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The Impact of the Via Bus System on Food Deserts

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THE IMPACT OF THE VIA BUS SYSTEM ON FOOD DESERTS

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A variety of different methods have been used to analyze food deserts. One method, Geographic Information Systems (GIS), is particularly useful when trying to better visualize the impact an issue has on a region. GIS is a method of mapping which can be used to map food deserts or other social or medical issues, which allows for a better visualization of which regions are most impacted by such issues. This study used GIS to map all grocery stores, convenience stores, farmers markets, food pantries, WIC clinics, and Mobile Mercados in San Antonio, Texas to determine whether they were within walking distance, defined as ≤ 0.5 miles and ≤ 1 mile, of the bus stops. This was accomplished by placing a half-mile and one-mile buffer region around each bus stop and determining which location of interest fell within the buffer. It was found that the majority of the bus stops were within walking distance of the locations of interest, 95.93% in the half-mile buffer and 97.58% in the one-mile buffer. This indicates that public transportation is likely not a factor affecting the obesity rates in San Antonio, TX, meaning that other factors such as socioeconomic status may have a larger impact.

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According to the World Health Organization, as of 2014, 39% of adults are considered overweight worldwide and 13% are considered obese (2016). The Centers for Disease Control and Prevention (CDC) defines a body mass index (BMI) of >24.9 as overweight and a BMI of 30 and greater as obese (2015). Obesity is associated with the development of chronic diseases such as diabetes, atherosclerosis, metabolic syndrome, and cancer (Ng et al., 2014). These chronic diseases are a major economic burden, not just on the individuals that have them but on the cities, states, and countries in which these individuals live. Healthcare costs for diseases associated with obesity are estimated at $147 billion annually as of 2008, this number has likely risen as obesity rates have increased (CDC, 2015).

Many factors contribute to the development of obesity and chronic disease, one of which is limited access to fruits and vegetables due to the prevalence of food deserts (Ayala, Baquera, Loraia, Ji, & Linnan, 2013). The United States Department of Agriculture (USDA) defines a food desert as having limited access to supermarkets, grocery stores, farmer's markets, and as having no grocery stores or super market within 1 mile of ones residence in urban areas and 10 miles within rural areas (USDA, 2017). This purpose of this study is to determine whether the VIA bus system has stops within walking distance of grocery stores, convenience stores, food pantries, and WIC clinics for the San Antonio population.

Background

There are many approaches to studying food deserts. Investigators have looked for a correlation between the prevalence of food deserts and one's BMI (Block & Subramanian, 2015; Chen, Jaenicke, & Volpe, 2016; Mejia, Lightstone, Basurto-Davila, Morales, & Sturm, 2015; Miller et al., 2016). Some have studied the effect of altering the available food stores within food

deserts to increase the consumption of fruits and vegetables (Ayala et al., 2013; Ortega et al., 2016). Others have examined the variety of factors that make a food desert a food desert, such as lacking personal transportation, poor public transportation design, lack of grocery stores, and prevalence of fast food restaurants (Clary, Matthews & Kestens, 2017; Drewnowski, Aggarwal, Cook, Stewart, & Moudon, 2016; Strome, Johns, Scicchitano, & Shelnutt, 2016; Williamson, McGregor-Shenton, Brumble, Wright, & Pettinger, 2017).

Correlation Between BMI and Food Deserts

Some studies have sought to establish a correlation between the prevalence of food deserts and BMI or a correlation between food deserts and food intake behaviors. Chen et al. (2016) used data from the IRi Consumer Panel and IRi Medprofiler data, which is self-reported data gathered from home-scanning devices, consisting of all purchases between 2008 and 2012 with associated self-reported data on height, weight, and answers to questions about health outcomes and health behaviors. They found a negative association with the availability of full-service restaurants and obesity and found a strong association between living in a food desert tract and being overweight and obese, although this could also be attributed to socioeconomic status. Similarly, Mejia et al. (2015) found a significant positive association between number of fast food restaurants within walking distance and obesity and a significant negative association between number of grocery stores within walking distance and obesity. Block and Subramanian (2015) did not find an association between food environment and body weight. Miller et al. (2016) conducted surveys before and after the closure of the only grocery store in the city of Alderson in West Virginia to determine whether people changed their shopping, gardening, and food preservation habits before the only grocery store in town closed and once the new Green Grocer, a chain of grocery stores, opened a few months later. They found that once the Green

Grocer opened people did not shop there and instead continued shopping at the grocery store 11 miles away because it was cheaper. They also did not increase their consumption of fast food or increase their use of community gardens and food preservation practices. These articles suggest that the availability of grocery stores may not be the only factor that contributes to eating habits and obesity rates.

Alteration of Available Stores

Many studies implemented an intervention on stores in food deserts to increase the consumption of fruits and vegetables, which they believe will ultimately effect BMI, although impact on BMI was not an outcome that was measured in the studies. Ortega et al. (2016) studied the effect of altered layout and availability of fruits and vegetables at three corner stores to increase consumption of fruits and vegetables, as well as improving the image of corner stores. They succeeded in improving the image of corner stores as a viable option for buying groceries but had no significant effect on the purchase and consumption of fruits and vegetables.

Ayala et al. (2013) took their method a step farther by not only altering the layout of the stores but also providing training for the employees and managers about marketing of fruits and vegetables and providing recipes and healthy food preparation demos of foods commonly eaten by the locals. This study succeeded in increasing consumption of fruits and vegetables. Both studies focused on Latino populations, the choice to use tiendas, small stores that sell foods native to Latin countries, rather than grocery stores in one of the studies was the belief that these stores were less daunting to new immigrants from Mexico (Ayala et al., 2013). Neither study established weight as an issue in these populations and neither addressed BMI in their demographic sections (Ayala et al., 2013; Ortega et al., 2016).

Other Factors

There are a variety of other factors and methods that researchers have examined to determine which factors contribute to food deserts. These include foodscapes, regional cost of foods, transportation factors, socioeconomic status, and the use of geographic information systems (GIS). Clary et al. (2017) sought to determine whether food access or food exposure had a greater impact on food choices. They found that while having access to healthy foods is important, exposure to healthy foods and knowing how to use and prepare them was just as important if not more so. They found that having education materials and recipes for how to prepare different items had a greater impact on fruit and vegetable intake than simply having access to the foods. Strome et al. (2016) sought to determine how different factors pertaining to access to foods affected fruit and vegetable intake. The different types of access evaluated were proximity, transportation access, and realized access. Proximity was defined as distance from one's home to the grocery store. Being within close proximity was defined as having a grocery store within walking distance which was defined as 1 mile. Transportation was defined as whether a car was available. Realized access was defined as where individuals actually shopped. They found that proximity and access to personal transportation had little effect on where individuals shopped and how many servings of fruits and vegetables they ate. This study suggested that having one's own transportation and being close to a grocery store had little effect on where someone chose to shop or whether they consumed fruits and vegetables. Drewnowski et al. (2016) used property values as a measure of socioeconomic status combined with results from a food frequency questionnaire to determine whether socioeconomic status affected fruit and vegetable consumption. They determined that lower socioeconomic status was associated with lower consumption of fruits and vegetables. Another Study by Drewnowski et al. (2012)

used a combination of GIS and surveys to determine whether proximity or local supermarket prices had a larger impact on obesity. They found that lower socioeconomic status was associated with higher rates of obesity and that lower socioeconomic status was also linked to lower education. In terms of proximity to grocery stores, they found that only 1 in 7 participants shopped at the nearest store and that those that shopped at more expensive stores had a 9% obesity rate whereas those that shopped at a low-price grocery store had a 27% obesity rate. They concluded that price had a higher impact on where the participants chose to shop than proximity.

Williamson et al. (2017) used GIS and a healthy food basket survey to determine the impact of food deserts on healthy food cost. They did this by mapping out all the grocery stores in the Plymouth region of UK and did a healthy food basket survey of these stores to determine what it would cost to eat healthily. A healthy food basket survey is a survey in which a standard list of healthy foods is established and each store is evaluated to determine how many of these foods they provide and at what price. They found that there were more stores in areas with lower socioeconomic status and food costs were found to be roughly the same in areas of low and high socioeconomic status. However, availability of healthy foods was lower in the areas of lower socioeconomic status. Also, those in areas of lower socioeconomic status were less likely to have a car which would increase the burden when grocery shopping. GIS proved to be very useful in illustrating their findings and making them clearer.

Using GIS to evaluate social and medical issues is a growing field and can be beneficial for changing nutrition policies as this method provides a compelling visual that most can understand. Williamson et al. (2017) suggested that lack of personal transportation may be a barrier to grocery shopping, those that lack personal transportation would likely rely upon public

transportation, this study will use GIS to evaluate the VIA bus routes in San Antonio and determine whether they are within walking distance, defined as ≤ 0.5 miles and ≤ 1 mile, of places one would buy food to determine whether the bus system helps to alleviate the barrier that is lacking one's own personal transportation.

Methods

Design

This is a descriptive study assessing whether the existing VIA bus routes are within walking distance, walking distance is defined as ≤ 0.5 miles and ≤ 1 mile, for those trying to reach grocery stores, convenience stores, food pantries, farmers markets, Mobile Mercados, and WIC clinics as defined by there being a bus stop within walking distance of these locations.

Although the USDA defines walking distance as ≤ 1 mile they also used ≤ 0.5 miles in their analysis when they created their Food Access Research Atlas (2017) because 2 miles round trip may not be feasible for all, walking distance will be analyzed at both distances to determine whether bus stops are within walking distance for those that may have difficulty walking 2 miles round trip.

Research Question

Are the existing VIA bus routes within walking distance for consumers traveling to grocery stores, convenience stores, farmers markets, Mobile Mercados, WIC clinics, and food pantries?

Data

The geographic locations of VIA bus routes were obtained from the VIA GIS department and are updated every 3 months. Addresses for WIC Clinics were gathered from the State WIC webpage (Texas Health and Human Services, 2018). Addresses for grocery stores and

convenience stores were obtained from the city of San Antonio food inspections webpage (City of San Antonio, 2018) which is a complete list of all businesses licensed within the city to sell food. Grocery stores were defined as any store that sells a wide variety of foods not just "junk" foods such as chips and other snack foods. Based on this definition, stores such as Dollar Tree and Dollar General are also included in the grocery stores data set. Food pantry addresses were obtained from a combination of the San Antonio Food Bank Partner Agency Finder (2018), the City of San Antonio food inspections webpage (2018), and a Google search of food pantries. Google search results were verified by a combination of visiting the site's webpage and calling the locations to ensure they had a food pantry in operation. Mobile Mercado addresses were obtained from the San Antonio Food Bank Mobile Mercado webpage (2018); this is a program developed by the San Antonio Food Bank where a food truck that sells fresh fruits and vegetables and some readymade meals and snacks travels to areas that have limited access to healthy foods. The addresses of farmers markets were located using a combination of the San Antonio Food Bank's list of farmers markets (2018), city of San Antonio food inspections webpage (2018), and the San Antonio Certified Farmers Market webpage via the Texas Department of Agriculture (2018). The City Council Districts layer was obtained from the City of San Antonio's GIS Data page (2018), this data is updated any time changes are made to the districts, and could be added to the map without further alteration. For a table identifying where data was collected and who maintains it see Appendix A.

Procedure

Geographic locations and addresses for all VIA bus routes, WIC clinics, grocery stores, convenience stores, Mobile Mercados, farmers markets, and food pantries were mapped by ArcGIS, version 10.3.1 Student edition, as separate spatial layers. The VIA bus stops were

obtained in the form of a shapefile and could be added to the map without any further alteration, however the addresses for the grocery stores, conveniences stores, WIC clinics, farmers markets, and Mobile Mercados needed to be geocoded. This was done by creating an excel file for each type of location with separate columns for the name of the location, the address, the state, and zip codes. Each excel file was then saved as a comma delimited file (CSV). This type of file converts an excel file to a simple word file with each column separated by a comma and each row a separate line. This file type is necessary to geocode the addresses using the ArcGIS Online geocoding tool. The file is added, then the website converts them into a shapefile with points on the map for each address. These shapefiles were then exported to the desktop version of Arc GIS. Each location type was entered as a separate layer so analysis of the spatial distribution of each layer could be conducted.

