2021 REPORT

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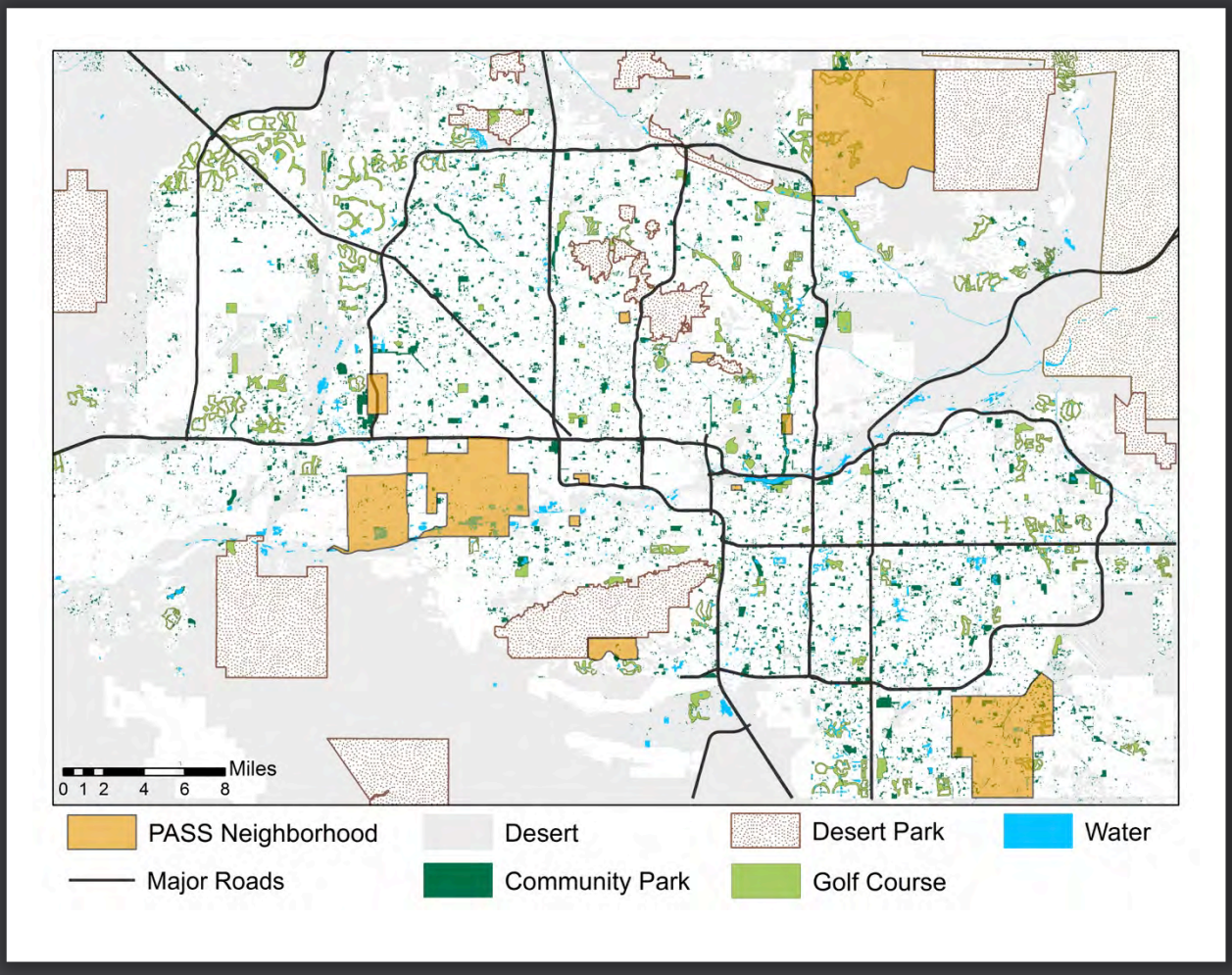
*Analyzing Neighborhood Social-Ecological Dynamics & Change Over Time*




*Central Arizona–Phoenix Long-Term Ecological Research Project*
*Global Institute of Sustainability and Innovation, Arizona State University*

2021 REPORT

# The Phoenix Area Social Survey V

*Analyzing Neighborhood Social-Ecological Dynamics and Change Over Time*

**Kelli L. Larson**[1,2,3], Professor and Director of PASS

**Jeffrey A. Brown**[1], Postdoctoral Researcher and Assistant Director of PASS

**Riley Andrade**[4], Postdoctoral Researcher

**Dayanara Avilez**[3], **Akilah Davitt**[3], and **Janelle Siefert**[2], Undergraduate Student Co-Authors

**Abigail York**[5], Professor and Associate Director of PASS

[1]Global Institute of Sustainability and Innovation, Arizona State University
[2]School of Geographical Sciences and Urban Planning, Arizona State University
[3]School of Sustainability, Arizona State University
[4]Department of Wildlife Ecology and Conservation, University of Florida
[5]School of Human Evolution and Social Change, Arizona State University

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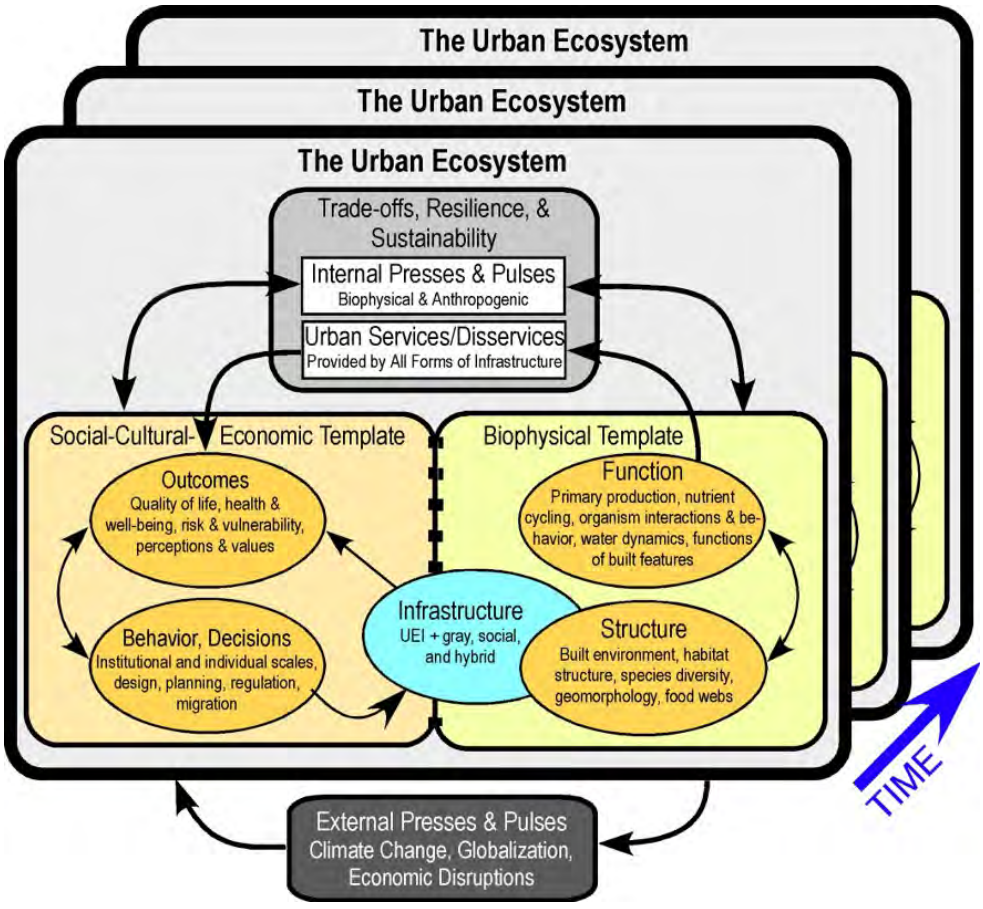
# Overview of the Phoenix Area Social Survey (PASS)

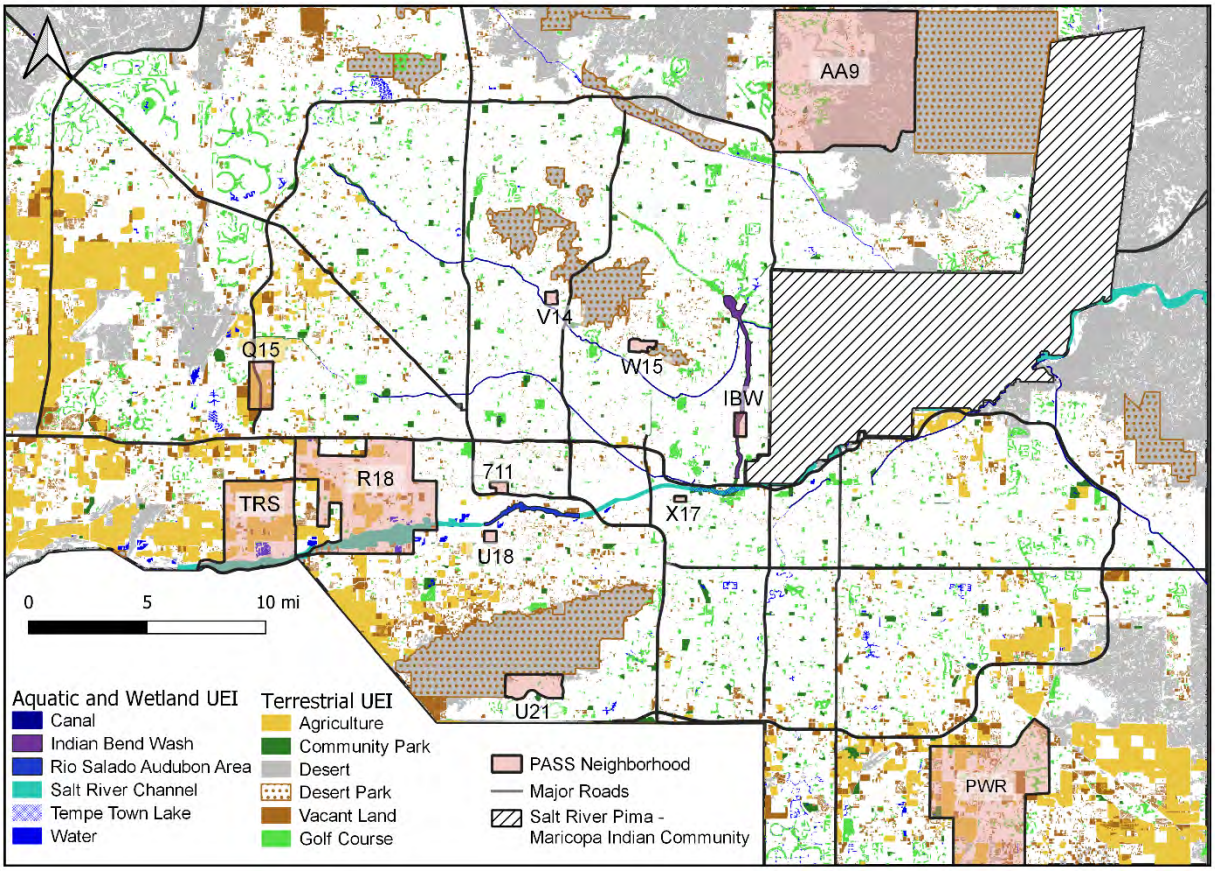
The Phoenix Area Social Survey (PASS) was established in 2001 as part of the Central Arizona–Phoenix Long-Term Ecological Research (CAP LTER) project's long-term monitoring program. Approximately every five years, we survey households in select neighborhoods in metropolitan Phoenix to better understand people's perceptions, attitudes, and behaviors about landscape choices and management, heat stress and climate change, and other environmental risks and conservation matters. The PASS also collects data on human wellbeing and socio-demographics. In 2001, the first PASS was piloted in 8 neighborhoods (n= 302) in the City of Phoenix. The 2006 (n= 808) and 2011 (n= 806) samples then expanded to a broader range of neighborhoods (40-45), aiming for 20 respondents per neighborhood. The neighborhoods were selected to represent the geography of the greater metropolitan area in terms of location, income, and other demographics. In 2017, the PASS sample was redesigned to target a larger number of people (~65) in fewer (12) neighborhoods across the region. The revised sampling design allows for intensive neighborhood analyses that link residents' perceptions, attitudes, and decisions to the local urban ecological infrastructure, as well as other biophysical features such as bird community composition and diversity measures (Childers et al., 2019; Warren et al., 2019; Brown et al., 2020; Andrade et al. 2021 and forthcoming). For the 2017 PASS, we achieved a sample size of 496 with a response rate of 39%; the samples sizes for neighborhoods ranged from a low of 20 individuals to a high of 60 (see the PASS IV report; Larson et al., 2017).

As seen in the *conceptual framework (right)*, recent CAP LTER research centers on urban ecological infrastructure (UEI; Childers et al. 2019) as a physical link between the human (left) and ecological (right) sub-systems. By linking the social survey data to various environmental datasets, the 2017 and 2021 PASS seek to answer the following research questions across



diverse local contexts: *How do the services provided by dynamic urban ecosystems and their infrastructure affect human outcomes and behavior, and how do human actions affect patterns of urban ecosystem structure and function, and ultimately, urban sustainability and resilience?* This multifaceted question guides the CAP LTER IV project, which spans 2016 to 2022.

Given CAP's focus on UEI, Brown and Larson et al. (2020) created a map of major urban ecological infrastructure in metropolitan Phoenix, as shown in the *map below—with the PASS neighborhoods outlined in red*. The different types of UEI include: *terrestrial* UEI such as desert and community parks as well as vacant land and cropland; *aquatic* features such as canals, lakes, and other surface water; *wetland* UEI including distinct Sections of the Salt River Channel (e.g., the Rio Salado Audubon site in central Phoenix and the Tres Rios wetlands at the 91st Avenue wastewater treatment plant).



## The Survey Content: Constructs and Variables

The PASS includes survey questions that address people's perceptions, attitudes, and decisions related to assorted urban environmental issues and measure residents' values, wellbeing, and socio-demographic factors, all of which can be important predictors or contextual factors that explain social-ecological dynamics and urban ecosystem outcomes. Below is an overview of the types of constructs evaluated through the 2021 PASS, followed by more details about the specific measures and sources of survey questions for each category.

### Human Health and Wellbeing

Quality of Life Now and into the Future
Environmental Satisfaction at the Neighborhood Level
Access to Local Services
Health Problems

### Place Attitudes and Outdoor Recreation

Place Identity: Neighborhoods and the Desert
Attitudes toward the Desert
Outdoor Recreation: Park Visitation and Otherwise[1]

### Ecosystem Services and Human-Wildlife Interactions

Perceived Ecosystem Dis/Services
Wildlife Values and Attitudes
Practices to Attract/Feed Birds

### Residential Landscaping Decisions

Landscape Choices and Management
Wildlife-Friendly Yard Practices

### Risk Perceptions and Mitigation Strategies

Environmental Problems
Heat Perceptions and Mitigation Practices
Flooding and Stormwater Management

### Values, Demographics, and Other Constructs

Personal Values and Political Orientations
Environmental Value Orientations
Personal, Household, and Neighborhood Attributes

Where possible, we have adopted (verbatim) or adapted (with wording modifications) established survey questions that form reliable composite scales for certain constructs. In other cases, we conceptualized and operationalized survey constructs and associated questions based on relevant scholarly literature. While some questions were asked across time periods for longitudinal analysis, others have been newly added in 2021 based on the specific research questions and interests of active investigators with PASS and the CAP LTER. In the descriptions that follow, we

[1]In 2021, we added some specific questions about outdoor recreation before and during the COVID-19 pandemic, which began around the turn of the 2019-2020 calendar year and persists at the time of the writing of this report.

describe longitudinal PASS questions and variables, as well as newer ones more recently added to the survey. All references to survey question (Q) numbers are based on the questionnaire implemented in 2021.

## *Human Health and Wellbeing*

Several questions on the survey were incorporated to evaluate people's evaluations of their lives. Specifically, wellbeing and perceived quality of life are multidimensional constructs that capture how people assess—either positively or negatively—varying aspects of their life (e.g., health, work, etc.) (Diener et al., 1985; Pavot & Diener, 2008; The Whoqol Group, 1998). To evaluate residents' wellbeing, we focused on overall quality of life, subjective measures of life satisfaction and satisfaction with local neighborhood environments, perceived access to local services, and health concerns, as described below.

- **Quality of Life Now and Into the Future**: Included in the PASS since 2006, two questions (Q1 & 2) asked residents to assess their views about the "quality of life" in the Valley. The first question asked about the quality of life in the Phoenix metro area, with responses ranging from "not at all good" (1) to "excellent" (5), and the second asked people to anticipate if the quality of life will be "much worse" (1) to "much better" (5) over the next 10 years. A new set of questions added to the 2021 survey explores people's perceptions regarding future threats to the quality of life in the Valley (Q46-47).

- **Life Satisfaction:** Since 2017, the well-cited scale developed and proven reliable by Diener et al. (1985) was included in the survey. To evaluate people's subjective evaluation of their own lives, this scale includes five statements such as "In most ways my life is close to my ideal" and "The conditions of my life are excellent," with a five-point response scale ranging from "strongly disagree" to "strongly agree" (Q48).[2] As a reliable composite measure of life satisfaction, we recommend averaging individuals' responses to the five statements or variables. For 2017 PASS findings regarding life satisfaction (see Pfeiffer et al., 2020's paper on influential factors such as neighborhood parks and objective measures of walkability).

- **Environmental Satisfaction:** Questions have been asked in previous versions of the PASS to assess residents' dis/satisfaction with various aspects of their neighborhoods. While previous questions in 2006 and 2011 focused on an array of local attributes (e.g., safety, crime), we modified the 2017 question to focus on environmental attributes such as parks and trees, as well as flowering and desert plants. For these variables, a five-point response scale ranged from "strongly dissatisfied" to "strongly satisfied" with a "neither" option in-between. These items were included again in the 2021 survey (Q7) with slight modifications, including questions about the quality and affordability of housing. We also added a new question focused specifically on people's negative to positive views of trees in their neighborhoods (Q9).

[2]Note, all questions with dis/agree response scales included a five-point response scale including "strongly disagree", "disagree", "neutral", "agree," and "strongly agree".

- **Access to Services**: Since 2017, a four-item question—from Sallis' Neighborhood Quality of Life Survey—has been included in PASS to assess residents' access to local amenities, including grocery stores, stores within walking distances, other places to go within walking distance, and walkability to transit stops (Q11 in the 2021 survey). A five-point dis/agree response scale was used for this question (Sallis, 2017).

- **Personal Health Concerns:** New questions added to the PASS 2021 center on human health. These include questions about access to food (Q55), particular health diagnoses (Q52), and an overall rating of personal health (Q51). As described below, we also asked questions regarding specific heat stress symptoms experienced over the last summer (Q53-54).

## *Place Attitudes and Outdoor Recreation*

In the 2017 survey, a series of questions gauged residents' personal connections with varied places in the study region, including their local neighborhoods, the desert environment, and open spaces include parks and areas with rivers or lakes. Some but not all these questions were included in a previous version of the PASS.

- **Place Identities**: Place attachment is a multi-dimensional construct—comprised of place identity, place dependence, and social bonding—commonly evaluated to a survey scale developed by William and Vaske (2003). Since CAP LTER investigators are most interested in residents' emotional bonding to where they live, we evaluated *place identity* with newly added items in the 2017 survey that were also included in 2021. Specifically focusing on two different scales—neighborhoods (Q10) and the region's desert parks (Q3), we included five of the six standard statements[3] for each 'place.' Evaluated on a five-point dis/agree response scale, example statements include: "My neighborhood means a lot to me," and "Desert parks in the Valley are very special to me."

- **Desert Attitudes**: In addition to measuring identification with desert preserves, we included five dis/agree statements to capture attitudes toward the desert (Q5). Two of these statements—"The desert is an empty wasteland" and "The desert is very special to me"—were repeated from the 2006 and 2011 surveys (see Andrade et al., 2019), while three more were newly added in 2017 based on written comments from survey respondents, as well as common literary descriptions of the desert. In 2020, one item was dropped from the 2017 survey based on data analyses (i.e., "The desert should be developed."), and one was added (i.e., "The desert is a nice place to spend time.").

- **Outdoor Recreation**: A set of new questions were developed for the 2017 PASS to gauge the frequency with which residents visit particular types of parks or outdoor areas, both in the "summer months of June, July, and August" as well as the "other, non-summer months". In 2021, these questions were combined into a single question asking about park visitation in "the past year or so." With a five-point response scale ranging from "never" to "at least once a week or more," we asked this question (Q4) for desert parks and neighborhood parks as well as

[3]The statement about "visiting" places" was omitted since this item is most relevant to tourism research, which is not central to the CAP LTER.

streams, ponds, and lakes—both within and outside of the metropolitan area. Given the ongoing COVID-19 pandemic at the time of the 2021 survey, we also asked residents if they spent more or less time gardening, hiking, and spending time in parks compared to the previous pre-pandemic spring season (Q38-39).

## *Ecosystem Services and Human-Wildlife Interactions*

The 2017 and 2021 PASS included several questions to evaluate people's perceptions of local ecosystem services and disservices, in addition to local birds and other wildlife. Most of these data were not collected in the PASS prior to 2017, and given increasing interests in human-wildlife interactions among CAP investigators, several questions were added to gauge residents' attitudes and practices related to wildlife.

- **Ecosystem Dis/Services**: Largely based on previous works, we developed a multi-item survey question for the 2017 PASS to gauge residents' perceptions of the degree to which the environment in *their neighborhood* provides particular ecosystem services (amenities or benefits) and disservices (dis-amenities or problems) (Brown et al., 2016; K. L. Larson et al., 2016). In referencing "*the environment,"* we specified consideration of "the grass, plants, and/or trees in the area, along with the streets, sidewalks, patios, porches and built structures as well as parks and open spaces" (Q12-13 in 2021). With a five-point dis/agree response scale, we asked about several ecosystem dis/services (16 items total). For research analyzing the 2017 data, see Larson et al. 2019 and Brown et al. 2020.

- **Wildlife Values and Attitudes:** In 2017 and 2021, we evaluated attitudes toward birds (Q33) in terms of residents' perceptions of local bird traits (see Andrade et al. forthcoming).[4] We also asked (Q42) respondents about the extent to which they "like" or "dislike" the following pollinators: bats, bees, butterflies, and hummingbirds. In 2021, we added a number of questions concerning to evaluate attitudes toward snakes (Q44) and other wildlife (Q41 & 43). Analyzing 2017 PASS data, a number of publications have examined human-wildlife interactions in Phoenix metro, including attitudes toward bees (Larson et al. 2020) and snakes (Bateman et al., 2021). Additional survey questions measured: wildlife value orientations (Q40, adapted from Manfredo, 2008) and, more specifically, values pertaining to residential wildlife experiences (Q32; Fulton et al., 1996).

- **Attracting and Feeding Birds:** In 2017 and 2021, PASS respondents were asked if they attract birds to their yards through various means (e.g., putting out food or water, planting vegetation, maintaining bird houses; Q34). Moreover, if residents feed birds at home, we asked what they feed them (Q35). In 2021, we also asked about bird-feeding behaviors at restaurants (Q37).

## *Residential Landscaping Decisions*

Since residential land is the most dominant land use in cities such as Phoenix, many PASS questions ask residents about their landscape preferences and practices, including assorted yard features, management inputs, and changes made to their

[4]A number of studies informed the development of these questions, including: (Belaire et al., 2015; Clergeau et al., 2001; Cox & Gaston, 2015; Lerman & Warren, 2011)

property. Many of these questions came from previous versions of PASS (see Larson et al. 2009; 2017) or a survey designed by Larson (see Larson et al. 2010).

- **Landscape Choices and Management**: Similar to previous PASS questionnaires (see Larson et al. 2009; Larson et al. 2017; Wheeler et al. 2020), the 2021 survey asked about the amount of grass in residential front- and back-yards (Q26-27) using five categories (none, less than half, about half, more than half, all). As detailed below, several questions also asked about changes to people's yards, including the adoption of green infrastructure (e.g., Q25). Same as in 2017, we also asked whether or not residents use pesticides (Q22-23) and fertilizers (Q24).

- **Wildlife-Friendly Landscaping:** To further advance CAP LTER research on residential landscapes, we asked new questions in the 2021 PASS that centered on attitudes toward native plants (Q28) and whether residents have planted or are likely to plant native vegetation to attract wildlife (Q20-21). Following Larson et al. (forthcoming), we also asked about the adoption of other wildlife-supporting yard features, in addition to asking residents about the likelihood of them adopting yard features to attract birds, pollinators, or other wildlife into the future (Q20-21).

## *Risk Perceptions and Mitigation Strategies*

Since the inception of PASS in 2001, survey questions have asked residents to rate the seriousness of other environmental risks. Linked to research on urban climate and water resources, we especially have focused on heat stress, mitigation, and adaptation as well as flood risks and their management.

- **Environmental Problems**: Since the 2011 PASS, survey respondents were asked to what extent they view the following environmental risks as problematic for their household: air pollution, global warming/climate change, extreme heat, normal summer temperatures, severe storms, floods, drought, water shortages, water pollution, and drinking water safety. Slight modifications in wording have occurred over time, but the essence of this question has remained the same. While many PASS questions have focused on risk perceptions and mitigation practices over the years, particular attention has centered on urban heat and stormwater issues (for example, see Meerow et al., 2021).

- **Heat Perceptions and Practices:** Several questions evaluated perceptions and practices regarding heat stress, adaptation, and mitigation (see especially the work by Harland and colleagues; Harlan et al., 2006; Jenerette et al., 2016; D. Ruddell et al., 2012; D. M. Ruddell et al., 2010). Repeat questions on various versions of PASS include whether residents think their neighborhood is relatively hot, cool, or about the same as others in the region (Q14), in addition to a question about residents' thermal comfort outdoors—measured in Fahrenheit or Celsius—"last summer" (Q15). Additional questions in 2021 evaluated the extent of air conditioning usage and vegetation planting as mechanisms for cooling (Q16 & 18), as well as experiences with indoor heat (Q17) and heat stress symptoms (Q53). Although modifications were made to the heat questions for 2021, many remain comparable with data from previous years (especially 2017).

- **Flooding and Stormwater Management**: In both 2017 and 2021, a series of four statements were designed to evaluate residents' personal and local experiences with stormwater drainage and flooding with a five-point dis/agree scale (Q29). With significant wording modifications in 2021, residents were also asked if they adopted various types of green infrastructure to manage stormwater on their properties (Q30). Changes made to yards "in the last five years" have also been repeatedly evaluated in PASS, including the addition or removal of grass, trees, and desert plants, among other features (Q25).

## *Values, Demographics, and Other Constructs*

As is common in survey research, several questions asked about personal or household demographic attributes. We also include a few common constructs measured by standardized scales published in the literature to measure assorted values, as detailed below.

