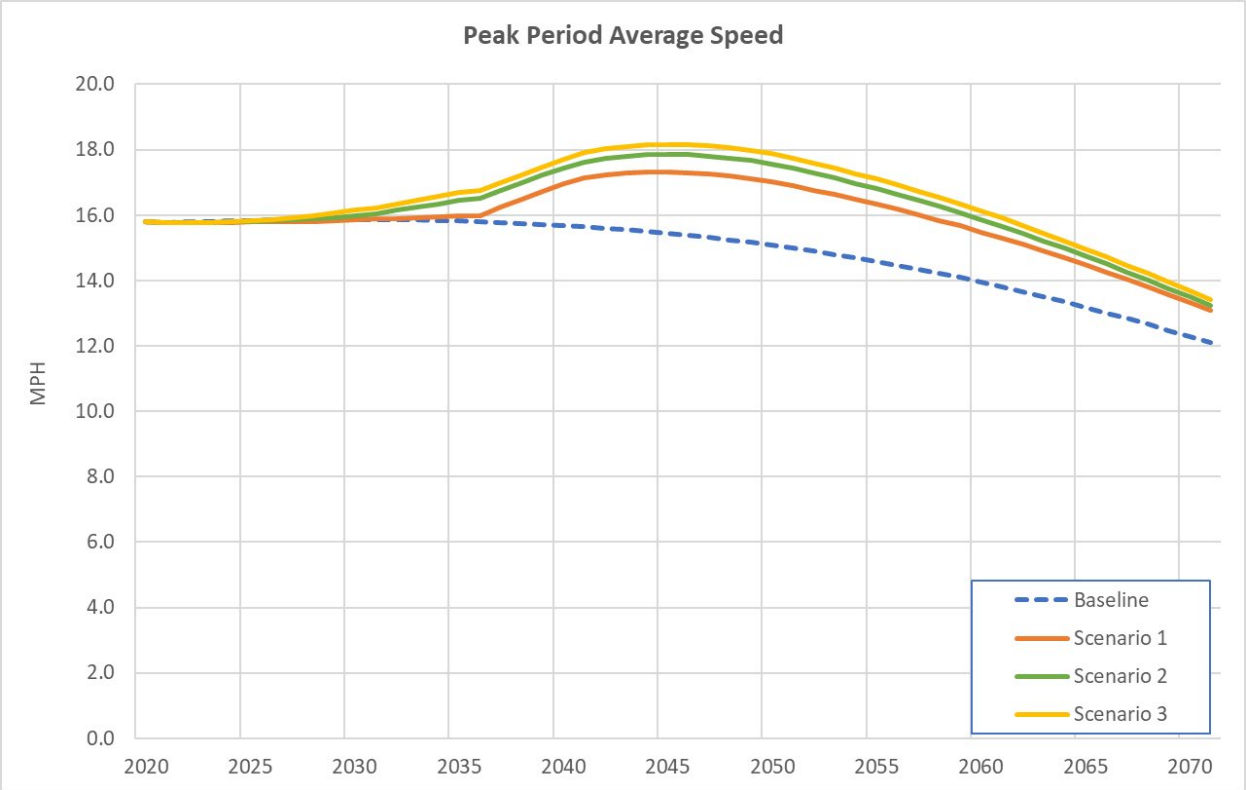


FIGURE 21: TRANSIT RIDERS WITHIN THE CITY OF CHANDLER