The Project tool, which is used to change the coordinate system of a shapefile, was used to convert the coordinate system of the geocoded shapefiles to the same geographic coordinate system (GCS) and projection used by the VIA bus system and the City of San Antonio, the GCS is NAD83 whereas the projection is NAD83 Texas StatePlane South Central FIPS 4204 Feet, this is a planar coordinate system, which is two dimensional and uses linear units, whereas the coordinate system ArcGIS Online defaults to is a spherical coordinate system which uses angular units. A two-dimensional projection is a flat surface projection whereas a spherical projection is three-dimensional. Ensuring that all the data uses the same projection removes potential discrepancies/errors that would have resulted from not using the same coordinate system for all data.

The Buffer tool was then applied to the VIA bus stops layer with a radius of 0.5 miles for one spatial layer and 1 mile radius for a separate spatial layer to denote walking distance. The

Buffer tool creates a polygon shapefile around the point or polygon of interest and can be used to determine whether other points or polygons fall within the buffer region. The Buffer tool uses a two-dimension algorithm working in Euclidean space to create a ring around the point that is the same width regardless of coordinate system and does not account for the curvature of the earth. This is part of the reason that the coordinate system of all data is planar rather than spherical. The Select By Location tool was then used on each point layer to determine which locations of interest were within 0.5 miles and 1 miles of all VIA bus stops. This tool selects items in a layer based on their spatial relationship to a separate layer of interest and will change the color of the points on the map to make them stand out as well as identifying the number of items out of the total were selected in the attribute table. This was then used to analyze the data.

The layers for each location of interest were individually joined to the city council districts layer, using the Join tool, to determine how many of each type of location fell within each individual district using the Select By Tool as was previously done with the buffer layers.

Analysis

Descriptive statistics were generated using ArcGIS. Descriptive statistics include the number of grocery and convenience stores, WIC clinics, and food pantries, and the frequency of these locations that are within walking distance of a bus stop. This data was then used to determine whether the existing bus routes are within walking distance of the locations of interest. The City Council Districts map was used to determine whether there is a disproportionate number of each location of interest in one city council district as compared to other districts.

Results

For maps of individual locations of interest see Appendices B through I. See Appendix B for the map of all locations of interest together with the VIA bus stops. Even prior to adding the

buffer regions to the VIA bus stops it is obvious many of the locations of interest are within close proximity to the bus stops. See appendices J and K for the half-mile and one-mile buffer regions placed around each bus stop. Appendices L and M depict the locations of interest that fall within the buffer regions as well as those that do not fall within the buffer regions once the Select By Tool was used. Most of the locations of interest fall within both the half-mile and one-mile buffers. Table 1 shows the number of locations that fell within the 0.5-mile buffer around each VIA bus stop. Overall, 95.93% of the locations fell within 0.5 miles of the bus stops.

Table 1

Locations Within .5 Mile Buffer

Category	# of Locations Within Buffer	Total # of Locations	% Within Buffer
Grocery Stores	398	422	94.31%
Convenience Stores	639	660	96.82%
Food Banks/Pantries	274	285	96.14%
Farmers Markets	52	55	94.55%
Mobile Mercados	9	9	100.00%
WIC Clinics	17	17	100.00%
Total	1389	1448	95.93%

Table 2 shows the number of locations that fell within the 1-mile buffer around each VIA bus stop. Overall, 97.58% of the locations fell within the 1-mile buffer around each VIA bus stop.

Table 2

Locations Within 1 Mile Buffer

Category	# of Locations Within Buffer	Total # of Locations	% Within Buffer
Grocery Stores	408	422	96.68%
Convenience Stores	651	660	98.64%
Food Banks/Pantries	276	285	96.84%
Farmers Markets	52	55	94.55%
Mobile Mercados	17	17	100.00%
WIC Clinics	9	9	100.00%
Total	1413	1448	97.58%

However, it should be noted that grocery stores and farmers markets, places where it is most likely to find fresh produce, had the fewest number of locations within walking distance, 0.5 miles and 1 mile, of bus stops. 94.31% of grocery stores and 94.55% of farmers markets were within 0.5 miles of a bus stop as opposed to 96.82% of convenience stores. At the 1-mile buffer level 96.68% of grocery stores and 94.55% of farmers markets were within walking distance of bus stops as opposed to convenience stores where 98.64% were within walking distance. Another point to note, there are more convenience stores than grocery stores and farmers markets, there are 660 convenience stores in San Antonio but only 422 grocery stores and only 285 farmers markets which are not open daily as grocery stores and convenience stores are.

See Appendix N for the map depicting the San Antonio City Council Districts and Appendix O for the map depicting the selected locations that fall within each city council district. Table 3 shows the percentage of each location of interest that falls within each city council district.

Table 3

Percent of Each Location of Interest That Falls Within Each District

	Percent of Total						
District	Bus Stops	Grocery Stores	Convenience Stores	Food Pantries	Farmers Markets	Mobile Mercados	WIC Clinics
1	15.38%	10.43%	14.24%	16.49%	40.00%	0.00%	11.76%
2	12.23%	10.66%	12.27%	17.19%	5.45%	11.11%	17.65%
3	11.24%	10.43%	11.06%	9.12%	9.09%	0.00%	11.76%
4	7.18%	9.95%	9.85%	5.96%	1.82%	22.22%	0.00%
5	12.42%	11.14%	12.88%	20.35%	5.45%	55.56%	23.53%
6	7.18%	9.24%	10.15%	5.26%	7.27%	0.00%	5.88%
7	8.97%	9.95%	7.88%	10.18%	5.45%	11.11%	17.65%
8	6.94%	10.43%	7.12%	3.86%	5.45%	0.00%	0.00%
9	4.47%	8.06%	4.55%	1.75%	12.73%	0.00%	0.00%
10	6.89%	8.06%	9.39%	3.16%	5.45%	0.00%	5.88%

Many of the city council districts appear to have a disproportionate number of one location of interest or another. For instance, district 5 has 11.14% of the total number of grocery stores versus districts 9 and 10 which only have 8%, or district 1 having 40% of the farmers markets while district 4 only has 1.82% of the total number of farmers markets.

Discussion

The results of this study, 95.93% of the locations falling within 0.5 miles of the bus stops and 97.58% of the locations falling within the 1-mile buffer around each VIA bus stop, indicate that the VIA bus system has stops within walking distance of the locations of interest for this study because over 90% of all locations of interest are within walking distance of the bus stops. However, grocery stores and farmers markets, places where it is most likely to find fresh produce, had the fewest number of locations within walking distance, 0.5 miles and 1 mile, of bus stops. 94.31% of grocery stores and 94.55% of farmers markets were within 0.5 miles of a bus stop as opposed to 96.82% of convenience stores. At the 1-mile buffer level 96.68% of grocery stores and 94.55% of farmers markets were within walking distance of bus stops as

opposed to convenience stores where 98.64% were within walking distance. It was also found that there are more convenience stores than grocery stores and farmers markets, there are 660 convenience stores in San Antonio but only 422 grocery stores and only 55 farmers markets which are not open daily as grocery stores and convenience stores are. This easier access to convenience stores, both in proximity and in overall number of locations, may encourage the consumption of junk foods as opposed to healthier foods that can be purchased at grocery stores and farmers markets.

In addition to there being easier access to and a larger number of convenience stores it was also found that there were a disproportionate number of grocery stores, farmers markets, WIC clinics, Mobile Mercados, food pantries, and bus stops between city council district. This may be a non-issue as the data was not paired with factors such as socioeconomic status, population density, or car ownership, however it may also be a factor that needs to be addressed as this may contribute to health disparities between city council districts due to increased difficulty in accessing healthy food. This data could be useful in future city management, planning, and development, however, since this information was not paired with other information, such as income level in these districts, any analysis of this data beyond pointing out major discrepancies is pure speculation.

This study used ≤ 0.5 miles and ≤ 1 mile as the definition of walking distance. The USDA (2017) and CDC (2017) both use these distances in their analysis of food deserts and as a definition of walking distance. However, these distances do not take into account several factors. First, they do not take into account whether the sidewalks are walkable or handicap accessible. Many sidewalks in San Antonio are in poor repair and would be very difficult for an elderly person, a person with a young child, a person in a wheelchair, or a person carrying heavy

groceries to walk on for very long. For a pregnant woman, walking two miles round trip, or even one mile round trip, in the Texas heat would be very difficult and would put her at risk for developing heat stroke. One mile round trip may not be possible for many of these people. Also, the USDA and CDC's definition of walking distance does not take into account whether there is a major highway with no under/overpass for pedestrians of there are safe sidewalks at all as is often the case in the older parts of town. Also, based on Google Maps walking a half mile takes about 10 minutes and one mile takes about 20 minutes to walk. This amount of time on ones feet, not even counting how long it would take to do the grocery shopping they are on their way to do, may be impossible for the aforementioned groups of people. This distance also does not take into account how long someone had to walk in order to reach the bus stop or how many bus transfers were necessary. In reality, it might be better for walking distance to be defined as ≤ 0.25 miles.

Based on the results of this study the VIA bus system has established a more than adequate infrastructure of bus stops. It is more likely that factors such as socioeconomic status and food insecurity contribute to the obesity rates in San Antonio, not access to grocery stores via public transportation. Low socioeconomic status has been linked to obesity (Drewnowski, 2016; Grazuleviciene et al., 2017; Janssen, Pickett, Simpson, & Boyce, 2006; Manios et al., 2018). Much of central and southern San Antonio is considered low income, at or below 200% of the poverty line, as can be seen in Figure 1, based on the USDA's Food Access Research Atlas that uses census tracts to create an interactive map. Based on results from the 2016 Bexar County Community Needs Assessment Report (Health Collaborative and Grow Healthy Together, 2016) these regions of low income also have the highest obesity rates, see Figure 2. This further illustrates the link between socioeconomic status and obesity.