- **Value Orientations:** Survey questions since the 2006 PASS have measured environmental values and political orientations, with the latter evaluated on a seven-point scale ranging from "very liberal" to "very conservative" with a "moderate" option in the middle (Q68). For environmental values, Dunlap et al.'s (2000) New Ecological Paradigm (NEP) scale—inclusive of fifteen agree-to-disagree statements—was included verbatim in both 2011 and 2017. In 2021, we truncated the scale to five items (Q50; for justification of shortened scale, see Cordano et al., 2003; Harraway et al., 2012; López-Bonilla & López-Bonilla, 2016). As a set of basic beliefs, these statements reflect environmental orientations or what is otherwise known as "ecological worldviews"—with emphasis on biocentric versus anthropocentric values (Larson 2010). In 2021, we newly added a question with eight statements (Q49) to evaluate general individual values, which reflect the strength of people's altruistic and biospheric values as egoistic and hedonic ones (Stern, 1999; van Riper et al., 2019).

- **Social Capital:** Social capital is another commonly used social science construct that can serve as an explanatory variable for much of the data collected in the PASS. Following Larsen et al. (2004), the PASS has included dis/agree statements to measure the social capital in local neighborhoods (see the last three items in Q10).

- **Personal and Household Attributes:** The demographic questions were mostly drawn from previous versions of PASS, often adapting similar wording to questions in the U.S. census. Starting with Q56 in the 2021 survey, demographic questions include: household income and size; sex, age, and education of the respondent; employment status; ethnicity and race; and, the number of years lived at the current address and in the Valley. We also asked about the type of home people live in, as well as whether residents rent or own their home and live in an area with a Homeowner's Association. We also asked about pets, and how much time cats and dogs spend time outside.

# Biophysical Data Linked to the PASS Neighborhoods

## *The Ecological Survey of Central Arizona (ESCA)*

In 2017, we focused on the redesign of the PASS sample to facilitate greater integration of the survey data in relation to other biophysical and ecological datasets. As such, the PASS study neighborhoods are co-located with long-term ecological monitoring efforts formerly called Survey 200 and renamed the Ecological Survey of Central Arizona (ESCA) in 2016. Conducted every five years since 2000, the ESCA is an extensive longitudinal field survey designed to characterize key ecological indicators of the CAP LTER study area. The survey is conducted at approximately 200 sample plots (30x30 meters) that were located randomly using a tessellation-stratified dual-density sampling design. Herein, we detail the types of data that can be linked to the PASS data in order to inform and encourage CAP LTER researchers to think about integrated analyses that advance knowledge about coupled social-ecological system dynamics. We also provide a few examples of how research has linked the social survey from 2017 or earlier with assorted, spatially explicit biophysical and/or environmental datasets.

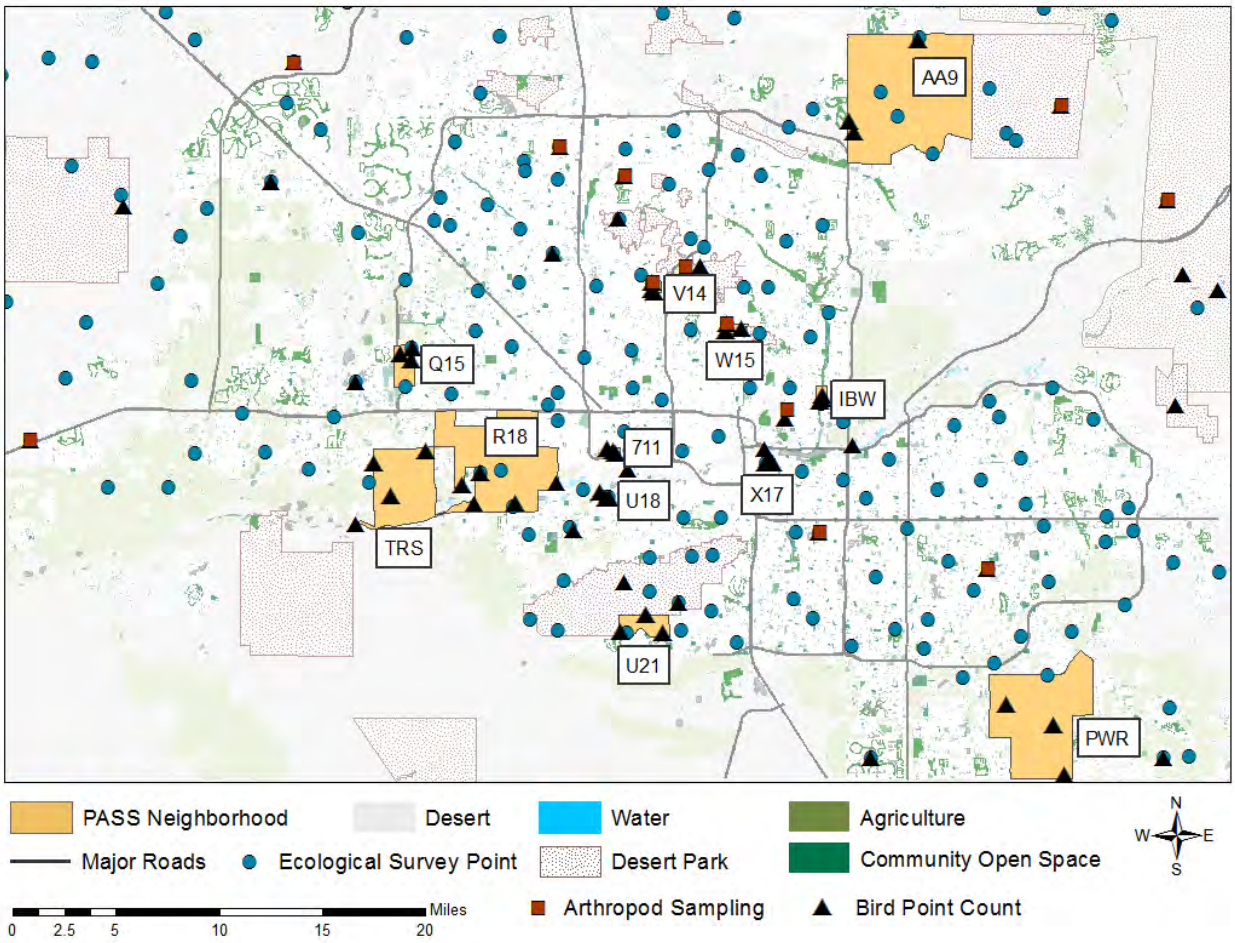
The ESCA design is intended to capture the diverse habitats encapsulated by the CAP LTER study area, ranging from the native Sonoran Desert to developed parcels with varying land use and cover characteristics. Major objectives are to characterize patches in terms of key biotic, physical, and chemical variables; and to examine relationships among land use, general plant diversity, native plant diversity, plant biovolume, soil nutrient status, and social-economic indices along indirect urban gradients. Specific field measurements include an inventory of the following:

- **annual and perennial plants** identified to the lowest possible taxonomic unit, typically species
- **plant size measurements** including the estimated plot cover of annuals and the biovolume of all trees and shrubs
- **physicochemical properties from soil** coring such as extractable ammonium, nitrate, and phosphorous; total, organic, and inorganic carbon; organic matter; pH and conductance, along with bulk density and texture
- **insects** from sweep-net sampling, including enumerations and identification to lowest practical taxonomic unit
- **general assessment of plots** including indicators of human activities, landscapes types and level of maintenance, nearby transportation infrastructure, and other neighborhood conditions
- **photos** of plants, plots, and surrounding environs

To better represent residential areas, the ESCA sampling protocol was expanded in 2010 to include surveys of one entire parcel (front and back yard) coinciding with each 30x30 m plot situated in single-family residential areas. In many cases, the 30x30 m plots include sections of more than one parcel. If this is the case, attempts are made to survey the parcel containing the greatest percentage of the 30x30 m plot, but this is not always possible. The map *below* illustrates the ESCA sampling points, along with additional bird and arthropod points, in relation to the PASS neighborhoods.

## *Ecological Sampling Beyond ESCA*

Additional long-term monitoring programs focus on ground-dwelling arthropods and bird censuses and coincide with some of the ESCA study plots but have been collected at more frequent intervals than every five years. Specifically, ground-dwelling arthropods—collected with pitfall traps—have been enumerated and identified quarterly since 2000 in five[5] of twelve PASS IV neighborhoods: V14, W15, R18, Q15, and TRS. Arthropod samples were last collected at site R18 in July 2012, and at Q15 and TRS in October 2016. Neighborhoods V14 and W15 maintain active pitfall sites. Other pitfall sites are located outside the PASS IV neighborhoods, most of which coincide with ESCA study plots.




At the time of the PASS III in 2011, bird census data were only collected at one point in each PASS neighborhood. In 2017, this number was increased such that each of the twelve PASS neighborhoods contained three bird census points. Eight of the twelve neighborhoods retained the previous bird point (associated with an ESCA plot) with two other points added, while the remaining four neighborhoods (711, IBW, PWR, and TRS) had three bird points added for 2017. Other bird points are located at ESCA sites outside of the PASS IV neighborhoods.

[5]In one case, the sampling point is located about 100 yards outside of the neighborhood boundary.

## *Additional Data for Integrated Social-Ecological Analyses*

Beyond the PASS and ESCA data, a number of other datasets could be combined with these primary long-term data sets for analysis of social-ecological dynamics in metropolitan Phoenix. Some of these datasets include: assorted demographic variables from the U.S. Census, parcel attributes from local tax assessor datasets, and a myriad of parameters from remotely sensed data (e.g., vegetation data from the Normalized Difference Vegetation Index, or NDVI) or Soil-Adjusted Vegetation Index (SAVI) for select years. The CAP LTER's land use/cover datasets also offer much potential for integrated analysis with the core social and ecological datasets. These include expert-based classifications from Landsat imagery (30-meter resolution) for 2000 and 2010 as well as classifications from the National Agricultural Imagery Program (NAIP; 1-meter resolution) for 2010 and 2015 (which is underway). Meteorological data capturing land surface temperatures is another dataset that can be linked to land use/cover as well as related survey data on heat risks and climate adaptation.

With the focus on urban infrastructure now and into the future of CAP LTER, aerial imagery and other datasets that provide information on the location and type of such infrastructure is also an avenue for further research. One example here is a study by Hale et al. (2015) that linked stormwater infrastructure in the region to water quality measures such as nutrient loads. In this work, data were obtained from the City of Scottsdale for the four types of stormwater infrastructure used in the region: stormwater drainage pipes, engineered channels, natural washes, and retention basins.

In the history of PASS, some investigators have conducted integrated analyses of social-ecological data from PASS and other CAP LTER datasets, providing important insights into how people influence and/or respond to local biodiversity, heat stress, or other environmental conditions. In the next section, we briefly describe three examples of how CAP LTER datasets have been linked with the goal of understanding social-ecological system dynamics.

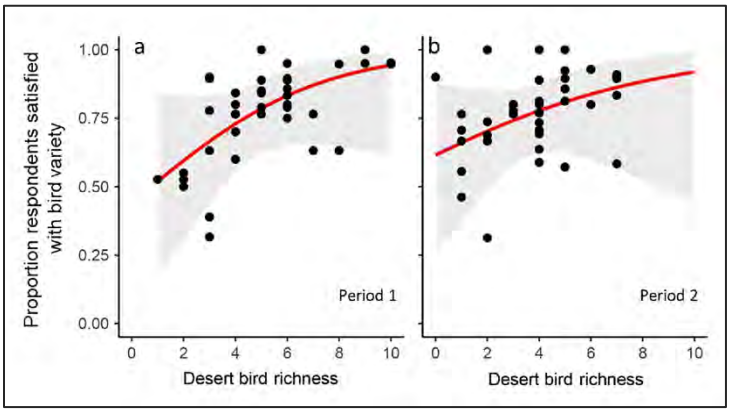
## *Examples of Integrated Social-Ecological Research*

First, substantial CAP LTER research has focused on heat vulnerability in the study area through coupled analyses of climatological and biophysical datasets. For example, combining survey data from the 2001 PASS with meteorological and remote sensing data measuring **temperatures and land use/cover** configurations, Harlan et al. (2006) demonstrated that neighborhoods with lower socioeconomic status and more ethnic minorities were likely to be warmer due to lower vegetation density, higher settlement density, and a lack of green space. Later work with 2006 and 2011 PASS data supported the findings of Harlan et al. (2006), demonstrating that impoverished populations are more likely to live in warmer neighborhoods with lower vegetation density. Ruddell et al. (2009) and Jenerette et al. (2016) further found that self-reported experience with and frequency of heat-related illness were positively correlated with air temperature and land surface temperature. Additional analyses of 2006 and 2011 data have demonstrated that residents' perceptions of and experiences with heat accurately reflect the observed land surface temperature (Jenerette et al. 2016), in addition to modeled air temperature differences between PASS neighborhoods (Ruddell et al. 2009, Ruddell et al. 2012). Collectively, the results of this work show that residents' perceptions of neighborhood temperatures and

conditions (e.g., less vegetation and more asphalt) correspond to heightened heat stress and vulnerabilities.

Analyzing 2017 PASS data, a second example of integrated social-ecological analyses is research on perceived ecosystem services and disservices in local communities relative to both social and environmental factors, including proximity to diverse types of **urban ecological infrastructure** (see map on page 5) and areas with varying **vegetation density** (per the NDVI; Brown et al. 2020). As referenced earlier, Brown et al. (2020) specifically analyzed residents' perceptions of bio-cultural services and disservices—respectively defined as beliefs about the extent to which local, neighborhood landscapes provide an aesthetically appealing variety of plants that support wildlife or weedy and messy landscapes that attract pests. The results revealed that while desert preserves and vegetation density enhance the perception of bio-cultural *services*, particularly in wealthier areas of the north-central Phoenix Valley, proximity to the Salt River Channel, vacant land, and cropland increase the perception of bio-cultural *disservices*, particularly in lower-income areas of the West Valley (Brown et al. 2020).

A third example pertains to residents' satisfaction with **local bird community composition** in their neighborhoods, wherein Lerman and Warren et al. (2011; 2019) analyzed 2006 PASS and bird point data. They found that people's satisfaction with birds in their neighborhoods was positively associated with actual bird diversity. The following section further discusses the longitudinal analyses of these survey and bird data for 2006 and 2011 (figures *at right*), along with other examples of longitudinal analyses.




## Longitudinal Analyses of the PASS Data

For the 2021 phase of PASS, we underscore longitudinal analyses of the survey data over time, especially in the eight neighborhoods surveyed since 2006 or in the 12 surveyed in 2017 and 2021. Herein, we provide a couple of examples of such temporal analyses conducted in recent years, in addition to highlighting the data collected over time and, thus, available for longitudinal analyses.

Perhaps the best example of longitudinal analyses is the research published by Warren and Lerman et al. (2019), which demonstrates a persist relationship between public satisfaction with their local bird communities and bird diversity in the PASS neighborhoods. As the figure *above* shows, residents who live in neighborhoods with higher bird richness expressed higher satisfaction with the variety of birds in their neighborhoods both in 2006 and 2011. While this trend persisted across the two time periods, the more recent time period exhibited lower satisfaction with birds and lower bird richness in PASS neighborhoods. The 2021 survey and bird data can be similarly

analyzed to see if this downward trend in bird diversity and satisfaction with local bird communities has continued.

Another example of temporal analysis of PASS data was conducted for residents' landscape choices by Wheeler et al. (2020). The figure *below* presents data on actual, existing yards and preferred yards (at the time of each survey) using data PASS respondents in the eight neighborhoods surveyed in 2006, 2011, and 2017. These trends show an increase in xeric yards—with gravel groundcover instead of mesic lawns. Meanwhile, preferences for different yard types—based on the extent of grass—have not trended in a similar direction. Together, these patterns suggest that people's preferences may not be driving the observed shift toward xeric landscaping in the study region. The temporal trends shown here were validated by the reported and preferred yard choices of homeowners from the 2017 PASS, which show that many residents with xeric yards actually prefer more grass (Wheeler et al. 2020). Specifically, 46% preferred more grass than they have, and only 8% wanted less grass.

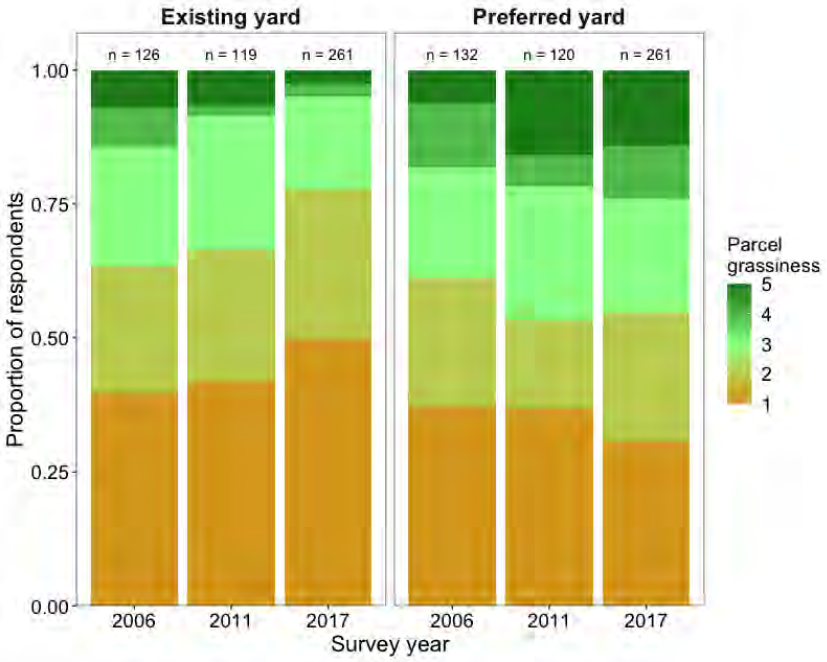



Figure above created by Megan Wheeler.

Into the future, we strongly encourage researchers to use the PASS datasets to explore human-environment relationships over time. Since the dataset tracks houses and neighborhoods, as opposed to individuals, it is important to recognize the limitations on longitudinal analysis. In particular, only a portion of the respondents are repeat respondents from the previous year (Larson et al. 2015). For example, between 2016 and 2011, only 196 (24%) of the 808 respondents were the same individuals. Meanwhile, 365 (45%) were re-sampled houses represented in both survey periods but with a different resident (at the same location) completing the survey in the latter (2011) year. In 2017, the number of surveyed respondents across the three time periods dropped to only 21 individuals and 43 household addresses, thereby complicating longitudinal analyses over multiple years.

Given the limitations to longitudinal research sign PASS data, as well as the change in sampling design in 2017, time-series analyses are most viable between two time periods (e.g., 2006 and 2011, 2017, 2021). For the most recent datasets, analyses can focus on the *repeat neighborhoods (12) and respondents (138) across 2017 and 2021*. This could involve paired analyses of how individuals' responses changed over time using only the subset of repeat participants for the data that were collected in both time

periods. Where survey questions asked about the house or property, as opposed to individuals' attitudes or perceptions, the subset of repeat houses/properties can be analyzed as paired responses linked to locations. Otherwise, we suggest the types of analyses described above to explore broader trends in residents' responses—in aggregate—over time. Beyond examining temporal trends, investigating the steadiness of social-ecological relationships over time can help validate empirical results and thereby aid with generalizing findings that help build theories of human-environment dynamics and urban environmental change.

Beyond data limitations, one reason for the lack of temporal analyses using PASS data is that the data across time periods have not been integrated into a single dataset for analysis by CAP researchers. The one exception is a combined dataset developed for 2006 and 2011 survey data (see Larson et al. 2015), which highlighted the attrition of repeat respondents over time. For Wheeler et al. (2020), the repeat neighborhoods for 2006, 2011, and 2017 were integrated, but the published results from this work ultimately incorporated only the 2017 data.

For the 2017 and 2021 surveys, CAP LTER postdoctoral researcher and the Assistant Director of PASS V, Jeff Brown, will provide the integrated datasets for questions that were asked verbatim over the two time periods or are otherwise comparable due to only minor changes in wording. A list of the types of questions asked to produce the same survey variables over the 2017 and 2021 time periods follows, with the question (Q) numbers from the 2021 questionnaire noted in parentheses.

- Perceived quality of life in the Valley, now and in 10 years (Q1 and 2)
- Personal life satisfaction (Q48)
- Place identity: attachment to local desert parks (Q3) and neighborhoods (Q10)
- Perceived social capital within local neighborhoods (Q10)
- Attitudes toward the desert (Q5)
- Neighborhood extent (Q6) and satisfaction with local environmental features (Q7)
- Access to services in neighborhoods (Q11)
- Perceived ecosystem dis/services from neighborhood environment (Q12/13)
- Perceived heat relative to other neighborhoods and outdoor thermal comfort (Q14-15)
- Extent of grass in front and back yards (Q26-27) and addition and removal of trees, grass, desert plants, and concrete (Q25)
- Experiences with local flooding (Q29)
- Perceptions of birds and bird-feeding behaviors (Q33 and 34-35)
- Environmental risks to households (Q45)
- Environmental value orientations (Q50)
- Political orientations (Q68)
- Personal or household attributes: gender, race, and ethnicity; income and educational levels; age, years in Valley and at current address; housing type, homeowner/renter, and presence of HOA; household size and kids at home; pets and time cats spend outdoors (see Q56 onward)

# Survey Methods: PASS V (2021)

## *The Sampling Design*

As in all versions of the PASS, U.S Census block groups defined the spatial extent of the neighborhoods that were targeted to represent a diverse array of areas based on both location and socio-demographics. The focal neighborhoods across all time periods of PASS have also been stratified to cover the central (core) parts of the city, suburban areas, and along the urban fringe (see maps above). Since the boundaries of the census block group change over time, we have maintained the original 2006 boundaries. The table *below* highlights the characteristics of the 12 PASS neighborhoods while flagging three neighborhoods that were added[6] to the sample in 2017. These neighborhoods were added to capture diverse areas of the Valley and to encompass areas proximal to ecological sampling in the CAP LTER: 1) Indian Bend Wash (IBW)[6], which is an area in the City of Scottsdale designed to mitigate flooding that constitutes a linear urban park system of walkways and sports infrastructure with significant recreational services; 2) Power Ranch (PWR), which is a site chosen to represent a fringe community with significant agricultural land in the East Valley; and 3) Tres Rios Wetlands (TRS), which is a site designed to manage treated wastewater from the 91st Ave City of Phoenix treatment plant that improves water quality and provides habitat for birds. The other nine neighborhoods were surveyed in the 2006 and 2011 versions of PASS.

| ID | Location: Municipality^ | Avg. Year Developed | Median Per Household Income | Median Per Household Change | Percent Non-White | Change Non-White |
|---|---|---|---|---|---|---|
| 711 | Core: P | 1975 | $35,221 | +60% | 93% | +8% |
| AA9 | Fringe: S | 2000 | $155,712 | +12% | 13% | +1% |
| IBW* | Suburban: S | 1974 | $71,742 | +3% | 25% | +7% |
| PWR* | Fringe: G | 2008 | $104,466 | +58% | 33% | +7% |
| Q15 | Suburban: P | 2005 | $84,090 | +91% | 83% | +7% |
| R18 | Suburban: P | 2003 | $60,323 | +101 | 87% | -1% |
| TRS* | Fringe: P | 2006 | $70,457 | +96% | 87% | +4% |
| U18 | Core: P | 1953 | $56,389 | +134% | 96% | +1% |
| U21 | Fringe: P | 1996 | $153,601 | +42% | 25% | +1% |
| V14 | Core: P | 1971 | $61,238 | +5% | 43% | +14% |
| W15 | Core: P | 1971 | $179,204 | +22% | 7% | +5% |
| X17 | Core: T | 1988 | $53,347 | -4% | 40% | +10% |

Notes: *The asterisks by IDs indicate the three neighborhoods added to PASS 2017. ^The carrot for the location of neighborhoods indicates the following municipalities: P = Phoenix, S = Scottsdale, G = Gilbert, and T = Tempe.

[6] In 2006 and 2011, a neighborhood in the Indian Bend Wash area was surveyed but was not proximal to the site. Thus, in 2017, we moved the IBW neighborhood to be adjacent to the area.

The total sample invited to participate in PASS included 1,549 addresses, including 496 addresses provided from former PASS respondents (from the 2017 survey) and 1,053 new addresses provided by the Marketing Systems Group (MSG). The MSG addresses come from U.S. Postal Service's (USPS) Delivery Sequence Files, which provide a high-coverage list that includes all mailable USPS addresses. For the MSG sample, addresses were randomly selected across the 12 neighborhoods. In 2021, we oversampled 5 neighborhoods with lower participation in 2017 (711, Q15, R18, TRS, U18); specifically, we randomly drew 105 addresses from these neighborhoods, while 75 addresses were drawn from the remaining seven neighborhoods. An additional 40 addresses were randomly drawn to replace duplicates with the previous sample; MSG drew the additional addresses proportionally based on the number of flagged duplicates in each neighborhood, with five additional addresses drawn in both IBW and X17, and 3 additional addresses in the remaining 10 neighborhoods. Addresses identified by MSG as "drops" (a single delivery address for multiple residents such a boarding house or fraternity house), PO Boxes (addresses where a PO Box is the only option for mail delivery), or vacant (known vacant for 90+ days) were excluded from the sample.

## *Survey Implementation*

We contracted the University of Northern Iowa's Center for Social and Behavior Research to administer the survey. Drs. Kyle Endres and Mary Losch—both faculty members with expertise in survey research at UNI—oversaw the implementation of the survey via a web-based Qualtrics form and a printed questionnaire. They also oversaw the drawing of the sample, formatting and programming/printing of the surveys, and mailing and tracking of the survey packages. They also provided expert input on the survey content. Their team also managed data input and processing.

A five-wave mailing was employed to collect the survey data. First, on May 10 of 2021, we sent an advance letter with a unique URL to a web-based survey to encourage participation online. Next, we sent a full-packet mailing with the printed, 20-page questionnaire and a self-addressed, postage-paid envelope. The first of these full packets included a $5 cash pre-incentive. In addition to the pre-incentive, individuals who completed the survey were sent $25 in the form of a generic Visa gift card. Between the first and second mailings of the full packets (on May 26 and June 25), a postcard reminder was sent (on June 10). The informed consent letters in each of the packets included a Spanish language notice with a phone number and email where potential participants could request a Spanish copy of the survey. The third full packet was sent on July 19. For households with Hispanic surnames (n=245), we sent both an English and Spanish version of the survey with the third and final packet. Since responses in Spanish have been rare in previous versions of the PASS, we used this technique rather than mailing all households in the sample both an English and Spanish questionnaire. A sixth mailing with a second postcard reminder was sent to the six neighborhoods (711, IBW, R18, TRS, U18, X17) where we received less than 40 questionnaires.

