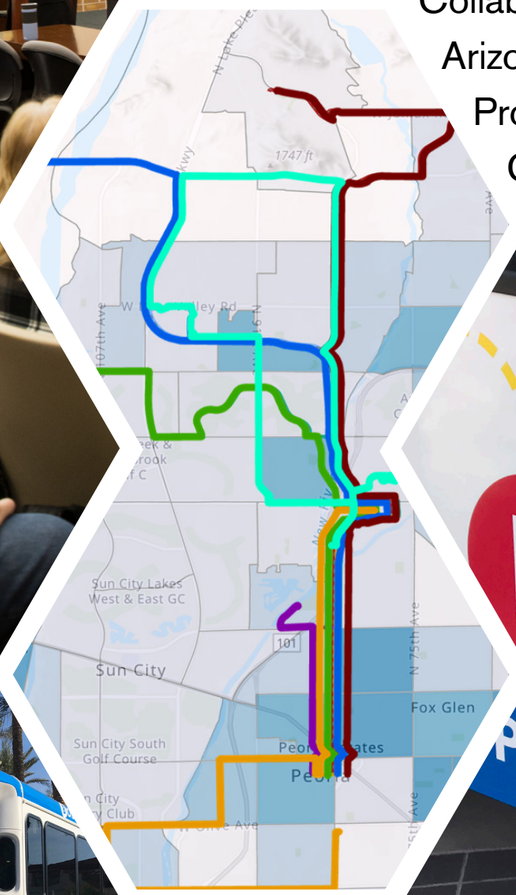
Optimizing POGO Services Through Case Study Analysis

A Spring 2020 Collaborative Project with Arizona State University's Project Cities & the City of Peoria



Sustainable Cities Network

Arizona State University

Project Cities

Cover images:

Ashley Lowery,
City of Peoria,
Project Cities,
Rui Li, and Keith Morphis

ACKNOWLEDGMENTS

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Cathy Carlat, Mayor

Michael Finn, Vice Mayor

Jon Edwards, City Councilmember

Vicki Hunt, City Councilmember

Bill Patena, City Councilmember

Bridget Binsbacher, City Councilmember

Denette Dunn, City Councilmember

Jeff Tyne, City Manager

Erik Strunk, Deputy City Manager

Katie Gregory, Deputy City Manager

Andrew Granger, Deputy City Manager

Arizona State University (ASU)

Julie Ann Wrigley Global Futures Laboratory

Peter Schlosser, Vice President, Global Futures Laboratory

Christopher Boone, Dean, College of Global Futures

Patricia Reiter, Director of Strategic Initiatives, Global Futures Laboratory

Meredith Simpson, Director of Operations, Global Futures Laboratory

On behalf of the Julie Ann Wrigley Global Futures Laboratory, the Global Institute of Sustainability and Innovation, and the School of Sustainability, we extend a heartfelt thank you to the City of Peoria for enthusiastically engaging with students and faculty throughout the semester. These projects provide valuable real-world experience for our students and we hope that their perspectives shine light on opportunities to continuously improve Peoria's future livelihood and community well-being.

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To access the original student reports, additional materials, and resources, visit:
links.asu.edu/PCPeoriaTransit20S

ABOUT PROJECT CITIES

The ASU Project Cities program uses an innovative, new approach to traditional university-community partnerships. Through a curated relationship over the course of an academic year, selected Community Partners work with Project Cities faculty and students to co-create strategies for better environmental, economic, and social balance in the places we call home. Students from multiple disciplines research difficult challenges chosen by the city and propose innovative sustainable solutions in consultation with city staff. This is a win-win partnership, which also allows students to reinforce classroom learning and practice professional skills in a real-world client-based project. Project Cities is a member of Educational Partnerships for Innovation in Communities Network (EPIC-N), a growing coalition of more than 35 educational institutions partnering with local government agencies across the United States and around the world.

ABOUT SUSTAINABLE CITIES NETWORK

Project Cities is a program of ASU's Sustainable Cities Network. This network was founded in 2008 to support communities in sharing knowledge and coordinating efforts to understand and solve sustainability problems. It is designed to foster partnerships, identify best practices, provide training and information, and connect ASU's research to front-line challenges facing local communities. Network members come from Arizona cities, towns, counties, and Native American communities, and cover a broad range of professional disciplines. Together, these members work to create a more sustainable region and state. In 2012, the network was awarded the Pacific Southwest Region's 2012 Green Government Award by the U.S. EPA for its efforts. For more information, visit *sustainablecities.asu.edu.*

PROJECT CITIES TEAM

Director

Anne Reichman
anne.reichman@asu.edu
480-965-2168

Program Manager

Steven Russell
steven.russell@asu.edu
480-727-2698

Program Assistant

Lindsey Sikorski, Master of Landscape Architecture

Program Assistant

Jordan Sene, Bachelor of Science in Sustainability

ASU Sustainable Cities Network
Arizona State University

Project Cities

projectcities.asu.edu

Sustainability through local action

ABOUT PEORIA

Ranked as the No. 1 place to live in Arizona by Money Magazine and the only Arizona city named as one of the best cities in the U.S. by Yahoo! Finance, the City of Peoria is currently home to more than 171,000 residents. The City enjoys a reputation as a family-oriented, active community with an exceptional quality of life. Peoria entertainment and recreational amenities include popular attractions such as Lake Pleasant, a large network of trails and open space, community parks, recreation centers, community theater, libraries, pools, and the spring training home for the San Diego Padres and the Seattle Mariners.

The City has demonstrated a strong commitment to sustainability, as evidenced by its directive to incorporate LEED building design standards, a council-adopted Sustainability Action Plan, and a dedicated full-time staff person to manage and coordinate organization-wide sustainability initiatives.

PEORIA TEAM

Project Cities Community Liaison

Jay Davies, Chief of Staff, City Manager's Office

Peoria Project Leads

Jennifer Stein, Director of Communications

John Sefton Jr., Parks, Recreation, and Community Facilities Director

Cape Powers, Water Services Director

Kevin Burke, Public Works Director

Jay Davies, Chief of Staff, City Manager's Office

Scott Whyte, Real Estate Development Officer

Cathy Colbath, Transit Manager

Daniel Kiel, Planning and Engineering Manager, Water Services

Victoria Caster, Sustainability and Water Conservation Coordinator

Peoria is the place
World class ▪ Sustainable ▪ Future Ready

peoriaaz.gov

8401 West Monroe Street
Peoria, Arizona 85345
T 623.773.7300
F 623.773.7309

June 4, 2020

Dear Peoria community members,

It is with tremendous gratitude and excitement that we bring to your attention the results of the first year of our partnership with ASU's Project Cities program. This collaboration provided the opportunity to move beyond traditional resources, and explore all that is possible by working alongside faculty and students across several academic programs.

Project Cities is one of several partnerships we enjoy with ASU, and part of our ongoing strategy to learn from innovative community leaders as we address the complex challenges and opportunities we face as a fast-growing community. With a modest investment in this program, we received extensive research, creative recommendations, diverse perspectives, and innovative deliverables that take several key initiatives to the next level for us.

These include our efforts around water conservation, transit, placemaking, smart cities, and the possibilities around our Skunk Creek corridor near the P83 Entertainment District. Many of these efforts entailed public participation, and you may have participated by speaking to students at one of several Peoria events they attended, or by sharing your personal insight through a survey. By engaging students and faculty on these subjects, we have advanced our understanding and positions on each topic much more quickly than we could have without their assistance.

The project results provided us with invaluable insights into many of our most important opportunities and we are proud to see the students' deliverables advancing. We hold our partnership with ASU and Project Cities in high esteem and look forward to continuing this work on additional projects in the coming year.

Sincerely,

Cathy Carlat, Mayor

Jeff Tyne, City Manager

Peoria, Arizona

Proud partner of

ASU Sustainable Cities Network

Arizona State University

Project Cities

Rio Vista Recreation Center

Demographics

total population: **172,259**

median age: **39.5**

highly skilled and educated workforce of 85,252

11,997 veterans live in Peoria

73% of residents are homeowners

median property value: **$230,400**

31% of residents hold a Bachelor's degree or higher

median household income: **$73,039**

Schools

#3 of 131 Best School Districts for Athletes in Arizona

#5 of 40 Best School Districts in Phoenix Metro Area

#7 of 130 Best School Districts in Arizona

The Peoria Unified School District is one of the largest employers in the West Valley. The district consistently receives high ratings and offers signature programs such as the Career and Technical Education programs.

Peoria is also home to Huntington University, a liberal arts college offering digital media education in animation, broadcasting, film, graphic design and other digital media arts.

Leading industries

Peoria, Arizona is not just a scenic suburb of Phoenix, but also a thriving economic development hub with an educated workforce and high-end residential living. There are 22,470 employers and more than 75,000 people employed within Peoria. Leading industries include health care and social assistance, retail trade, and finance and insurance. Highest-paying industries include utilities, manufacturing and public administration. Beyond these industries, Peoria works actively to attract businesses from aerospace and defense, film and digital media, technology and innovation, hospitality and tourism, and research and development. Peoria is the place for business owners, developers and investors.

Health Care & Social Work

10,905 employees

Retail Trade

10,628 employees

Finance & Insurance

6,574 employees

History

Founded in 1886 by Midwestern settlers, Peoria is nestled in the Salt River Valley and extends North into the foothills around Lake Pleasant. Beginning as a small agricultural town, the economy received a major boost when a railroad spur line was built along Grand Avenue. The construction of the Roosevelt Dam in 1910 secured a reliable water supply, attracting more settlers to the area and business endeavors to the town center. Peoria's economy continued to have an agricultural focus for decades. Continually growing, Peoria assumed city status in 1971 with a population of 4,792. It has since grown into a city with a population over 172,000, and is renowned for its high quality of life and recreational amenities.

Sustainability

Peoria has demonstrated leadership in municipal sustainability efforts through a wide range of actions. Listed below are some of the City's sustainability accomplishments.

- Incorporation of LEED building design standards
- Appointment of a full-time city staff member who manages and coordinates sustainability initiatives
- Sustainable urban planning practices including open space planning and water management principles
- Sustain and Gain: Facebook page and brochures keep residents up to date on city sustainability efforts and ways to get involved
- Water Conservation Program: free public classes, public outreach at city events, and water rebate incentives for residents
- Council-Adopted Sustainability Action Plan: this strategic planning document, in its second iteration, ensures city departments are developing sustainability-oriented goals, tracking success metrics, and encouraging cross-communication in the preparation of Sustainability Update presentations made to the Peoria City Council on an annual basis
- Sustainable University: courses and workshops to empower residents to make small changes that make Peoria a better place to live. Topics covered include residential solar, gardening, composting and recycling

Awards and recognition

- Received three Crescordia awards by Arizona Forward at the annual Environmental Excellence Awards in 2016
- 12th City for Green Space in the U.S. in 2019 *(Wallethub)*
- Top 15 Safest Cities in the U.S. 2017-2019 *(Wallethub)*
- 6th Wealthiest ZIP Code in 2020 *(Phoenix Business Journal)*
- Top 50 Hottest Hoods in 2018 *(Phoenix Business Journal)*
- 10th Best City to Raise a Family in 2018 *(Wallethub)*
- Top 100 Golf Course in U.S. 2017-2019 *(Golf Digest)*