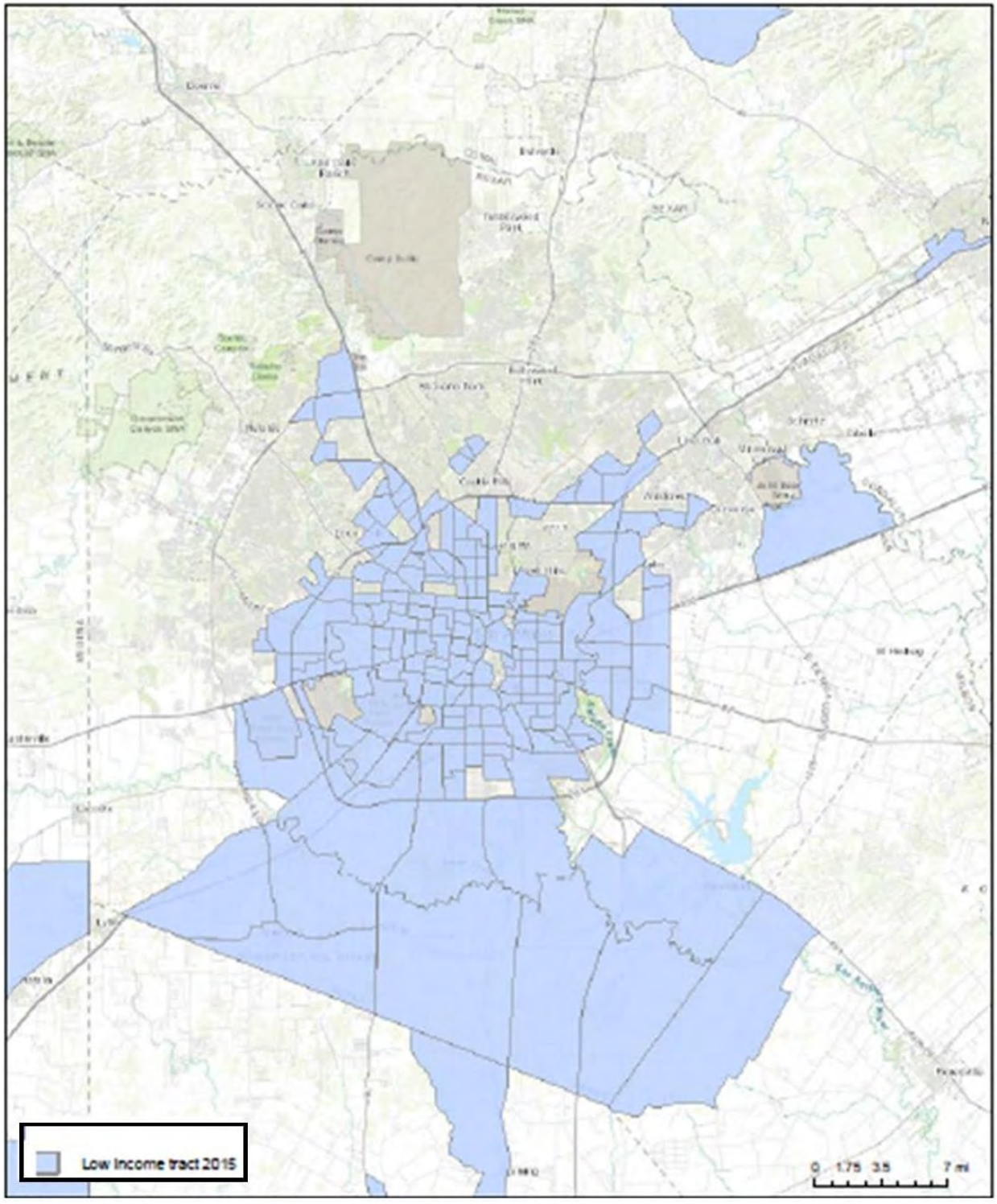

Figure 1. Census tracts at or below 200% of the poverty line in San Antonio. Courtesy of the United States Department of Agriculture.

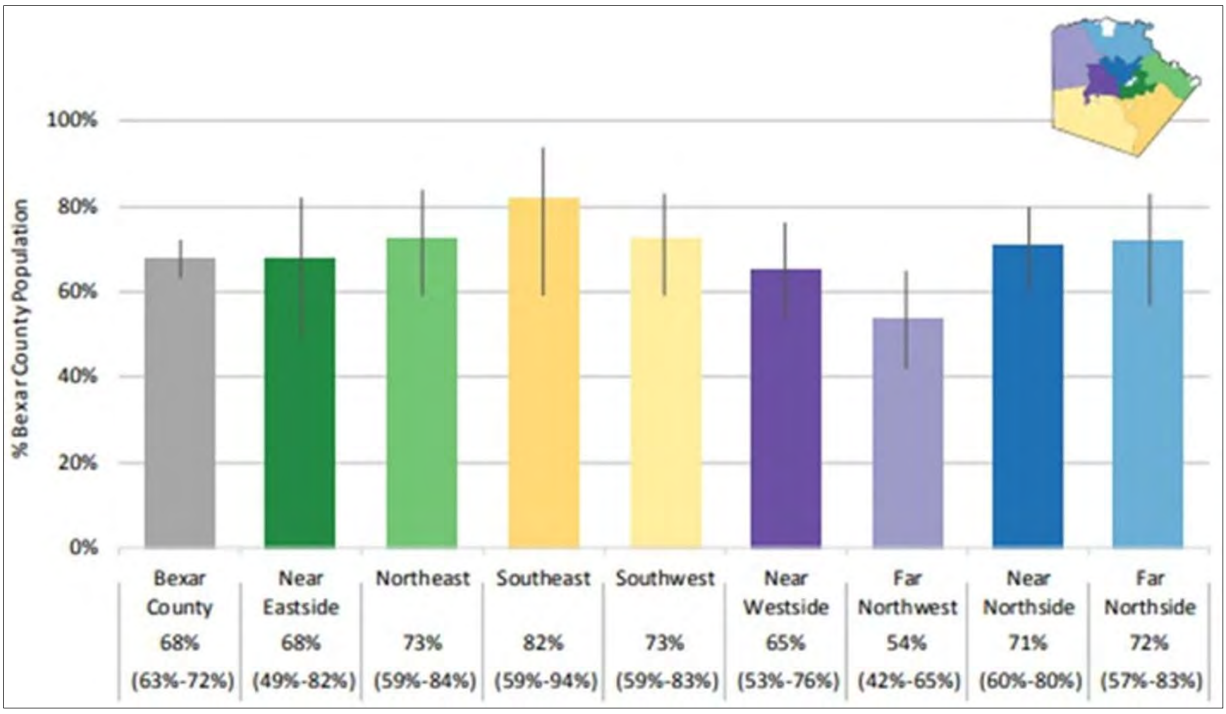

Figure 2. Obesity rates per region in Bexar County. Courtesy of the Texas Department of Health and Human Services.

Currently, the bus stops, grocery stores, convenience stores, food pantries, farmers markets, and Mobile Mercados are found in areas of higher population density but these areas are not the ones with the highest obesity rates and lowest-income levels, see Figure 3 for population density according to Health Collaborative and Grow Healthy Together's community needs assessment (2016). To help fight these obesity rates it may be beneficial to build more grocery stores and increase the number of food pantries and other assistance programs in these areas of low income and high obesity rather than relying upon population density to guide where these locations are placed. Low socioeconomic status and food insecurity, being unsure when your next meal will be or where your next meal will come from, are also closely linked due to the physiology and psychology of starvation. The prolonged stress of dealing with food insecurity, even in the absence of starvation, is linked to weight gain due to a variety of factors such as stress eating,

decreased metabolic efficiency leading to fat storage, depression which lowers activity levels and may increase food consumption, and stress on the body's organs which can lead to chronic diseases such as cardiovascular disease and diabetes (Dinour, Bergen, & Yeh, 2007; Drewnowski & Darmon, 2005; Grazuleviciene et al., 2017).

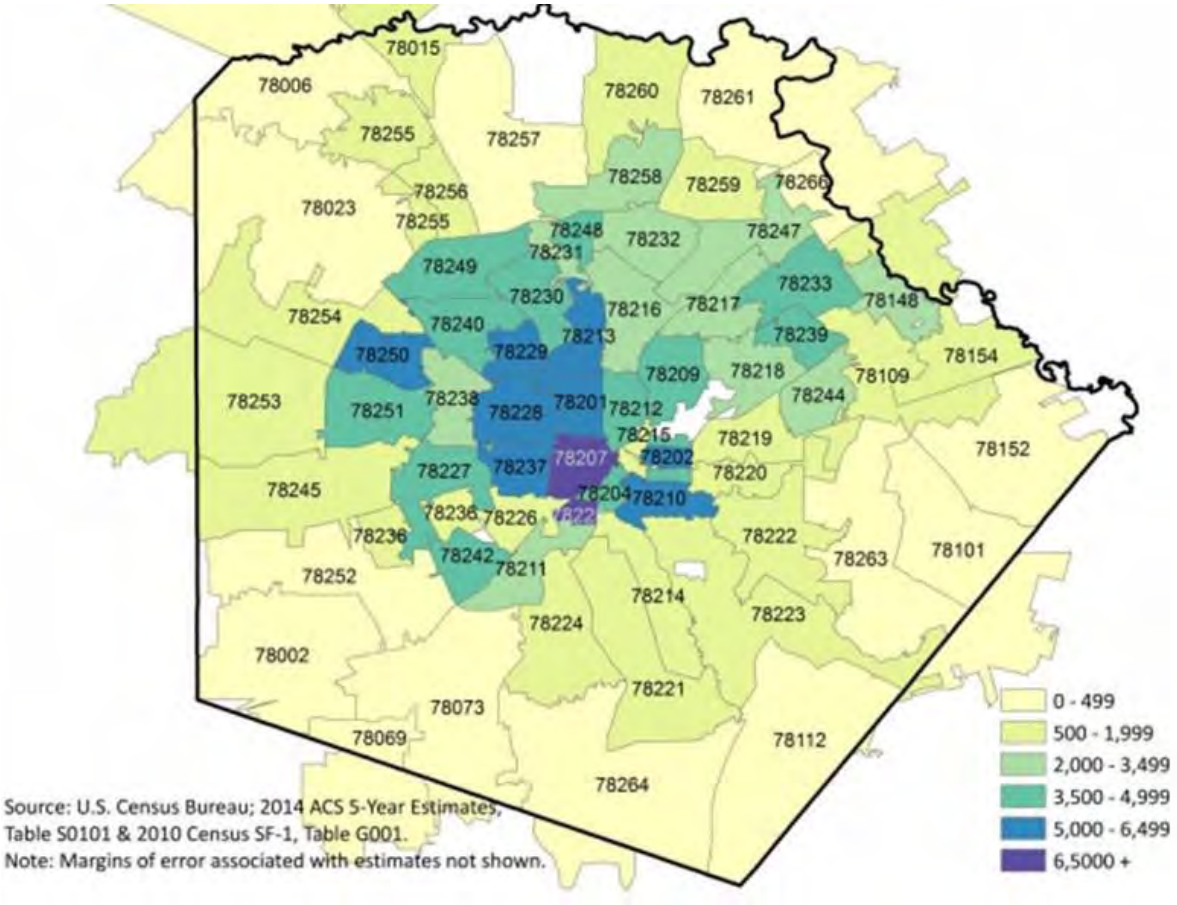

Figure 3. Population density by zip code. Courtesy of the U.S. Census Bureau.

Prolonged starvation has a lasting impact on one's eating behaviors and psychological wellbeing as was discovered by Keys et al. (1950). Even after the study was over the participants still had obsessive behaviors in regard to food and had issues with obesity and chronic disease. The same

may be possible for those that experience prolonged food insecurity although there is little research on the topic (Becker et al, 2018).

This study sets the framework for future research and city planning for the City of San Antonio. If future studies included data on the state of existing sidewalks or whether sidewalks are needed as well as data on car ownership and socioeconomic status, funding could be used to encourage stores to move to areas where they are needed, such as central and south San Antonio. Additional studies on bus placement would also be beneficial to ensure they are in the optimal locations. Due to the higher number of convenience stores, this study could also be used to encourage convenience stores to improve their selection of healthier foods as was done by Ayala et al. (2013) and Ortega et al. (2016) where, the stores that participated in the study were given coolers to sell fresh produce and in the case of Ortega et al. (2016) the stores also received training on how to market them which resulted in an increase in fresh fruit and vegetable consumption.

This study had several limitations. First, the half-mile and one-mile buffers did not account for whether the distance was truly walkable. There may have been damaged sidewalks, major highways, or no sidewalk at all, and elevated crime in the region that would prevent someone from getting to a location of interest from a bus stop. Future studies should examine whether it is possible to walk from a bus stop to a location of interest looking at whether traffic, poor sidewalk repair, or major highways are impediments to walking from a stop to a grocery stores, WIC clinic, etc. It would also be beneficial to examine whether a half-mile or one-mile distance is a feasible walking distance for everyone not just those that are healthy adults. Second, the student version of this software was used which made more complex analysis of the data, such as hot spot analysis to determine whether there were greater clusters of places of interest in

one region as opposed to another, difficult if not impossible. This was due to the student version limiting geocoding to 250 locations at a time so a layer that was geocoded by the software could only contain 250 locations and analysis such as hot spot analysis requires more locations within a layer which would have been possible if it were possible to geocode more than 250. Future studies would need to invest in the professional version to allow for this more complex type of analysis. Third, the VIA bus system updates their routes every three months meaning the results of this study are likely already out of date. It would likely be more feasible for future studies on this topic to be conducted by local government in conjunction with VIA to ensure the data is as accurate and up to date as possible. Last, this study did not account for socioeconomic status of the various regions in San Antonio. Future studies should pair this data with census tracts to further determine if regions with lower socioeconomic status are underserved both by the VIA bus system and by grocery stores, farmers markets, WIC clinics, food pantries, and Mobile Mercados.