## *Response Rate Details by Neighborhood and Overall*

We calculated response rates as the number of sampled address minus undeliverable and vacant households divided by the number of fully or partially completed survey. As

seen in the table below, the overall response rate for the survey was 35.6% (n=510), with a low of 19.2% (n=24) in U18 to a high of 57.8% (n=75) in U21. Seven respondents filled out less than 60% of the survey and are considered partial responses. A total of 503 surveys are considered complete.

| Details | 711 | U18 | R18 | TRS | Q15 | X17* | V14 | PWR | IBW | U21 | W15 | AA9 | All |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| All Re/ Sampled Addresses | 128 | 133 | 136 | 137 | 141 | 114 | 125 | 138 | 112 | 132 | 129 | 124 | 1549 |
| **Full/partial completes** | **36** | **24** | **32** | **25** | **42** | **33 (32)** | **35** | **65** | **43** | **74** | **60** | **41** | **510* (509)** |
| Refused | 43.9 | 42.2 | 36.7 | 31.0 | 36.9 | 38.5 | 38.0 | 62.0 | 59.5 | 72.4 | 57.4 | 54.2 | 62 |
| Undeliv-erable | 6 | 1 | 6 | 3 | 1 | 8 | 10 | 3 | 4 | 2 | 4 | 9 | 57 |
| Vacant Addresses | 2 | 7 | 1 | 2 | 3 | 8 | 11 | 4 | 7 | 2 | 10 | 3 | 60 |
| **Response Rate (%)** | **30.0** | **19.2** | **24.8** | **18.9** | **30.7** | **33.7 (28.1)** | **33.7** | **49.6** | **42.6** | **57.8** | **52.2** | **36.6** | **35.6** |

Note: *one respondent was reportedly 16 years old and was deleted from the database due to ineligibility. This brings the sample size to 509.

Among the total sample, a total of 235 respondents from repeat addresses (from 2017) completed the questionnaire, amounting to a response rate of 46% of the longitudinal sampling frame (n=496). This ranged from a low of 9 (711 and TRS) to a high of 40 (U21) across neighborhoods. Of the 235 repeat households, 138 (27% of the entire sample) are the same individual surveyed in 2017 based on a survey question that asked if they themselves had participated in the previous survey, or if someone else in their household did. Meanwhile, 11 respondents (~2%) reportedly were different respondents from the same address (one of these is the 16-year old deleted from the database), while 46 (9%) were new residents and 40 (8%) were unsure. Of the 137 valid repeat individual respondents, the sample sizes range from a low of 4 (711) to a high of 26 (U21). The portion of the sample that were new addresses was 54% (n=275).

| Details | 711 | U18 | R18 | TRS | Q15 | X17* | V14 | PWR | IBW | U21 | W15 | AA9 | All |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Re-sampled Addresses from 2017 | 22 | 34 | 28 | 29 | 39 | 39 | 50 | 60 | 37 | 56 | 56 | 46 | 496 |
| **Full/partial completes** | **9** | **14** | **10** | **9** | **14** | **14** | **19** | **36** | **22** | **40** | **31** | **24** | **242** |
| **Re-interview Response Rate (%)** | **45.0** | **41.2** | **37.0** | **31.0** | **37.8** | **43.8** | **45.2** | **63.2** | **62.9** | **74.1** | **60.8** | **54.5** | **52.3** |
| Refused | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 1 | 1 | 0 | 6 |
| Undeliverable | 2 | 0 | 0 | 0 | 1 | 3 | 8 | 2 | 0 | 2 | 4 | 1 | 23 |
| Vacant | 0 | 0 | 1 | 0 | 1 | 4 | 0 | 1 | 2 | 0 | 1 | 1 | 11 |

*16-year old respondent removed from this table.

## *2021 Survey Respondent Demographics*

The average age of survey respondents was 54 years, with a low of 18 and a high of 100. More respondents were women (62%) than men, and 1% identified as neither female or male. Regarding race and ethnicity, 68% of the sample is White/Anglo, 20% Hispanic/Latinx, 6% Black/African American, 5% Asian or Asian American, 1% Native American or American Indian, and 3% reported "other." The median/mean for household income and education were, respectively, 5/5.9 and 6/5.3, which amounts to roughly $100,000 and an educational level between vocational/technical schooling and a Bachelor's degree. Relative to the population of the study neighborhoods, the sample reflects residents' average age (considering the adult eligibility requirement), as well as household income levels (average for median household income of the population is $90,483) compared to the average of around $100,000. However, the respondents were more highly educated (35% hold Bachelor's degrees) compared to the population (25%). Our respondents were also relatively White (about two-thirds compared to 46% of population), with less Hispanic/Latinx respondents (20% compared to 35% for the study-area population). Regarding the other categories of race and ethnicity, the sample is representative of the study area population (see details on page 24).

## *Survey Experiment: Testing the Effects of Logos on Response Rates*

UNI also conducted an experiment to determine how logos affect response rates, since recent research has suggested that PTW and self-administered mail surveys have a higher response rate when outreach is mailed without a logo (Glancey, Rapoport, and Kline 2021). Specifically, the UNI team randomized the envelopes used for each mailing of the survey packets (mailings 2, 4, and 5). Addresses were randomly assigned to one of three envelope conditions: (1) the UNI logo and return address, (2) the UNI logo and return address, plus the ASU logo, and (3) the UNI return address only with no logo. Details are in the table *below*, wherein envelope (1) is the comparison group.

| Details | Packet 1 | | Packet 2 | | Packet 3 | | Pooled | |
|---|---|---|---|---|---|---|---|---|
| UNI & ASU | .031 | .033 | .005 | .006 | .010 | .009 | .017 | .018 |
| Logo | (.025) | (.024) | (.018) | (.018) | (.013) | (.013) | (.013) | (.012) |
| Address only, | .048+ | .049* | .008 | .008 | .008 | .008 | .023+ | .025* |
| No Logo | (.025) | (.024) | (.018) | (.018) | (.013) | (.013) | (.013) | (.012) |
| Constant | .148* | .109* | .056* | .031 | .023* | .003 | .084* | .125* |
| | (.018) | (.036) | (.013) | (.027) | (.009) | (.020) | (.009) | (.019) |
| N | 1,353 | 1,353 | 1,037 | 1,037 | 952 | 952 | 3,342 | 3,342 |
| $R^2$ | .00 | .08 | .00 | .05 | .00 | .02 | .00 | .10 |
| Covariates | No | Yes | No | Yes | No | Yes | No | Yes |

Notes: Each cell displays the linear regression model coefficient with standard error in parentheses. The comparison group is the envelope with UNI's logo and return address. The second model controls for pre-treatment covariates including neighborhood and if the address participated in 2017. The pooled model also includes controls for letters2 and 3. An asterisk *represents a p-value <.05 and a plus sign +represents a p-value <.10.

As shown in the table *above*, envelope (2) with the UNI & ASU logos and envelope (3) with the address only but no logo outperformed the standard envelope (1) with only UNI's logo and return address for each packet mailing. For the first packet mailed on May 26th, 17.4% of addresses mailed the packet either participated online or mailed

back the paper questionnaire. Envelope 2 (with the UNI & ASU logos) yielded a higher completion rate by 3.3 percentage above compared to envelope 1 (UNI logo and return address), as shown in the table below, for packet 1 using the covariate adjusted model. The address-only envelope, no logo produced a 4.9 percentage point higher completion rate than did envelope 1 (UNI logo and return address), a statistically significant increase, for packet 1 using the covariate adjusted model. The difference between envelope 2 (with the UNI & ASU logos) and envelope 3 (address only, no logo) was not statistically significant. For more information on this experiment, contact Kyle Endres and Mary E. Losch at the University of Northern Iowa.

# The Study Neighborhoods

In this section, we describe the study neighborhoods based on parcel characteristics, population density, and demographic factors. We then present survey data from 2017 to compare residents across neighborhoods based on their perceived quality of life, satisfaction with local environmental features (i.e., vegetation and parks), and identification with their neighborhoods (i.e., as a form of place attachment).

## *Parcel Characteristics*

Parcel characteristics were obtained from the 2020 tax assessor dataset. On average, homes in our sample were built in 2003 with the oldest neighborhood averaging a 1953 construction year and the youngest averaging 2008 construction year. Overall, the average parcel size in the sample neighborhoods is 13,249 square feet, with a range from 3,052 to 30,208. The average size of home is 2,021 $ft^2$, with a range of averaged sizes from 1,059 $ft^2$ in neighborhood 711 to 3,640 $ft^2$ in AA9. Meanwhile, the average home value is $480,762 across study neighborhoods, with an averaged low of $81,362 in U18 to a high of $894,055 in AA9.

## *Neighborhood Populations and Density*

The populations of the PASS neighborhoods vary significantly based on their size and number of residents, as well as their density. As seen in the *table below*, the population densities range from a low of 460 people per square mile in the fringe neighborhood (AA9) in the northern part of the Valley to a high of 18,416 in a central neighborhood (W15) of downtown Phoenix). The areal size of the neighborhoods corresponds to density, with the largest neighborhood (AA9)—which encompasses a desert preserve—spanning 34.3 square miles and the smallest (W15) spanning only 0.12 of a square mile. This variation is based on how the U.S. Census delineates the boundaries of census block groups, with more populated areas having smaller census units and less populated areas larger ones.

As a result, the total populations of the study neighborhoods vary from a low of 1,169 residents (again, in the centrally located W15) to a high of 60,619 (PWR). The latter neighborhood is located in suburban Gilbert, which is located along the fringe of the metro region but has been experience significant growth in recent decades.

| Parcel Characteristics Overall and by Neighborhood | | | | | |
|---|---|---|---|---|---|
| **NBHD ID** | **Number of Resid'l Parcels** | **Mean (St. Dev.) Tax Assessed Value: 2020** | **Mean (St. Dev.) Parcel Size in Square Feet** | **Mean (St. Dev.) House Size in Square Feet** | **Mean (St. Dev.) Construction Year** |
| All | 48,524 | $480,762 ($1,488,751) | 13,249 (31,464) | 2,506 (1,439) | 2003 (12) |
| 711 | 408 | $93,738 ($72,326) | 6,154 (1,221) | 1,081 (401) | 1975 (31) |
| U18 | 447 | $81,362 ($60,282) | 11,048 (518) | 1,091 (364) | 1953 (8) |
| R18 | 5,475 | $218,321 ($487,777) | 7,430 (11,479) | 1,763 (527) | 2003 (9) |
| TRS | 8,390 | $191,074 ($177,436) | 7,030 (16,757) | 2,024 (1,970) | 2006 (5) |
| Q15 | 901 | $203,060 ($77,391) | 7,154 (10,413) | 2,146 (570) | 2005 (8) |
| X17 | 399 | $318,278 ($190,499) | 3,052 (9,964) | 1,059 (405) | 1984 (18) |
| V14 | 302 | $203,619 ($82,670) | 7,144 (11,390) | 1,266 (544) | 1971 (18) |
| PWR | 21,018 | $363,086 ($300,882) | 11,864 (16,834) | 2,583 (950) | 2008 (6) |
| IBW | 711 | $250,402 ($176,122) | 4,656 (2,921) | 1,660 (415) | 1974 (10) |
| U21 | 1,705 | $415,742 ($199,801) | 12,069 (18,053) | 2,872 (946) | 1996 (4) |
| W15 | 530 | $750,583 ($299,342) | 17,982 (7,171) | 2,590 (956) | 1971 (18) |
| AA9 | 7,947 | $894,055 ($899,295) | 30,208 (66,378) | 3,640 (1,783) | 2001 (8) |

All Information from Maricopa County Assessor's Office 2020 dataset.

| Population Characteristics (2019) | | | |
|---|---|---|---|
| **NBHD ID** | **Population** | **Area (mile$^2$)** | **Population Density*** |
| 711 | 2,207 | 0.31 | 7,122 |
| U18 | 2,636 | 0.25 | 10,547 |
| R18 | 28,752 | 20.79 | 1,383 |
| TRS | 37,250 | 11.21 | 3,323 |
| Q15 | 3,598 | 2.00 | 1,799 |
| X17 | 2,209 | 0.12 | 18,416 |
| V14 | 1,282 | 0.28 | 4,580 |
| PWR | 60,619 | 21.33 | 2,842 |
| IBW | 1,901 | 0.50 | 3,803 |
| U21 | 4,745 | 2.20 | 2,157 |
| W15 | 1,169 | 0.50 | 2,339 |
| AA9 | 15,791 | 34.33 | 460 |

*Population density = individuals per sq. mi. *Census data are from 2019 since that is the most recent year available at the time of this report.*

## *Demographics of the PASS Neighborhoods*

Demographic data for the PASS neighborhoods were collected from census block group data for 2019. Although the PASS neighborhoods vary demographically, they differ somewhat from the neighborhoods across the broader region (table *below*).

| Demographics of the Study Neighborhoods and the Phoenix Metro Region (2019) | | |
|---|---|---|
| **Variables** | **Metropolitan Area** | **Study Neighborhoods** |
| Per Capita Income (Median) | $34,744 | $41,128 |
| Household Income (Median) | $68,649 | $90,483 |
| Owner-Occupied Homes | 63.2% | 68.7% |
| Bachelor's Degree | 22% | 24.6% |
| Graduate Degree | 12% | 14.1% |
| Household Size | 2.75 | 3.3 |
| Median Age | 36.9 | 35.6 |
| Population Under 18 (%) | 23.5% | 32.6% |
| Population Over 65 (%) | 15.5% | 8.5% |
| Male Population (%) | 49.4% | 49.0% |
| White, Non-Hispanic (%) | 79.1% | 46.3% |
| Hispanic/Latinx (%) | 31.4% | 35.0% |
| Black (%) | 5.9% | 4.0% |
| Asian (%) | 4.3% | 5.0% |
| Native American/Indian (%) | 2.9% | 1.0% |

Relative to the greater Phoenix area (Maricopa County), the residents of the PASS study neighborhoods have a higher socioeconomic status in terms of both income and education. The households in the PASS neighborhoods are also slightly larger than those across the region, which reflects an over-sampling of areas with children and families and an under-sampling of areas with elderly populations. The ethnic and racial composition of the neighborhoods is comparable to that of the region. However, the study neighborhoods over-represent the Latinx/Mexican community and under-represent white residents. This mismatch in ethnic representation is due to the purposeful targeting of neighborhoods with high Latinx/Mexican populations to represent this significant part of the region's population.

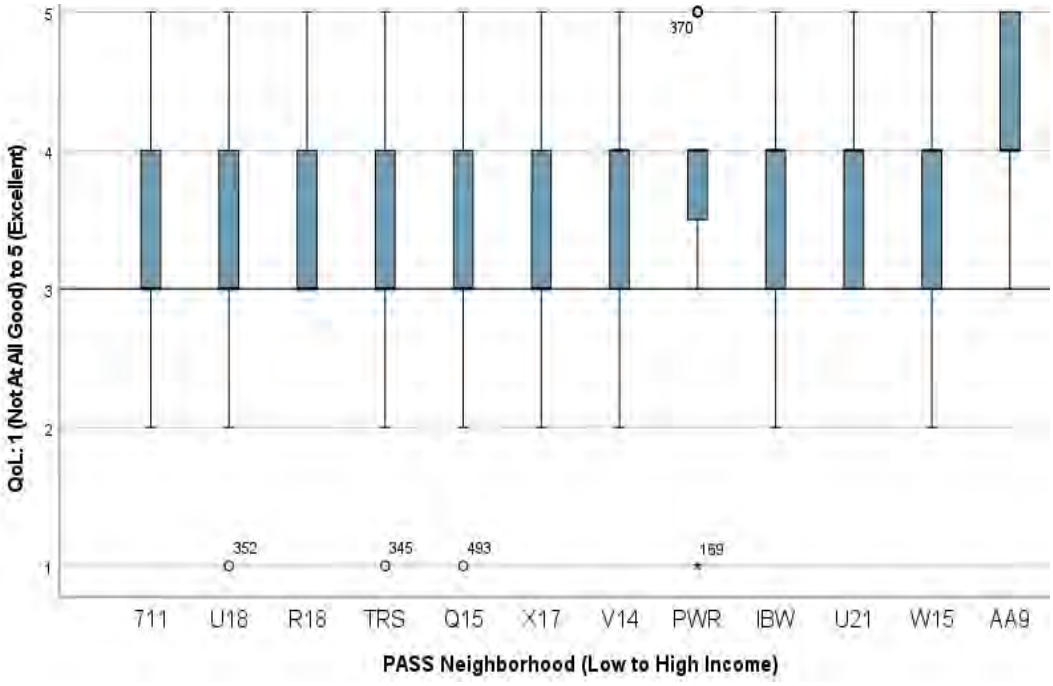
## *Residents' Perceptions across Neighborhoods: PASS 2017 Data*

In this section, we briefly present the patterns across the surveyed neighborhoods using 2017 PASS data for three constructs: perceptions of quality of life in the Valley, satisfaction with local vegetation and parks, and identification with neighborhoods (as a form of place attachment; see Williams and Vaske 2003). The figures *below* demonstrate the trends in residents' perceptions and attitudes of the Valley and their local area by neighborhood. For the detailed statistics of survey variables, please refer to the Appendices.

**Perceived Quality of Life in the Valley, Circa 2017 and in 10 Years**

As seen in the figure *below*, survey respondents in the PASS neighborhoods reported, on average, a fairly to very good quality of life in metro Phoenix "today" (2017). A few outliers reported that the quality of life in the Valley was "not at all good."

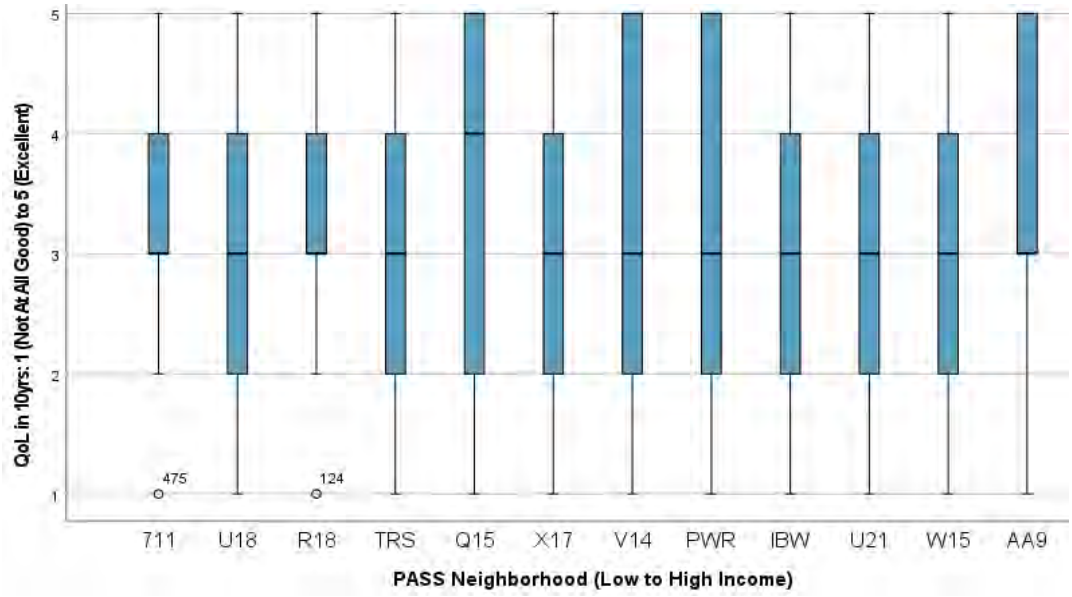
*Boxplot for Perceived Quality of Life by Neighborhood: Valley-wide in 2017*




Overall, perceived quality of life trended slightly by the income level of neighborhoods. In particular, the wealthiest neighborhood—AA9 near the McDowell Mountain Preserve—reported the highest quality of life in the Valley overall. Meanwhile, the

fringe PWR neighborhood—which has recently experienced increased residential development—stands out as having the least variation in perceived quality of life. However, the socioeconomic status of neighborhoods—as measured by average income levels—does not appear to drive the perceived quality of life in the Valley. The results for anticipated quality of life in 10 years—figure *below*—are a bit different.

*Boxplot for Anticipated Quality of Life by Neighborhood: Valley-wide in 10 Years*

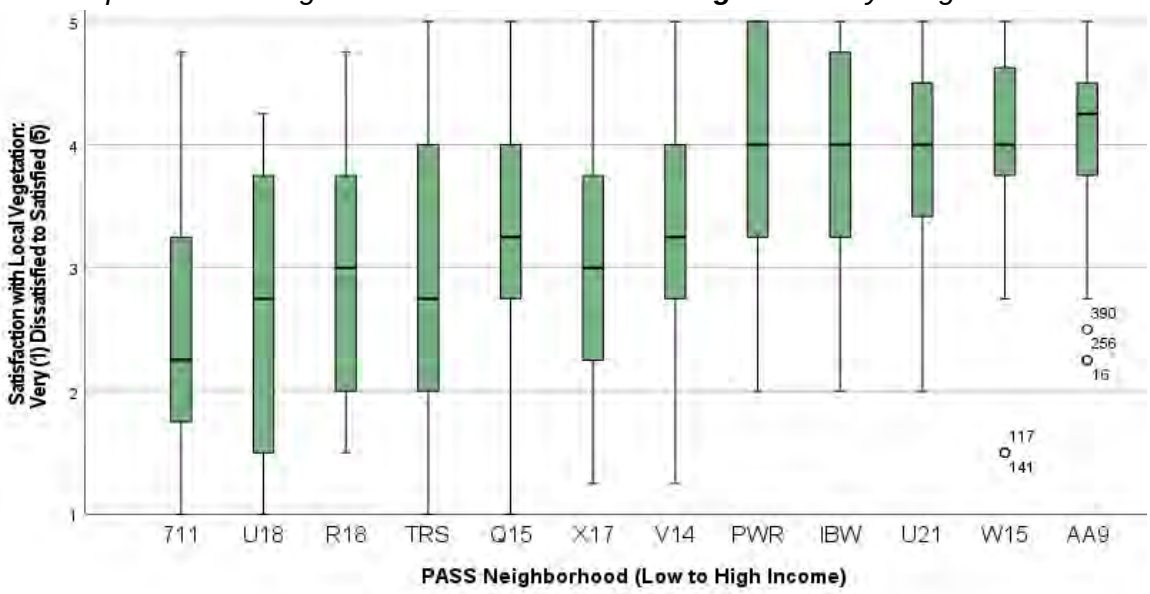



As seen *above*, residents varied somewhat in their perceptions of quality of life into the future, although again, the income level of neighborhoods does not appear to have a strong influence. On average, residents in most neighborhoods expected the quality of life to be about the same. The suburban (Q15) neighborhood in the West Valley was an exception, with residents trending toward a slightly better quality of life into the future. Also notable are two lower-income neighborhoods (711 and R18), each with only one 'outlier' anticipating a "much worse" quality of life. Overall, these trends indicate that perceived quality of life—both currently (circa 2017) and ten years from then—may be influenced more my personal factors, or perhaps environmental features of neighborhoods, than the socioeconomic status of neighborhoods. Further analyses of the 2017 and 2021 survey data will further reveal what factors are influencing perceived quality of life now and into the future, and whether these perceptions and their drives have changed between to two time periods.

**Satisfaction with Local Vegetation and Parks by Neighborhood**

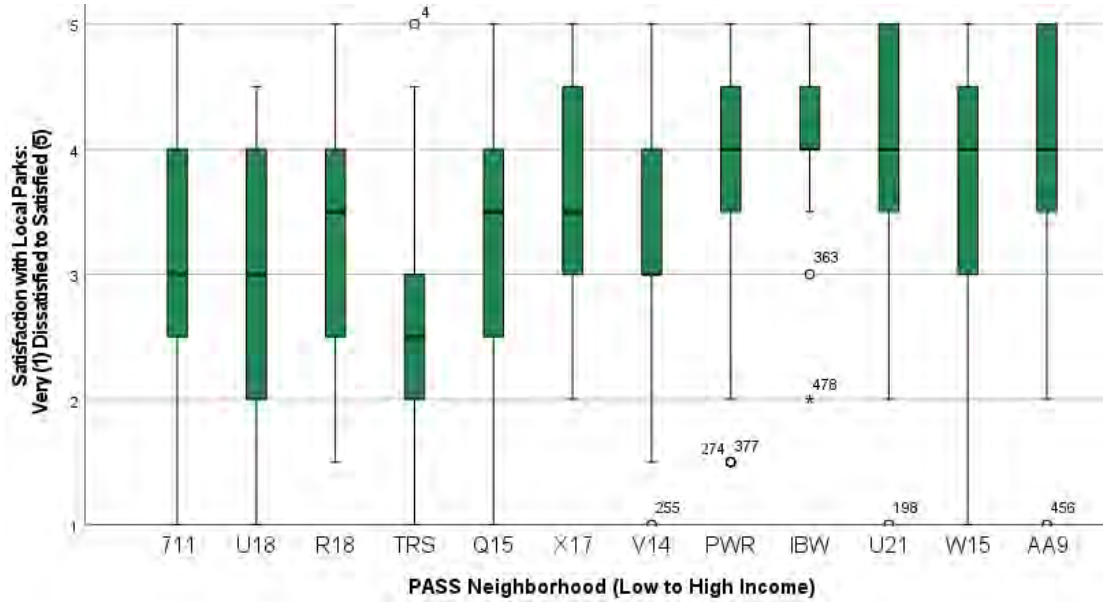
We now present patterns in survey respondents' personal satisfaction with local environmental features of their neighborhoods based on data from the 2017 PASS. First, we present a composite survey scale of respondents' level of satisfaction, as measured by the average response of individuals to four variables: the amount of trees, flowering plants, desert plants, and shade trees (Cronbach's alpha = 0.86). Second, we present respondents' average level of satisfaction with local parks and nearby desert preserves (Spearman's rho = 0.48, $p<0.001$). As seen in the figures *below*, both measures of residents' satisfaction with their local neighborhood environments strongly trended with the level of income in the neighborhood.

*Boxplot for Average Satisfaction with Local **Vegetation** by Neighborhood*




The neighborhood trend in residents' satisfaction with vegetation appears slightly stronger for vegetation than with parks, as seen by comparing the graphic *above* to the one *below*. However, residents of lower-income neighborhoods appear to vary more widely in their satisfaction with location vegetation compared to residents in higher-income neighborhoods. Moreover, the TRS neighborhood–located near the Tres Rios Wetlands area—stands out since residents there are least satisfied with their local parks. In contrast, residents near the Indian Bend Wash area—which has a linear network of parks and open spaces designed to mitigate flooding—almost unanimously are satisfied with local parks.