Lake Pleasant

1886 — **2020**

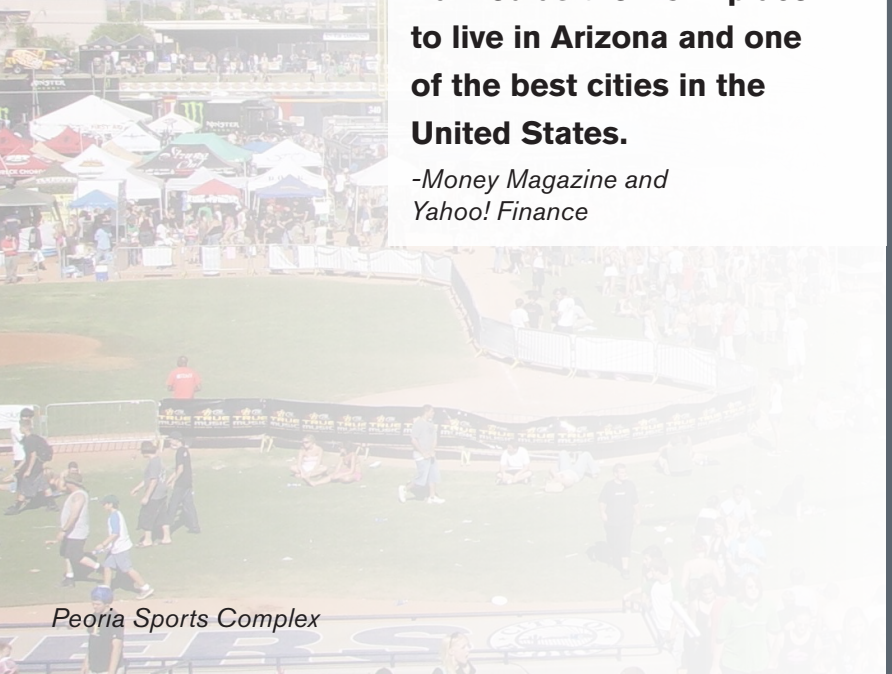
- **1889** — Peoria founded by William J. Murphy
- **1889** — First school district formed
- **1919** — Chamber of Commerce organized
- **1954** — Assumed city status with a population of 4,792
- **1954** — Peoria incorporated
- **1971** — Centennial celebration
- **1977** — Brewers spring training begins at Greenway Sports Complex
- **1986** — Theater for the Performing Arts and Rio Vista Recreation Center opened
- **1994** — Peoria Sports Complex opened
- **2007** — 20-year extension spring training agreement with San Diego Padres and Seattle Mariners
- **2012** — Selected as site of new $70M health clinic for Maricopa County Integrated Health System
- **2017**

Livability

Peoria is renowned as a great place to raise a family and start a career. A plethora of local amenities and attractions contribute to Peoria's livability. Beyond the tourist attractions of Spring Training and Lake Pleasant, the City offers many community facilities and recreational opportunities for all ages and interests such as an extensive public park system and annual community events. Peoria's dedication toward livability is also evident in the City's latest General Plan which addresses sustainable water use, housing, public services and more.

Ranked as the No. 1 place to live in Arizona and one of the best cities in the United States.

-Money Magazine and Yahoo! Finance



Peoria Sports Complex

Peoria strives to uphold these six major livability priorities in order to maintain an exceptional quality of life for its citizens.

- Arts, Cultural and Recreational Enrichment
- Economic Prosperity
- Smart Growth
- Superior Public Services
- Healthy Neighborhoods
- Integrated Transportation

Community facilities

- Peoria Community Center
- Rio Vista Recreation Center
- Peoria Sports Complex
- Peoria Center for the Performing Arts
- 36 neighborhood parks
- 2 libraries
- 3 swimming pools
- 6 golf courses
- 9 lighted multi-purpose ball fields
- 15 tennis courts

Lake Pleasant

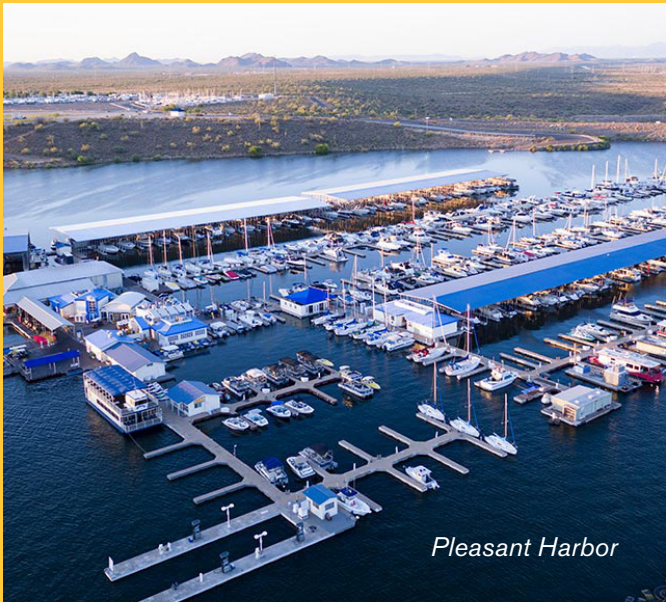
Urban ecology, ecotourism and recreation

Peoria is surrounded by the natural beauty of the Sonoran Desert and is home to Lake Pleasant, a 23,000-acre park and major recreational asset to the North Valley. The transient Agua Fria River and New River flow through Peoria, as do a multitude of washes and creeks. Most notable perhaps is Skunk Creek — known for the recreational trails running alongside it — which forges a connection between Peoria and Glendale. Northern Peoria is home to beautiful mountains and buttes including Sunrise Mountain, Calderwood Butte and Cholla Mountain.

Boasting over 300 days of sunshine annually, Peoria's ecotourism opportunities are a steady industry for residents and visitors. The City features over 60 miles of trails for walking, biking and horseback riding, as well as 570 total acres of accessible park land.

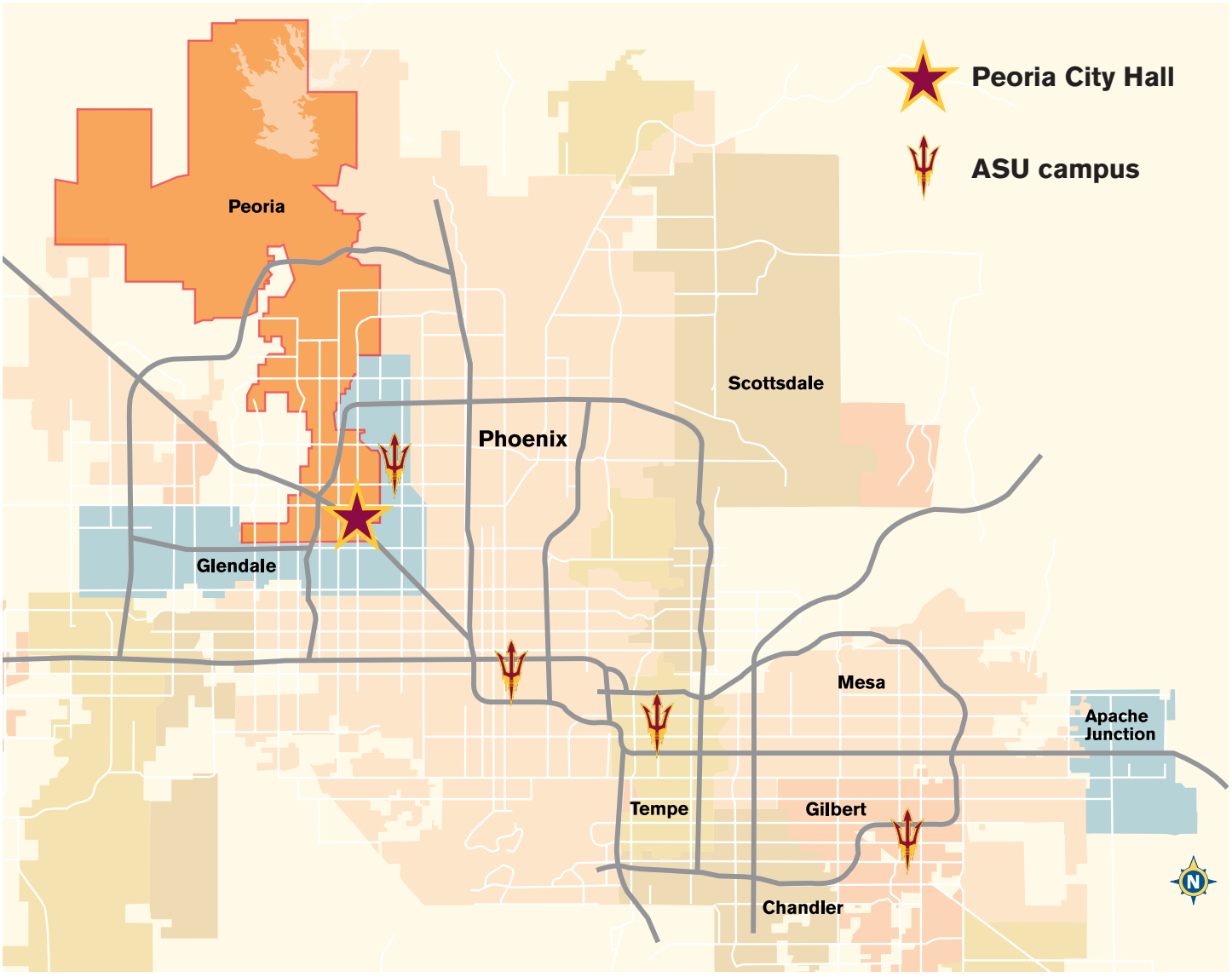
Lake Pleasant Regional Park contains a full-service marina, providing opportunities for water-oriented recreation such as kayaking, water skiing and even scuba diving. Visitors can also go horseback riding, take gliding lessons, hike, camp and more.

Skunk Creek



Pleasant Harbor

MAP OF PEORIA & GREATER PHOENIX, ARIZONA



The following report summarizes and draws highlights from work and research conducted by students in PUP 598 Transportation and Land Use Planning, for the Spring 2020 partnership between ASU's Project Cities and the City of Peoria.

To access the original student reports, additional materials, and resources, visit:

links.asu.edu/PCPeoriaTransit20S

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EXECUTIVE SUMMARY

Public transportation is a critical service for residents and visitors alike, no matter where they are located. In suburban areas like Peoria, small neighborhood circulators like Peoria on the Go (POGO) can serve an even more important role by providing access to vital services or connecting to larger transit systems. Robust public transit is also important in the fight toward lowering greenhouse gas emissions by providing an alternative to using personal vehicles for daily commutes.

Peoria's POGO transit circulator aims to provide service to residents and visitors by connecting neighborhoods to much-needed amenities and activity centers. In recognition of the need for ongoing self-assessment and development, Peoria partnered with ASU students in Fall 2019 to determine how POGO could better serve youth riders, and again in Spring 2020 for a continuation focused on developing relevant community circulator best practices tailored to POGO's specific circumstances.

Figure 1 *Peoria on the Go circulator bus, by City of Peoria.*

Two graduate students in David King's **PUP 598: Transportation and Land Use Planning** class were tasked with the challenge of helping Peoria continue their POGO enhancement efforts. Students identified and studied almost 50 circulators across the U.S. and distilled this list down to 4 case studies to analyze in-depth. Cases were chosen for their similarity to POGO's geographic conditions or intended service features. Students also developed a circulator taxonomy to categorize the studied circulators as access to transit, employment, entertainment, or service.

The four case studies were examined to determine what factors make them such successful systems in their respective communities. Two major themes were identified: understanding rider needs and intent, and providing services that empower riders with differing needs to use the circulators.

Students also designed individual surveys for POGO drivers, POGO riders, and other circulator riders throughout the Phoenix Metropolitan area. Due to the interruptions in POGO service caused by the COVID-19 pandemic, the in-person surveys intended for POGO drivers and riders were not deployed. However, the online survey targeted at other riders across the Valley was still launched. Results from this survey were interesting, and students suggest continuing survey research to further understand POGO ridership needs and behaviors.

Figure 2 *Interior of a Peoria on the Go circulator bus*

Through their data collection and research, ASU students aim to assist the City of Peoria in its continual improvement of public transit services. By better understanding POGO riders and their specific needs, adjustments can be made to the circulator system that can potentially contribute to increased ridership and subsequently enhance service throughout the community.

PROJECT GOALS

The following study aims to help the City of Peoria identify public transit circulator systems that are similar to POGO in order to determine relevant successes and potential best practices that can be applied in Peoria. Through their analysis, students aim to provide valuable information that may assist city decision-makers in their continual efforts to improve vital services for Peoria residents and visitors.