Conclusion

Based on the results of this study, the VIA bus system has placed its stops within walking distance of most places where people would buy healthy food. However, additional more detailed research is necessary, to truly determine whether the stops are where they are needed and to determine whether there is greater need for places to buy healthy food.

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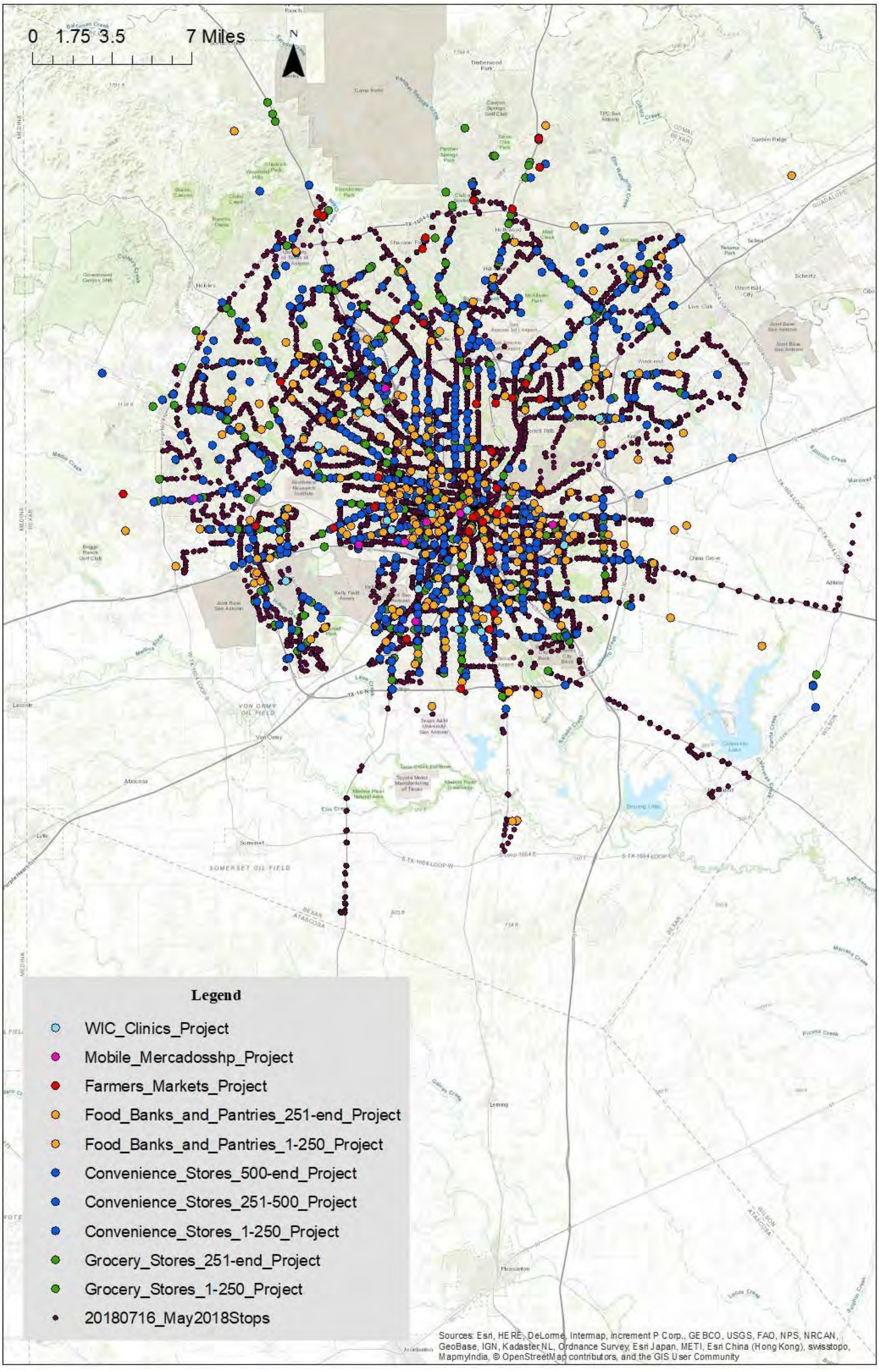
Appendix A

Spatial Data

Data Type	Obtained From	Maintained by
WIC Clinics	http://txhealth.ziplocator.com/	Texas WIC
Mobile Mercado	https://safoodbank.org/social-enterprises/mobile-mercado/	San Antonio Food Bank
Farmers Markets	https://safoodbank.org/our-programs/farmers-market-nutrition-program/	San Antonio Food Bank
	https://www.sanantonio.gov/Health/FoodLicensing/FoodEstablishmentInspections	City of San Antonio
	http://www.gotexan.org/LocateGOTEXAN/CertifiedFarmersMarkets/SanAntonio.aspx.	Texas Department of Agriculture
Food Pantries	https://safoodbank.org/partner-agencies/find-an-agency/	San Antonio Food Bank
	https://www.sanantonio.gov/Health/FoodLicensing/FoodEstablishmentInspections	City of San Antonio
	https://www.google.com/maps/search/Food+Pantries/@29.4607422,-98.5666079,15z/data=!3m1!4b1?hl=en	Google
Grocery Stores	https://www.sanantonio.gov/Health/FoodLicensing/FoodEstablishmentInspections	City of San Antonio
Convenience Stores	https://www.sanantonio.gov/Health/FoodLicensing/FoodEstablishmentInspections	City of San Antonio