*Boxplot for Average Satisfaction with Local **Parks** by Neighborhood*

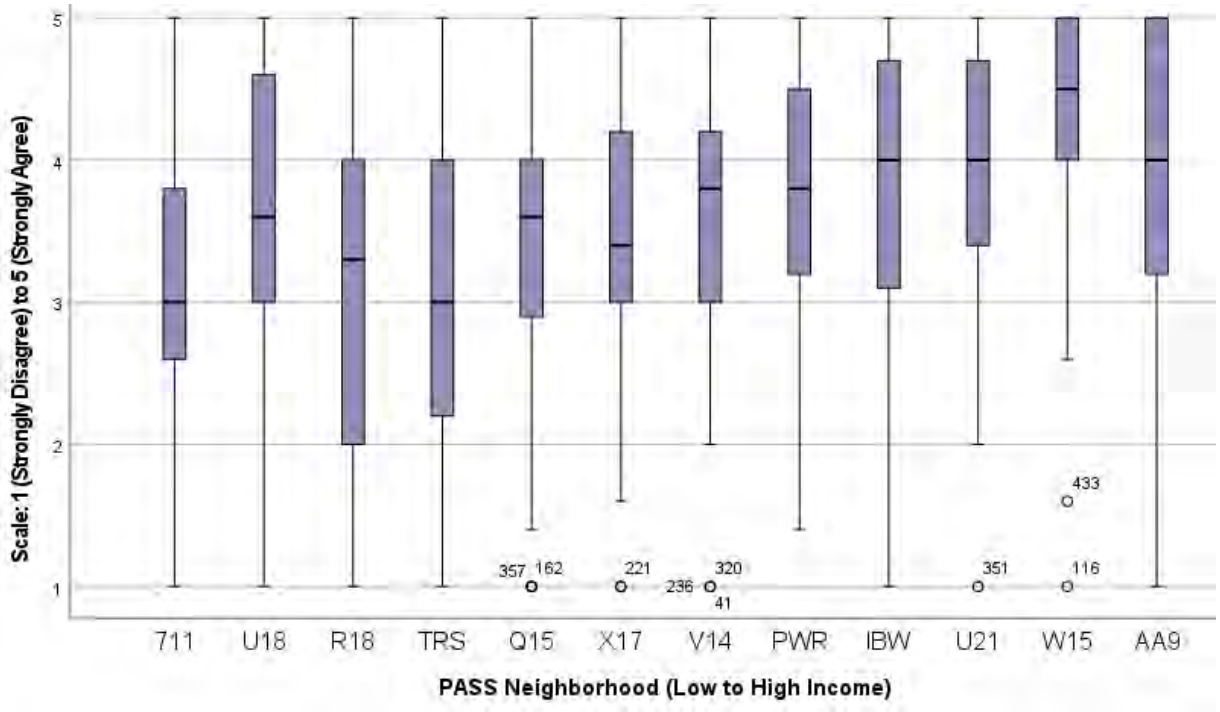


While these trends in local environmental satisfaction signal disparities between neighborhoods based on relative household income levels as well as local environmental features, additional analyses will more clearly discern how personal- and neighborhood-level factors influence residents' satisfaction with their local environments. Such analyses can integrate diverse datasets at multiple scales to examine how both local landscape features and socio-demographics influence environmental satisfaction across space, as well as how satisfaction may change over time with local changes in neighborhoods.

**Local Place Attachment by Neighborhood**

Adapting survey measures developed by Vaske and Williams (2003), the PASS 2017 composite scale for identification with one's neighborhoods was highly reliable (Cronbach's alpha of 0.96; see the Appendix for details on this scale). As shown *below*, residents' level of attachment to their local home environments appears to increase with the wealth of neighborhoods. However, a significant range in attachment is shown across neighborhoods. Additional multi-variate and spatial analyses can illuminate the social and environmental factors that are driving these trends, while longitudinal analyses can identify if any significant changes have occurred between 2017 and 2021.

*Boxplot for Residents' Identification with their Neighborhoods*

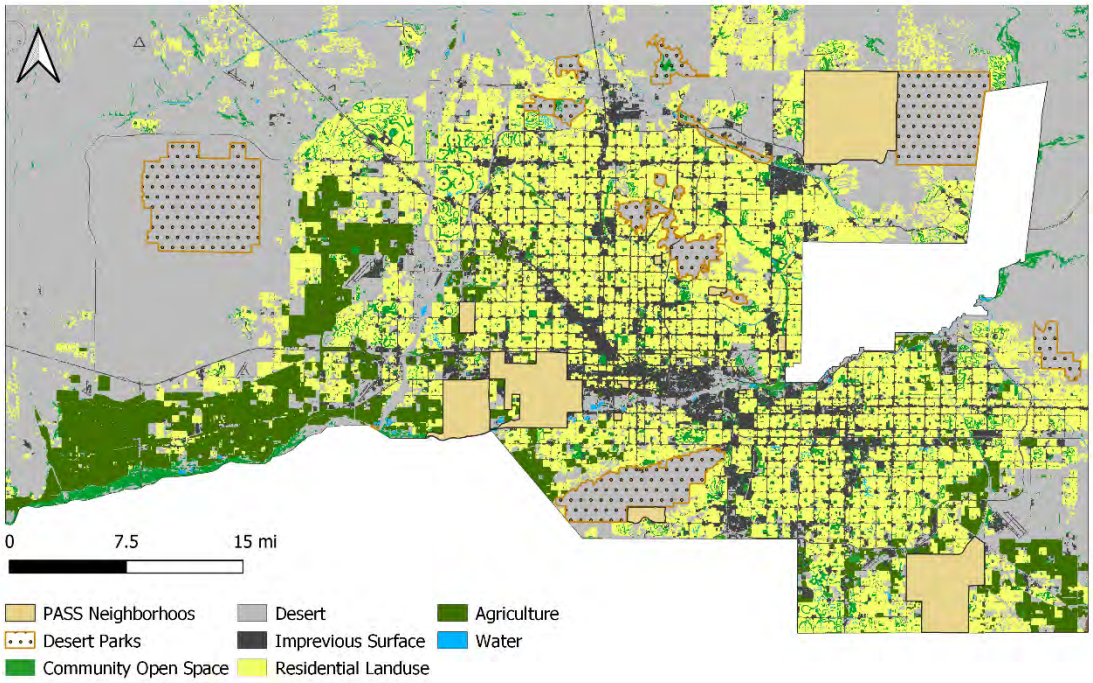


## *Neighborhood Profiles*

In this section, we describe each of the PASS neighborhood in terms of their land use and cover, parcel attributes, and demographics. The data and these descriptions were updated from the 2017 PASS report, with newly added information on land cover changes from 2010 to 2015 and demographics changes (from the American Community Survey) across three periods over the last twenty years (2000, 2010, and 2019).

### Land Use

At the start of each neighborhood profile is a land-use map based on National Agriculture Imagery Program (NAIP) four-band, 30-meter data (Zhang and Li 2017). This data is from 2010 imagery and identifies five major land-use categories based upon this data: Agriculture, Desert, Impervious Surface, Residential Land, and Water (for more information on these classifications, visit the CAP LTER website or the Environmental Data Inventory portal. In addition to these categories, desert parks – large, municipally maintained natural areas – and community parks – green spaces that are designed primarily for human use – are also highlighted, as seen in the regional *map of metropolitan Phoenix below*.




### Land Cover

The land-cover data in this report were generated using National Agriculture Imagery Program (NAIP) four-band, one-meter data (Li et al. 2014). All imagery for both data sets was collected between June and August of the corresponding year, although 90% of the imagery was collected in June (Li 2015, Zhang and Turner 2020). For 2010 and 2015, land-cover features were identified at a resolution of 1 meter determined through a combination of red, green, blue, and near-infrared bands as well as radiometric resolution to represent brightness (Li 2015; Zhang and Turner 2020). For the 2010 data, the NAIP imagery, radiometric resolution, and normalized difference vegetation

index (NDVI) were run through an automated classification process following the Baltimore Ecosystem Study and Plum Island Ecosystems LTER sites that classified land cover twelve land classification categories (for details, see Li et al. 2014). For 2015, a similar classification scheme (Zhang and Turner 2020) was used but land cover was classified into eight categories such that some of the earlier categories can be combined to compare across the two time periods. For each neighborhood below, we compare land cover in 2010 and 2015 based on the following classifications.[7]

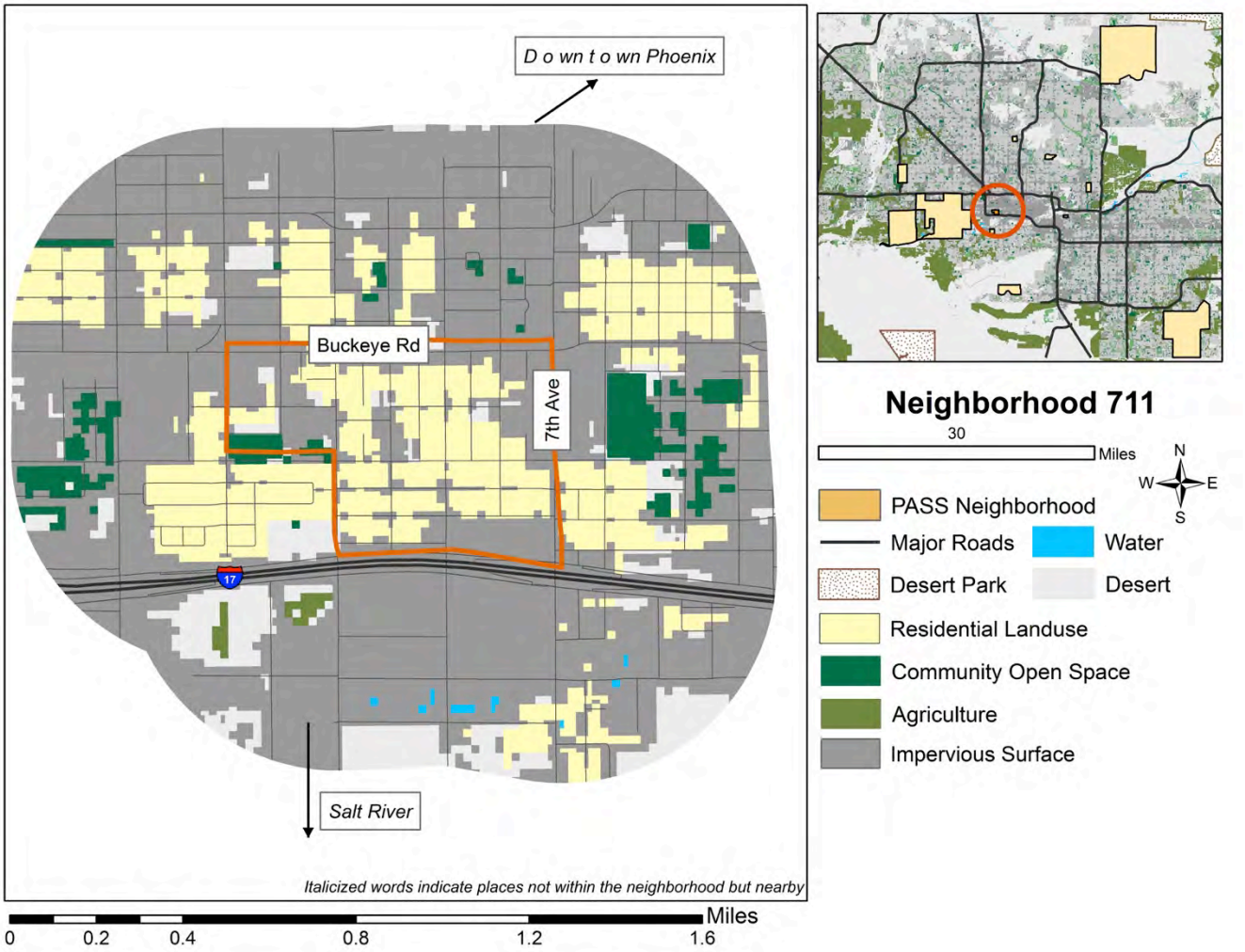
- **Building:** commercial (office spaces, retail, etc.), residential (houses, apartments, etc.), and industrial (factory, mill, warehouse, etc.) facilities[8]
- **Asphalt:** roads, surfaced roofs, parking areas, runways, sidewalks, and other asphalt surfaces[9]
- **Soil:** bare soil, sand, gravel, and rock in urban and desert landscapes, including impervious surface such as concrete that are lighter in color; this includes xeric landscapes with gravel or rock groundcover unless vegetation makes up over 50% of a one meter-by-one-meter pixel, in which case pixels were classified as trees and shrubs[10]
- **Tree and Shrub:** trees generally include a singular woody trunk, while shrubs include small-medium woody perennials; includes all vegetation (in the green spectrum) except grass and agriculture (see below)[11]
- **Grass:** short plants that grow wild or cultivated on land, including lawns and other vegetation groundcover[12]
- **Agriculture:** land used for the growing of crops or the cultivation of plants for commercial purposes, including active and inactive croplands. Vegetation in these lands tends to be highly organized (i.e. in rows) and the reflectance from these agricultural lands tend to also be highly uniform.[13]
- **Water:** any body of water including pools, lakes, rivers, etc.[14]

[7] Note the seven land-cover types combine active and inactive cropland for the agricultural classification relative to the eight categories from the 2015 data.
[8] For the temporal comparison, the same Building classification applies to both years.
[9] The 2010 Road classification is comparable to the 2015 Asphalt.
[10] The 2010 Bare Soil and Concrete classification is comparable to the 2015 Soil.
[11] The 2010 Tree, Shrub classification is comparable to the 2015 Tree and Shrub.
[12] The same Grass classification applies.
[13] The 2010 Orchard, Active Cropland, Inactive Cropland classification is comparable to 2015 Agriculture.
[14] The 2010 Lake, Canal, Swimming Pool, and Seasonal River classification is comparable to the 2015 Water. However, the 2010 data classified water in multiple categories including lake, canal, seasonal river, and swimming pool. The 2010 classifications were distinguished based on location as well as knowledge of the area and the source of the water. In 2015, these distinctions were no longer established and all water was classified under a single category.

# 711 (Phoenix, AZ)

*Low-Income Urban Core*

**Location within the Valley (upper right) and Land Uses (2010)**




**Photos from Neighborhood 711 (2017)**

*Highlights for 711*

1. Older urban neighborhood (built in the 1970s) with low per-capita income rates
2. Largely Mexican/Latino (65%); “other” (18%), and white (7%)
3. Little vegetation in neighborhood with high levels of concrete and pavement
4. Lowest bird richness and diversity among neighborhoods

*Neighborhood Description*

Located in downtown Phoenix, this neighborhood (711) is surrounded by a high percentage of impervious surface (concrete, pavement, etc.). A railroad track also cuts through the neighborhood. The area is relatively old and has smaller homes and parcel sizes. The landscaping in private yards is predominately xeric or packed dirt, with large amounts of crushed gravel and very little vegetation. The residents of the neighborhood exhibit relatively low socioeconomic status; the median household income is $39,275, and only 4% of the population has a bachelor’s degree or higher level of education (see table *below*). Most of the individuals that live in the neighborhood are Mexican or Latino, with the highest population of non-English speaking residents. The average household size is relatively large at 4.4 people. Residents tend to be younger, including a large percentage of children (36% of the population is aged 0-18) and a relatively low portion (6%) of residents who are 65 or older.

**Home and Parcel Information (from Tax Assessor data, 2020)**

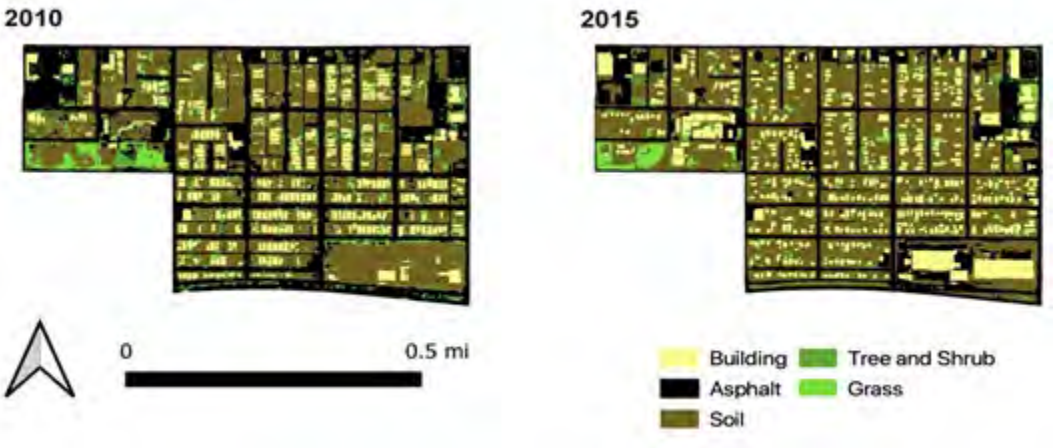
| Variable | Study Area 711 | All PASS Neighborhoods |
|---|---|---|
| **Parcel Area (sq. ft.)** | 6,154 | 13,249 ± 31,464 |
| **House Size (sq. ft.)** | 1,081 | 2,506 ± 1,439 |
| **House Age (years)** | 1975 | 2003 ± 12 |
| **Price ($)** | 93,738 | $480,762 ± 1,488,751 |

**Socio-Economic Information (from U.S. Census Bureau, 2019)**

| Variable | Study Area 711 | All PASS Neighborhoods |
|---|---|---|
| **Household Income (median)** | $39,275 | $90,483 |
| **Median Age (years)** | 24.9 | 35.6 |
| **Bachelor’s Degree or Above (%)** | 4.01 | 24.6 |
| **Owner Occupied (%)** | 38.1 | 68.7 |
| **Household Size** | 4.41 | 3.3 |

| Demographic Change Over Time (from U.S. Census Bureau: 2000, 2010, 2019) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Population** | **White** | **Black** | **Latinx** | **Native American** | **Asian** | **Pacific Islander** | **Other** | **Two or More** |
| 2000 | 1313 | 1% | 28% | 69% | 1% | 0% | 0% | 0% | 0% |
| 2010 | 1015 | 6% | 13% | 79% | 1% | 0% | 0% | 0% | 0% |
| 2019 | 2219 | 7% | 5% | 65% | 1% | 0% | 0% | 18% | 3% |

**Recent Land Cover Changes in Neighborhood 711 (Phoenix, AZ)**
*Increased Development, Decreased Greening*




| Land Cover | 2010 | 2015 | Change |
|---|---|---|---|
| **Soil** | 44% | 50% | +6% |
| **Asphalt** | 35% | 27% | -8% |
| **Building** | 12% | 16% | +4% |
| **Tree and Shrub** | 2% | 4% | +2% |
| **Grass** | 6% | 2% | -4% |
| **Water** | 0% | 0% | 0% |
| **Agriculture** | 0% | 0% | 0% |

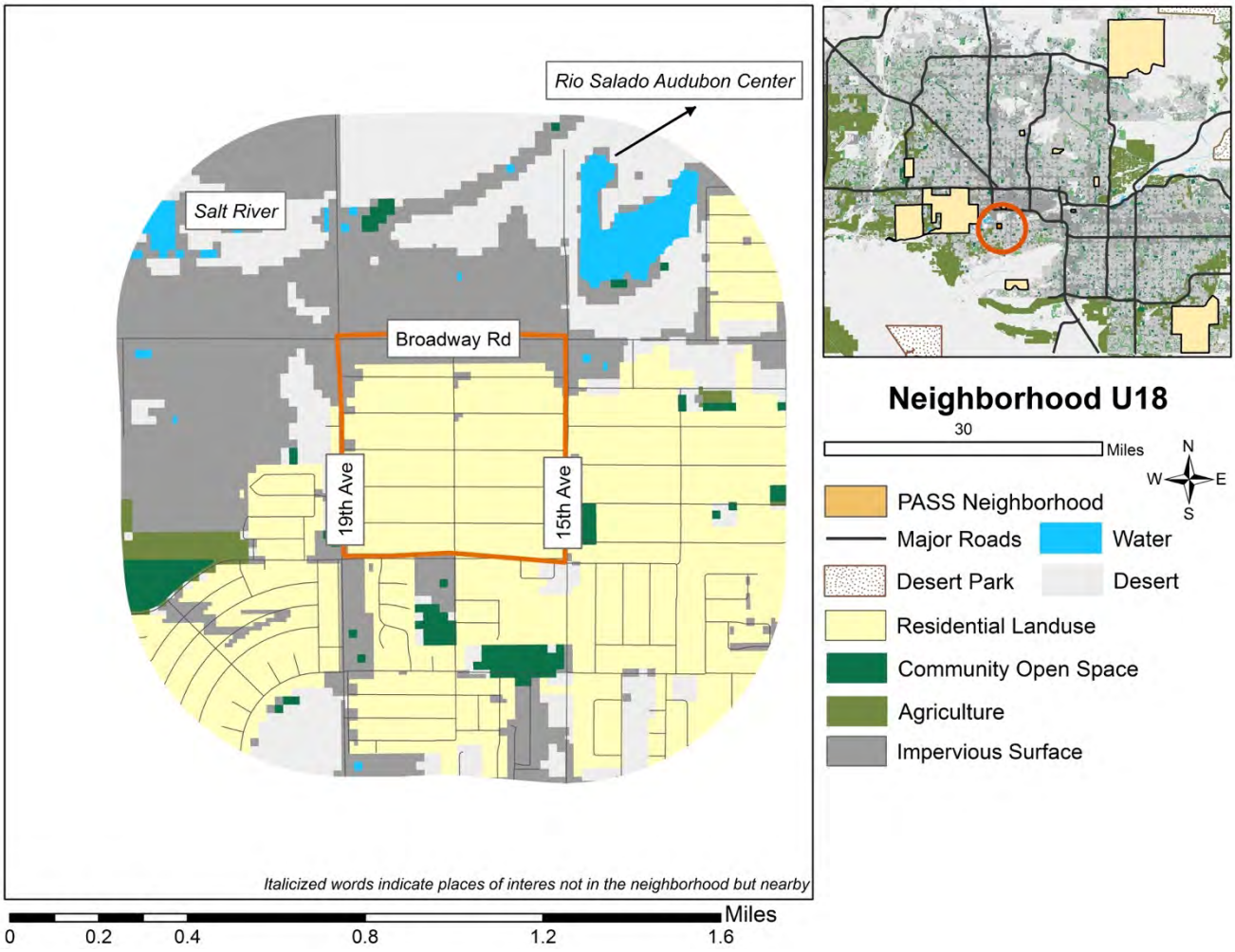
Total area: 0.31 square miles

In this downtown Phoenix neighborhood, the largest percentage of land coverage consists of soil—including xeric yards in the residential areas, which increased from 44% in 2010 to 50% in 2015. The growth in the soil is largely observed in the northwest corner (where some development occurred) and southern areas of the neighborhood (where buildings were removed). With the addition of commercial buildings, asphalt decreased from 35% to 27%, which was the biggest change within the 5-year period. Buildings increased from 12% to 16% with industrial growth in the southeast corner, commercial growth in the northeast area, and additions to the Mary McLeod Bethune School in the northwest area. Meanwhile, grass decreased from 6% to 2%, and trees and shrubs increased from 2% to 4% for a net decrease in vegetation.

## U18 (Phoenix, AZ)

*Low-Income, Urban Core near Restored Section of the Salt River*

### Location within the Valley (upper right) and Land Uses (2010)




### Photos from U18 (2010)

*Highlights for U18*

1. Oldest homes (built in 1950s) & lowest priced homes among study neighborhoods
2. Relatively low socioeconomic status in terms of income and education
3. Mostly Mexican/Latinx (85%); white (4%) and “other” (8%)
4. Largest average household size with lots of children

*Neighborhood Description*

Located in the southern portion of central Phoenix, this neighborhood (U18) has a significant amount of impervious surface nearby. It is located south of a restored reach (the Rio Salado habitat restoration area) of the Salt River. The neighborhood is the oldest among the study neighborhoods, with average age of development being 1953. The local landscaping is predominately oasis or xeric, with large amounts of grass in front yards—perhaps due to its historic access to flood irrigation. The homes and yards in this area are well-maintained. The residents, on average, have the one of the lowest socioeconomic status amongst the study neighborhoods. As seen in the table *below*, the median household income is $56,389, and only 5% of the population has a bachelor’s degree or higher level of education. However, the level of income has increased by over $20,000 in the last five years. This neighborhood also has the highest percentage of Mexican or Latino residents. The average household size is also the largest among the study neighborhood; at 4.55 people per household, the residents include a large percentage of children (35% of the population is aged 0-18).