Figure 3 *Jay Davies speaks to multiple classes participating in Project Cities at the Spring 2020 semester Kickoff event*

KEY RECOMMENDATIONS AND NAVIGATION GUIDE

Recommendations to optimize POGO services
Further explore Ahwatukee's ALEX circulator system. Relevant aspects of ALEX that made it a successful circulator include efficient and easy access to many different service centers and transit centers connecting to other systems (pp.23, 24, 37).
Evaluate and, if necessary, further develop the stated goals for the POGO system. Outlining clear transportation goals may help guide future decision-making efforts regarding changes to the circulator (p.45).
Determine what target demographics exhibit high transit ridership rates and investigate ways to better serve those groups. Specifically, tailoring services to certain disadvantaged areas of southern Peoria may help increase ridership by serving the neediest in the community (pp.32-35).
Consider developing key areas in the P83 district, along 83rd Avenue, and along Paradise Lane, to be more pedestrian-oriented. Land use changes in these zones could increase POGO usage by zoning for mixed-use and mixed density to create more walkable entertainment and retail districts (p.29).
Reduce the amount of parking space in the P83 district to further encourage individuals to use the POGO system for transportation to the district rather than driving personal vehicles (p.29).
Conduct a follow-up qualitative study of interviews with POGO riders who use bikes or wheelchairs to gain more information on the high numbers of boarders POGO has in these categories (pp. 40, 46).
Conduct a follow-up quantitative study in which POGO drivers record rider boarding and departure locations for users with bikes and wheelchairs. This quantitative data could also be supplemented by geographic information system (GIS) analysis of interest points around the given stops (pp.40, 46).

FACULTY
DAVID KING

PUP 598: TRANSPORTATION AND LAND USE PLANNING
SCHOOL OF GEOGRAPHICAL SCIENCES AND URBAN PLANNING

Optimizing POGO

Lessons learned and best practices from an examination of relevant neighborhood circulator systems

ACKNOWLEDGMENTS

Faculty

David King

Students

Rui Li

Keith Morphis

Editors

Lindsey Sikorski

Steven Russell

Anne Reichman

Peoria Staff Team

Kevin Burke

Cathy Colbath

Jay Davies

INTRODUCTION

This report is an analysis of neighborhood transit circulator systems across the United States, intended to provide best practices and suggestions relevant to Peoria's local circulator service, Peoria on the Go (POGO). Students developed performance measures that were applied to each studied circulator to systematically determine the characteristics of successful systems. Best practices were distilled from these characteristics for potential application to POGO.

Editor's Note

Throughout the report, the "current" POGO route refers to the original loop route (Figure 1) that was suspended due to the COVID-19 pandemic. The "proposed" route refers to the City of Peoria's proposed changes to POGO, including the addition of 5 routes situated on a hub and spoke model (Figure 2), and changes in running times.

Background

POGO started serving the community on April 22, 2019 (New Peoria on the Go, n.d.). The current loop route (Figure 4) runs every 30 minutes, Monday through Friday, from 6 a.m. to 6 p.m. (Peoria On the Go Schedule, n.d.). POGO was originally estimated to serve approximately 18,000 residents within walking distance of its route, with 16 percent of riders being over the age of 65 (New Peoria on the Go, n.d.). After nearly one year of operation, POGO has not met these ridership goals, and it is unknown how seniors use the system. In early 2020, the Peoria Public Works Department released new proposed POGO routes, built on a hub and spoke model to serve more riders by reaching more areas of the city and connecting to other transit services. Specifically, Peoria's proposed improvements (Figure 5) feature five new routes which run Friday, Saturday, and Sunday from 10:00 a.m. to 10:00 p.m. The following sections of the report analyze the current and re-imagined POGO system, and compare it to other circulators with the goal of establishing best practices and recommendations for the City of Peoria to apply to POGO.

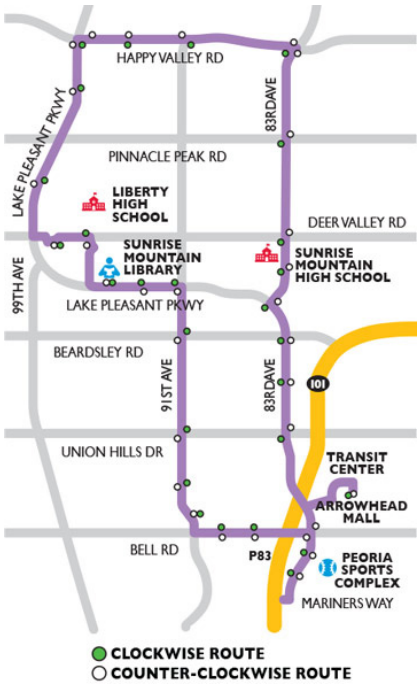

Figure 4 *Current POGO service map, by City of Peoria*

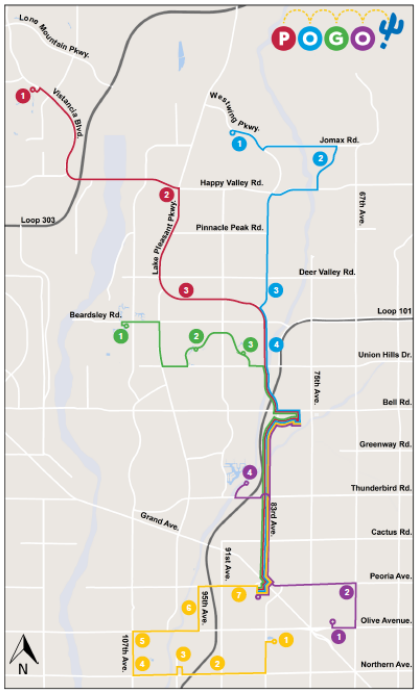

Figure 5 *Proposed POGO services map, by City of Peoria*

RESEARCH METHODS

This project intends to analyze the POGO system's characteristics, identify other systems that share these characteristics, and develop measures to assess transit circulator success. To identify relevant case studies for comparison, students examined circulator systems across the United States and developed a taxonomy classification system to be applied to each case study. The constructed taxonomy is based on the different types of access each circulator provides. The ALEX neighborhood circulator in Ahwatukee, Arizona, and the Round Rock circulator in Round Rock, Texas, were identified as cases closely related to POGO and subsequently chosen to conduct in-depth comparative case studies.

Taxonomy development

Throughout this project, a major research question was whether the accessibility of a circulator would influence its operation routines, such as service hours, bus frequency, and operational days. This was addressed by studying circulator schedules, geolocation, access to employment, transit centers, entertainment facilities, and services. Accessibility data was then used as the primary factor in developing the taxonomy used throughout the semester.

Initial searches were done through Google to collect examples of the circulators for comparative study. Keywords used included “circulators” or “local transit buses.” This search method only identified a limited number of cases since circulators are often named with different mechanisms as a branding tactic. Additional cases were identified from Dan Boyle’s “Practices in the Development and Deployment of Downtown Circulators,” which surveyed 78 agents across the U.S. about their circulating bus and trolley operation challenges and successes (2011). This resulted in identifying 47 relevant circulators running in 25 cities across the U.S. (Appendix A). The case studies are intended to be supplemental to the taxonomy and identify best practices relevant to POGO and the City of Peoria.

POGO analysis

In addition to studying circulators across the country, students conducted additional analyses of Peoria’s proposed POGO system changes. Geographic Information System (GIS) displays were used to investigate ridership statistics, geographic features, and POGO demographic information to identify the circulator’s performance, prospective ridership, and potential growth. Peoria land use and job centers were also identified (Figure 6) and juxtaposed with the circulator route. After this information was compiled, cases sharing similar characteristics were identified from the previously distilled list of circulators for further comparison with POGO. In their comparisons, students analyzed route design, population density, and demographic features along the routes to identify potential opportunities for POGO to improve its system. A survey was also deployed to gather information on POGO riders and drivers' personal use and experiences.

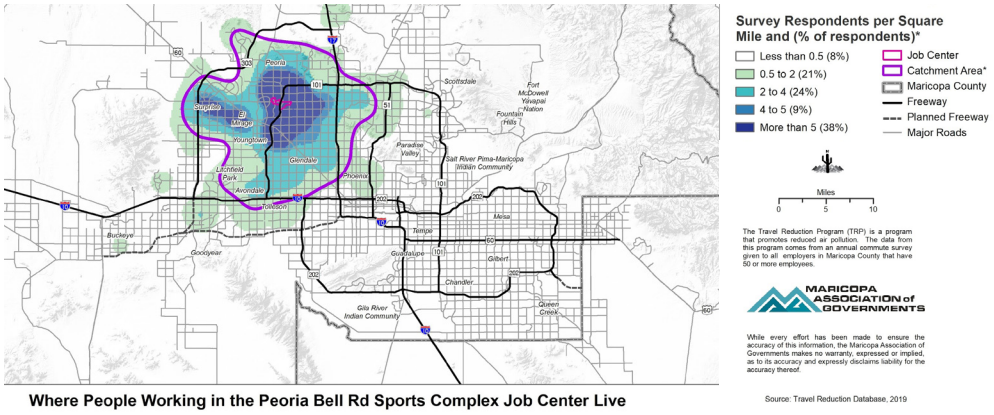

Figure 6 *Peoria job center mapping by Maricopa Association of Governments, available in Appendix D of original student work at* **links.asu.edu/PCPeoriaTransit20S**

Analyzed datasets include:

Ridership data

This report reviewed the monthly ridership data archived in the Valley Metro website. Students analyzed average daily boarding, monthly bike and wheelchair boarding, and revenue hours between circulator systems in the Valley to identify current POGO system performance (Ridership Report, n.d.).

GIS and Census data

A GIS study was conducted to compare land use, services, and access along circulator routes of the identified cases and POGO system. U.S. Census data was used to determine population density, numbers of households without personal vehicles, and poverty rate distribution in Peoria (ACS, 2017).

Survey and site visits

To better understand the POGO system and riders' purpose of using the circulator, three surveys were designed for distribution to POGO passengers, POGO drivers, and circulator passengers in other areas in the Valley. Unfortunately, the onset of the COVID-19 pandemic triggered a decrease in POGO use, followed by a suspension of services. Subsequently, the in-person survey developed for POGO passengers and drivers was canceled. Instead, the three separate surveys were condensed into one online version to sample circulator riders across the Valley. View the original surveys in Appendix C in the original student content at **links.asu.edu/PCPeoriaTransit20S**.

FINDINGS AND ANALYSIS

Taxonomy of circulators

Throughout the research process, it became clear there is limited research in existence about public circulator systems. There is currently no standard definition of operating characteristics that comprise circulator systems. A taxonomy of the circulator systems was built based on the study of existing systems' service hours, route design, and geographic and land use features along the route. Efforts were made to research the systems in existence by analyzing all major metropolitan regions in the U.S. with over one million people. This list was further investigated and quickly reduced to 37 systems. The comprehensive list is available in Appendix A of the original student content at **links.asu.edu/PCPeoriaTransit20S**. Ridership numbers and navigation software were also analyzed where the data was available. The taxonomy is intended to act as a framework for understanding how to evaluate success for different systems and help inform the design, which benefits the greatest number of riders and fits Peoria's geography, demographics, and urban form.

Circulator systems were classified based on their connections to various services. These classifications included:

- Access to transit
- Access to employment
- Access to entertainment
- Access to service

Taxonomy of neighborhood circulators

Category	*Connections*	*Examples*	*Hours of Operation*
Access to transit	Transit systems	Orbit, ALEX, Miller/Hayden	6:00 a.m. - 10:00 p.m. (Monday - Sunday)
Access to employment	Job centers	Denver, NCSU Wolfline	6:00 a.m. - 7:00 p.m. (Monday - Friday)
Access to entertainment	Theaters, restaurants, clubs	CBUS, South Beach	10:00 a.m. - 2:00 a.m. (Friday - Sunday)
Access to service	Businesses, hospitals, schools	Round Rock, Buzz, CM68, DART	9:00 a.m. - 6:00 p.m. (Monday - Friday)

Figure 7 *Circulators studied, organized via student-developed circulator taxonomy*

Access to transit

Circulators that primarily provide access to larger regional transportation networks are categorized as access to transit. An example of this type of system is the Orbit system in Tempe, Arizona, which connects many areas of North Tempe with the Valley Metro light rail stations and multiple bus transit centers that have express busses to other parts of the city. The ALEX is a similar system in the Ahwatukee neighborhood of South Phoenix. Ahwatukee is relatively isolated from much of Phoenix because of its proximity to South Mountain. ALEX is designed to connect this area to the Valley Metro bus network, which runs through most of the Phoenix Metro area.