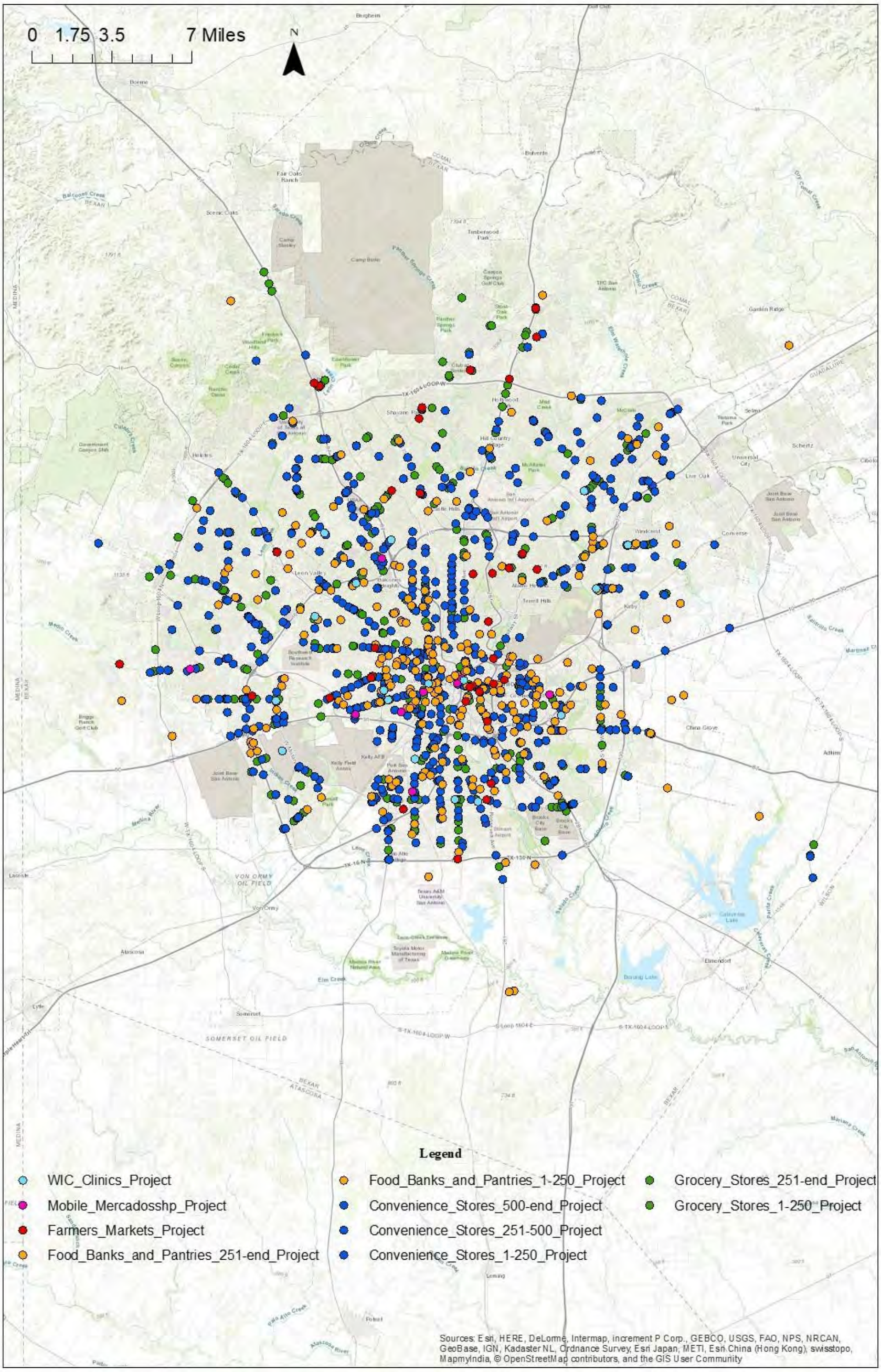
Appendix B

Maps of All Locations of Interest

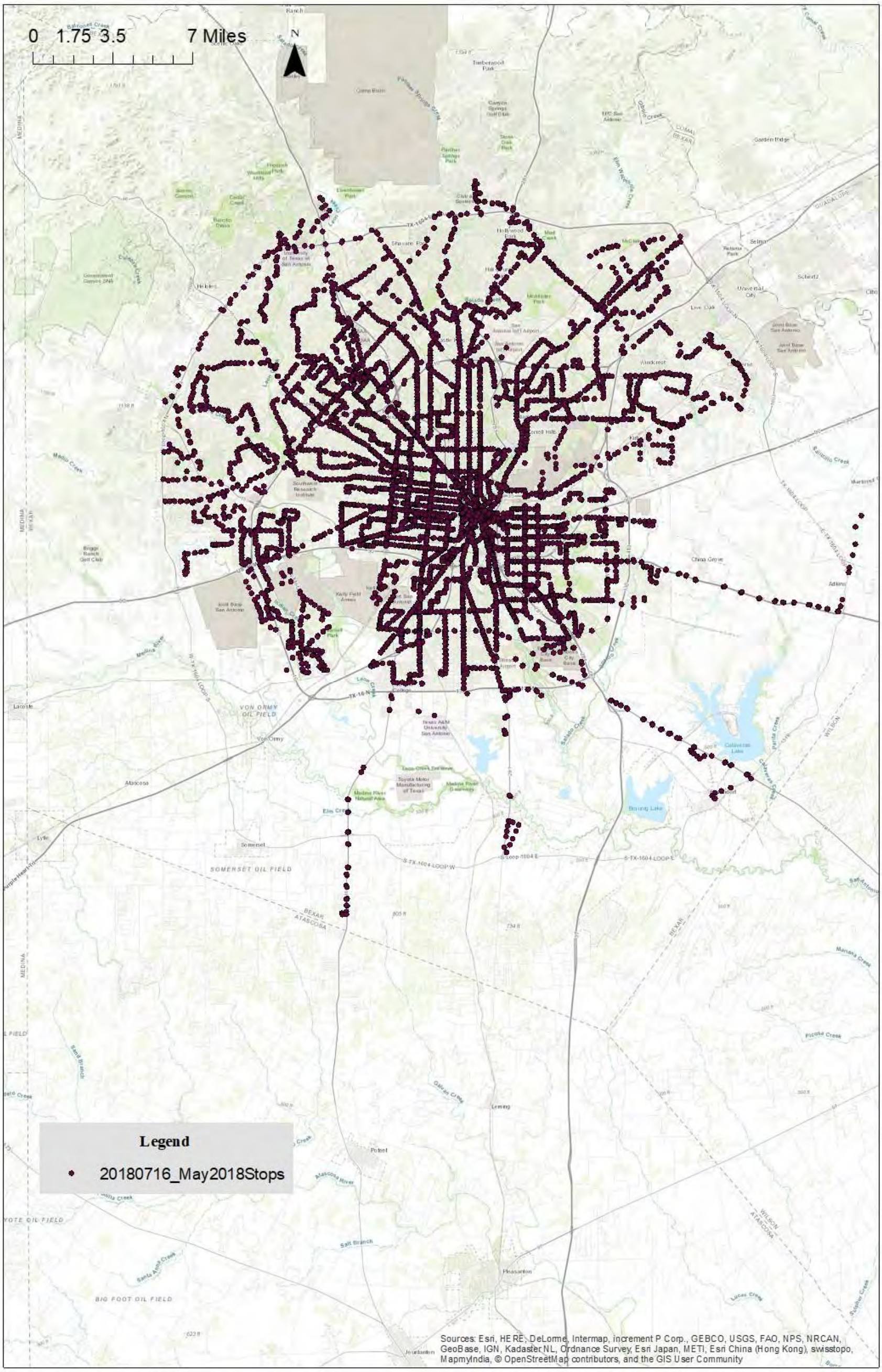


Appendix C

Maps of All Locations of Interest Without Bus Stops

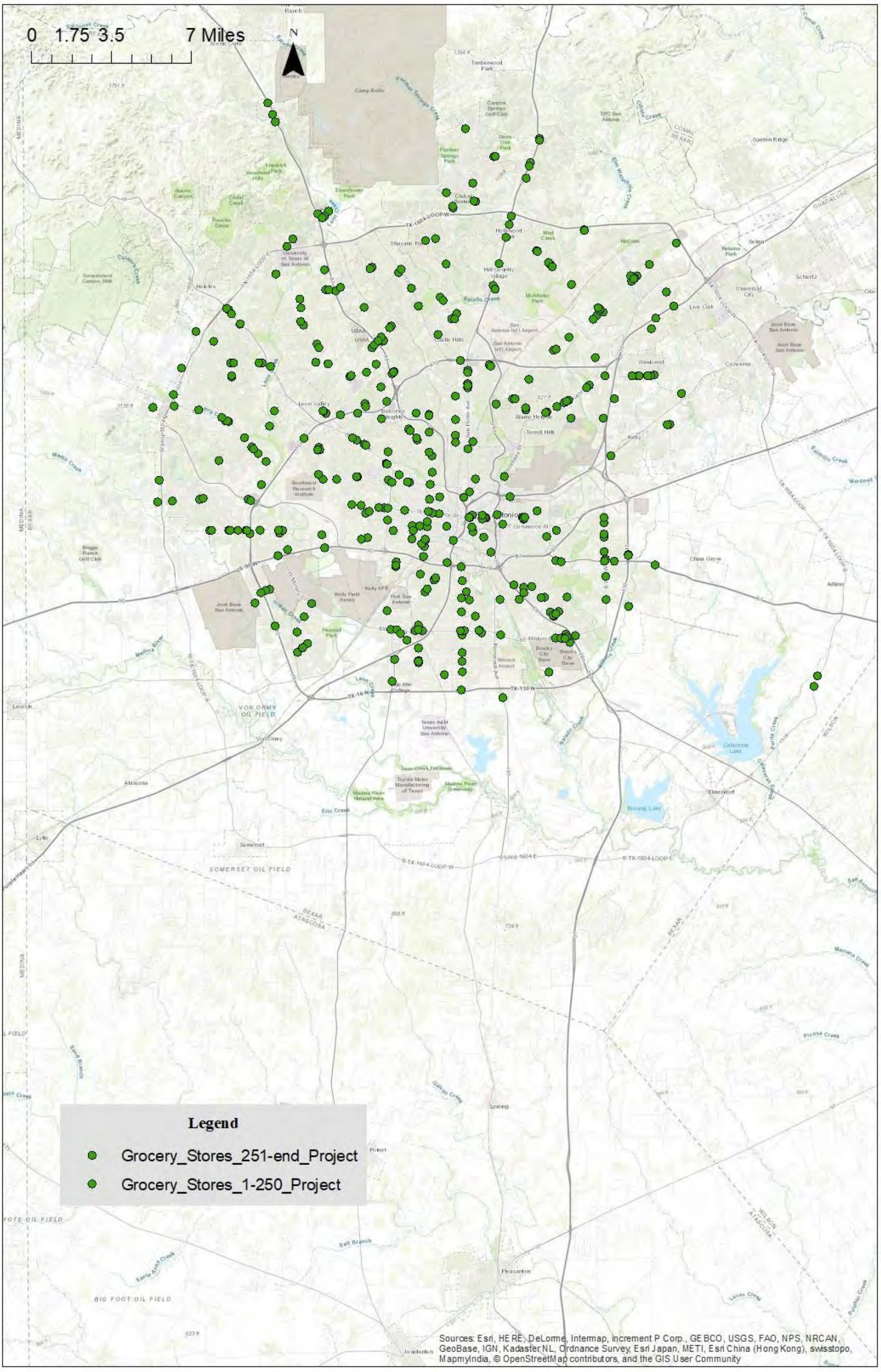


Appendix D Map of Bus Stops



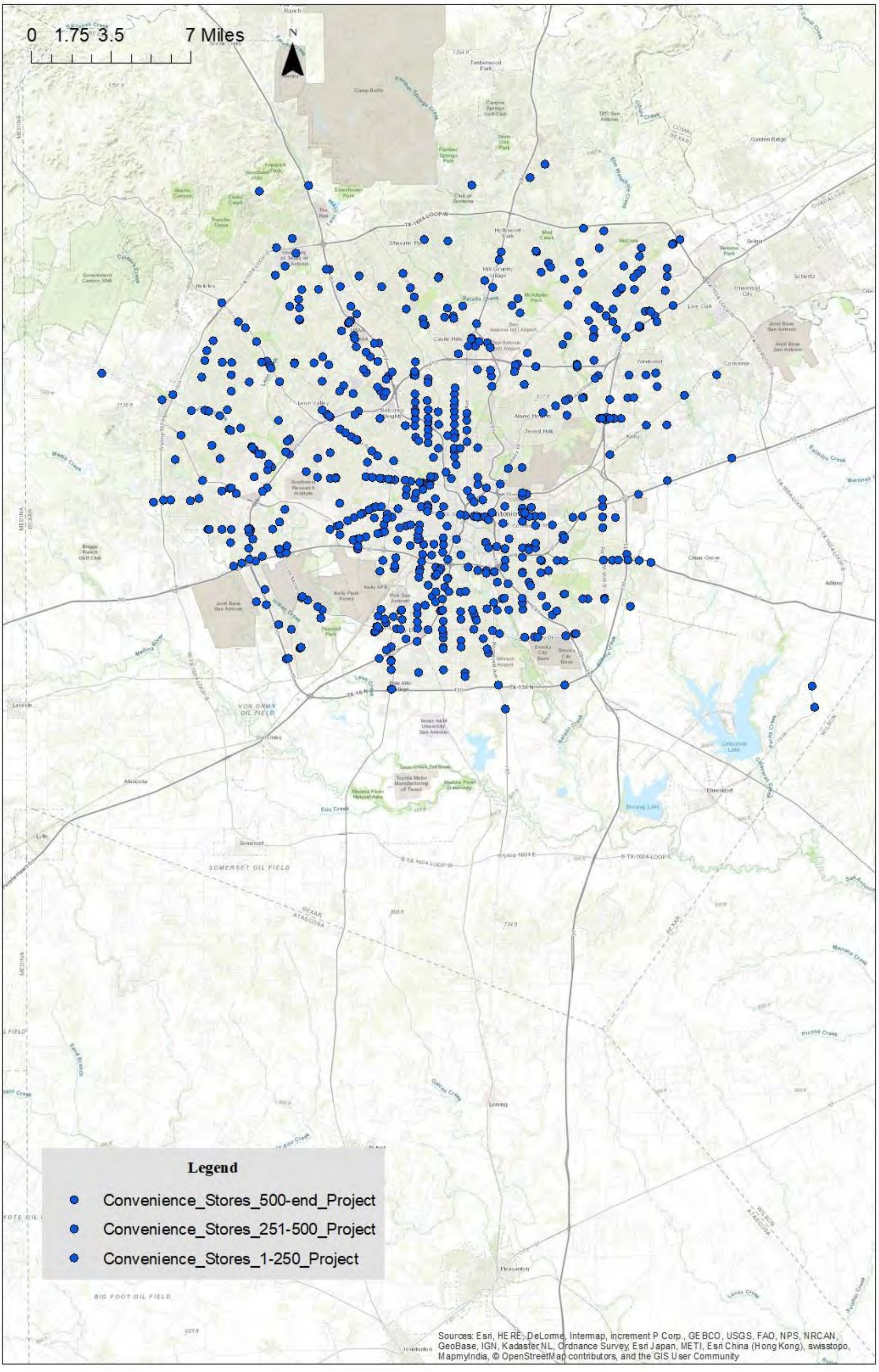
Appendix E