**Home and Parcel Information (from Tax Assessor data, 2020)**

| Variable | Study Area U18 | All PASS Neighborhoods |
|---|---|---|
| **Parcel Area (sq. ft.)** | 11,048 ± 518 | 13,249 ± 31,464 |
| **House Size (sq. ft.)** | 1,091 ± 364 | 2,506 ± 1,439 |
| **House Age (years)** | 1953 ± 8 | 2003 ± 12 |
| **Price ($)** | $81,362 ± 60,282 | $480,762 ± 1,488,751 |

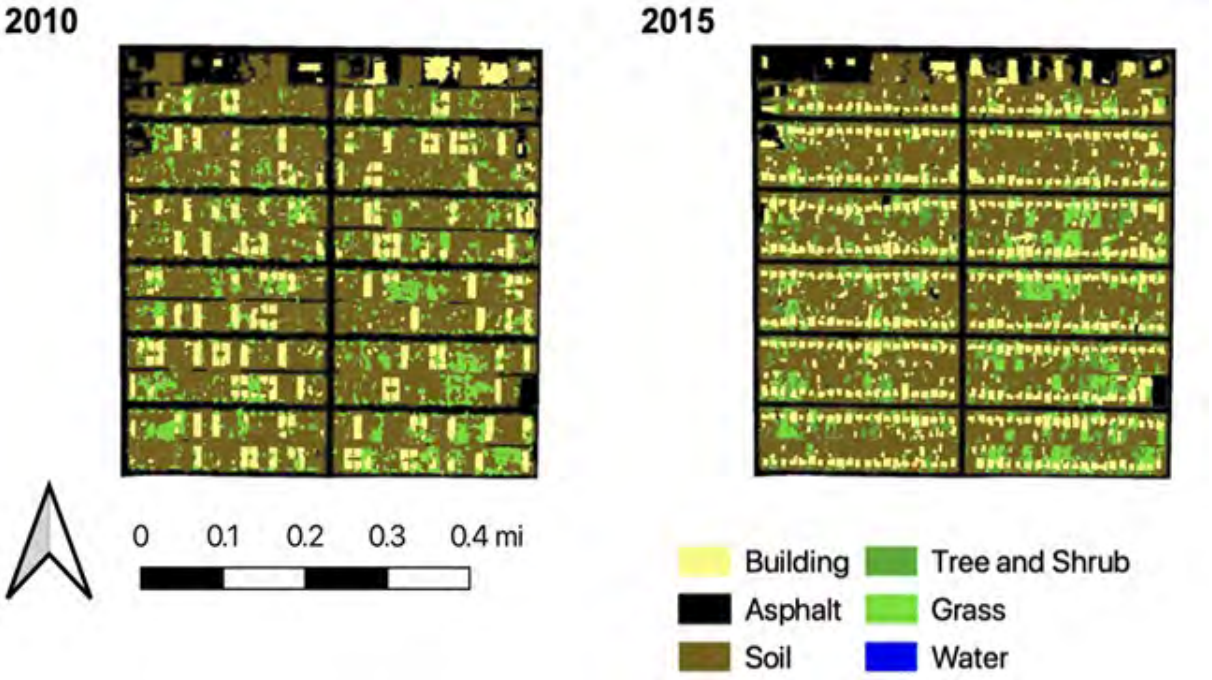
**Demographic and Economic Information (from U.S. Census Bureau, 2019)**

| Variable | Study Area U18 | All PASS Neighborhoods |
|---|---|---|
| **Household Income (median)** | $56,389 | $90,483 |
| **Median Age (years)** | 25.20 | 35.6 |
| **Bachelor’s Degree or Above (%)** | 5.11 | 24.6 |
| **Owner Occupied (%)** | 42.81 | 68.7 |
| **Household Size** | 4.55 | 3.3 |

| Demographic Change Over Time (from U.S. Census Bureau: 2000, 2010, 2019) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Population** | **White** | **Black** | **Latinx** | **Native American** | **Asian** | **Pacific Islander** | **Other** | **Two or More** |
| 2000 | 1,995 | 10% | 2% | 87% | 1% | 0% | 0% | 0% | 0% |
| 2010 | 1,220 | 8% | 1% | 89% | 1% | 0% | 0% | 0% | 0% |
| 2019 | 2,662 | 4% | 0% | 85% | 1% | 0% | 0% | 8% | 2% |

**Recent Land Cover Changes in Neighborhood U18 (Phoenix, AZ)**

*Reaching Build Out with Increased Trees and Shrubs*




| Land Cover | 2010 | 2015 | Change |
|---|---|---|---|
| **Soil** | 57% | 54% | -3% |
| **Building** | 12% | 17% | +5% |
| **Asphalt** | 18% | 15% | -3% |
| **Tree and Shrub** | 1% | 8% | +7% |
| **Grass** | 11% | 5% | -6% |
| **Agriculture** | 0% | 0% | 0% |
| **Water** | 0% | 0% | 0% |

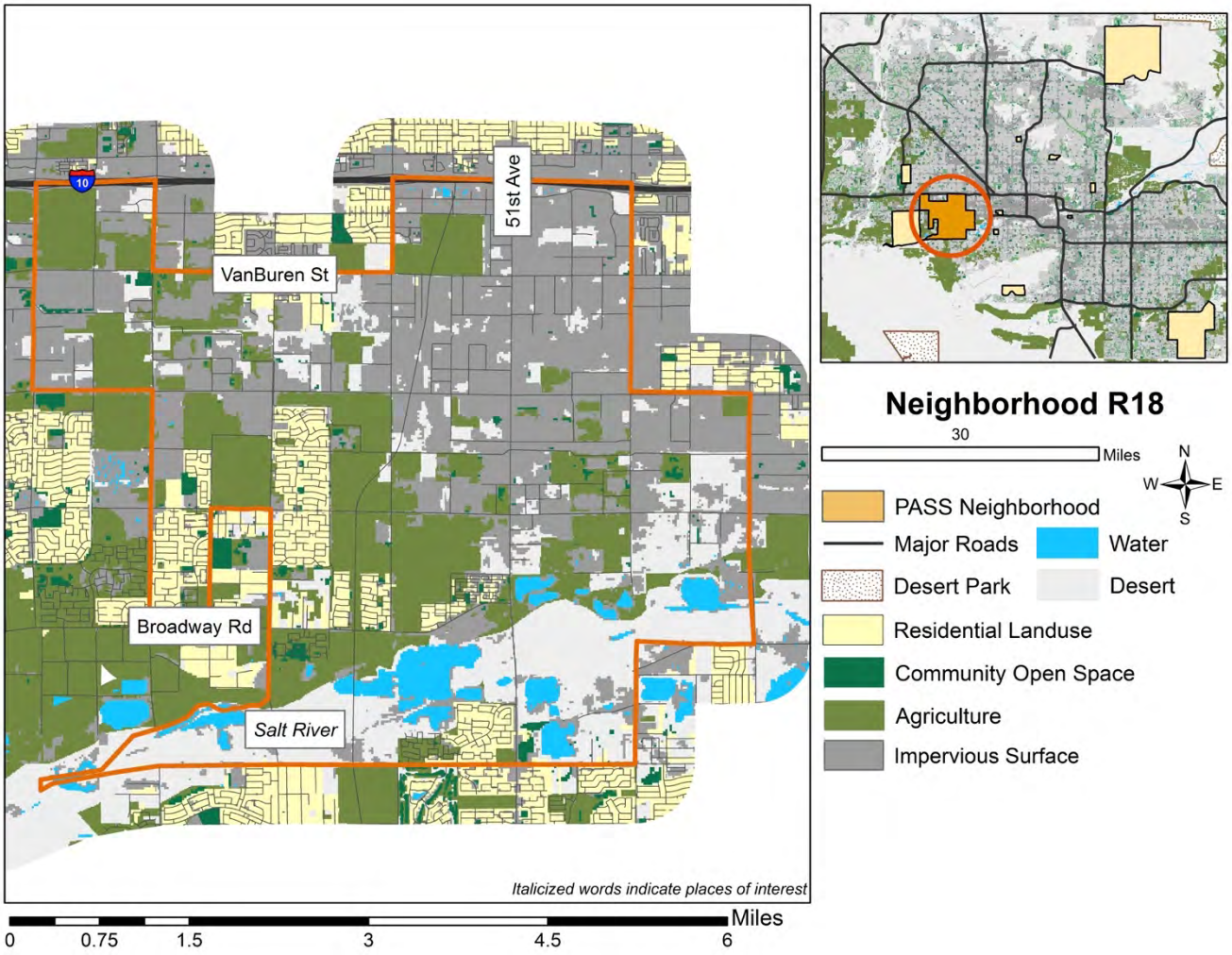
Total area: 0.25 square miles

Located near the Salt River Channel in south Phoenix, neighborhood U18 mostly consists of soil and concrete, which decreased from 57% in 2010 to 54% in 2015. Meanwhile, buildings increased from 12% to 17%, mostly as residential areas with some commercial buildings in the north. With the addition of soil and residential buildings, grass decreased from 11% to 5% and mostly remained as part of residential yards. Asphalt also decreased from 18% to 15%, while trees and shrubs increased from 1% to 8%, the largest percentage change in land coverage within this neighborhood.

## Neighborhood R18 (Phoenix, AZ)

*Mixed-Development Area near Salt River Channel in West Phoenix*

### Location within the Valley (upper right) and Land Uses (2010)




### Photos from R18 Neighborhood (2017)

*Highlights for R18*

1. Newer homes (built around 2003); relatively middle-income residents
2. Mix of suburban construction and large agricultural properties
3. Mostly Mexican/Latino (69%); black (12%), white (12%), Native (4%) & Asian (2%)
4. Area borders unmanaged section of the Salt River Channel

*Neighborhood Description*

Located in southwest Phoenix, this neighborhood (R18) shares many demographic and land use traits with the TRS neighborhood. The biggest difference is that the nearby Salt River Channel is a dry, unmanaged reach of the stream. Land use is heterogeneous with a mixture of residential and agricultural properties. Land cover is a mix of agricultural crops but there is also a high percentage of impervious surface in the area. The average home age is relatively new (built around 2003), but the neighborhood also has older agricultural properties with flood irrigation and large lots. The median household income is $60,323, and only 12% of the population has a bachelor's degree or higher education (see table *below*). Most of the individuals that live in the neighborhood are Mexican or Latino, the area is quite diverse and is home to the largest portion of black residents among our study areas. With an average size of 4.0 people, households tend to be families with young children (33% of the population is aged 0-18).

**Home and Parcel Information (from Tax Assessor data, 2020)**

| Variable | Study Area R18 | All PASS Neighborhoods |
|---|---|---|
| **Parcel Area (sq. ft.)** | 7,430 ± 11,479 | 13,249 ± 31,464 |
| **House Size (sq. ft.)** | 1,763 ± 527 | 2,506 ± 1,439 |
| **House Age (years)** | 2003 ± 9 | 2003 ± 12 |
| **Price ($)** | $218,321 ± 487,777 | $480,762 ± 1,488,751 |

**Demographic and Economic Information (from U.S. Census Bureau, 2019)**

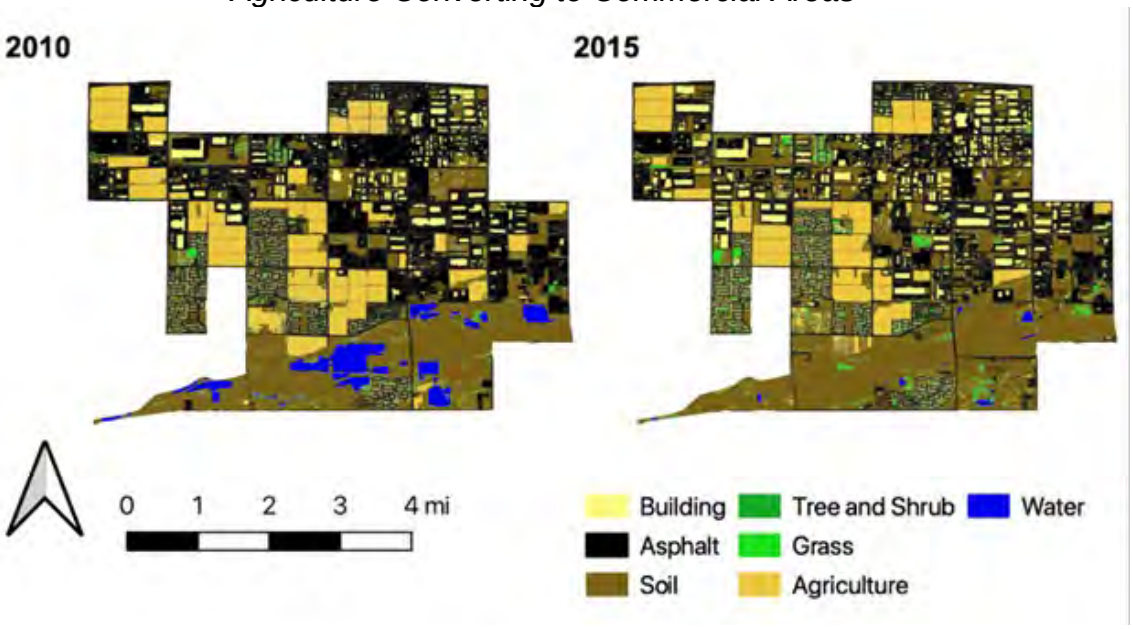
| Variable | Study Area R18 | All PASS Neighborhoods |
|---|---|---|
| **Household Income (median)** | $60,323 | $90,483 |
| **Median Age (years)** | 25.7 | 35.6 |
| **Bachelor's Degree or Above (%)** | 12.50 | 24.6 |
| **Owner Occupied (%)** | 53.41 | 68.7 |
| **Household Size** | 3.93 | 3.3 |

**Demographic Change Over Time (from U.S. Census Bureau: 2000, 2010, 2019)**

| Year | Population | White | Black | Latinx | Native American | Asian | Pacific Islander | Other | Two or More |
|---|---|---|---|---|---|---|---|---|---|
| 2000 | 2,772 | 30% | 5% | 62% | 1% | 1% | 0% | 0% | 1% |
| 2010 | 12,261 | 21% | 12% | 60% | 2% | 4% | 0% | 0% | 1% |
| 2019 | 28,766 | 13% | 9% | 61% | 2% | 2% | 0% | 8% | 4% |

**Recent Land Cover Changes in Neighborhood R18 (Phoenix, AZ)**

*Agriculture Converting to Commercial Areas*




| Land Cover | 2010 | 2015 | Change |
|---|---|---|---|
| **Soil** | 36% | 49% | +13% |
| **Asphalt** | 29% | 22% | -7% |
| **Building** | 10% | 13% | +3% |
| **Agriculture** | 15% | 10% | -5% |
| **Tree and Shrub** | 2% | 3% | +1% |
| **Grass** | 3% | 2% | -1% |
| **Water** | 4% | 0% | -4% |

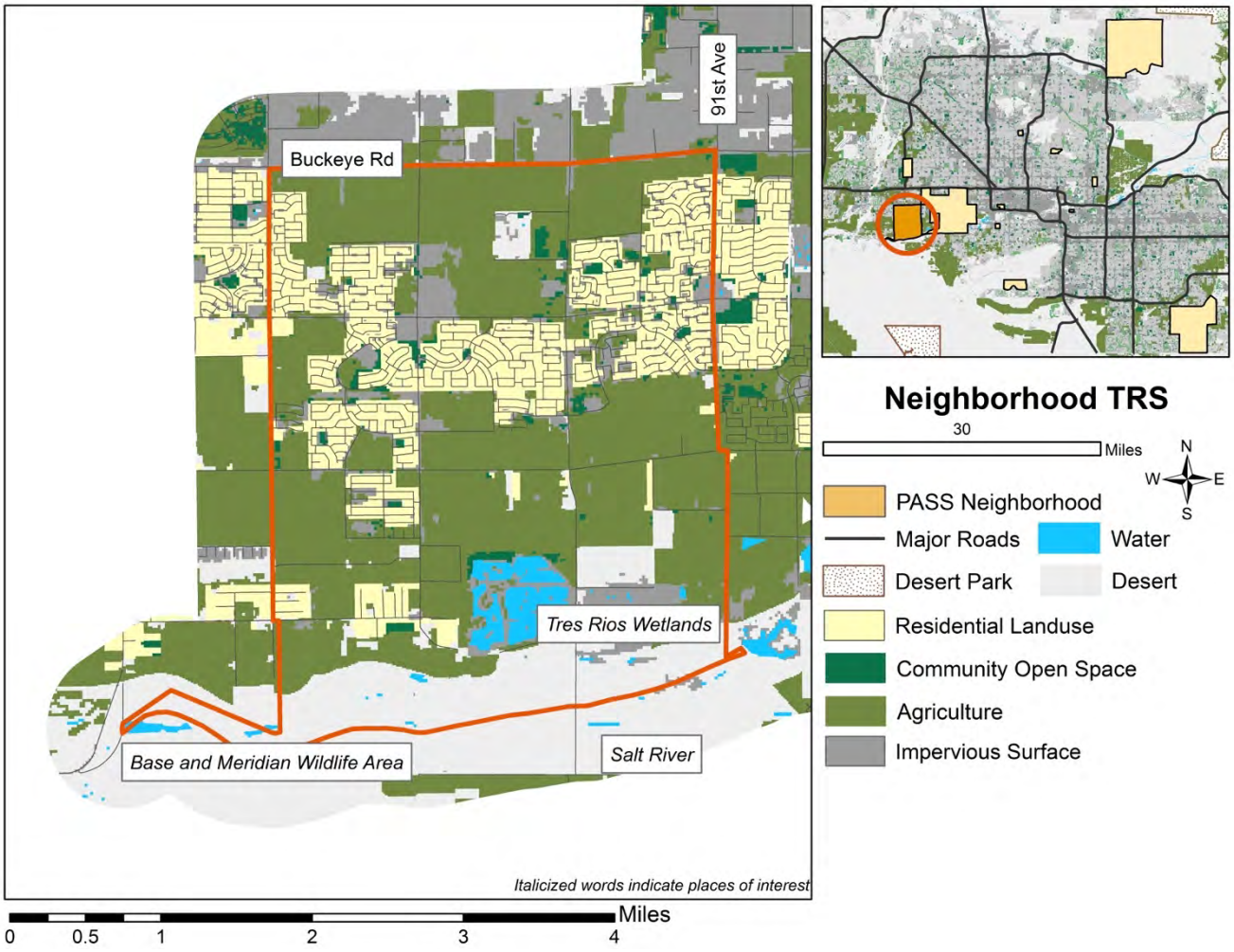
Total area: 20.8 square miles

In this mixed-development neighborhood, soil and concrete make up the largest percentage of land cover, which grew from 36% to 49% between 2010 and 2015. Meanwhile, agriculture decreased from 15% to 10% north of the Salt River, as did asphalt (from 29% to 22%) in the north and central areas. Industrial commercial development occurred with new buildings (10% to 13%) in the central and western portions of the neighborhood. Trees and shrubs also increased slightly from 2% to 3% while grass decreased from 3% to 2%. Yet a distinct shift in vegetation can be seen away from the river channel toward the developed portion of the neighborhood Water in the Salt River Channel decreased from 4% to 0%, which may be a function of recent rain at the time the 2010 images were captured.

## Neighborhood TRS (Phoenix, AZ)

*West Agricultural Fringe near the Tres Rios Wetlands*

**Location within the Valley (upper right) and Land Uses (2010)**




**Photos from TRS Neighborhood (2017)**

*Highlights for TRS*

1. Newer homes (built, on average, in 2006) surrounded by agricultural lands
2. Highest percent of children among study neighborhoods
3. Mostly Mexican/Latinx (65%); white (13%), black (8%), and “other” (8%)
4. The local blue-green infrastructure has been actively restored and managed

*Neighborhood Description*

Located at the southwest fringe of the metro area, this neighborhood (TRS) is a mix of residential and agricultural land. The homes are relatively new, established around 2006, but the neighborhood also has older agricultural properties with flood irrigation and large lots. The residential landscaping is mixed, with many homes having xeric or oasis yards. The neighborhood borders the Salt River and includes the Tres Rios Wetlands, which the City of Phoenix developed for wastewater treatment and to restore native riparian vegetation and wildlife habitat. The local water infrastructure, along with a nearby wildlife area, have been actively restored and offer outdoor amenities. The median household income is $70,457, but only 15% of the population has a Bachelor’s degree or higher level of education. Though most residents are Mexican or Latino, the area is diverse. With an average size of 3.93 people, households tend to be families with young children (33% of the population is aged 0-18).

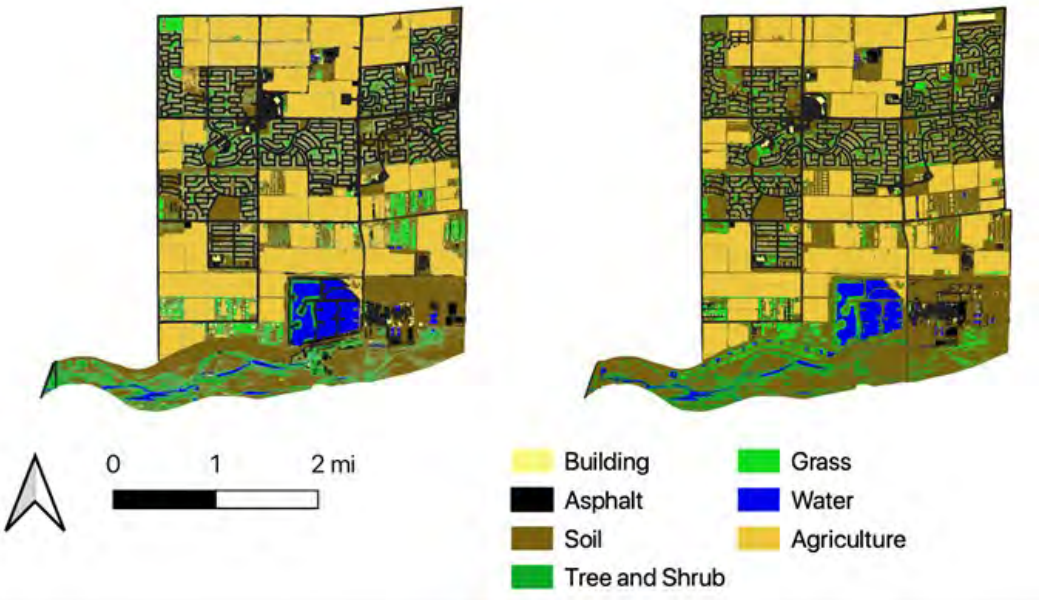
| **Home and Parcel Information (from Tax Assessor data, 2020)** | | |
|---|---|---|
| **Variable** | **Study Area TRS** | **All PASS Neighborhoods** |
| **Parcel Area (sq. ft.)** | 7,030 ± 16,757 | 13,249 ± 31,464 |
| **House Size (sq. ft.)** | 2,024 ± 1,970 | 2,506 ± 1,439 |
| **House Age (years)** | 2006 ± 5 | 2003 ± 12 |
| **Price ($)** | $191,074 ± 177,436 | $480,762 ± 1,488,751 |

| **Demographic and Economic Information (from U.S. Census Bureau, 2019)** | | |
|---|---|---|
| **Variable** | **Study Area TRS** | **All PASS Neighborhoods** |
| **Household Income (median)** | $70,457 | $90,483 |
| **Median Age (years)** | 25.93 | 35.6 |
| **Bachelor’s Degree or Above (%)** | 15.58 | 24.6 |
| **Owner Occupied (%)** | 64.52 | 68.7 |
| **Household Size** | 3.93 | 3.3 |

| Demographic Change Over Time (from U.S. Census Bureau: 2000, 2010, 2019) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Population** | **White** | **Black** | **Latinx** | **Native American** | **Asian** | **Pacific Islander** | **Other** | **Two or More** |
| 2000 | 799 | 61% | 0% | 36% | 2% | 0% | 0% | 0% | 1% |
| 2010 | 14,148 | 24% | 10% | 61% | 1% | 3% | 0% | 0% | 1% |
| 2019 | 37,251 | 13% | 8% | 65% | 6% | 1% | 1% | 8% | 4% |

**Recent Land Cover Changes in Neighborhood TRS (Phoenix, AZ)**

*Continued Agriculture with Some Increase in Residential Areas*




| Land Cover | 2010 | 2015 | Change |
|---|---|---|---|
| **Soil** | 34% | 40% | +6% |
| **Agriculture** | 31% | 30% | -1% |
| **Asphalt** | 10% | 8% | -2% |
| **Building** | 6% | 8% | +2% |
| **Tree and Shrub** | 10% | 7% | -3% |
| **Grass** | 5% | 5% | 0% |
| **Water** | 3% | 3% | 0% |

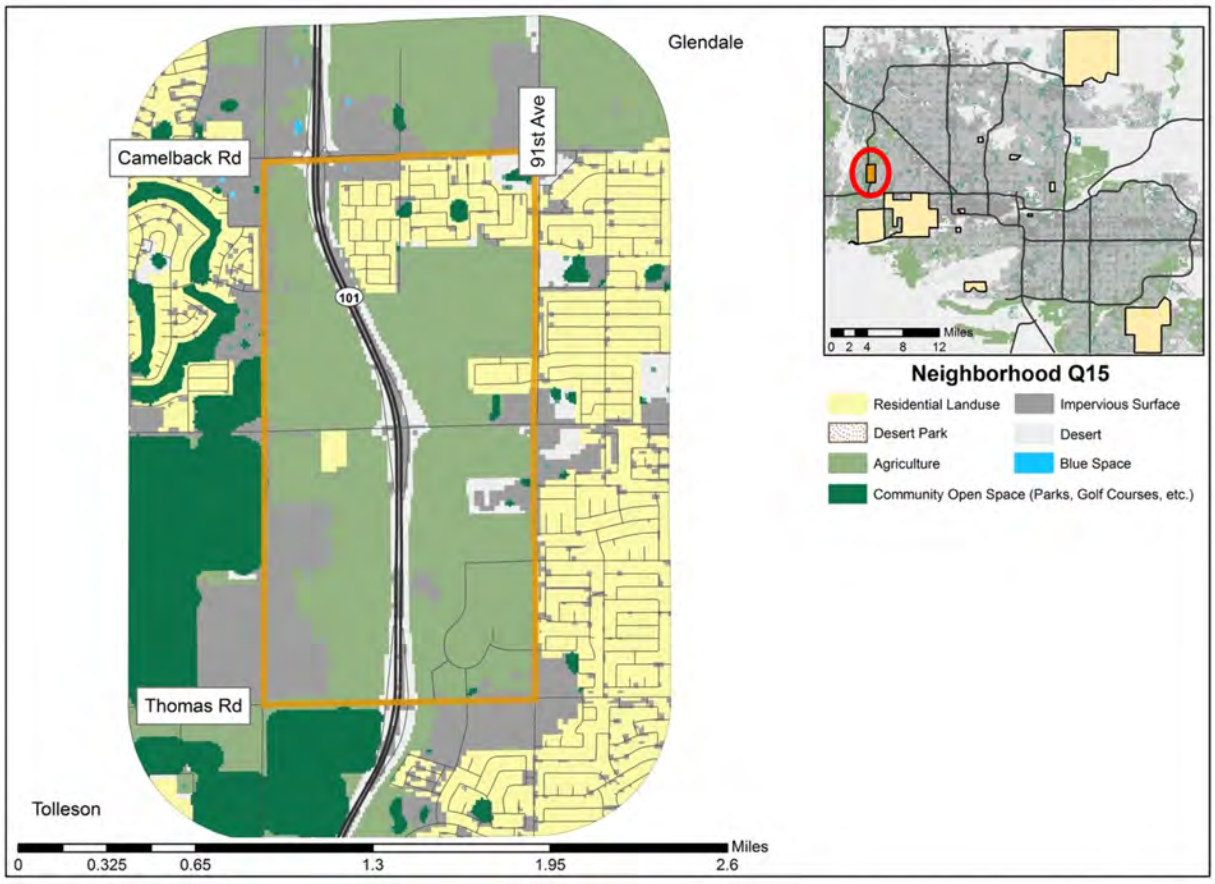
Total area: 11.21 square miles

This neighborhood near the Tres Rios Wetlands in western Phoenix has a large percentage of soil, which increased from 34% to 40% from 2010 to 2015, especially in the river channel in the southeast area. Asphalt decreased from 10% to 8%, including with increased soil in the southeast corner. Meanwhile, trees and shrubs decreased from 10% to 7%. Water in the Tres Rios Wetlands, the Tolleson Water Treatment Plant, and residential pools kept the percent of water land cover at 3%. The percentage of grass also stayed the same at 5%, though its spatial distribution appears to have shifted throughout the neighborhood (e.g., away from the river channel to the residential areas in the northern section). Buildings increased from 6% to 8% with the addition of a warehouse in the northeast corner. Lastly, agriculture—which makes up a large percentage of land cover—mostly stayed the same with a slight decrease from 31% to 30%.