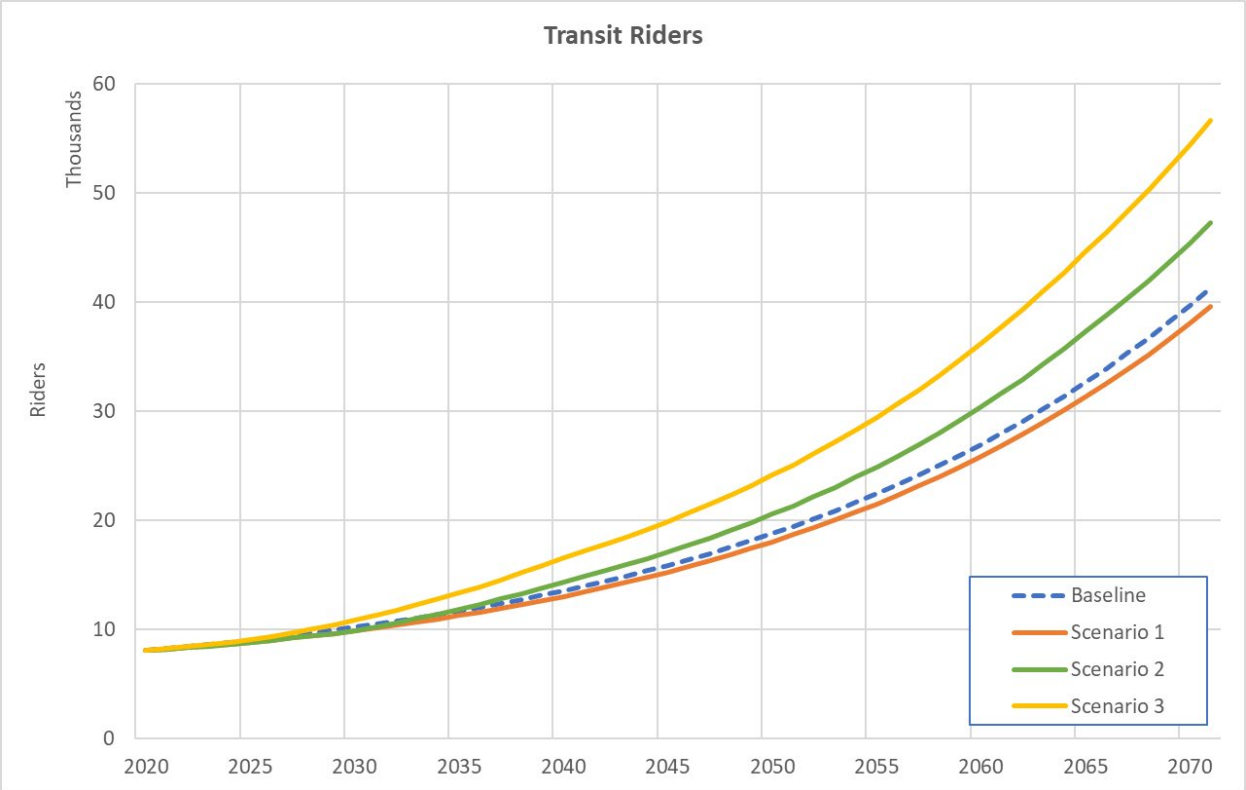
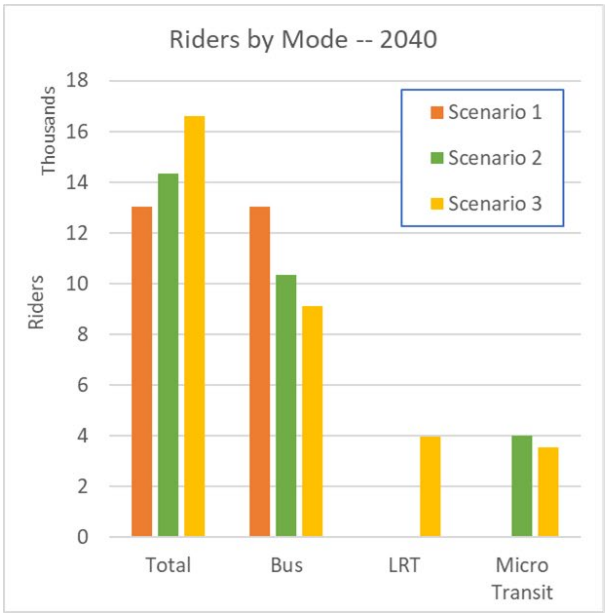
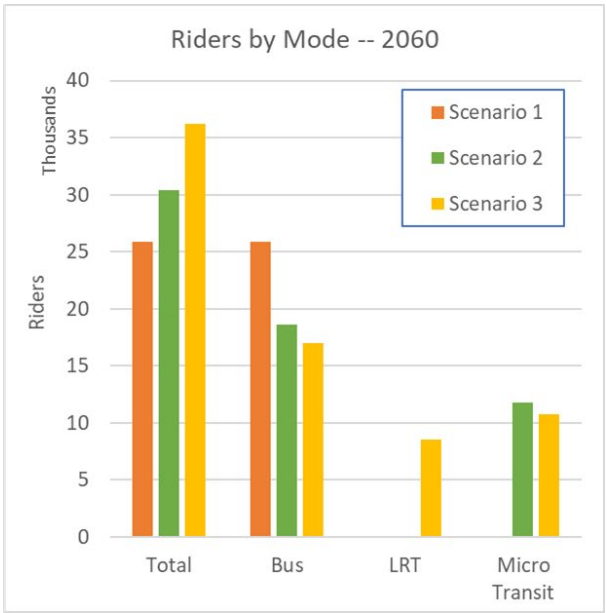