Map of Grocery Stores

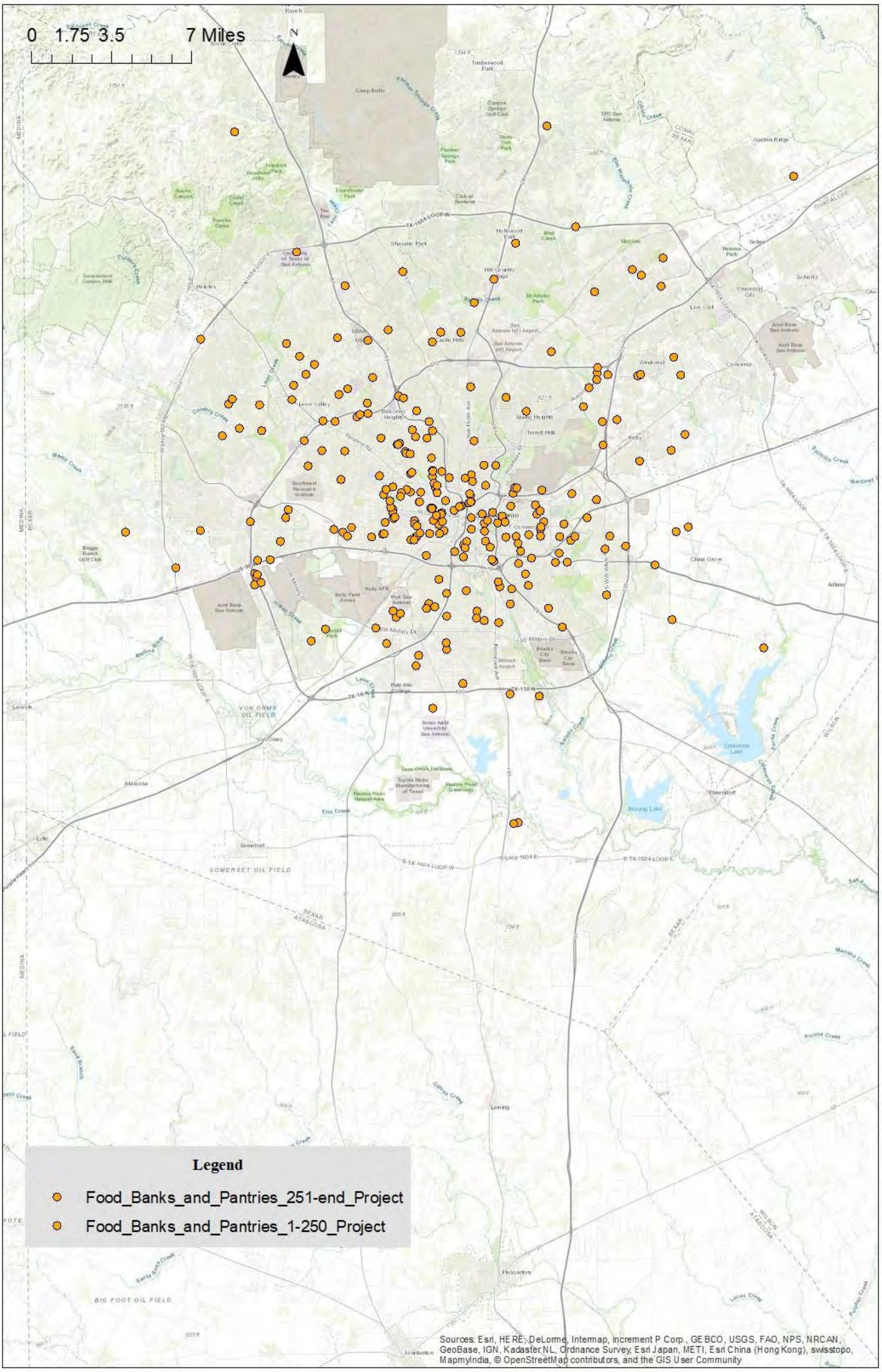


Appendix F

Map of Convenience Stores

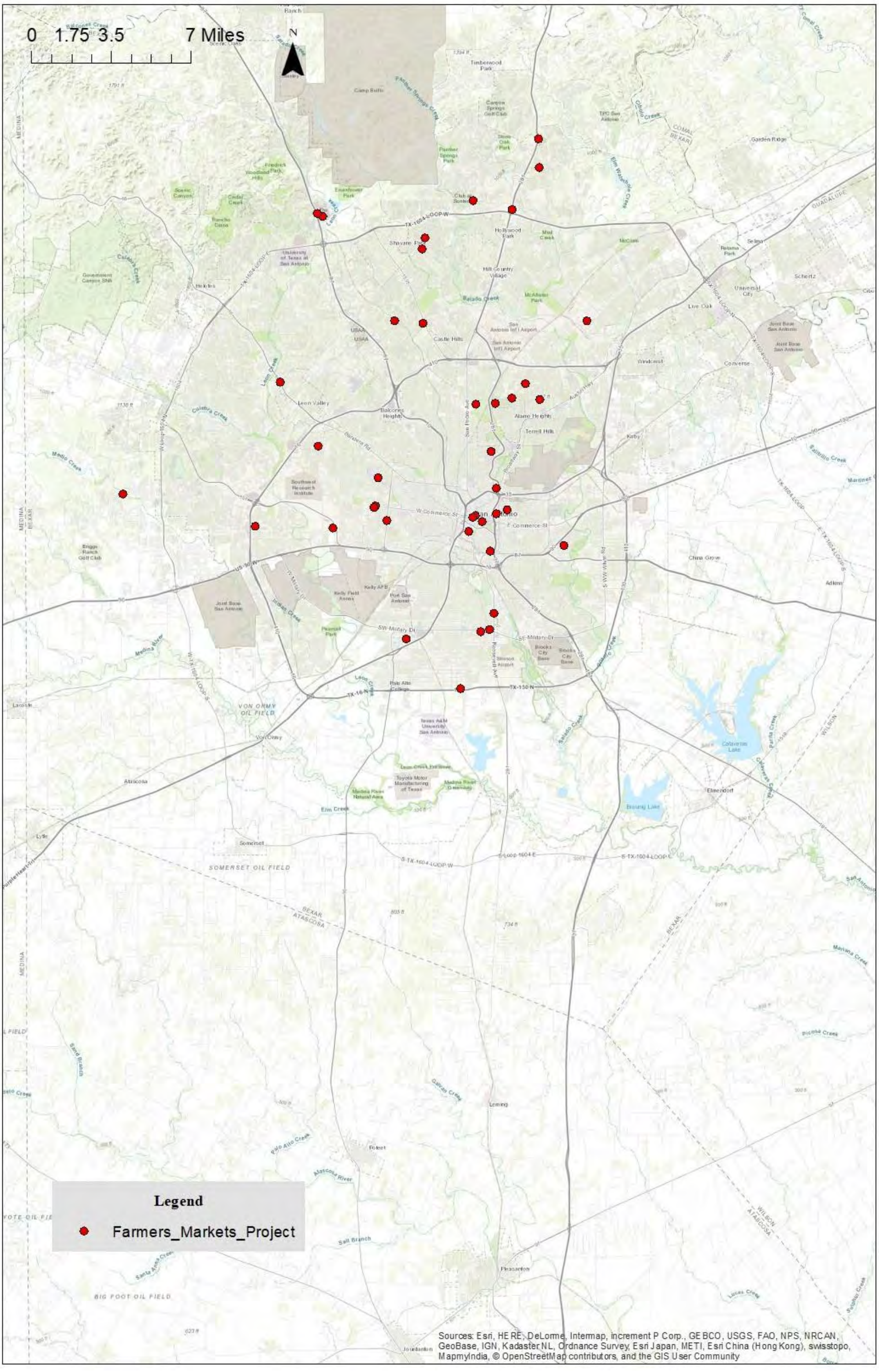


Appendix G Map of Food Pantries



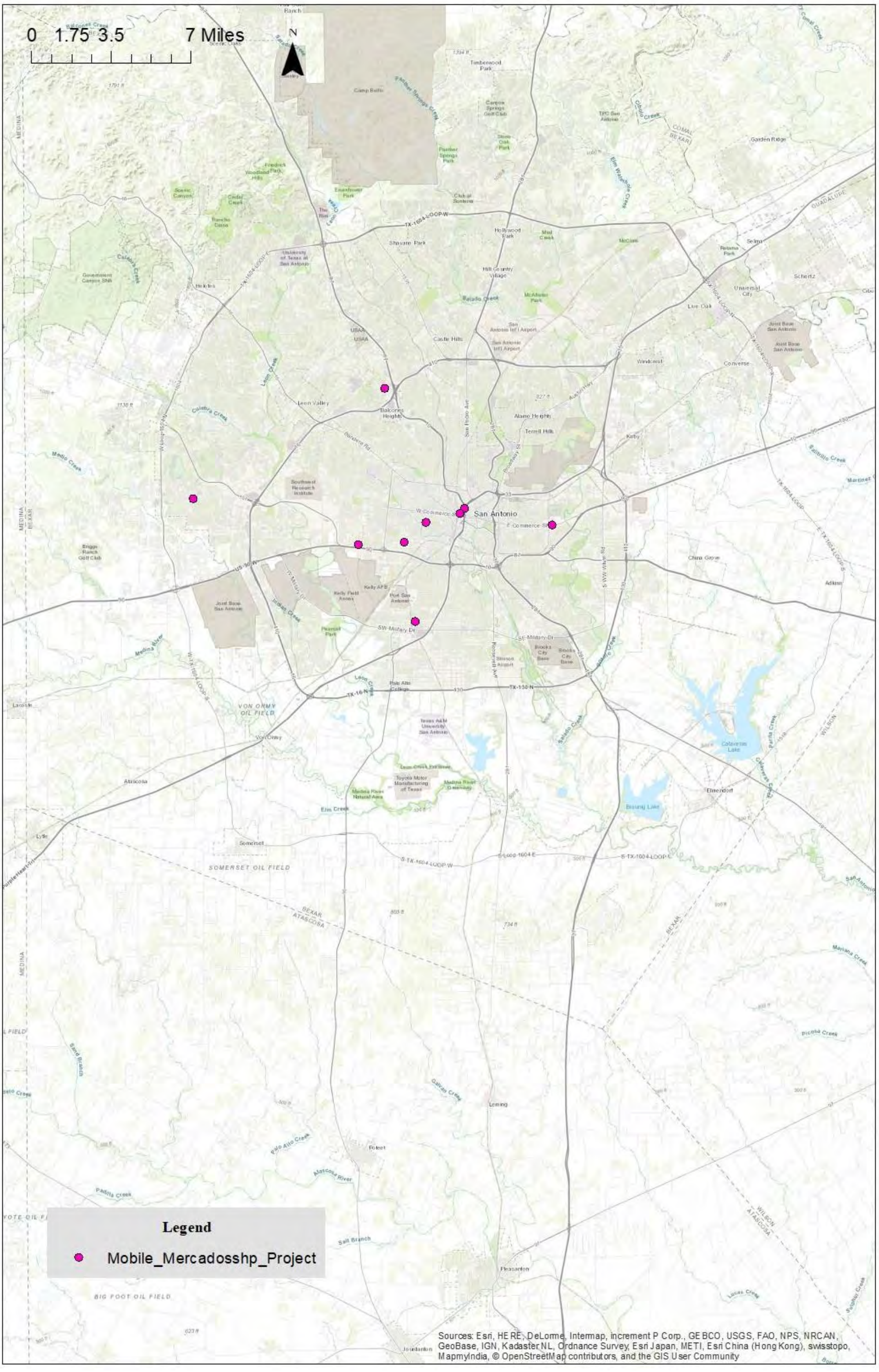
Appendix H

Map of Farmers Markets



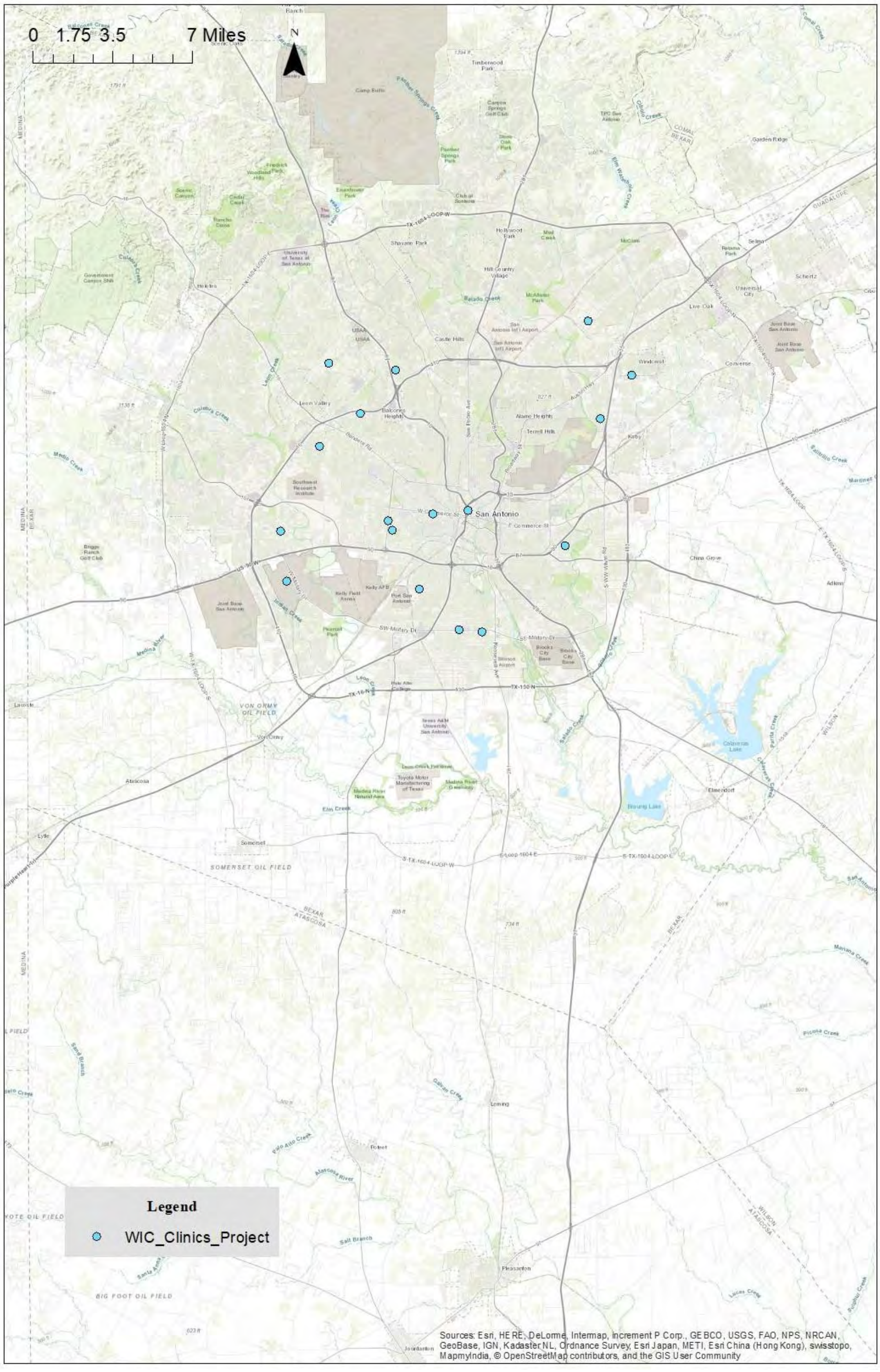
Appendix I

Map of Mobile Mercados