## Neighborhood Q15 (Phoenix, AZ)

*Urban-Agricultural Neighborhood in the West Valley*

**Location within the Valley (upper right) and Land Uses (2010)**




**Photos from Q15 Neighborhood (2017)**

*Highlights for Q15*

1. Newer homes (built, on average, in 2005) with mixed landscaping
2. Land use has recently shifted from agricultural to residential developments
3. Mostly Mexican/Latinx (39%); white (17%), Asian (13%), black (10%)
4. Close to two major sports arenas (football and hockey)

*Neighborhood Description*

Located at the western edge of Phoenix, this neighborhood (Q15) shares many land-uses and home traits with the PWR neighborhood in the East Valley. Historically agricultural land, residential development has occurred in recent years. Thus, homes in the area are relatively new, built around the turn of the century. The landscaping is mixed, with many homes having xeric or oasis yards, and the neighborhood has two urban parks within its boundaries. The demographics resemble a middle-class population; the median household income is $84,090, but only 19% of residents have a bachelor's degree or higher level of education however this number has been increasing (see table *below*). Most of the individuals that live in the neighborhood are Mexican or Latino, but the racial composition is relatively mixed. With an average size of 3.68 people, households tend to be families with young children (26% of the population is aged 0-18); relatively few people (2%) are 65 years or older.

| **Home and Parcel Information (from Tax Assessor data, 2020)** | | |
|---|---|---|
| **Variable** | **Study Area Q15** | **All PASS Neighborhoods** |
| **Parcel Area (sq. ft.)** | 7,154 ± 10,413 | 13,249 ± 31,464 |
| **House Size (sq. ft.)** | 2,146 ± 570 | 2,506 ± 1,439 |
| **House Age (years)** | 2005 ± 8 | 2003 ± 12 |
| **Price ($)** | $203,060 ± 77,391 | $480,762 ± 1,488,751 |

| **Demographic and Economic Information (from U.S. Census Bureau, 2019)** | | |
|---|---|---|
| **Variable** | **Study Area Q15** | **All PASS Neighborhoods** |
| **Household Income (median)** | $84,090 | $90,483 |
| **Median Age (years)** | 27.5 | 35.6 |
| **Bachelor's Degree or Above (%)** | 19.1 | 24.6 |
| **Owner Occupied (%)** | 65.58 | 68.7 |
| **Household Size** | 3.68 | 3.3 |

| Demographic Change Over Time (from U.S. Census Bureau: 2000, 2010, 2019) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Population** | **White** | **Black** | **Latinx** | **Native American** | **Asian** | **Pacific Islander** | **Other** | **Two or More** |
| 2000 | 219 | 43% | 3% | 50% | 0% | 0% | 0% | 0% | 0% |
| 2010 | 1,531 | 33% | 9% | 48% | 0% | 8% | 0% | 0% | 0% |
| 2019 | 3,611 | 17% | 10% | 39% | 0% | 13% | 0% | 20% | 4% |

**Recent Land Cover Changes in Neighborhood Q15 (Phoenix, AZ)**

*Continued Agriculture with some De-Greening*


| Land Cover | 2010 | 2015 | Change |
|---|---|---|---|
| **Agriculture** | 57% | 58% | +1% |
| **Soil** | 17% | 23% | +6% |
| **Asphalt** | 13% | 10% | -3% |
| **Building** | 4% | 4% | 0% |
| **Tree and Shrub** | 4% | 3% | -1% |
| **Green** | 4% | 2% | -2% |
| **Water** | 0% | 0% | 0% |

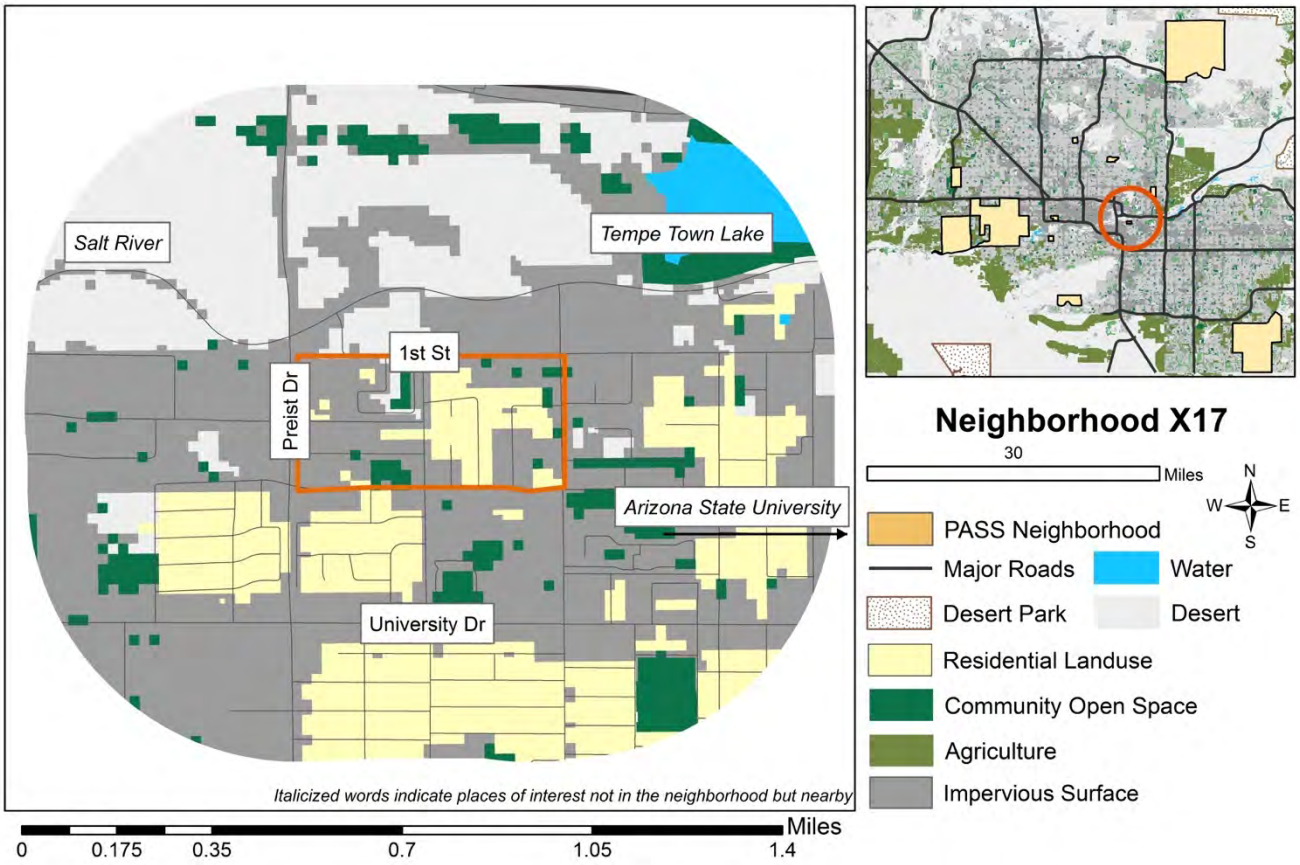
Total area: 2.0 square miles

This West Valley neighborhood is mostly comprised of agricultural land cover, which grew slightly from 57% in 2010 to 58% in 2015. Soil on both sides of Highway 101 in the eastern portion of the neighborhood increased from 17% to 23%, which accounts for the largest percent increase in any land cover type. Meanwhile, asphalt decreased from 13% to 10% with the growth in soil around Highway 101 and southeast corner. Buildings stayed the same at 4% with residential buildings in the north, a commercial area in the southeast corner and east-central area (north of Camelback Road), and Pendergast Elementary School (south of the road in the eastern section). Trees and shrubs decreased from 4% to 3%, and grass decreased from 4% to 2%.

## Neighborhood X17 (Phoenix, AZ)

*Central University Area near Tempe Town Lake (Salt River Channel)*

### Location within the Valley (upper right) and Land Uses (2010)




### Photos from X17 (2017)

*Highlights for X17*

1. Neighborhood borders an artificial lake developed in the Salt River channel
2. Above-average education levels, with lower home values, racially diverse
3. White (40%), Mexican/Latinx (32%), black (5%), Native (1%), and Asian (2%)
4. Landscaping is mixed, increased grass and vegetation

*Neighborhood Description*

Located in Tempe within walking distance to Arizona State University's central campus, this neighborhood (X17) borders the Salt River and associated accidental wetlands and is also adjacent to Tempe Town Lake, an artificial water body created in the otherwise dry Salt River channel. Neighborhood homes are relatively old (built, on average, around 1982) and have a small square footage, with a large percentage of townhomes and condos. The local landscaping is predominately mesic lawns or mixed oasis yards. As seen in the table *below*, the median household income is $53,347, and 56% of the population has a bachelor's degree or higher level of education (12% have post-baccalaureate degrees). The racial and ethnic composition of the neighborhood is most diverse among the study areas; 40% of residents are white, 32% are Mexican or Latino, and 1% are Native which has decreased by 6% in the last five years. The average household size is 2.43, with residents tending to be families (21% of the population is under 18) or young adults (35% of individuals are 25-34).

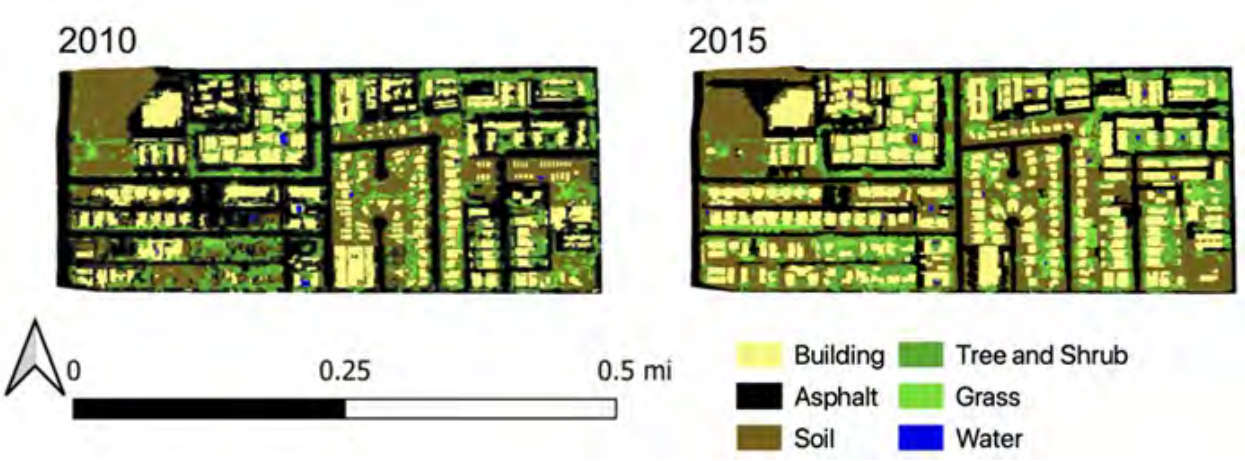
| **Home and Parcel Information (from Tax Assessor data, 2020)** | | |
|---|---|---|
| **Variable** | **Study Area X17** | **All Neighborhoods** |
| **Parcel Area (sq. ft.)** | 3,052 ± 9,964 | 13,249 ± 31,464 |
| **House Size (sq. ft.)** | 1,059 ± 405 | 2,506 ± 1,439 |
| **House Age (years)** | 1984 ± 18 | 2003 ± 12 |
| **Price ($)** | $318,278 ± 190,499 | $480,762 ± 1,488,751 |

| **Demographic and Economic Information (from U.S. Census Bureau, 2019)** | | |
|---|---|---|
| **Variable** | **Study Area X17** | **All Neighborhoods** |
| **Household Income (median)** | $53,347 | $90,483 |
| **Median Age (years)** | 25.7 | 35.6 |
| **Bachelor's Degree or Above (%)** | 56.29 | 24.6 |
| **Owner Occupied (%)** | 6.32 | 68.7 |
| **Household Size** | 2.53 | 3.3 |

| Demographic Change Over Time (from U.S. Census Bureau: 2000, 2010, 2019) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Population** | **White** | **Black** | **Latinx** | **Native American** | **Asian** | **Pacific Islander** | **Other** | **Two or More** |
| 2000 | 1,676 | 54% | 5% | 30% | 4% | 3% | 1% | 0% | 3% |
| 2010 | 1,253 | 57% | 9% | 22% | 5% | 4% | 0% | 0% | 2% |
| 2019 | 2,252 | 40% | 5% | 32% | 1% | 2% | 0% | 14% | 7% |

**Recent Land Cover Changes in Neighborhood X17 (Phoenix, AZ)**

*Increased Residential and Commercial Development*




| Land Cover | 2010 | 2015 | Change |
|---|---|---|---|
| **Soil** | 24% | 29% | +5% |
| **Building** | 23% | 27% | +4% |
| **Asphalt** | 33% | 23% | -10% |
| **Tree and Shrub** | 16% | 14% | -2% |
| **Grass** | 5% | 7% | +2% |
| **Agriculture** | 0% | 0% | 0% |
| **Water** | 0% | 0% | 0% |

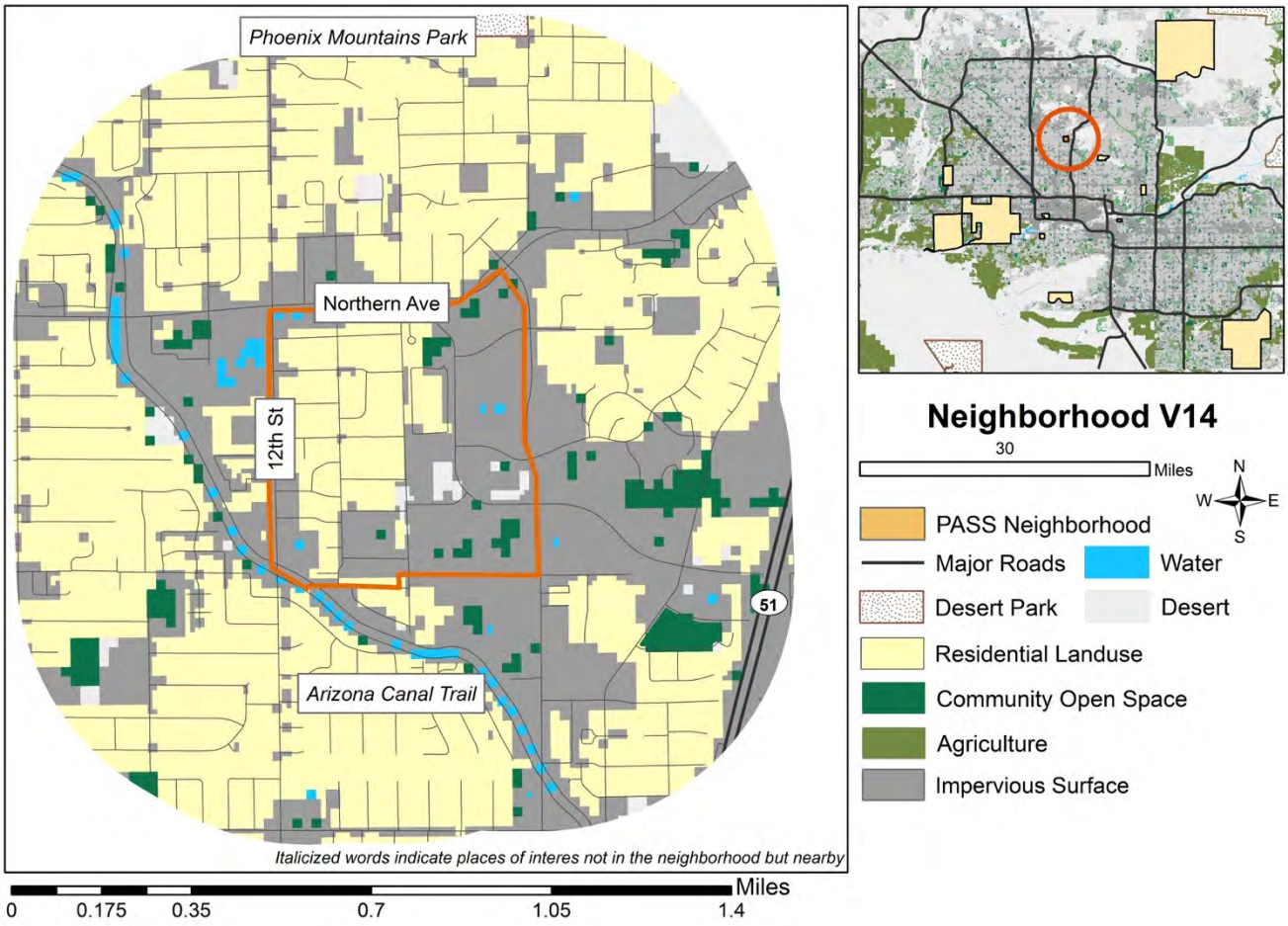
Total area: 0.12 square miles

Neighborhood X17 is located south of Tempe Town Lake and west of Arizona State University. Buildings increased in this neighborhood from 23% to 27%, mostly consisting of apartments and townhouses, with some commercial spaces in the northwest corner and south- central areas. Soil in this neighborhood also increased from 24% to 29% in the southern portion around the buildings. Meanwhile, asphalt decreased by 10%, at least partly due to growth in soil as well as grass. Grass grew along roads and in residential yards from 5% to 7%. Yet trees and shrubs decreased from 16% to 14%, especially in the southwestern portion where development occurred.

# Neighborhood V14 (Phoenix, AZ)

*North-Central Corridor near Arizona Canal and Phoenix Mountains*

## Location Within the Valley (upper right) and Land Uses (2010)




## Photos from V14 (2017)

*Highlights for V14*

1. Older homes have mesic landscaping and newer ones have xeric landscaping
2. Mostly white (57%) & Mexican/Latinx (29%); Asian (9%) and black (1%)
3. Borders the 69-mile Arizona Canal Trail with the Phoenix Mountains nearby
4. Lowest bird abundance among study neighborhoods

*Neighborhood Description*

Located in the North-Central corridor of Phoenix, this neighborhood (V14) is primarily residential with high levels of impervious surface nearby. The Arizona Canal and the associated multi-use trail border the neighborhood. Homes are old (on average, built in 1971), but the neighborhood is in transition as newer development has occurred in recent years. The area encompasses older mesic parcels neighboring remolded homes with xeric landscaping. Though the area has large, mature shade trees, bird abundance is low. The population is middle-class; the median household income is $61,238, and 22% of the population has a bachelor's degree or higher level of education. The residents are mostly white but somewhat diverse, especially with a significant Mexican/Latino population which has increased in recent years. The neighborhood also has the largest portion of Asian residents among the neighborhoods surveyed. Household size is relatively small, with 2 residents per household at the average age of 46 years and about 30% between the ages of 45 and 64.

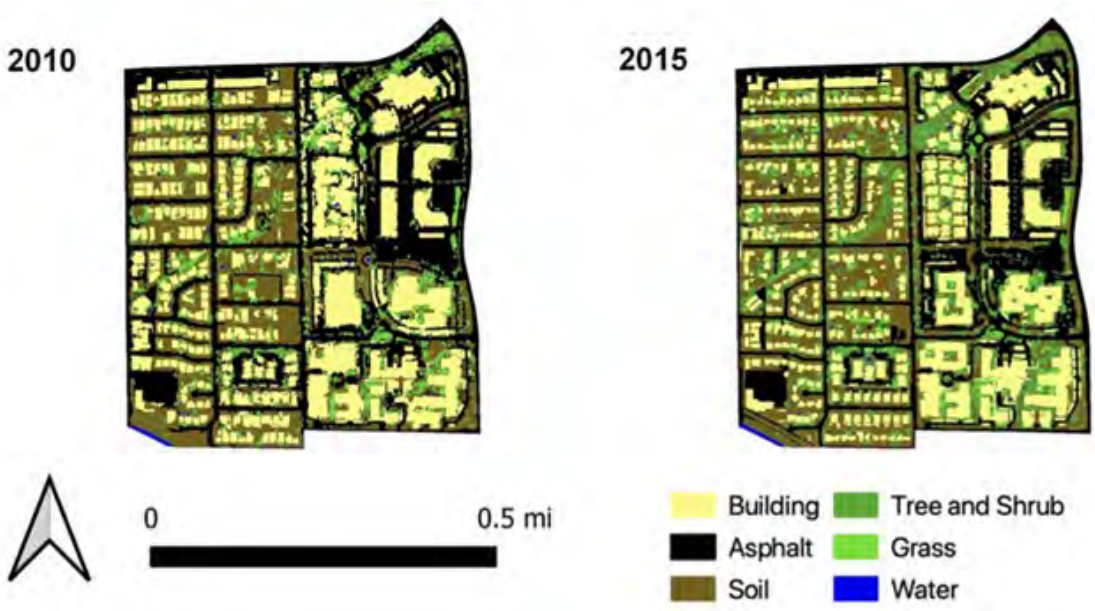
| Home and Parcel Information (from Tax Assessor data, 2020) | | |
|---|---|---|
| **Variable** | **Study Area V14** | **All PASS Neighborhoods** |
| **Parcel Area (sq. ft.)** | 7,144 ± 11,390 | 13,249 ± 31,464 |
| **House Size (sq. ft.)** | 1,266 ± 544 | 2,506 ± 1,439 |
| **House Age (years)** | 1971 ± 18 | 2003 ± 12 |
| **Price ($)** | $203,619 ±82,670 | $480,762 ± 1,488,751 |

| Demographic and Economic Information (from U.S. Census Bureau, 2019) | | |
|---|---|---|
| **Variable** | **Study Area V14** | **All PASS Neighborhoods** |
| **Household Income (median)** | $61,238 | $90,483 |
| **Median Age (years)** | 46.2 | 35.6 |
| **Bachelor's Degree or Above (%)** | 22.47 | 24.6 |
| **Owner Occupied (%)** | 17.55 | 68.7 |
| **Household Size** | 2.02 | 3.3 |

| Demographic Change Over Time (from U.S. Census Bureau: 2000, 2010, 2019) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Population** | **White** | **Black** | **Latinx** | **Native American** | **Asian** | **Pacific Islander** | **Other** | **Two or More** |
| 2000 | 1,488 | 76% | 3% | 17% | 1% | 1% | 0% | 0% | 1% |
| 2010 | 1,101 | 73% | 4% | 13% | 2% | 5% | 0% | 0% | 2% |
| 2019 | 1,268 | 57% | 0% | 29% | 0% | 10% | 0% | 0% | 3% |

**Recent Land Cover Changes in Neighborhood V14 (Phoenix, AZ)**

*Increased Greening*




| Land Cover | 2010 | 2015 | Change |
|---|---|---|---|
| **Soil** | 26% | 31% | +5% |
| **Asphalt** | 35% | 28% | -7% |
| **Building** | 29% | 25% | -4% |
| **Tree and Shrub** | 5% | 13% | +8% |
| **Grass** | 5% | 3% | -2% |
| **Agriculture** | 0% | 0% | 0% |
| **Water** | 0% | 0% | 0% |

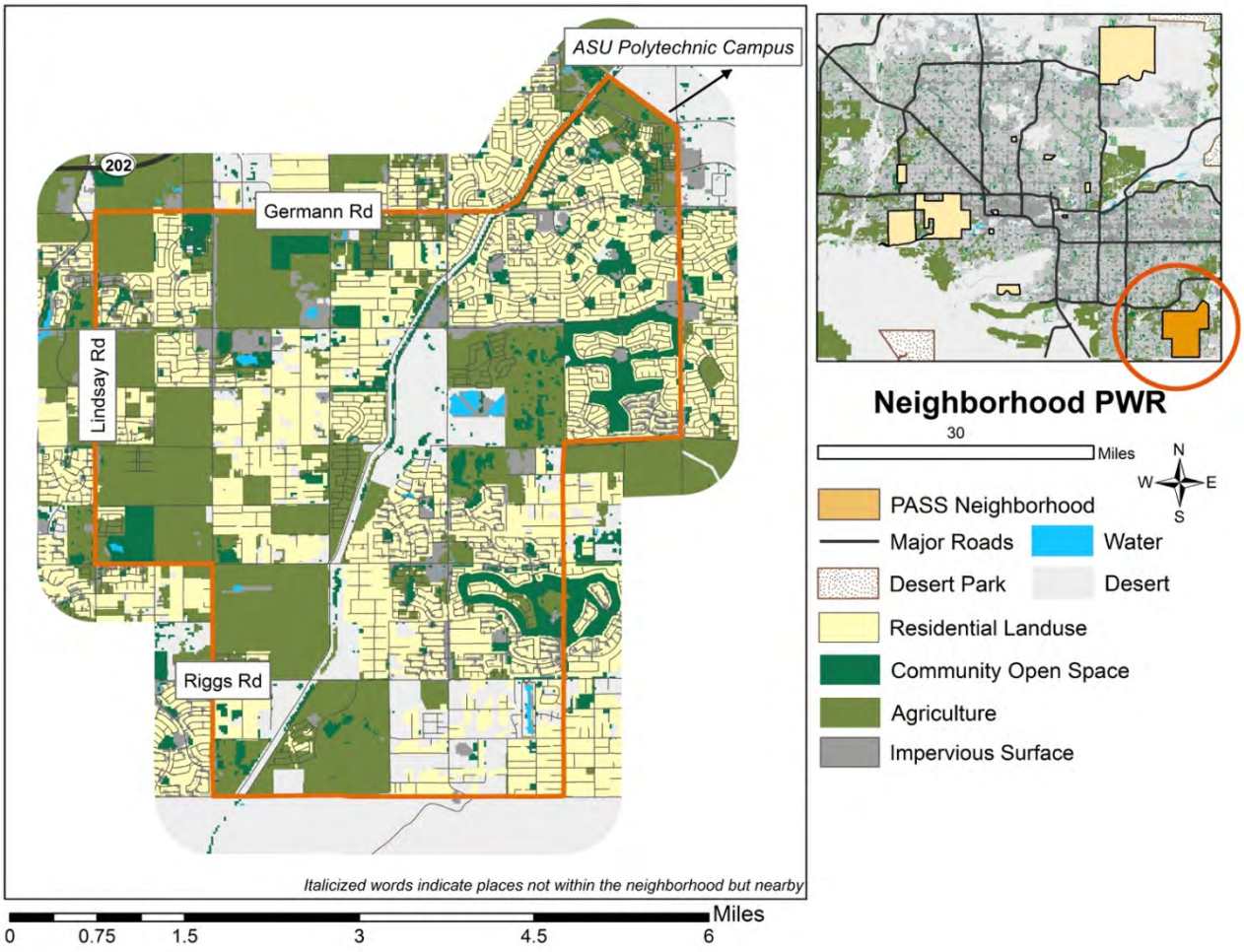
Total area: 0.28 square miles

From 2005 to 2010, PASS neighborhood V14—next to the Arizona Canal Trail— experienced an increase in trees and shrubs from 5% to 13%, which was the largest growth in any land-cover class. The smallest percentage of land cover change was grass, which decreased from 5% to 3% while soil increased from 26% to 31%. Conversely, asphalt decreased from 35% to 28%, specifically in the eastern portion of the neighborhood. Buildings also decreased from 29% to 25%, mostly affecting the commercial buildings on the eastern side. Overall, this neighborhood appears to have experienced increased 'greening' in this time period.

## Neighborhood PWR (Gilbert, AZ)

*Urban–Agricultural Fringe near ASU's East (Polytechnic) Campus*

### Location within the Valley (upper right) and Land Uses (2010)




### Photos from PWR Neighborhood (2017)

*Highlights for PWR*

1. Newest neighborhood in terms of average home age (on average, 10 years)
2. Homes are a mix of suburban developments and large agricultural properties
3. Mostly white (67%); Mexican/Latinx (15%), Asian (7%), black (2%)
4. Mixed land uses: residential and agricultural, with open spaces throughout

*Neighborhood Description*

Located in southeast Gilbert and near Arizona State University's Polytechnic (East Valley) campus, this neighborhood (PWR) is primarily residential and agricultural (cultivated crops and vegetation) with several urban parks (some serve as flood retention areas) and golf courses as open spaces. With relatively recent urban (residential) development, neighborhood homes are new and most resemble suburban cul-de-sacs with stucco walls and clay tile roofs. Residential landscaping is well mixed with mesic, oasis, and xeric yards. Interestingly, the neighborhood has the highest bird richness among the study neighborhoods. As seen in the table *below*, the demographics resemble a middle-class neighborhood; the median household income is $104,466, and 44% of the population has a bachelor's degree or higher level of education. Most of the individuals that live in the neighborhood are white. The average household size of 3.3 residents indicates households with young children (36% aged 0-18) and their parents (30% of the population is aged 25-44).