Access to employment

Circulators in this category provide access to employment by transporting riders to various job centers throughout their cities. The Chicago area's Rosemont circulator, and Denver, Colorado's downtown connector bus fall into this category. A common feature of these circulators is their limited hours of operation, usually Monday through Friday between 6:00 a.m. and 6:00 p.m. These systems connect employment centers to residential or transit locations for the benefit of employment centers. The Denver connector bus links to Union Station in Downtown, the main transit hub for 6 lines of its rail network and 10 bus bays, for many transit connections in the region.

Similarly, the Wolfline, based in Raleigh, North Carolina, services the community around North Carolina State University (NCSU). At first glance, the Wolfline may appear most similar to Tempe's Orbit system, which functions around Arizona State University (ASU). However, the area around NCSU also features significant research and office parks. Therefore, many employees use the system to reach offices from off-site bus stops, in addition to students using it for transportation to the NCSU campus.

Access to entertainment

Entertainment circulators connect residents and tourists to various entertainment areas featuring bars, clubs, and other social venues. Circulators in this category include the CBUS in Columbus, Ohio, and the many buses that operate along South Beach in the Miami, Florida area. In addition to their entertainment-driven routes, these circulators also distinctly operate later hours (10:00 a.m. to 2:00 a.m.) and primarily run on weekends. These systems usually have a limited number of stops and run a short geographic distance, as is the case with the CBUS system, which is less than four miles in length. The buses also tend to serve tourists by connecting hotels to entertainment areas. For example, the CBUS runs from the Short North, a bar and club district, to the Brewery District south of downtown Columbus.

Access to service

Service access circulators reach medical facilities, post offices, retail locations, and other important amenities. Systems that match this profile include the Round Rock circulator in Round Rock, Texas, the Buzz in Mesa, Arizona, and the CM68 line in Scottsdale, Arizona. These systems operate during usual business hours but sometimes do not begin running until 9:00 a.m. rather than 6:00 a.m. The service in Round Rock is provided by Capital Metro, which is based in Austin, Texas. This circulator provides local service access around the City of Round Rock and a connection to the main transit hub in downtown Austin. The Buzz circulator in Mesa connects the suburban downtown to the River View shopping district. This service touches multiple apartment complexes and businesses while also connecting riders to the light rail line with its terminus in downtown Mesa. The light rail line also connects to the four largest job centers in the region.

It is important to note the developed taxonomy classifications are not mutually exclusive. All four access categories are present in most systems, with the main use being identified as only providing a plurality and not a majority of users. This is due to common land use patterns, with many job centers and services being dispersed over large geographic areas. The path to each circulator route would cross over each other's potential use at different points. Examples include POGO's current loop route that meets at a transit center and also crosses a library, multiple schools, and other service locations. Despite this, analytically it is useful to assess the route and service planning implications of their primary service goals.

Variations also exist in all categories of systems in the public and private sectors. One such example is DARTS (About Us - Serving Older, n.d.). This bus circulator operates in Dakota County, Minnesota, is operated by a non-profit, and has been running for over 40 years. DARTS operates similarly to the Miller Hayden line in Scottsdale, Arizona. It is a comprehensive service for seniors with various issues, and its operation connects senior citizens to medical appointments, church services, sporting events, and restaurants. The DARTS service is not free but is heavily discounted for users, making it an affordable option for Dakota County's aging population.

POGO is one of the few systems with a circular route, as most other systems feature a hub-and-spoke layout similar to Peoria's proposed route changes. However, the original and proposed POGO routes are similar to the aforementioned circulators for its access to a variety of amenities, such as broader transit (Valley Metro - Arrowhead Mall transit center), entertainment (P83 district), and service areas, including schools, libraries, and medical offices. The City of Peoria is also planning to test out an automated vehicle in its P83 district called the "ROBO Ride," which will operate entirely in the district. This service gives the POGO system the ability to offer park and ride transit feasibility. Without this tandem, people who use POGO to connect to P83 without a personal vehicle are often limited in their ability to move around the district.

POGO system analysis

POGO's operational performance and geospatial characters must be understood before choosing a comparable system from which to draw useful practices. Currently, POGO runs Monday through Friday, 6:00 a.m. to 6:00 p.m., with a frequency of 30 minutes. Peoria's proposed service expands to five separate routes which only run Friday through Sunday, 10:00 a.m. to 10:00 p.m., with a frequency of 60-120 minutes. The following sections use ridership data to study current POGO performance. The GIS, land use, and census data analysis were done for both the existing and proposed POGO routes to determine the new system's potential benefits and challenges.

GIS data analysis

POGO's spatial characteristics, such as location of the system, accessibility to other bus routes, and connection to other circulators, are studied by visualizing the GIS data. The current POGO loop route lies in a suburban area and is relatively isolated from other transit systems as illustrated by Figure 8. While most of the current POGO system serves as the only public transit for the community, the southeast portion of the system (where P83 is located) connects riders to the local transit bus and express shuttles to north Scottsdale, Avondale, and Phoenix (Figure 9).

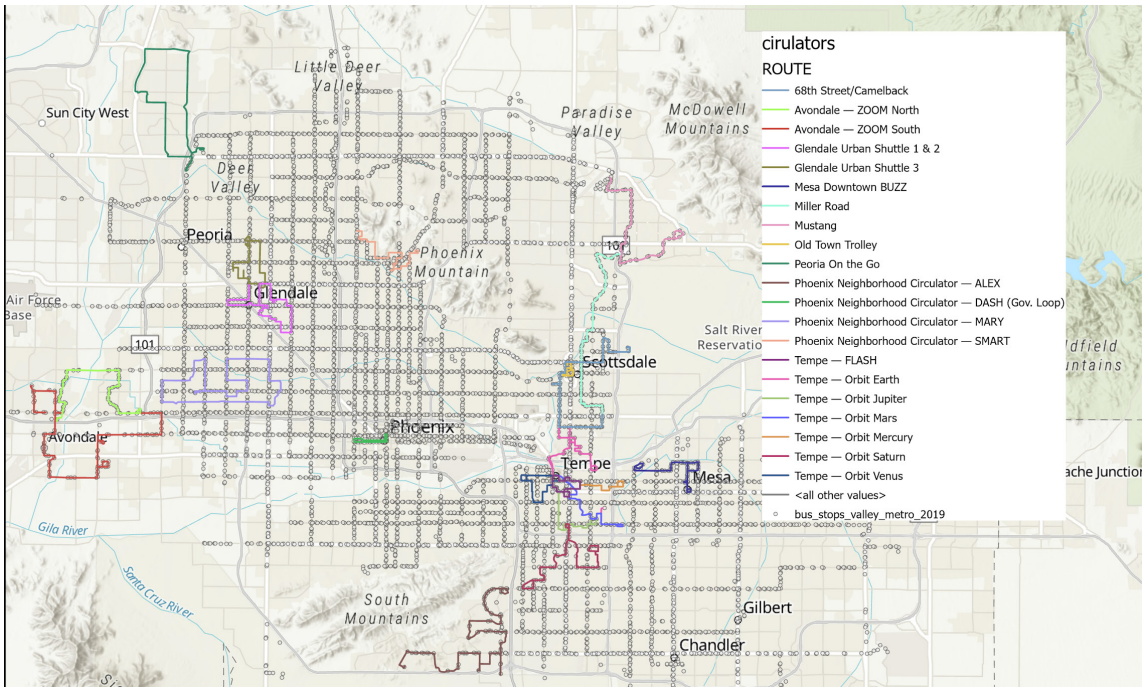

Figure 8 *Circulator systems across the Phoenix Metro Area*

Peoria's proposed changes cover more area and shift service hours to run only Friday, Saturday, and Sunday. The proposed enhancements would connect to more express and local buses that reach Avondale, Phoenix, Glendale, and other parts of the Valley.

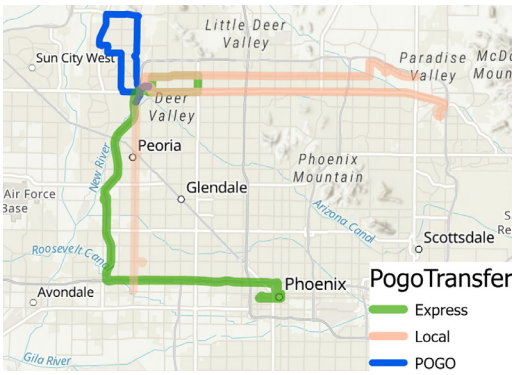

Figure 9A *Current POGO connections*

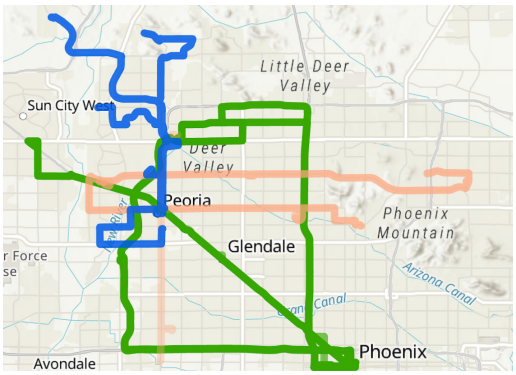

Figure 9B *Proposed POGO connections*

Figure 9 *Student plotted connections to other transit systems*

From the Maricopa County Travel Reduction Program's (TRP) analysis on live-work patterns for jurisdictions and job centers within Maricopa County (see Appendix D in the original student content at **links.asu.edu/PCPeoriaTransit20S**), South Central and Bell Road Sports Complex have more jobs than the North Central Peoria job center. POGO currently passes through the Bell Road Sports Complex (P83), and the proposed POGO enhancements would connect all three job centers. Residents who live in central and south Peoria also travel to Deer Valley and Downtown Phoenix for work. As the proposed POGO connects to the express bus from Peoria to Phoenix, riders might use it to connect to job centers both in and out of the city. However, a Friday through Sunday service model could hinder riders who wish to use POGO to commute on weekdays.

Land use and job centers

Peoria wants to make the P83 district the focal point of the current POGO system, as well as the future updated system. The P83 district is about 2/3 of a square mile in area, forming a triangle that extends one mile from Bell Road to the crossing of Skunk Creek Trail on 83rd Avenue, and one mile from the Agua Fria Freeway (101) east to 75th Avenue (Figure 10). POGO is envisioned to transport riders to P83, where they can then walk to places of interest. The district has many restaurants, stores, a theater, and a minor league ballpark that seats 12,000 people.

Figure 10 *Peoria's P83 retail and entertainment district, outlined in orange, as described by students*

One problem with this plan is that pedestrians are generally only willing to walk up to a half-mile to reach a destination. The P83 district is approximately one mile across, with about half of its area devoted to parking. This means visitors have limited choices for traveling between businesses within the district if they did not arrive in a personal vehicle.

Land use changes to further increase usage of the POGO system could include the development of the P83 district along 83rd Avenue, as well as land use changes along Paradise lane. Tailoring the environment to more pedestrian-oriented developments, and zoning for mixed-use and mixed density along these roads would create a denser, more walkable district. Reducing the number of parking spaces in the district could also encourage individuals to use POGO rather than drive personal vehicles.

Editor's Note
Ambient temperatures can be uncomfortably high in the Phoenix Metro area, which tends to discourage pedestrian activity, especially during summer. The strategic installation of shade structures and trees along pedestrian paths is one strategy to increase comfort and walkability.

Ridership analysis

Daily passenger, bike, and wheelchair boarding numbers were compared between circulator systems in the Valley. Figure 10 shows the POGO average daily boarding number increased from 22 persons per day when launching in April 2019, to 111 persons per day only two months later. This rate continued to slowly rise from June 2019 to February 2020, from 111 persons per day to 147 persons/day, increasing between 2% and 10% each month. POGO ridership rates also appear to show little correlation with academic seasons compared to other circulators that experience drops in ridership during winter and summer breaks, such as the Tempe Orbit system. The boarding rates also show that POGO has the lowest ridership in the Valley.