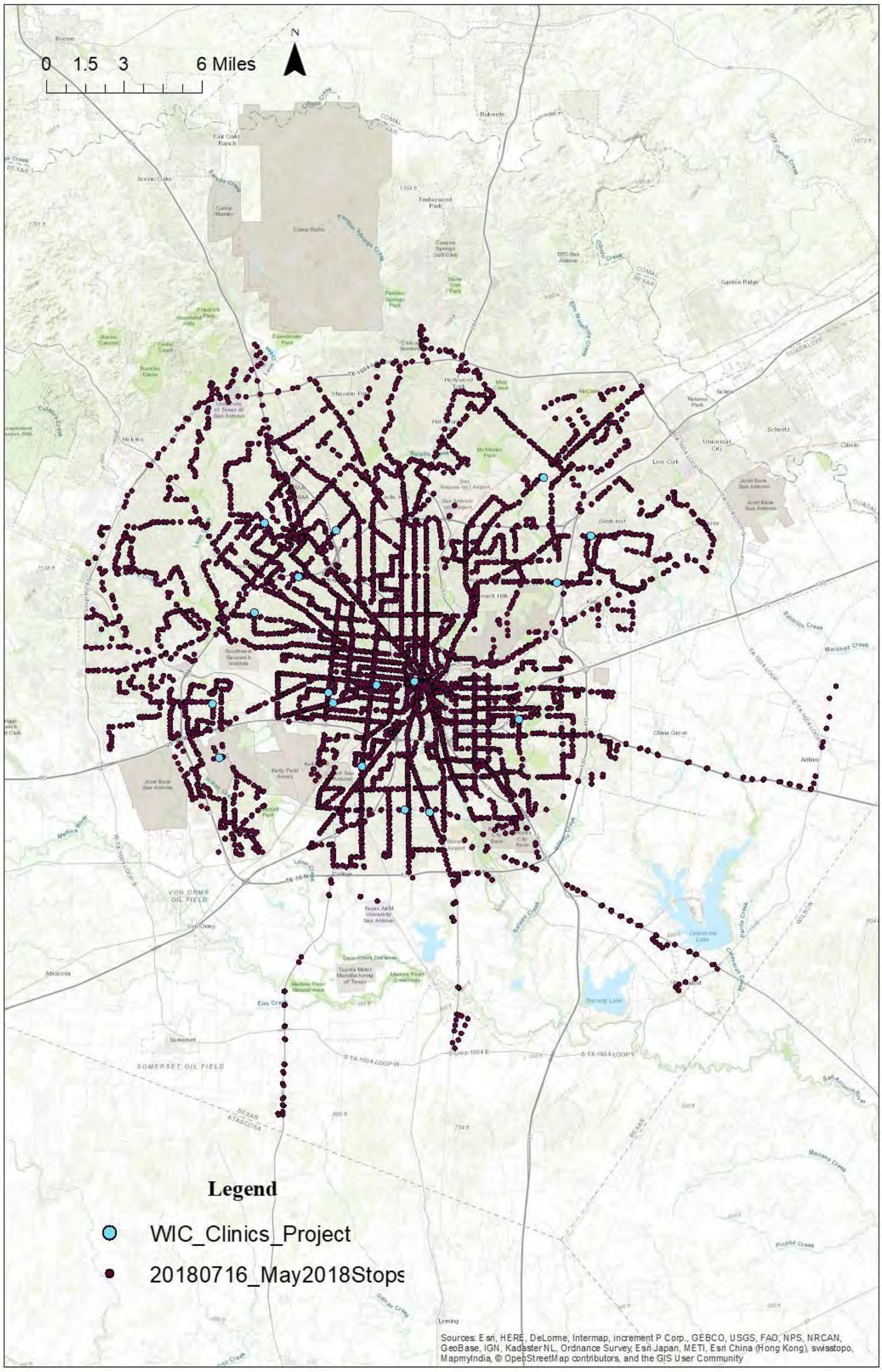
Appendix J

Map of WIC Clinics



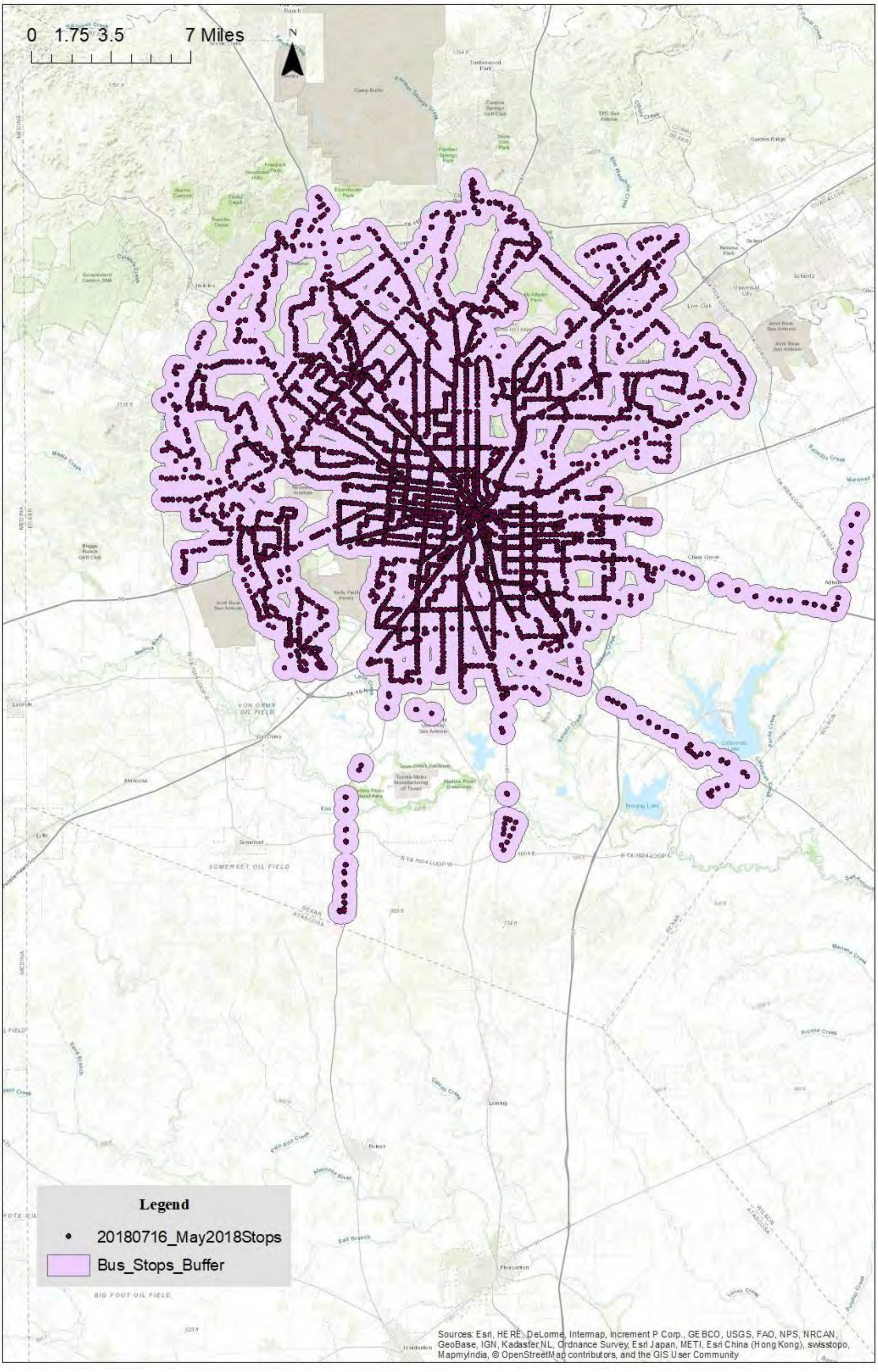
Appendix K

Map of WIC Clinics with Bus Stops



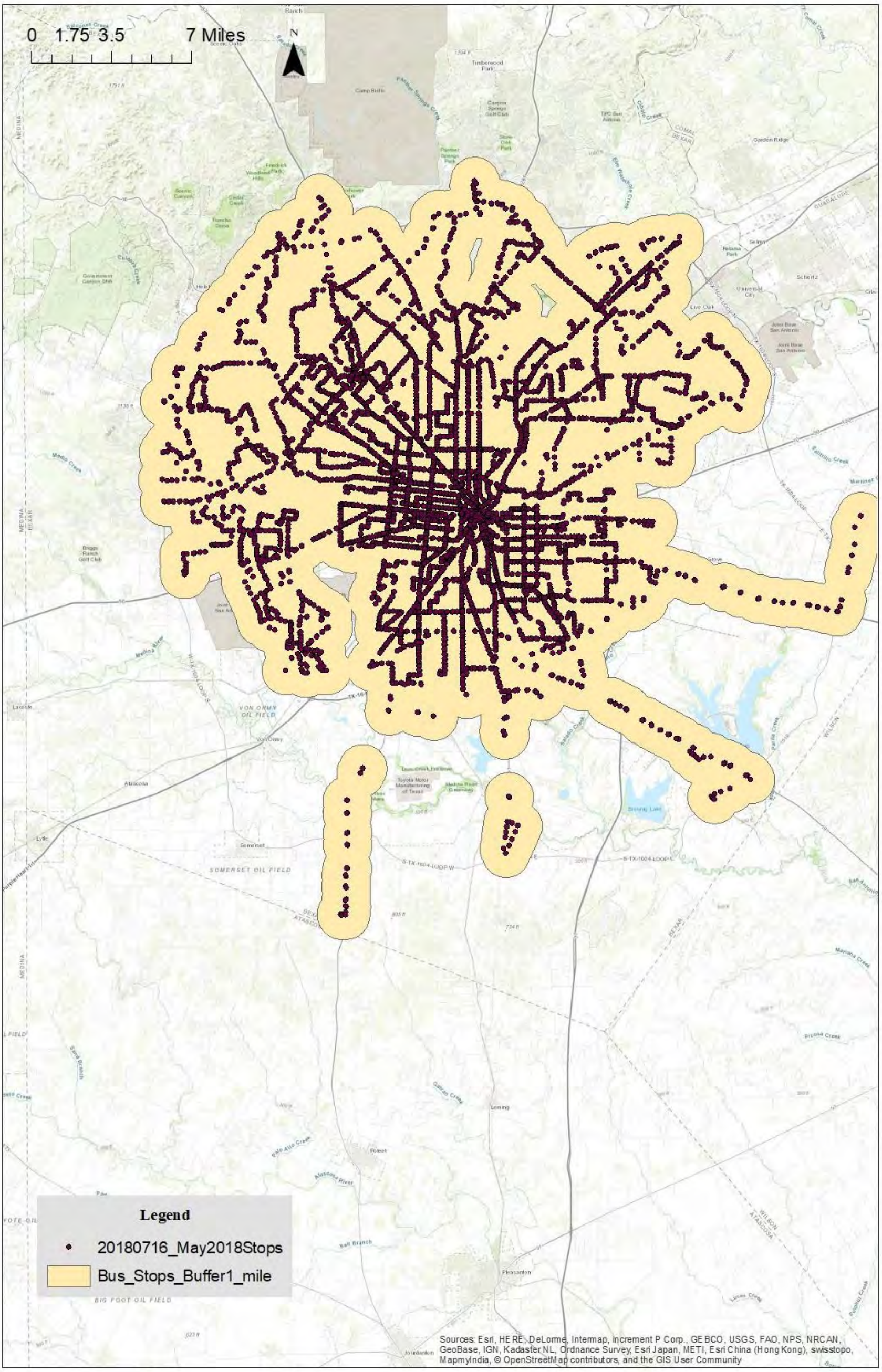
Appendix L

Map of Half-Mile Buffer Region



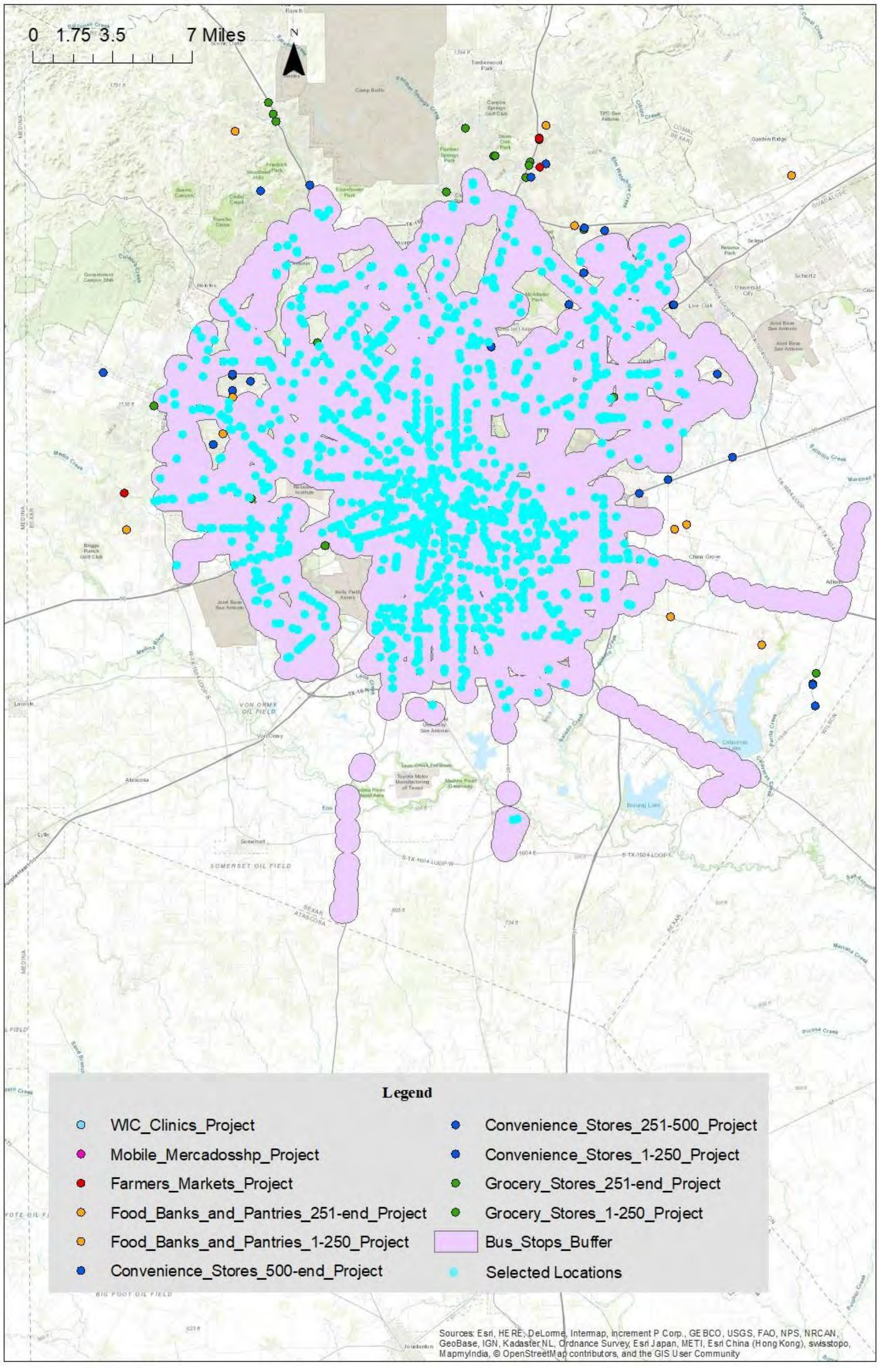
Appendix M

Map of One-Mile Buffer