**Home and Parcel Information (from Tax Assessor data, 2020)**

| Variable | Study Area PWR | All PASS Neighborhoods |
|---|---|---|
| **Parcel Area (sq. ft.)** | 11,864 ± 16,834 | 13,249 ± 31,464 |
| **House Size (sq. ft.)** | 2,583 ± 950 | 2,506 ± 1,439 |
| **House Age (years)** | 2008 ± 6 | 2003 ± 12 |
| **Price ($)** | $363,086 ± 300,882 | $480,762 ± 1,488,751 |

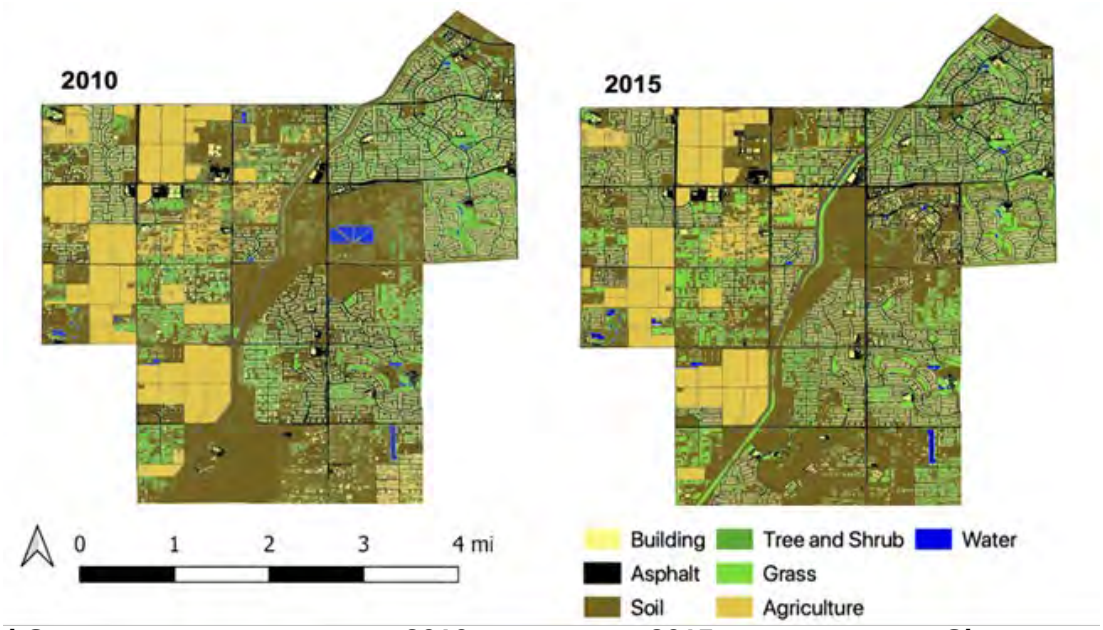
**Demographic and Economic Information (from U.S. Census Bureau, 2019)**

| Variable | Study Area PWR | All PASS Neighborhoods |
|---|---|---|
| **Household Income (median)** | $104,466 | $90,483 |
| **Median Age (years)** | 35.02 | 35.6 |
| **Bachelor's Degree or Above (%)** | 44.33 | 24.6 |
| **Owner Occupied (%)** | 80.68 | 68.7 |
| **Household Size** | 3.3 | 3.3 |

| Demographic Change Over Time (from U.S. Census Bureau: 2000, 2010, 2019) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Population** | **White** | **Black** | **Latinx** | **Native American** | **Asian** | **Pacific Islander** | **Other** | **Two or More** |
| 2000 | 2,495 | 77% | 0% | 20% | 0% | 0% | 0% | 0% | 1% |
| 2010 | 25,484 | 76% | 3% | 12% | 0% | 7% | 0% | 0% | 1% |
| 2019 | 60,628 | 67% | 5% | 15% | 0% | 7% | 0% | 2% | 3% |

**Recent Land Cover Changes in Neighborhood PWR (Phoenix, AZ)**

*Agriculture converting to residential*




| Land Cover | 2010 | 2015 | Change |
|---|---|---|---|
| **Soil** | 48% | 45% | -3% |
| **Asphalt** | 11% | 13% | +2% |
| **Agriculture** | 15% | 11% | -4% |
| **Building** | 7% | 11% | +4% |
| **Tree and Shrub** | 9% | 11% | +2% |
| **Grass** | 9% | 7% | -2% |
| **Water** | 1% | 1% | 0% |

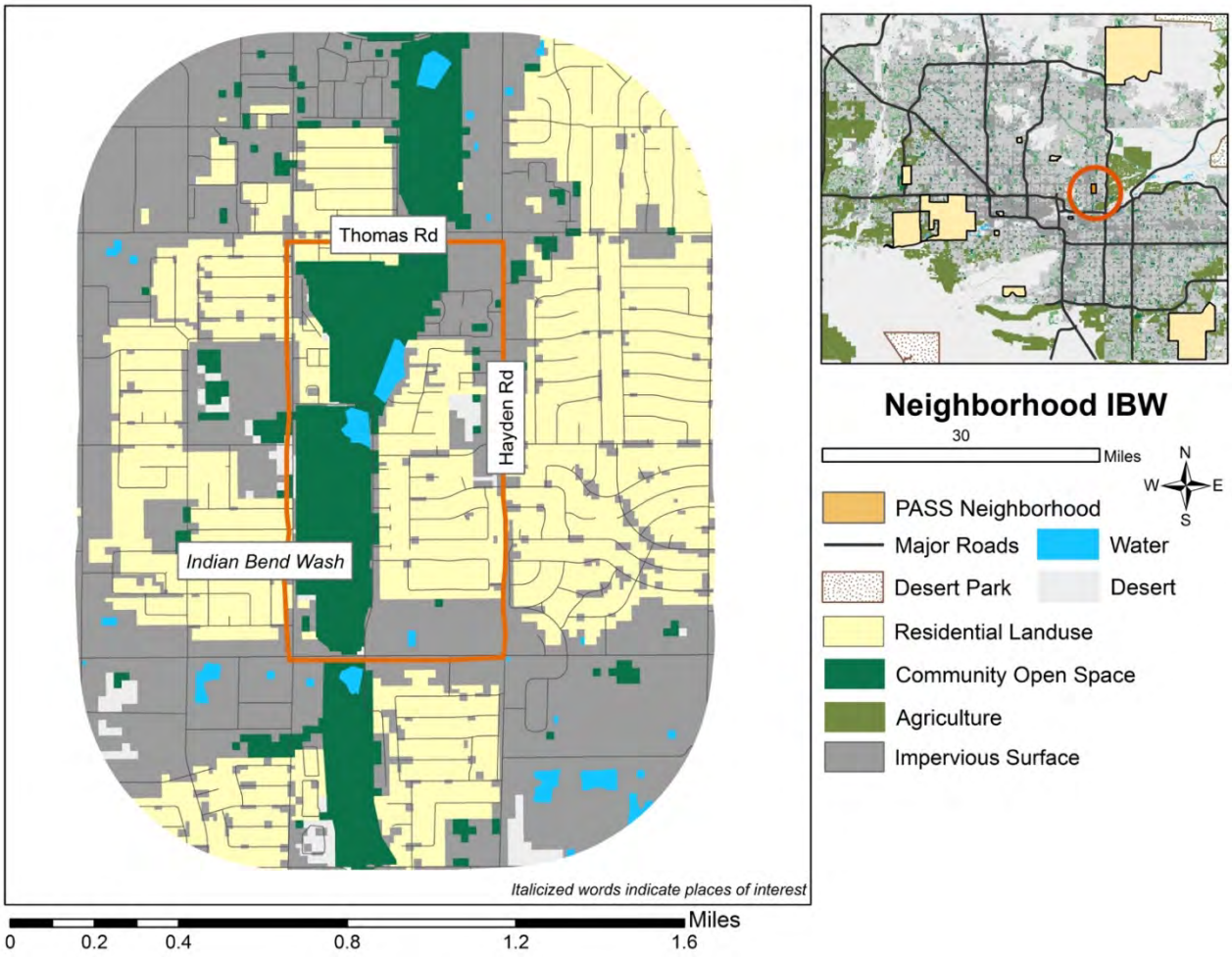
Total area: 21.33 square miles

Located in Gilbert, the PWR neighborhood has a large percentage of soil, which decreased from 48% to 45% between 2010 and 2015. Asphalt increased from 11% to 13% on main roads, roads for new residential areas, and parking lots. Trees and shrubs also increased from 9% to 11%, potentially with the increase in homes signified by the rise in buildings from 7% to 11%. As the largest growth in the neighborhood, the expansion of buildings includes new residential areas east and west of the Queen Creek Canal. Meanwhile, agriculture decreased from 15% to 11% with development in the west. The distribution of grass also shifted, with a net decrease from 9% to 7%. Although the retention ponds in the east-central area were cleared of water, the percentage of water stayed the same between 2010 and 2015 at 1% with the increase of pools and ponds near residential areas.

## Neighborhood IBW (Scottsdale, AZ)

*Flood Retention Greenway in an Inner Suburban Context*

### Location within the Valley (upper right) and Land Uses (2010)




### Photos from Neighborhood IBW (2017)

*Highlights for IBW*

1. Neighborhood encompasses a flood retention project that also serves as a park
2. Middle-income and above-average education residents; many town/patio homes
3. Mostly white (75%); Mexican/Latino (17%), Asian (3%), & black (1%)
4. Landscaping is mixed with grassy (mesic) and desert (xeric) yards

*Neighborhood Description*

Located in south Scottsdale and near Arizona State University, this neighborhood (IBW) encompasses a flood retention zone—known as Indian Bend Wash—that also functions as a neighborhood park and greenway. Homes in the area are relatively old and have the smallest square footage among study neighborhoods, with a large percentage of townhouses and patio homes. Residential landscaping is predominately oasis, with a high prevalence of grassy lawns but a mix of xeric, desert-like yards as well. The demographics resemble a middle-class neighborhood (see table *below*); the median household income is $71,742, and 54% of the population has a bachelor's degree or higher level of education (19% have post-baccalaureate degrees). Most of the individuals that live in the neighborhood are white. With an average household size of 1.9 and a relatively low portion of children (3%) living in the area, residents tend to be relatively young adults (nearly half are aged 18-34).

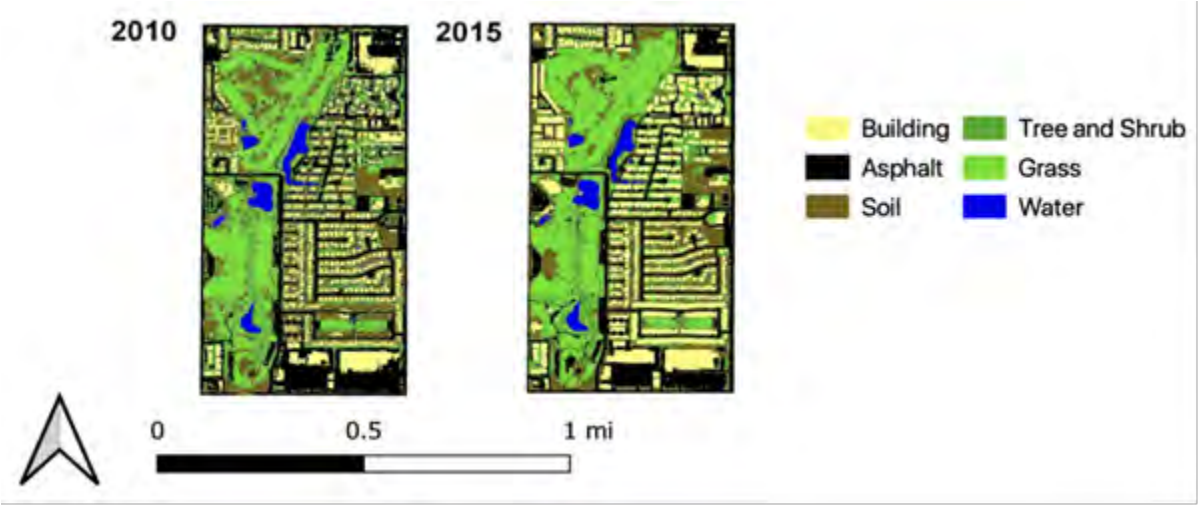
| **Home and Parcel Information (from Tax Assessor data, 2020)** | | |
|---|---|---|
| **Variable** | **Study Area IBW** | **All Neighborhoods** |
| **Parcel Area (sq. ft.)** | 4,656 ± 2,921 | 13,249 ± 31,464 |
| **House Size (sq. ft.)** | 1,660 ± 415 | 2,506 ± 1,439 |
| **House Age (years)** | 1974 ±10 | 2003 ± 12 |
| **Price ($)** | $250,402 ± 176,122 | $480,762 ± 1,488,751 |

| **Demographic and Economic Information (from U.S. Census Bureau, 2019)** | | |
|---|---|---|
| **Variable** | **Study Area IBW** | **All Neighborhoods** |
| **Household Income (median)** | $71,742 | $90,483 |
| **Median Age (years)** | 33.50 | 35.6 |
| **Bachelor's Degree or Above (%)** | 54.23 | 24.6 |
| **Owner Occupied (%)** | 51.62 | 68.7 |
| **Household Size** | 1.9 | 3.3 |

| Demographic Change Over Time (from U.S. Census Bureau: 2000, 2010, 2019) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Population** | **White** | **Black** | **Latinx** | **Native American** | **Asian** | **Pacific Islander** | **Other** | **Two or More** |
| 2000 | 1,778 | 90% | 1% | 4% | 0% | 2% | 0% | 0% | 1% |
| 2010 | 1,619 | 84% | 2% | 9% | 0% | 3% | 0% | 0% | 2% |
| 2019 | 1,911 | 75% | 0% | 17% | 1% | 3% | 0% | 2% | 2% |

**Recent Land Cover Changes in Neighborhood IBW (Phoenix, AZ)**

*Increased Urban Development*




| Land Cover | 2010 | 2015 | Change |
|---|---|---|---|
| **Asphalt** | 28% | 24% | -4% |
| **Grass** | 19% | 22% | +3% |
| **Soil** | 25% | 22% | -3% |
| **Building** | 13% | 19% | +6% |
| **Tree and Shrub** | 13% | 11% | -2% |
| **Water** | 3% | 3% | 0% |
| **Agriculture** | 0% | 0% | 0% |

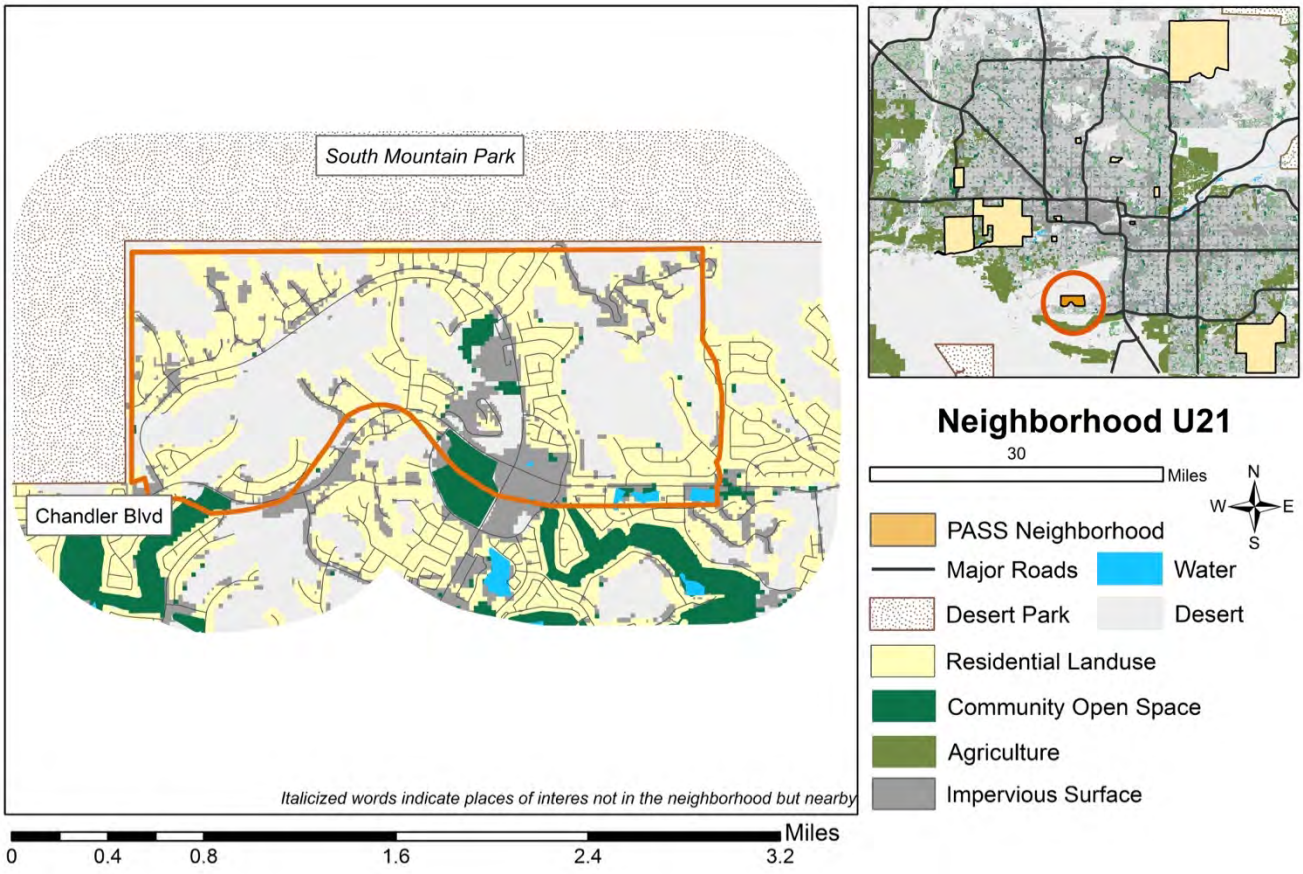
Total area: 0.5 square miles

This Indian Bend Wash greenway is surrounded by residential buildings with asphalt covering 28% of the land in 2010, which decreased to 24% by 2015 around the southeast and northwest corners. Buildings increased from 13% to 19% with the addition of residential buildings in the southeast as well as the development of the Eldorado Aquatic and Fitness Center in the west and a fire station in the southwest. Grass also increased from 19% to 22% in the northern portion of the Coronado Golf Course, while soil decreased from 25% to 22%. Trees and shrubs decreased from 13% to 11%. Water stayed the same at 3% between 2010 and 2015.

## Neighborhood U21 (Phoenix, AZ)

*High Income Cul-de-sac near South Mountain Preserve*

### Location within the Valley (upper right) and Land Uses (2010)




### Photos from U18 (2010)

*Highlights for U21*

1. Large homes on relatively small parcels with pools
2. Highest percent of family households among study neighborhoods
3. Mostly white (75%); Mexican/Latinx (8%), Asian (9%), & black (2%)
4. Close access to desert park and highest bird diversity values

*Neighborhood Description*

Nestled at the base of the South Mountain Preserve, in the southern most point in the City of Phoenix, this mostly residential area (U21) is surrounded by a large amount of open (desert) space. South Mountain offers over 16,000 acres and 51 miles of park space. The homes in the area are large and relatively new (average year build is 1995), with the highest percent of ownership. The landscaping is predominately xeric, and the neighborhood has the highest levels of bird diversity among the study neighborhoods. Over three-fourths (76%) of homes have a pool in their private yards, and the area has a relatively high socioeconomic status (see table *below*). The median household income is $153,601, and 65% of the population has a bachelor's degree or higher level of education (27% have post-baccalaureate degrees). The majority of the individuals that live in the neighborhood are white. With an average size of 3 residents, households tend to be families with young children (27% of the population is aged 0-18) and their parents.

**Home and Parcel Information (from Tax Assessor data, 2020)**

| Variable | Study Area U21 | All PASS Neighborhoods |
|---|---|---|
| **Parcel Area (sq. ft.)** | 12,069 ± 18,053 | 13,249 ± 31,464 |
| **House Size (sq. ft.)** | 2,872 ± 872 | 2,506 ± 1,439 |
| **House Age (years)** | 1996 ± 4 | 2003 ± 12 |
| **Price ($)** | $415,742 ±199,801 | $480,762 ± 1,488,751 |

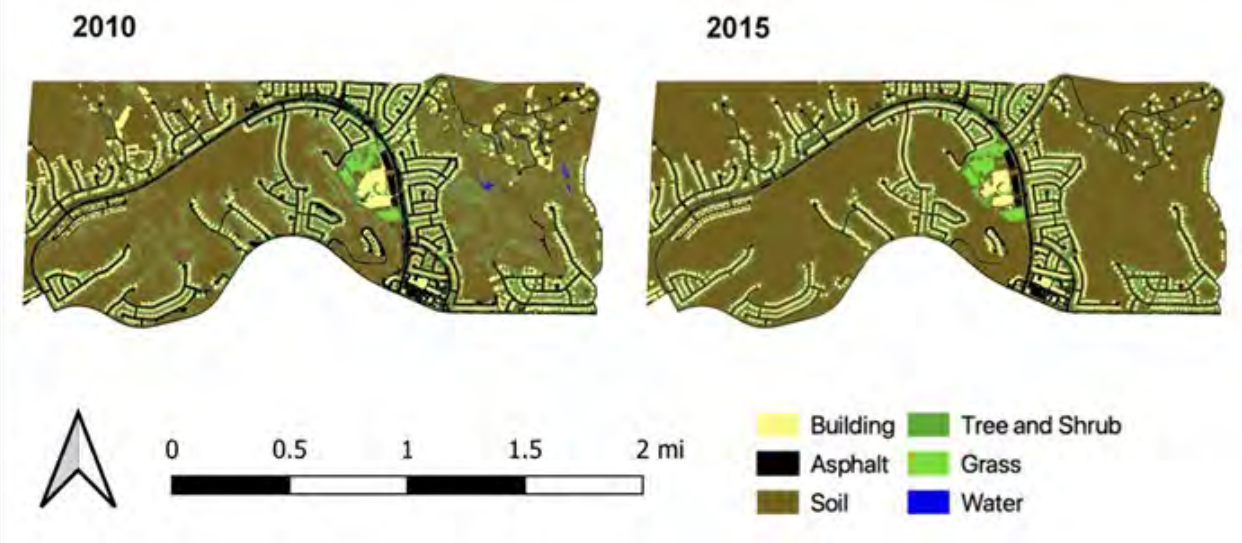
**Demographic and Economic Information (from U.S. Census Bureau, 2019)**

| Variable | Study Area U21 | All PASS Neighborhoods |
|---|---|---|
| **Household Income (median)** | $153,601 | $90,483 |
| **Median Age (years)** | 43.20 | 35.6 |
| **Bachelor's Degree or Above (%)** | 65.31 | 24.6 |
| **Owner Occupied (%)** | 95.71 | 68.7 |
| **Household Size** | 3.03 | 3.3 |

| Demographic Change Over Time (from U.S. Census Bureau: 2000, 2010, 2019) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Population** | **White** | **Black** | **Latinx** | **Native American** | **Asian** | **Pacific Islander** | **Other** | **Two or More** |
| 2000 | 4,345 | 85% | 3% | 6% | 0% | 4% | 0% | 0% | 1% |
| 2010 | 3,230 | 82% | 3% | 6% | 0% | 7% | 0% | 0% | 2% |
| 2019 | 4,756 | 75% | 2% | 8% | 2% | 9% | 0% | 1% | 3% |

**Recent Land Cover Changes in Neighborhood U21 (Phoenix, AZ)**

*Increased Xeric Lands*




| Land Cover | 2010 | 2015 | Change |
|---|---|---|---|
| **Soil** | 63% | 71% | +8% |
| **Building** | 12% | 12% | 0% |
| **Asphalt** | 12% | 8% | -4% |
| **Tree and Shrub** | 9% | 7% | -2% |
| **Grass** | 4% | 2% | -2% |
| **Water** | 0% | 1% | +1% |
| **Agriculture** | 0% | 0% | 0% |

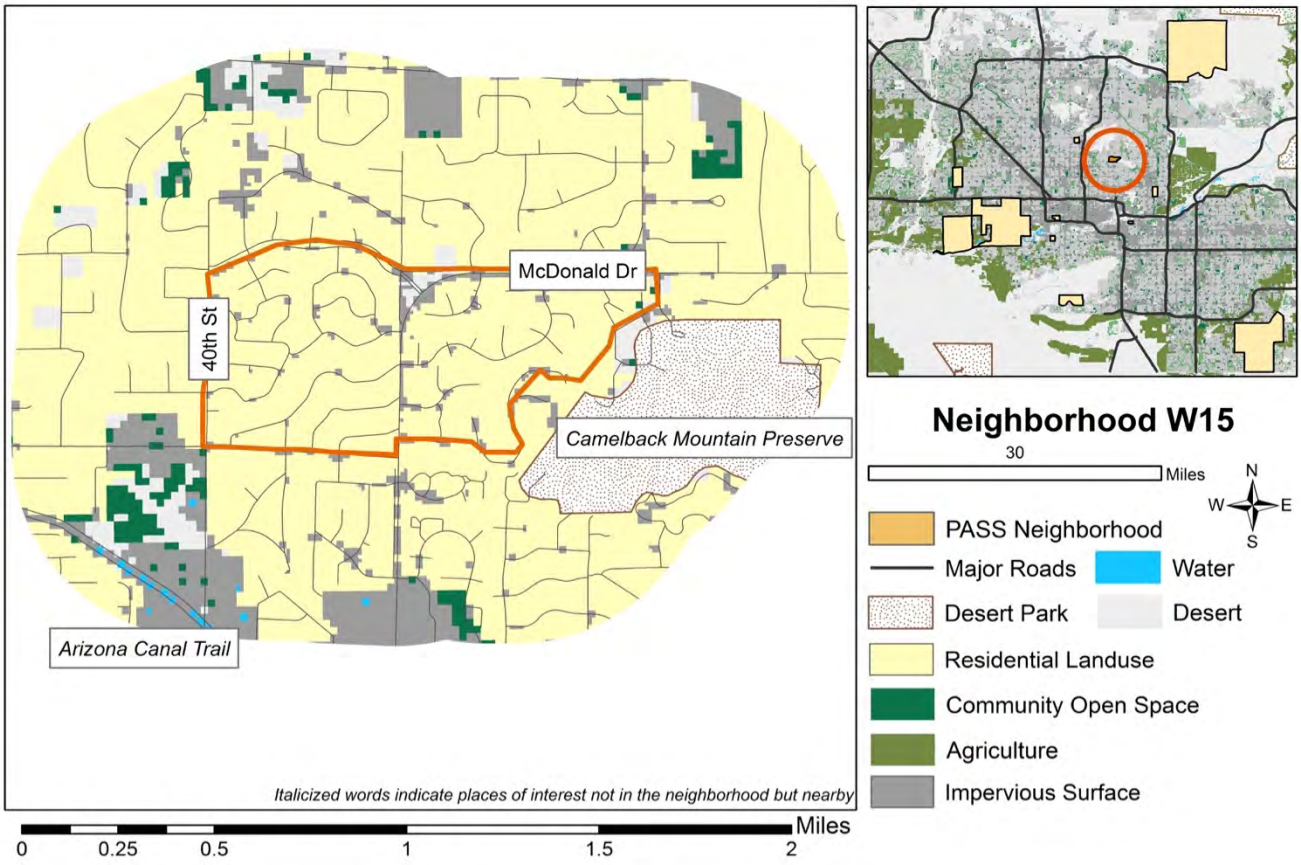
Total area: 2.2 square miles

This neighborhood—south of the South Mountain desert preserve—is mostly covered by soil and desert. The amount of soil grew from 63% to 71%, the largest change in land cover in U21, which appears associated with a decline in trees and shrubs (from 9% to 7%) and grass (4% to 2%). Asphalt also decreased from 12% to 8% with the increase in soil. The land covered by buildings—mostly residential with some commercial clusters in the center—stayed the same at 12%. While small natural pools are present in 2010 and not in 2015, overall, water increased from 0% to 1% since a significant number of homes installed pools.