FIGURE 22: TRANSIT RIDERS BY MODE IN THE CITY OF CHANDLER





SUMMARY OF CITY OF CHANDLER ESTIMATES

The change in key performance measures between each scenario and the estimated baseline conditions for 2040 and 2060 are summarized in Table 5. It shows a change in vehicle miles of travel between -1 and 11 percent in 2040 that increases to between 3 and 29 percent by 2060. The largest increases are for Scenario 1 – Household-Owned AV and the smallest increase is for Scenario 3 – Promote Transit. Vehicle Hours of Travel and Hours of Delay are reduced for most scenarios and time periods. The largest exception is Scenario 1 in 2060 where a 16 percent increase in hours of travel is estimated. In most cases the percent reduction in delay is more than twice as large as the change in hours of travel. This implies a reduction in congestion and an increase in speeds. Improvements in peak period average speeds are in the range of 8 to 16 percent. The percent increases in speeds are greater in 2060 than 2040, but the actual average speeds are lower in 2060 than 2040. The speeds are also higher for the scenarios with more transit investments. Transit ridership is reduced by Scenario 1 – Household-Owned AV but increases with increasing transit investments. A major component of the ridership increase for Scenario 3 – Promote Transit is the introduction of the light rail line on Arizona Avenue. Light rail in combination with complementary investments in first mile / last mile services, reduced wait times, Micro Transit and AV bus routes results in significant ridership increases.

TABLE 5: CITY OF CHANDLER PERFORMANCE MEASURES FOR 2040 AND 2060

	Performance Measure				
	Vehicle Miles of Travel	Vehicle Hours of Travel	Vehicle Hours of Delay	Peak Period Speed (mph)	Transit Riders
2040					
Baseline	8,674,738	417,729	206,884	15.7	13,543
Scenario 1	9,607,968	427,168	194,699	17.0	13,022
Percent Change	11%	2%	-6%	8%	-4%
Scenario 2	9,324,984	404,174	181,324	17.4	14,352
Percent Change	7%	-3%	-12%	11%	6%
Scenario 3	8,616,209	368,060	161,549	17.7	16,589
Percent Change	-1%	-12%	-22%	13%	22%

	Performance Measure				
	Vehicle Miles of Travel	Vehicle Hours of Travel	Vehicle Hours of Delay	Peak Period Speed (mph)	Transit Riders
2060					
Baseline	12,456,167	700,643	285,004	14.0	26,962
Scenario 1	16,078,587	813,103	275,135	15.5	25,865
Percent Change	29%	16%	-3%	11%	-4%
Scenario 2	14,072,717	708,645	235,501	15.9	30,378
Percent Change	13%	1%	-17%	14%	13%
Scenario 3	12,780,756	634,955	204,827	16.1	36,239
Percent Change	3%	-9%	-28%	16%	34%
Scenario 1 -- Household-Owned AV Scenario 2 -- Micro Transit and Freeway Automation Scenario 3 -- Promote Transit					

Conclusions

The impacts of connected and automated vehicles on the study subarea and the City of Chandler may be significant. Much of the impact on system performance depends on many of the assumptions included in the three scenarios studied. Scenario 1 – Household-Owned AV tends to make system performance slightly worse compared to the estimated baseline conditions. There are reductions in delay and improved speeds that could compensate for increased VMT and less transit ridership. Adding the transit investments tends to improve system performance for most of the performance measures. Scenario 3 – Promote Transit shows the greatest benefits. One concern with Scenario 3 is that it includes so many highway improvements and a full array of transit improvements that the impacts of adding light rail to Arizona Avenue is less effective given automated technologies. In many respects the benefits estimated for Scenario 2 – Micro Transit and Freeway Automation are comparable to Scenario 3 and are likely to be more cost-effective and easier to implement.

Automated vehicles (AV) could be used poorly to continue the status quo (Scenario 1), or they could be used for good (Scenario 3). In Scenario 1, AV is largely used like current automobiles, with little multi-modal investment, and system performance degrades (greater emissions, longer travel times, etc.). In Scenario 3, AV is used for multi-modal solutions including Micro Transit and high capacity transit and system performance improves (lower emissions, less travel time, etc.). Therefore, the takeaway is that transit should be part of the automated mobility future. Riders (more riders than in the baseline) will be using transit in the future if the benefits of AV are applied to transit services and operations. It is up to planners and policy makers to plan a future that includes multi-modal AV solutions.