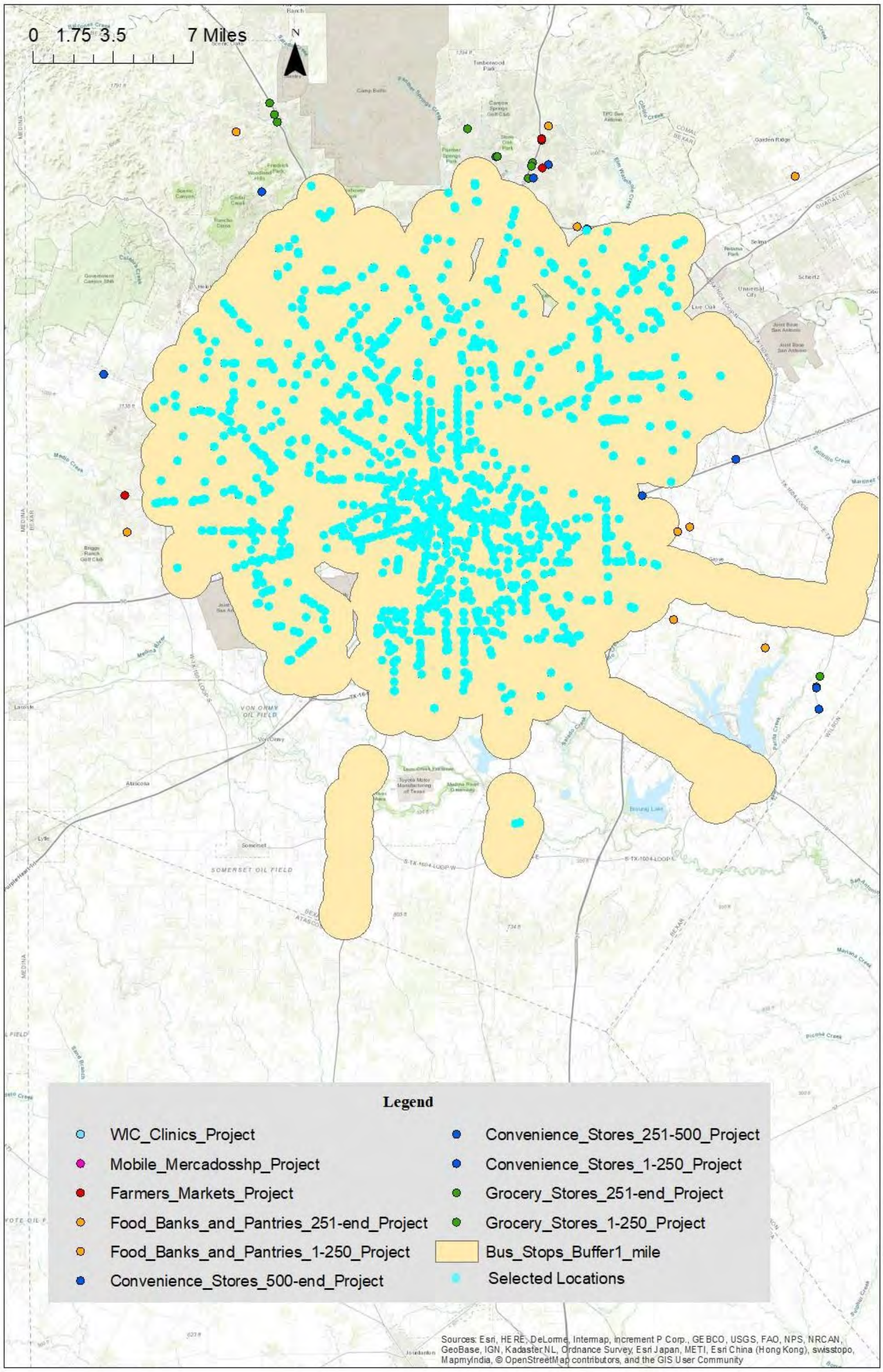
Appendix N

Map of Selected Places of Interest Half-Mile Buffer



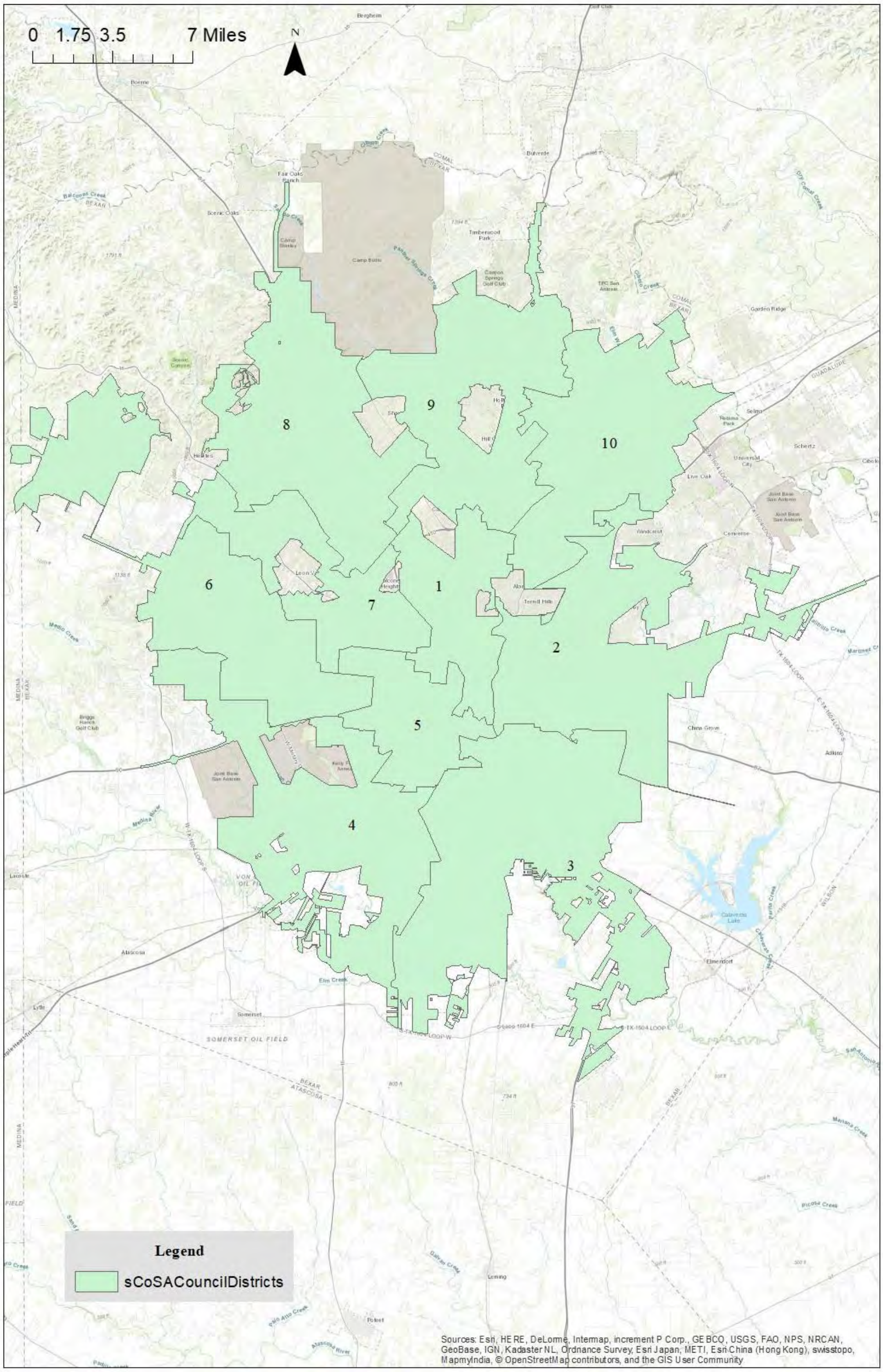
Appendix O

Map of Selected Places of Interest One-Mile Buffer



Appendix P

Map of San Antonio City Council Districts



Appendix Q

Map of Selected Locations Within Each City Council District