POGO average daily boarding numbers												
	2019									***2020***		
Month	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar*
Average daily boarding	22	83	111	110	115	126	123	127	130	134	147	97
Comparing to last month		277%	34%	-1%	5%	10%	-2%	3%	2%	3%	10%	-33%
**Service affected by COVID-19*												

Figure 11 *POGO daily boarding rates and monthly comparisons from April 2019 through March 2020*

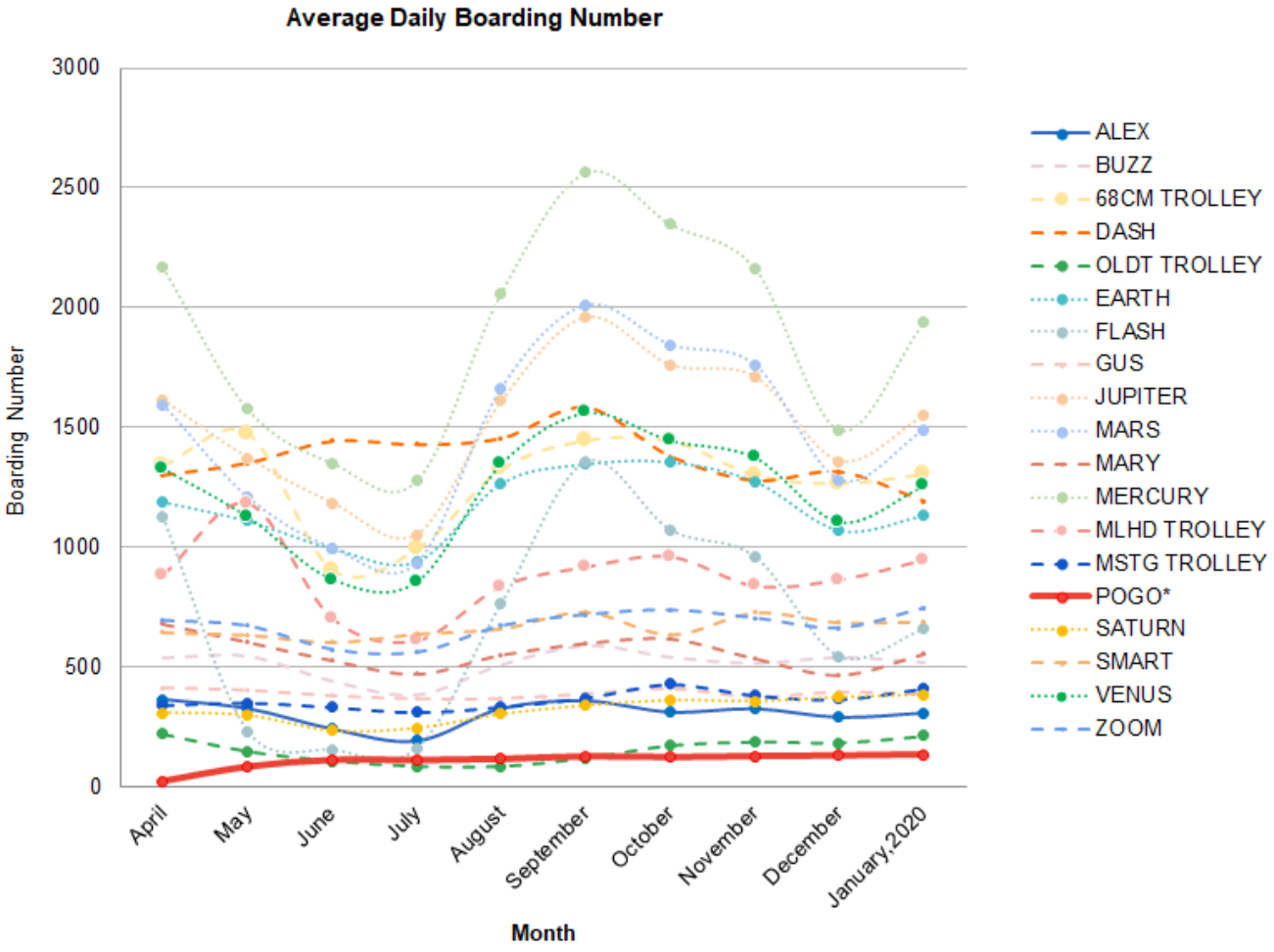

Figure 12 *Average daily boarding of different circulators throughout the Phoenix metropolitan area*

The bike and wheelchair ridership of POGO is impressive. Bike boarding numbers have consistently risen since POGO's launch and exceeded all other Valley systems by its third month of service (Figure 13A). One officer from the City of Peoria mentioned that biking clubs in Peoria might be using POGO to access local biking trails. Alternatively, wheelchair boarding numbers do not show a consistent trend (Figure 13B). The high wheelchair boarding numbers compared to other systems still show a high demand for local wheelchair users. Further analysis into bike and wheelchair boarding rates was cut short during the study due to the COVID-19 pandemic and subsequent suspension of POGO services. Under normal conditions, further data collection and analysis could have occurred through two potential processes: A qualitative study of interviews with POGO riders who use bikes or wheelchairs, or a quantitative study where POGO drivers record bike and wheelchair rider locations of boarding and departure. The driver quantitative data could also be supplemented by GIS analysis of interest points around the given stops.

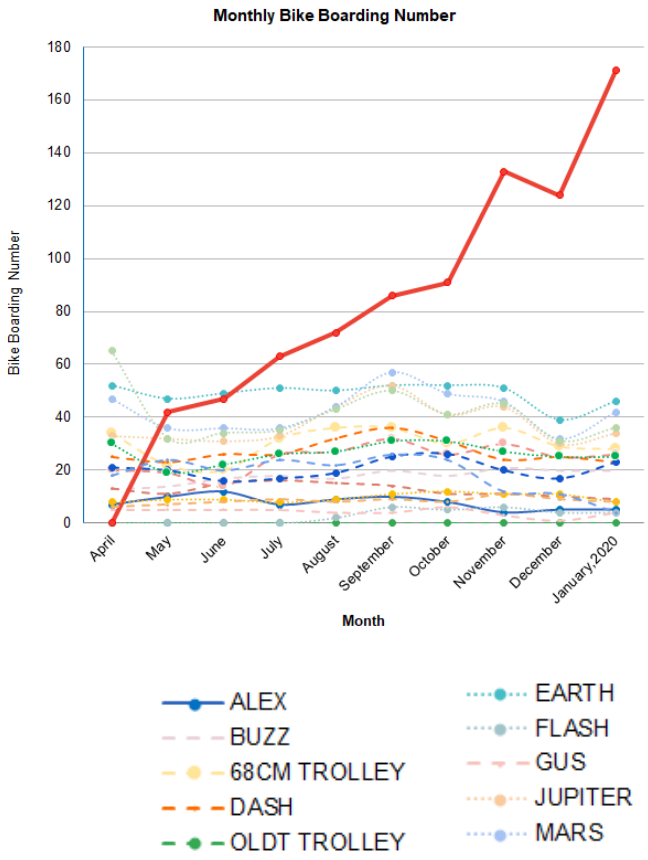

Figure 13A *POGO monthly bike boarding*

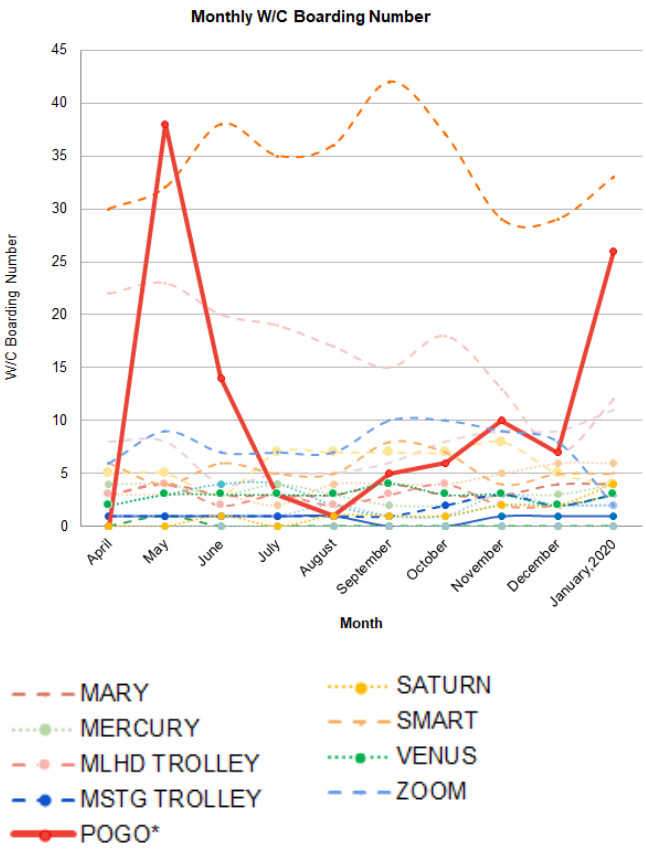

Figure 13B *POGO monthly wheelchair boarding*

Figure 13 *POGO bike and wheelchair boarding rates in comparison to other circulators throughout the Phoenix metropolitan area*

Demographic analysis

Fare-free circulator ridership has a strong co-relationship with population density, number of households without cars, and household income, as is illustrated by the statistical regression of ridership and demographic characteristics for circulators in South Florida (Chavarria, 2004).

Population density, number of households without a car, and household income appear to be significant factors in circulator ridership. It seems there is a strong correlation between low-income households and high transit ridership. The same appears true for the reverse situation, as high-income households tend to have consistently low ridership numbers. It is clearly important to be aware of an area's demographic features to anticipate the needs of its potential riders. The following sections use the 2018 ASC 5 Years Survey Estimation, Arizona Census Tract GIS map, and a map of Peoria's proposed POGO routes to determine and analyze the system's demographic features.

Population density

Peoria is a suburban city of the larger Phoenix metropolitan area, with a population of 172,259 and an overall density of 980 people per square mile. This overall density figure is not completely accurate however, as most residents live in the city's southern half. Considering this, the actual density of the southern portion of the city is closer to 3,000 people per square mile. Peoria does not have one primary employment center but has the popular P83 retail and entertainment district, which services much of the northwest Phoenix metro region.

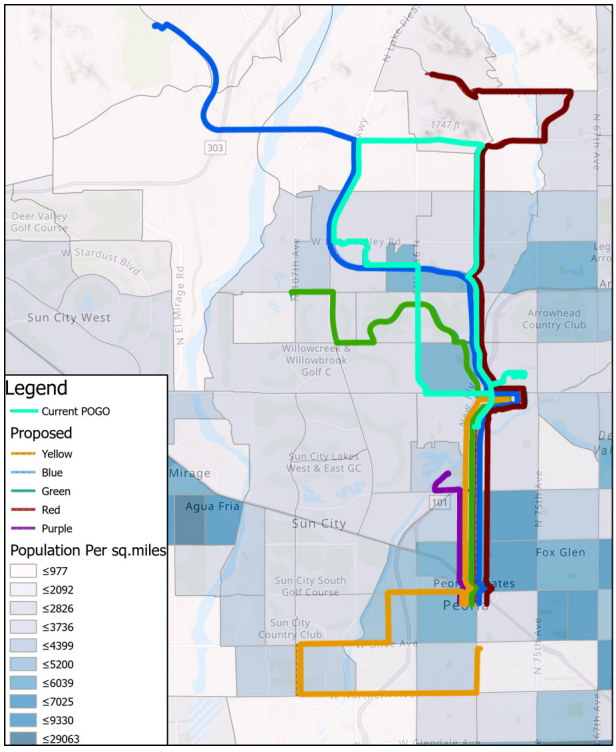

Figure 14 *Current and proposed POGO routes overlaid with Peoria population density*

Vehicle ownership

As illustrated by Figure 15, there are communities with low car ownership rates clustered South of Bell Road, to which the current POGO system does not provide service, but to which Peoria's proposed POGO system would reach. For households with vehicles, the circulator could still prove useful by providing a viable option to shift daily commutes to public transit. However, studies have shown it can be difficult for drivers to abandon their personal vehicles. Therefore, catering to this demographic should be considered with caution. Alternatively, households without vehicles tend to highly depend on public transit and other modes of travel to commute (Noel et al., 2013). For this reason, it can be assumed a free circulator running south of Bell Road could have high potential to attract riders.