## Neighborhood W15 (Phoenix, AZ)

*High-Income, Central Mountain Residential Area*

### Location within the Valley (upper right) and Land Uses (2010)




### Photos from V14 (2017)

*Highlights for W15*

1. Older neighborhood in the urban center of metropolitan Phoenix
2. High home values, high income, and older residents
3. Mostly white (93%); Mexican/Latinx (2%), Asian (2%)
4. Borders a small desert preserve with a multi-use urban trail system nearby

*Neighborhood Description*

Situated at the base of a small desert preserve known as Camelback Mountain in central Phoenix, this predominantly residential area (W15) borders the Arizona Canal and the associated 69-mile, multi-use trail. The area is relatively mature in terms of housing, with 1968 as the average age of development. The yards predominately have matured xeric landscaping, and about two-thirds of homes have a pool in their private yards. The residents have a relatively high socioeconomic status; the median household income is $179,204, and 74% of the population has a bachelor's degree or higher level of education (41% have post-baccalaureate degrees). Most of the individuals that live in the neighborhood are white (93%). With an average household size of 2.4 individuals, the residents are the oldest among the study neighborhoods (25% of the population is 65+ and 34% is 45-64).

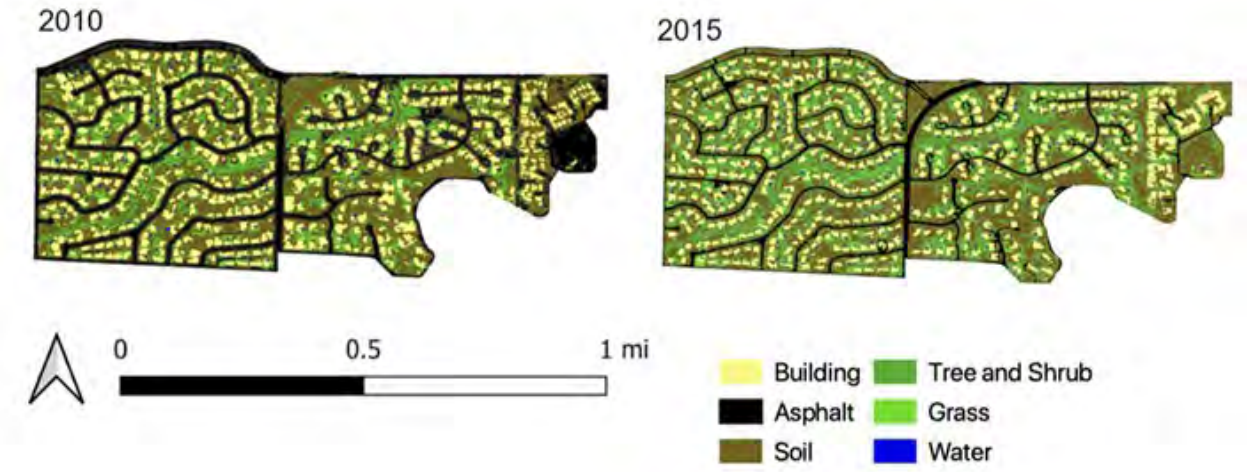
| Home and Parcel Information (from Tax Assessor data, 2020) | | |
|---|---|---|
| **Variable** | **Study Area W15** | **All Neighborhoods** |
| **Parcel Area (sq. ft.)** | 17,982 ± 7,171 | 13,249 ± 31,464 |
| **House Size (sq. ft.)** | 2,590 ± 956 | 2,506 ± 1,439 |
| **House Age (years)** | 1971 ± 18 | 2003 ± 12 |
| **Price ($)** | $750,583 ± 299,342 | $480,762 ± 1,488,751 |

| Demographic and Economic Information (from U.S. Census Bureau, 2019) | | |
|---|---|---|
| **Variable** | **Study Area W15** | **All Neighborhoods** |
| **Household Income (median)** | $179,204 | $90,483 |
| **Median Age (years)** | 52.1 | 35.6 |
| **Bachelor's Degree or Above (%)** | 74.01 | 24.6 |
| **Owner Occupied (%)** | 88.40 | 68.7 |
| **Household Size** | 2.41 | 3.3 |

| Demographic Change Over Time (from U.S. Census Bureau: 2000, 2010, 2019) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Population** | **White** | **Black** | **Latinx** | **Native American** | **Asian** | **Pacific Islander** | **Other** | **Two or More** |
| 2000 | 1,488 | 76% | 3% | 17% | 1% | 1% | 0% | 0% | 1% |
| 2010 | 1,101 | 73% | 4% | 13% | 2% | 5% | 0% | 0% | 2% |
| 2019 | 1,268 | 57% | 0% | 29% | 0% | 10% | 0% | 0% | 3% |

**Recent Land Cover Changes in Neighborhood W15 (Phoenix, AZ)**

*Increased Trees and Shrubs from Landscaping*




| Land Cover | 2010 | 2015 | Change |
|---|---|---|---|
| **Soil** | 42% | 43% | +1% |
| **Tree and Shrub** | 12% | 23% | +11% |
| **Building** | 20% | 17% | -3% |
| **Asphalt** | 18% | 11% | -7% |
| **Grass** | 7% | 5% | -2% |
| **Water** | 1% | 1% | 0% |
| **Agriculture** | 0% | 0% | 0% |

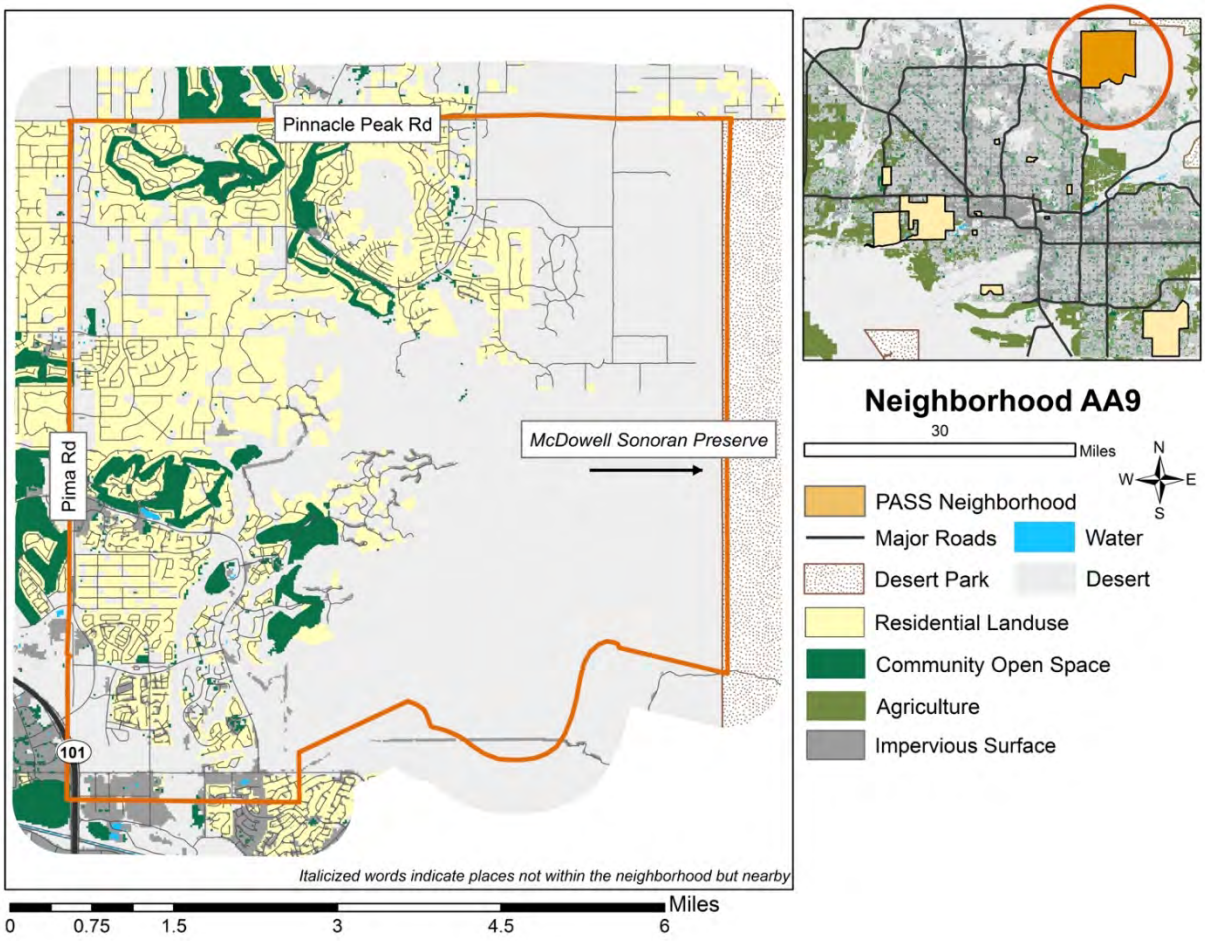
Total area: 0.50 square miles

This neighborhood near the Arizona Canal Trail and Camelback Mountain Preserve has a significant percentage of soil, which increased slightly from 42% to 43%. Trees and shrubs grew significantly from 12% to 23%, especially in residential yards where vegetation increasingly covered asphalt roadways. Asphalt decreased from 18% to 11%. Grass decreased from 7% to 5%, most likely replaced by trees and shrubs. Water, made up from residential pools, stayed the same at 1%. Buildings—entirely made up of residential homes—decreased from 20% to 17%.

## AA9 (Scottsdale, AZ)

*High-Income Fringe with a Desert Preserve and Open Space*

### Location within the Valley (upper right) and Land Uses (2010)




### Photos from Neighborhood AA9 (2017)

*Highlights for AA9*

1. Largest homes and yards of study neighborhoods; also, most expensive homes
2. Oldest median age of residents (54 years)
3. Mostly white (94%); Mexican/Latinx (4%), Asian (5%), and black (1%)
4. Close access to desert park and prevalence of desert-specialist bird species

*Neighborhood Description*

Located at the northeastern fringe of the Phoenix metropolitan area, this neighborhood (AA9) borders the McDowell Sonoran Preserve and has a high percentage of open space (desert). Homes in this area are relatively new (the average year of housing development is 2000) and large, with private pools in about two-thirds (63%) of residents' yards. The landscaping in the neighborhood is mostly xeric, and this neighborhood also has a high prevalence of native bird species. As seen in the table *below*, the residents of the area exhibit relatively high socioeconomic status; the median household income is $155,712, and 63% of the population has a bachelor's degree or higher level of education (28% have post-baccalaureate degrees). Most of the individuals that live in the neighborhood are white (86%). With an average household size of 2.43**,** residents tend to be older individuals (around 25% are >65 years) with fewer young children compared to the other PASS neighborhoods.

**Home and Parcel Information (from Tax Assessor data, 2020)**

| Variable | Study Area AA9 | All Neighborhoods |
|---|---|---|
| **Parcel Area (sq. ft.)** | 30,208 ± 66,378 | 13,249 ± 31,464 |
| **House Size (sq. ft.)** | 3,640 ± 1,783 | 2,506 ± 1,439 |
| **House Age (years)** | 2001 ± 8 | 2003 ± 12 |
| **Price ($)** | $894,055 ± 899,295 | $480,762 ± 1,488,751 |

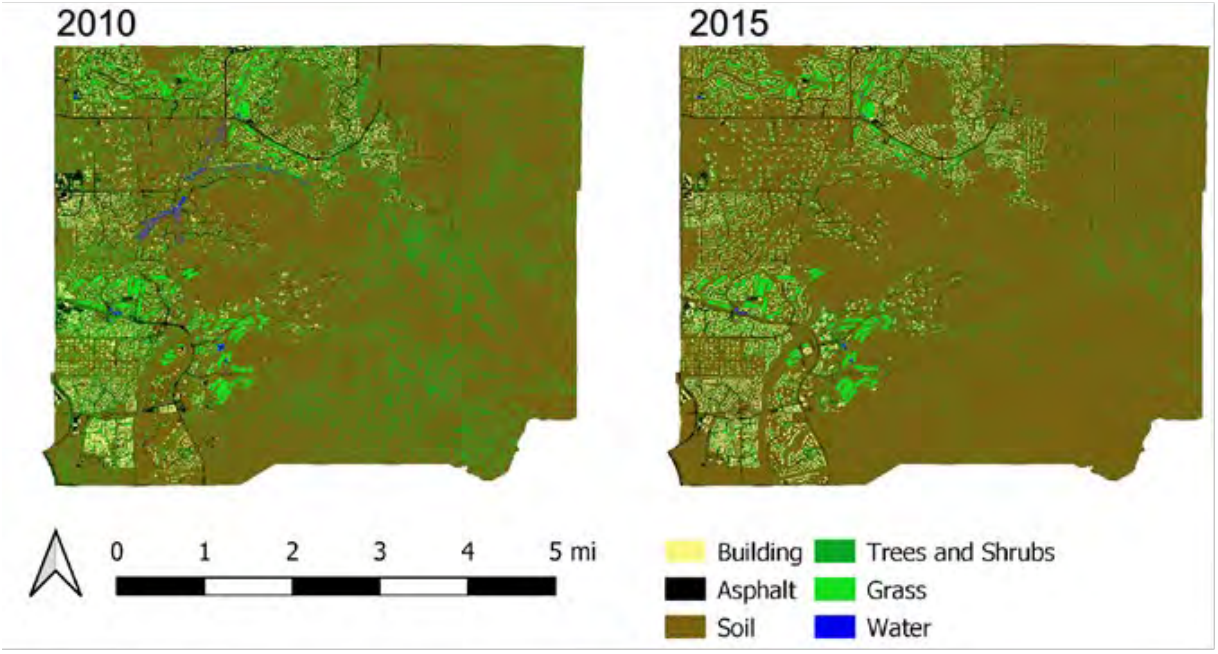
**Demographic and Economic Information (from U.S. Census Bureau, 2019)**

| Variable | Study Area AA9 | All Neighborhoods |
|---|---|---|
| **Household Income (median)** | $155,712 | $90,483 |
| **Median Age (years)** | 54.29 | 35.6 |
| **Bachelor's Degree or Above (%)** | 63.45 | 24.6 |
| **Owner Occupied (%)** | 86.34 | 68.7 |
| **Household Size** | 2.43 | 3.3 |

| Demographic Change Over Time (from U.S. Census Bureau: 2000, 2010, 2019) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Population** | **White** | **Black** | **Latinx** | **Native American** | **Asian** | **Pacific Islander** | **Other** | **Two or More** |
| 2000 | 7,708 | 94% | 1% | 2% | 0% | 2% | 0% | 0% | 1% |
| 2010 | 10,397 | 92% | 1% | 3% | 0% | 3% | 0% | 0% | 1% |
| 2019 | 15,807 | 87% | 1% | 4% | 2% | 5% | 0% | 1% | 1% |

**Recent Land Cover Changes in Neighborhood AA9 (Phoenix, AZ)**

*Increased Xeric Landscaping and Wild Vegetation*




| Land Cover | 2010 | 2015 | Change |
|---|---|---|---|
| **Soil** | 71% | 79% | +8% |
| **Tree and Shrub** | 18% | 11% | -7% |
| **Building** | 3% | 4% | +1% |
| **Asphalt** | 4% | 3% | -1% |
| **Grass** | 4% | 2% | -2% |
| **Agriculture** | 0% | 0% | 0% |
| **Water** | 0% | 0% | 0% |

Total area: 34.33 sq miles

Neighborhood AA9 is made up of open space with the McDowell Sonoran Preserve in the eastern portion, as well as commercial and residential areas to the west. This neighborhood mostly consists of the soil land classification, which grew from 71% to 79%, largely replacing trees, shrubs, and grass. Trees and shrubs decreased most significantly from 18% to 11%, while grass decreased from 4% to 2%. Buildings in the southern portion of the neighborhood grew slightly from 3% to 4%, and asphalt decreased from 4% to 3%.

# Conclusion

This report details the goals, sampling design, and content of the fifth Phoenix Area Social Survey conducted in 2021. With the overall aim of increasing knowledge about human-environment interactions in the context of the urban ecosystem of metropolitan Phoenix, Arizona, the survey—focused on sampling residents throughout the region—addresses several issues including:

- perceived quality of life and satisfaction with environmental attributes in diverse neighborhoods across the region
- personal identification with the desert and geographical areas ranging from local neighborhoods to the region as a whole (i.e., the Valley of the Sun)
- perceptions and attitudes about birds and other wildlife as well as a variety of ecosystem services and disservices
- perceptions of various environmental risks including heat stress and flooding, along with household practices associated with their migration
- landscaping choices, yard-management practices, and changes made to housing and parcels that affect assorted social and environmental outcomes
- broad-based environmental, political, and broader values, length of residency, and other social and demographic variables

While the 2017 report focused on integrated social-ecological analyses of survey and environmental datasets in order to understand human-environment dynamics, this 2021 report builds upon that the previous one by emphasizing the potential to undertake longitudinal analyses of the PASS datasets, particularly between 2017 and 2021 time periods. Since we have 235 houses and 138 indviduals who participated in both the 2017 and 2021 surveys, the sample sizes are substantial enough for paired statistical comparisons.

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## **Appendices:** *Descriptive Statistics for PASS 2017 Variables*

**Quality of Life in the Valley by Neighborhood:**
**Currently (based on 2017 survey) and Expected in 10yrs**

Note the neighborhoods are ordered from lowest to highest household income levels.

| QoL in Valley by Neighborhood | | Mean | Std. Deviation | Std. Error | Minimum | Maximum | N |
|---|---|---|---|---|---|---|---|
| 711 | Currently | 3.23 | .69 | .15 | 2 | 5 | 22 |
| | In 10yrs | 3.23 | 1.02 | .22 | 1 | 5 | 22 |
| U18 | Currently | 3.24 | .86 | .15 | 1 | 5 | 34 |
| | In 10yrs | 2.94 | 1.20 | .21 | 1 | 5 | 34 |
| R18 | Currently | 3.36 | .56 | .11 | 3 | 5 | 28 |
| | In 10yrs | 3.36 | 1.10 | .21 | 1 | 5 | 28 |
| TRS | Currently | 3.14 | .79 | .15 | 1 | 5 | 29 |
| | In 10yrs | 3.10 | 1.05 | .19 | 1 | 5 | 29 |
| Q15 | Currently | 3.42 | .72 | .12 | 1 | 5 | 38 |
| | In 10yrs | 3.45 | 1.27 | .21 | 1 | 5 | 38 |
| X17 | Currently | 3.42 | .64 | .10 | 2 | 5 | 38 |
| | In 10yrs | 3.18 | 1.19 | .19 | 1 | 5 | 39 |
| V14 | Currently | 3.64 | .66 | .09 | 2 | 5 | 50 |
| | In 10yrs | 3.26 | 1.28 | .18 | 1 | 5 | 50 |
| PWR | Currently | 3.82 | .68 | .09 | 1 | 5 | 60 |
| | In 10yrs | 3.22 | 1.25 | .16 | 1 | 5 | 59 |
| IBW | Currently | 3.61 | .60 | .10 | 2 | 5 | 36 |
| | In 10yrs | 3.11 | 1.28 | .22 | 1 | 5 | 35 |
| U21 | Currently | 3.75 | .58 | .08 | 3 | 5 | 56 |
| | In 10yrs | 3.13 | 1.27 | .17 | 1 | 5 | 56 |
| W15 | Currently | 3.75 | .69 | .09 | 2 | 5 | 56 |
| | In 10yrs | 3.18 | 1.27 | .17 | 1 | 5 | 56 |
| AA9 | Currently | 4.04 | .73 | .11 | 3 | 5 | 46 |
| | In 10yrs | 3.43 | 1.22 | .18 | 1 | 5 | 46 |
| Total | Currently | 3.60 | .72 | .03 | 1 | 5 | 493 |
| | In 10yrs | 3.22 | 1.21 | .06 | 1 | 5 | 492 |

**Residents' Satisfaction with Local Vegetation in their Neighborhood**

| Individual Variables | Mean | Std. Deviation | Std. Error | Minimum | Maximum | N |
|---|---|---|---|---|---|---|
| The amount of trees | 3.46 | 1.29 | .058 | 1 | 5 | 495 |
| Trees that shade | 3.18 | 1.33 | .060 | 1 | 5 | 489 |
| Flowering plants | 3.62 | 1.19 | .053 | 1 | 5 | 493 |
| Desert plants | 3.84 | 1.08 | .049 | 1 | 5 | 493 |

**Residents' Satisfaction with Parks in their Neighborhood**

| Individual Variables | Mean | Std. Deviation | Std. Error | Minimum | Maximum | N |
|---|---|---|---|---|---|---|
| The amount of *neighborhood* parks and open spaces | 3.66 | 1.26 | .057 | 1 | 5 | 493 |
| The amount of *desert* parks and preserves | 3.53 | 1.11 | .050 | 1 | 5 | 491 |

The variables in each of the tables above were combined to create a composite index that represents individuals' average response to the four variables (for satisfaction with vegetation; at top) and the two variables (for satisfaction with parks; at bottom). See the next page for the descriptive statistics for each composite scale by neighborhood.

**Residents' Satisfaction with Local Environmental Features by Neighborhood**
Note the neighborhoods are ordered from lowest to highest household income levels.

| Satisfaction by Neighborhood | | Mean | Std. Deviation | Std. Error | Minimum | Maximum | N |
|---|---|---|---|---|---|---|---|
| **711** | Parks | 3.09 | 1.07 | .23 | 1.00 | 5.00 | 22 |
| | Vegetation | 2.50 | 1.12 | .24 | 1.00 | 4.75 | 21 |
| **U18** | Parks | 2.85 | 1.10 | .19 | 1.00 | 4.50 | 34 |
| | Vegetation | 2.69 | 1.10 | .19 | 1.00 | 4.25 | 34 |
| **R18** | Parks | 3.29 | 1.00 | .19 | 1.50 | 5.00 | 28 |
| | Vegetation | 3.01 | .97 | .18 | 1.50 | 4.75 | 28 |
| **TRS** | Parks | 2.67 | .99 | .18 | 1.00 | 5.00 | 29 |
| | Vegetation | 2.92 | 1.05 | .19 | 1.00 | 5.00 | 29 |
| **Q15** | Parks | 3.36 | 1.03 | .17 | 1.00 | 5.00 | 39 |
| | Vegetation | 3.29 | .91 | .15 | 1.00 | 5.00 | 39 |
| **X17** | Parks | 3.55 | .84 | .13 | 2.00 | 5.00 | 39 |
| | Vegetation | 3.04 | 1.02 | .16 | 1.25 | 5.00 | 39 |
| **V14** | Parks | 3.41 | .98 | .14 | 1.00 | 5.00 | 50 |
| | Vegetation | 3.41 | .94 | .13 | 1.25 | 5.00 | 50 |
| **PWR** | Parks | 3.92 | .92 | .12 | 1.50 | 5.00 | 60 |
| | Vegetation | 3.97 | .87 | .11 | 2.00 | 5.00 | 60 |
| **IBW** | Parks | 4.07 | .61 | .10 | 2.00 | 5.00 | 37 |
| | Vegetation | 3.91 | .83 | .14 | 2.00 | 5.00 | 37 |
| **U21** | Parks | 4.04 | .89 | .12 | 1.00 | 5.00 | 56 |
| | Vegetation | 3.90 | .76 | .10 | 2.00 | 5.00 | 56 |
| **W15** | Parks | 3.71 | 1.02 | .14 | 1.00 | 5.00 | 56 |
| | Vegetation | 4.06 | .76 | .10 | 1.50 | 5.00 | 56 |
| **AA9** | Parks | 4.03 | .91 | .14 | 1.00 | 5.00 | 45 |
| | Vegetation | 4.05 | .74 | .11 | 2.25 | 5.00 | 45 |
| **Total** | Parks | 3.59 | 1.03 | .05 | 1.00 | 5.00 | 495 |
| | Vegetation | 3.52 | 1.02 | .05 | 1.00 | 5.00 | 494 |

**Neighborhood Identification (Place Attachment)**

| Individual Variables | Mean | Std. Deviation | Std. Error | Minimum | Maximum | N |
|---|---|---|---|---|---|---|
| I feel my neighborhood is a part of me. | 3.60 | 1.17 | .053 | 1 | 5 | 492 |
| My neighborhood is very special to me. | 3.76 | 1.13 | .051 | 1 | 5 | 493 |
| I identify strongly with my neighborhood. | 3.57 | 1.19 | .053 | 1 | 5 | 492 |
| I am very attached to my neighborhood. | 3.58 | 1.24 | .056 | 1 | 5 | 492 |
| My neighborhood means a lot to me. | 3.76 | 1.16 | .052 | 1 | 5 | 492 |

The five variables in the table above were averaged to create a composite index (statistics below) that represents individuals' identification with their neighborhood.

**Averaged Composite Scale: Local Place Attachment by Neighborhood**

Note the neighborhoods are ordered from lowest to highest household income levels.

| Neighborhoods | Mean | Std. Deviation | Std. Error | Minimum | Maximum | N |
|---|---|---|---|---|---|---|
| 711 | 3.18 | 1.12 | .23 | 1.0 | 5.0 | 21 |
| U18 | 3.66 | 1.03 | .18 | 1.0 | 5.0 | 34 |
| R18 | 3.17 | 1.34 | .25 | 1.0 | 5.0 | 28 |
| TRS | 3.00 | 1.20 | .22 | 1.0 | 5.0 | 29 |
| Q15 | 3.26 | 1.10 | .18 | 1.0 | 5.0 | 39 |
| X17 | 3.42 | 1.08 | .17 | 1.0 | 5.0 | 39 |
| V14 | 3.58 | 1.02 | .14 | 1.0 | 5.0 | 50 |
| PWR | 3.71 | .96 | .12 | 1.4 | 5.0 | 59 |
| IBW | 3.72 | 1.21 | .20 | 1.0 | 5.0 | 36 |
| U21 | 3.96 | .87 | .12 | 1.0 | 5.0 | 56 |
| W15 | 4.29 | .85 | .11 | 1.0 | 5.0 | 56 |
| AA9 | 3.96 | .95 | .14 | 1.0 | 5.0 | 46 |
| *Total* | *3.66* | *1.09* | *.05* | *1.0* | *5.0* | *493* |