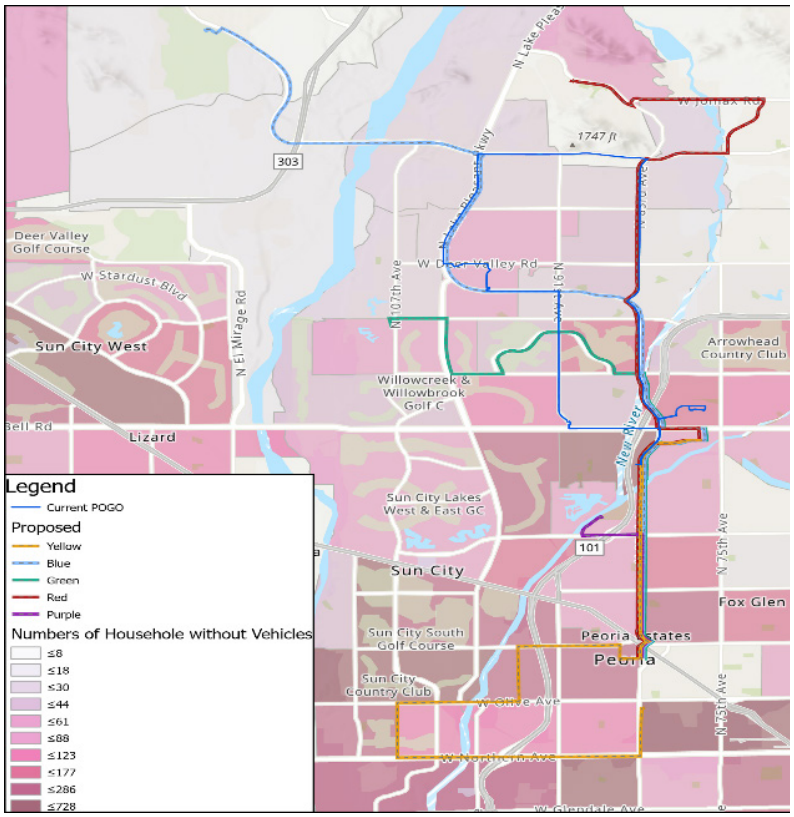

Figure 15 *Current and proposed POGO routes overlaid with Peoria vehicle ownership rates*

Income

The current POGO route mainly runs through areas with a low overall poverty rate. The proposed lines, however, would also provide service to many low-income neighborhoods throughout South Peoria. Serving areas that exhibit different poverty rates could be a factor that positively increases ridership. However, the proposed weekend-only running hours may not be ideal for riders in South Peoria looking to commute throughout weekday work hours.

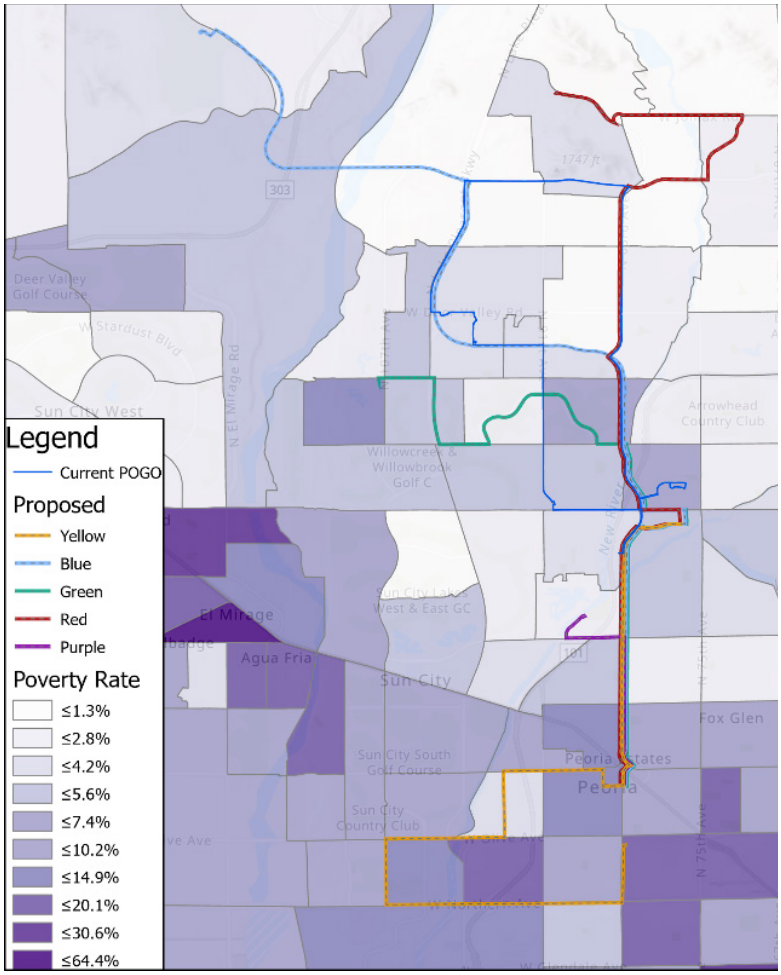

Figure 16 *Current and proposed POGO routes overlaid with Peoria poverty rates*

From the location, land-use, ridership, and demographic feature analysis, students determined that POGO is a unique circulator system in the Valley for the following reasons:

- The original loop route is located in a suburban area, with little connection to the other public transit services.
- It has substantial bike and wheelchair boarding numbers.

These factors suggest that riders may use POGO to shift between different modes of transit (e.g., to navigate from a residence to a bike trail). The high level of wheelchairs boarding may also indicate POGO as a potential low-cost alternative to the city's Dial-a-ride service. However, this could increase bus loading times and subsequently cause schedule delays.

Case studies of comparable systems

Four cases in Ahwatukee, Arizona, Round Rock, Texas, Columbus, Ohio, and Miami, Florida, were selected for comparative study. The ALEX circulator in Ahwatukee and the Round Rock circulator in Texas were selected due to their locations in suburban regions with similar population density to Peoria (Figure 17). The Columbus CBUS and Miami trolley systems were selected for their entertainment district service, similar to POGO's targeted service to the P83 district.

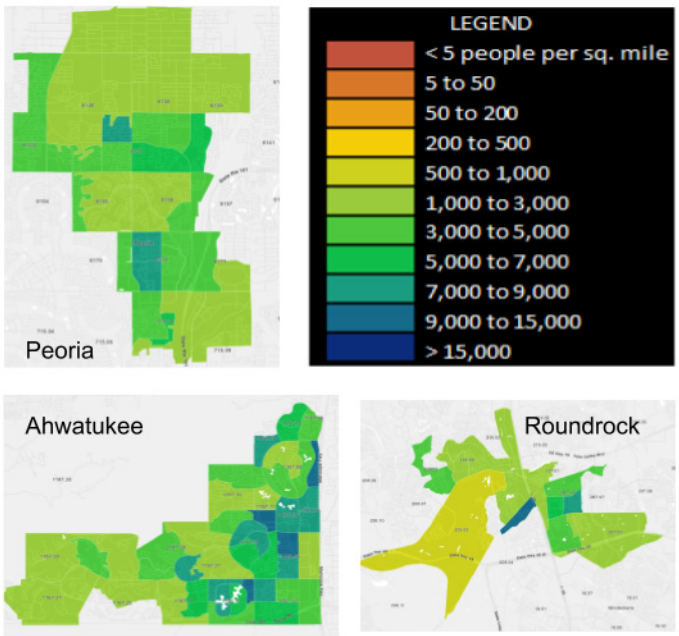

Figure 17 *Population density comparison between Peoria, Ahwatukee, and Round Rock*

Case 1: Round Rock circulator

Round Rock is a suburb of Austin, Texas, a metro region with a population over two million. The City of Round Rock has a population of 128,000 and an overall density of over 3,500 people per square mile. It is suburban in form but has multiple high paying job centers, which is a unique characteristic for a suburb. For example, the international headquarters for Dell Computers is located in Round Rock and accounts for half of the money in the city's general fund that originates from sales taxes (Wikipedia, 2020).

The Round Rock circulator system has a monthly average of 2,954 passengers, similar to POGO's ridership rate (Popular Round Rock, 2019). The Round Rock system connects three main routes (50, 51, 52) in a central hub in downtown Round Rock. These three routes cover different areas of the city, each connecting to various points of interest, including the Dell headquarters which employs 14,000 employees at its campus (Wikipedia, 2020), Austin Community College, several high schools, retail centers, and a hospital.

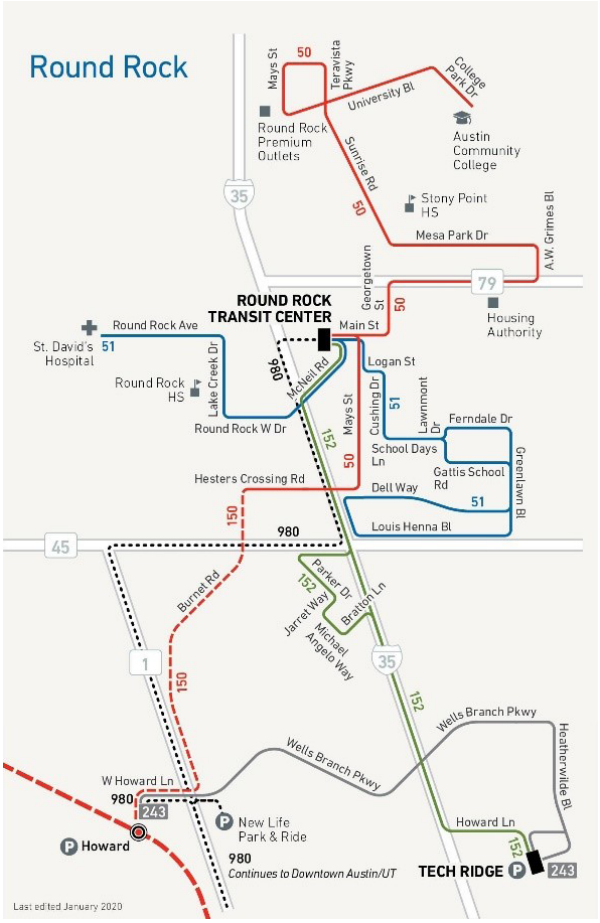

Figure 18 *Round Rock circulator system map*

Case 2: ALEX circulator

Ahwatukee, Arizona, is a suburban enclave that is largely separated from the rest of the City of Phoenix by the South Mountain Preserve. Ahwatukee has a population density of 1,783 people per square mile and a total population of 83,464 people. The area lacks any major job centers and is very much considered a "bedroom community" for the larger Phoenix Metro area (Ahwatukee Life, n.d.). The ALEX route was introduced in 2001 and reached 1,000 passengers per day by 2010. Unfortunately, the 2010 recession forced major budget reductions, and the City of Phoenix cut ALEX by 50% (Ahwatukee Life, n.d.). These cuts caused the route to be shortened, bus frequency to be reduced, and a weekend service spur that traveled into the City of Chandler to be removed. These changes led to the current route averaging between 250 and 400 passengers a day, down from the previous 1,000. Changes to the route were also significant as access to specific neighborhoods, schools, and amenities were reduced or removed altogether.

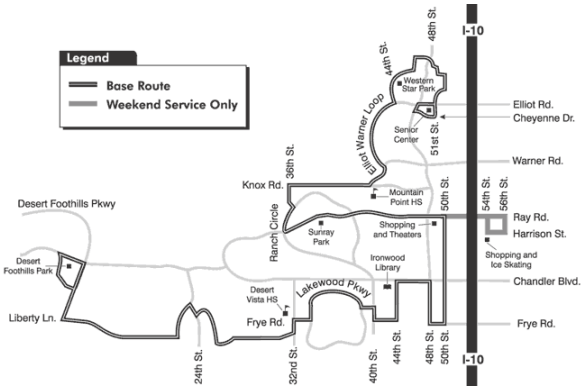

Figure 19 *ALEX circulator before service cuts*

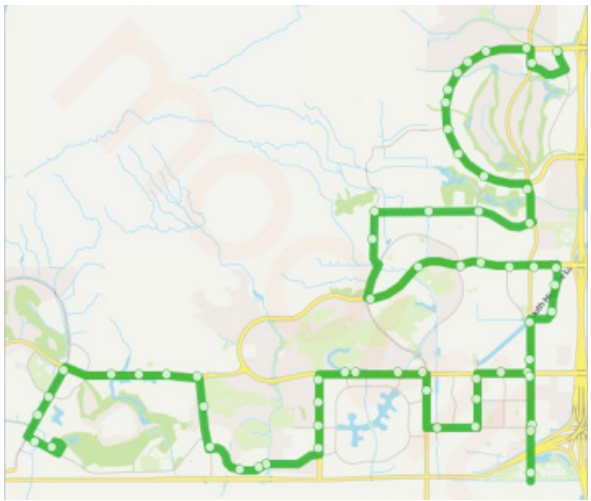

Figure 20 *ALEX circulator after service cuts*

Case 3: CBUS system

The CBUS system in Columbus, Ohio, was started in 2014 by the Central Ohio Transit Authority (COTA). The route is simple and serves the main purpose of connecting tourist destinations and local nightlife hubs. The CBUS runs along High Street through downtown Columbus, passing important locations, such as the Columbus convention center, Nationwide Arena, hotels, office buildings, and historical destinations (Poulin, 2019).

Even though the CBUS route was designed for tourism and nightlife, its ridership has skewed towards that of an employment circulator. This is most easily illustrated when comparing weekday ridership, averaged above 2,000, with weekend ridership averaging 500 to 1,000 riders (Poulin, 2019). No specific data on CBUS riders and their boarding origins could be found at the time of this report. However, it was determined that the neighborhoods of German Village, Victorian Village, and Italian Villages at either end of the CBUS route have population densities ranging from 8,500 to nearly 14,000 residents per square mile. This density is two to three times greater than Peoria's (City-Data, n.d.).

These areas also have higher percentages of residents in the age groups between 20 and 40 (City-Data.com). Many households in these districts consist of young professionals in high-income brackets. The northern neighborhood features a significant number of multifamily housing developments along the transit line. Contrarily, the southern portion of the system is mostly surrounded by small single-family homes.

Figure 21 *CBUS system map*

Case 4: Miami Beach Trolley system

The City of Miami started operating its free Miami Beach trolley system in 2017. The system consists of four separate lines, including North Beach, Miami Beach, Alton-West loop, and the Collins Link (Figure 22). These routes connect tourist spots around Miami while also weaving in and out of residential neighborhoods. The system operates 18 hours a day, 365 days a year, serving an average of 14,000 riders each day.

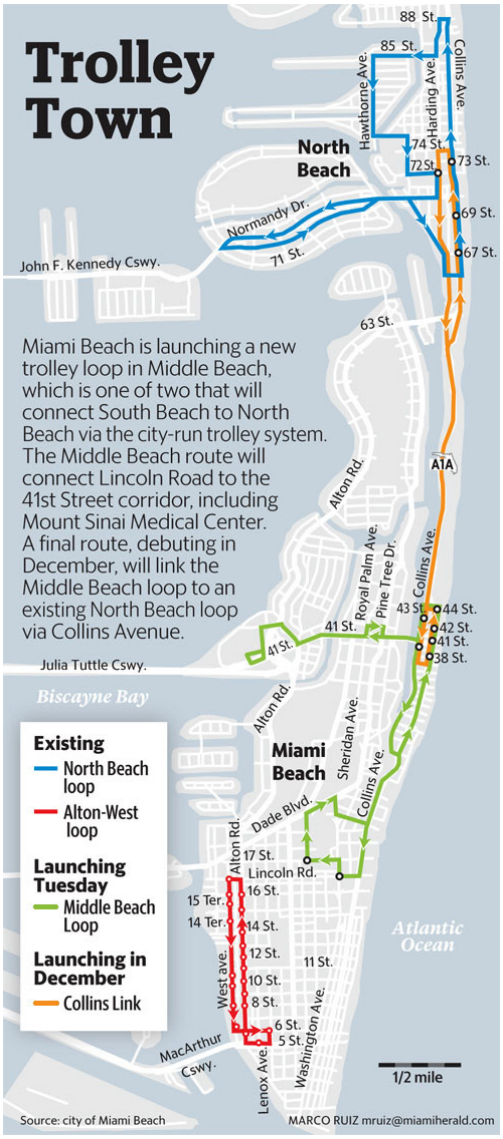

Figure 22 *Miami trolley system map*

Miami Beach is a major tourist destination, as well as a popular place to establish a residence. Density is around 12,000 people per square mile, not including the 36,400 tourists who visit and stay in the city's 26,500 hotel rooms each night (Miami Beach, n.d.). The trolley routes operate in neighborhoods of varying density from high rise condos and hotels to neighborhoods of single-family homes, connecting a diverse ridership with beaches and other points of interest.

From the Round Rock, Ahwatukee, Columbus, and Miami cases, it appears that (a) using a loop circulator in low-density suburban areas is very rare, and (b) most systems provide weekday services.

While the existing POGO schedule provides weekday service on a loop route, the new proposal features weekend services on multiple routes. Both Peoria's current and proposed POGO services are unique regarding the offered routes and service time arrangement.

Rider Survey

After analyzing POGO's geospatial and demographic features alongside the selected cases, students designed and deployed surveys targeted at public transit riders throughout the Valley. The purpose of the survey is to further understand why riders utilized the public circulators and identify any obstacles that explain why a rider may choose not to use the service.

Three separate surveys were designed for POGO drivers, POGO riders, and riders of other systems in the Valley. The POGO driver survey asks for basic information about the driver's onboarding hours, number of riders they pick up, number of bikes and wheelchairs that board, and the hourly ridership of their day. The POGO rider survey asks about a rider's boarding information, trip information, and how frequently they use POGO services. The purpose of surveying the POGO drivers and riders is to gain a more detailed understanding of how Peoria residents use POGO. The survey for riders of other circulators in the Valley has the same structure as the POGO rider survey but eliminates the questions about trip information. View the original surveys as they appeared to respondents in Appendix C of the original student content at **links.asu.edu/PCPeoriaTransit20S**.

The POGO driver and rider surveys were originally designed as paper questionnaires, which would be deployed by students boarding the POGO bus. Unfortunately, the arrival of the COVID-19 pandemic abruptly interrupted this process, and students were forced to eliminate the in-person survey components of their research. The student-designed surveys are included in the Appendix as a potential resource for stakeholders to conduct further research in the future.

Contrarily, the Valley Metro rider survey was designed to be taken online and was carried out through ASU Qualtrics despite the pandemic circumstances. Considering the influence COVID-19 could have on an individual's transit decisions, questions regarding the pandemic were also added to the online survey. At the time of this report, the Valley rider survey had 42 completed entries, with respondents from Tempe, Phoenix, Mesa, Glendale, and Scottsdale (Figure 23). Figure 24 demonstrates that only 26% of respondents stated they had ever used circulator services.

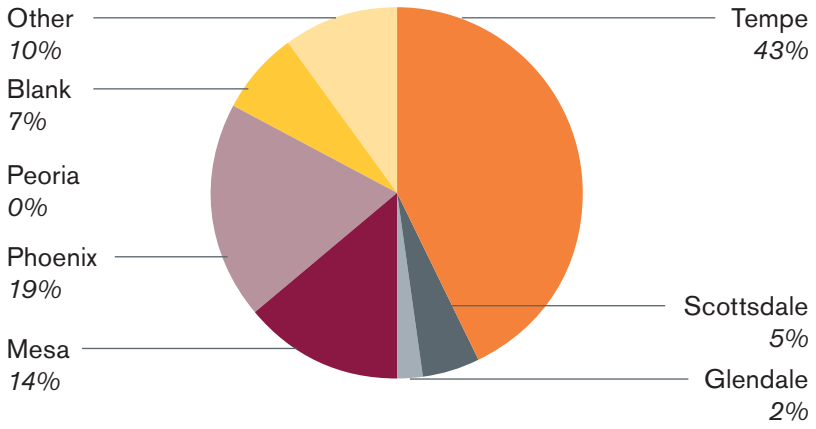

Figure 23 *Survey respondent city of residence*
"Where do you live?"

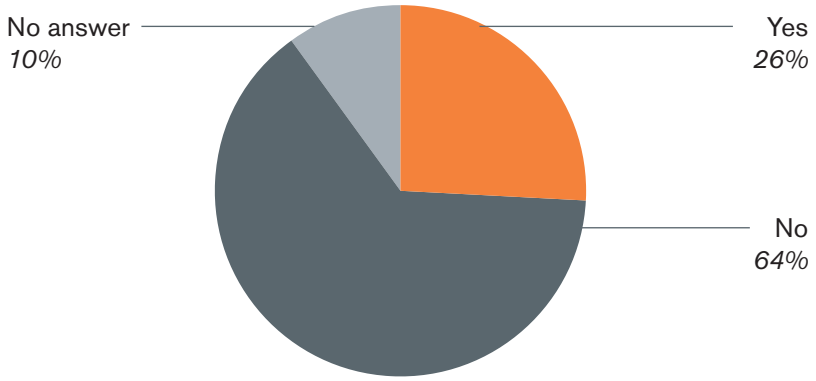

Figure 24 *Respondent circulator use*
"Do you ever ride your city's neighborhood circulators (e.g., Orbit in Tempe)?"

Editor's Note
While these results are not specific to Peoria riders, they support arguments for various changes to the POGO route, such as increased access to employment centers and strategically placed stops within walking distance of key areas.

This survey could not represent rider choices in Peoria, but the general results are interesting and can still prove applicable to POGO. Among the 11 respondents who stated they do use neighborhood circulators, 41% of them reported employment as the reason for their trips (Figure 25). Most respondents (77%) reported walking as the primary method of reaching their circulator stop (Figure 26), and 29% of respondents reported using a car-sharing service when there is no circulator available (Figure 27).

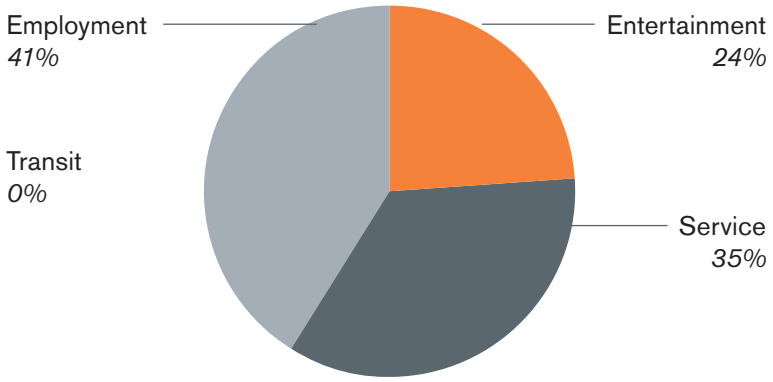

Figure 25 *Reason for circulator use*
"What is the purpose of your trip?"

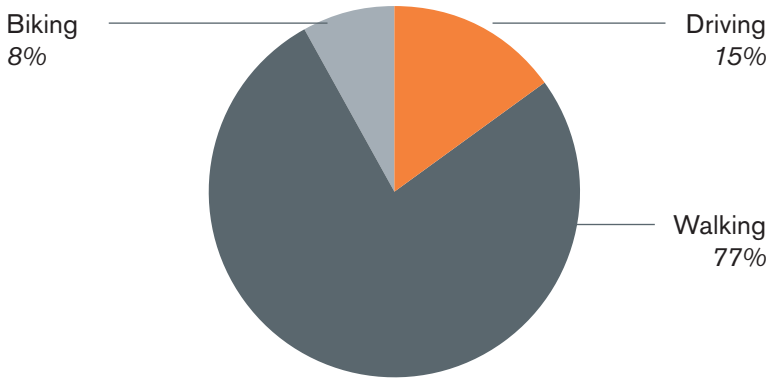

Figure 26 *Methods of reaching transit stops*
"How do you reach your circulator stop?"

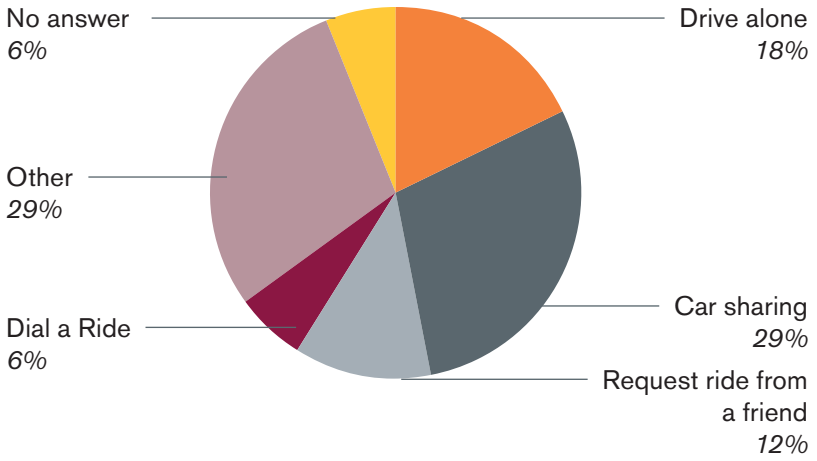

Figure 27 *Alternative transportation mode options*
"If the circulator service is not available, how would you otherwise get around?"

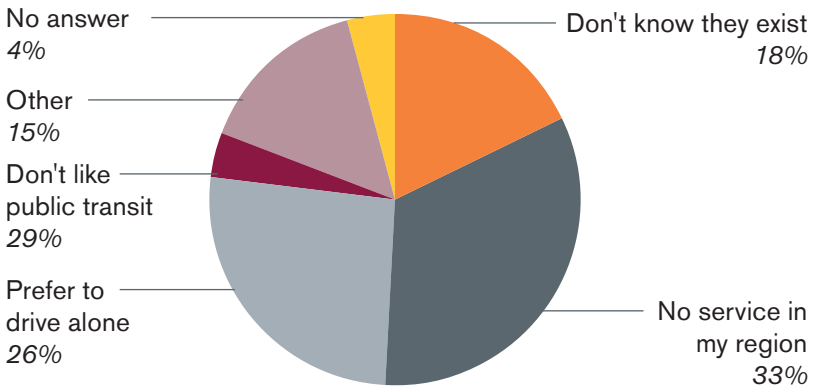

Figure 28 *Reported reasons to not use public circulators*
"Why do you not use a circulator service?"

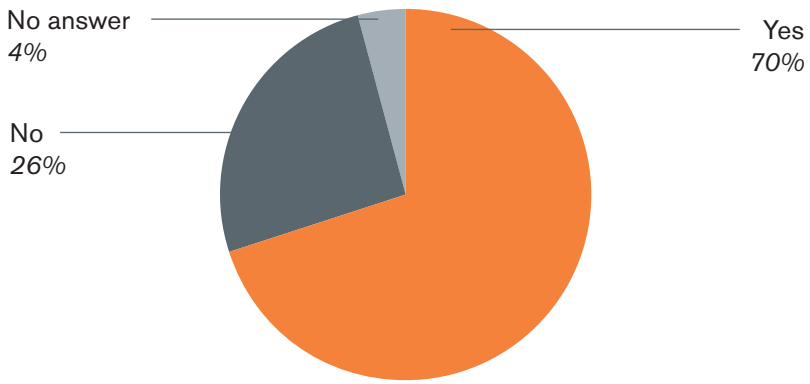

Figure 29 *Willingness to try a transit circulator in the future*
"Would you consider taking a circulator in the future?"

Among the 27 respondents who reportedly do not ride circulators, a lack of service in their regions, and a preference to drive alone were the two main reasons for their decisions (Figure 28). However, 70% of these respondents said they would consider using a circulator service in the future (Figure 29).

Considering the influence of COVID-19 on public transit services, questions were added to the Valley survey about the pandemic's influence on a rider's transit choice. 69% of respondents stated that after the pandemic, they would take public transit as frequently as before the pandemic (Figure 30). While this result represents a limited number of people, it is nonetheless notable that the majority of survey-takers report an intent to return to normal.

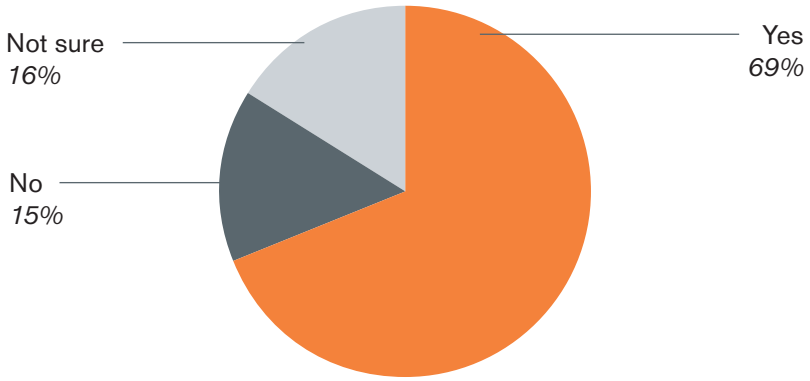

Figure 30 *Effects of the COVID-19 pandemic on ridership "After the pandemic, would you take transit as frequently as prior to the pandemic?"*

Recommendations

The results of this study have led to various suggestions for the City of Peoria. Examination of the numerous circulator systems, both in the Valley and across the U.S., helped develop a list of relevant circulators from which Peoria could potentially pull best practices. From the list of researched circulators, a taxonomy was developed that defined different types of systems. It should be noted that most successful systems serve multiple categories of the taxonomy. Students have developed the following list of recommendations for the City of Peoria's POGO system from the studied cases.

- Further explore Ahwatukee's ALEX circulator system. Relevant aspects of ALEX that made it a successful circulator include efficient and easy access to many different service centers and transit centers connecting to other systems.
- Evaluate and, if necessary, further develop the stated goals for the POGO system. Outlining clear transportation goals may help guide future decision-making efforts regarding changes to the POGO system.
    - For example, the Round Rock circulator has a specific goal to provide service to low-income households that lack mobility options, which in turn informed their route and schedule. Alternatively, if an established goal is not being achieved, it may be useful to determine why, and adjust the goal or efforts supporting the goal accordingly.
- Determine what target demographics exhibit high transit ridership rates and investigate ways to better serve those groups.
    - For example, areas of southern Peoria exhibit significant rates of poverty, lack of personal vehicles, and rented (rather than owned) properties. These demographics have relatively lower representation in the current POGO footprint, and focusing efforts on serving these high-need areas could increase usage rates.
- Consider developing key areas in the P83 district, along 83rd Avenue, and along Paradise Lane, to be more pedestrian-oriented. Land use changes in these zones could increase POGO usage by zoning for mixed-use and mixed density to create more walkable entertainment and retail districts.

- Reduce the amount of parking space in the P83 district to further encourage individuals to use the POGO system for transportation to the district rather than driving personal vehicles. This reduction in parking could also provide space to contribute to the previously mentioned environmental changes.
- Conduct a follow-up qualitative study of interviews with POGO riders who use bikes or wheelchairs to gain more information on the high numbers of boarders POGO has in these categories.
- Conduct a follow-up quantitative study in which POGO drivers record rider boarding and departure locations for users with bikes and wheelchairs. This quantitative data could also be supplemented by GIS analysis of interest points around the given stops.

CONCLUSION

Peoria's commitment to continually improving services for residents and visitors is exemplified in the POGO circulator. This is illustrated by city leadership taking key data and feedback from past riders and using it to develop a new system proposal, adapting POGO from a loop circulator to a proposed hub-and-spoke system. These changes are intended to serve more riders by reaching additional locations, connecting to other transit systems, and running revised hours.

Through their Spring 2020 semester project, students in David King's PUP 598: Transportation and Land Use Planning class wanted to build upon Peoria's existing transit service initiative to continue serving the city's residents and visitors in the best possible ways. By methodically examining other circulator systems in the Phoenix Metropolitan area and across the U.S., students were able to establish a concise list of relevant circulators to be used as examples to guide future improvements to POGO.

Recommendations were distilled from the selected case studies as well as student-conducted surveys and findings from the academic literature on circulator systems. The students' research aims to provide useful transit models that may assist city decision-makers with the complex, strategic choices needed to best serve the Peoria community through public transit. Peoria is well on the way to providing the best community circulator it can by continually investigating the community's ridership needs and adjusting services to suit those needs.

REFERENCES

Ahwatukee Life. (n.d.). *Ahwatukee Life.* Retrieved from **http://www.ahwatukeelife.com/**

About Us - Serving Older Adults in Dakota County. (n.d.). Retrieved from **https://dartsconnects.org/about-us/**

Chavarria, M, and J Volinski. 2004. "Identifying the Characteristics of Successful Local Transit Circulator Systems in Residential Areas of Southeast Florida." (December).

City-Data.com. (n.d.). German Village Neighborhood in Columbus, Ohio. Retrieved April 18, 2020, **from http://www.city-data.com/neighborhood/German-Village-Columbus-OH.html**

City-Data.com. (n.d.). Italian Village Neighborhood in Columbus, Ohio. Retrieved April 18, 2020, from **http://www.city-data.com/neighborhood/Italian-Village-Columbus-OH.html**

City-Data.com. (n.d.). Victorian Village Neighborhood in Columbus, Ohio. Retrieved April 18, 2020, from **http://www.city-data.com/neighborhood/Victorian-Village-Columbus-OH.html**

Boyle, D. (2011). Practices in the development and deployment of downtown circulators. Washington, DC: Transportation Research Board of the National Academies.

Lakeville LOOP Circulator Bus: Lakeville, MN. (n.d.). Retrieved April 17, 2020, from **https://www.lakevillemn.gov/824/Lakeville-LOOP-Circulator-Bus**

Minibuses: Shuttle Buses Dimensions & Drawings. (n.d.). Retrieved from **https://www.dimensions.guide/element/minibuses-shuttle-buses**

New 'Peoria on the Go' bus route is up and running. (n.d.). Retrieved from **https://www.valleymetro.org/blog/new-peoria-go-bus-route-and-running**

Noel, E. C., Arhin, S., & Thomas, J. (2013). Long-term trends in patron satisfaction of DC Circulator (No. CA-MTI-13-1138). Mineta Transportation Institute.

Peoria On the Go Schedule. (n.d.). Retrieved from **https://www.valleymetro.org/maps-schedules/pogo**

Poulin, S. (2019, June 30). Cbus at 5 years: Ridership has grown on free connector service. Retrieved from **https://www.dispatch.com/news/20190630/cbus-at-5-years-ridership-has-grown-on-free-connector-service**

Popular Round Rock bus routes see increased ridership, start 2019 with expanded hours. (2019, January 24). Retrieved from **https://www.roundrocktexas.gov/the-quarry/2018/12/mayor-morgan-popular-routes-start-2019-with-improved-services/**

Qin, F. (2014). Investigating the In-Vehicle Crowding Cost Functions for Public Transit Modes. Mathematical Problems in Engineering, 2014, 1–13. doi: 10.1155/2014/502708

Ridership Report. (n.d.). Retrieved from **https://www.valleymetro.org/ridership-reports**

Valley Metro. Valley Metro Bus Routes Gis Data. February 19, 2020. Retrieved from **http://geocenter-valleymetro.opendata.arcgis.com/search?groupIds=17de3fc1bc2a43948548613a27eb9c4d**

Wikipedia contributors. (2020, April 5). Ahwatukee, Phoenix. In Wikipedia, The Free Encyclopedia. Retrieved 07:25, May 8, 2020, from **https://en.wikipedia.org/w/index.php?title=Ahwatukee,_Phoenix&oldid=949333890**

Wikipedia contributors. (2020, April 28). Dell. In Wikipedia, The Free Encyclopedia. Retrieved 07:23, May 8, 2020, from **https://en.wikipedia.org/w/index.php?title=Dell&oldid=953658261**

Wikipedia contributors. (2020, April 29). Miami Beach, Florida. In Wikipedia, The Free Encyclopedia. Retrieved 07:16, May 8, 2020, from **https://en.wikipedia.org/w/index.php?title=Miami_Beach,_Florida&oldid=953845574**

Wikipedia contributors. (2020, April 24). Peoria, Arizona. In Wikipedia, The Free Encyclopedia. Retrieved 07:27, May 8, 2020, from **https://en.wikipedia.org/w/index.php?title=Peoria,_Arizona&oldid=952900313**

Wikipedia contributors. (2020, March 27). Round Rock, Texas. In Wikipedia, The Free Encyclopedia. Retrieved 07:30, May 8, 2020, from **https://en.wikipedia.org/w/index.php?title=Round_Rock,_Texas&oldid=947637252**

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