Lamar Avenue Corridor and Greater Memphis:

Environmental Justice

and

Historical Timeline Interactive Websites

Alexis Greenstreet, Maira Utebaliyeva, Nick Monfeli, Meg Healy

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Table of Contents

Abstract

The presence of the Memphis International Airport, the national headquarters of Federal Express, as well as dozens of factories and industrial plants has resulted in both crippling congestion and high levels of toxic emissions around Lamar Avenue in southeast Memphis. As part of a study of the livability of neighborhoods in this area, our website interactively displays the many negative factors affecting these various communities. Containing data on pollution, demographics, schools, noise maps, zoning, warehouse locations, traffic levels and congestion, low food access, employment rates, and other factors, our website provides a resource for researchers, policy-makers, and the public alike. Our paper provides additional information on the historical events leading up to the current problems found in the Greater Memphis area, as well as a background of concerns pertaining to public health and environmental justice issues. The GIS analysis of this project is summarized in an easy-to-read graphic intended for public dissemination, and our interactive historic timeline website contains further historical maps, visuals, and multimedia.

Introduction

Over the last four decades, the rapid development of the freight and cargo industries in Memphis, Tennessee has earned the city the title of North America's Distribution Center. The city serves as a shipping hub, where warehouses, freight facilities, truck terminals, and rail nodes cover the landscape, particularly in close proximity to the Memphis International Airport. The Memphis International Airport was the world's busiest cargo airport from 1993-2009, and still remains the busiest cargo airport in the United States today. This is largely attributable to the presence of the national headquarters of the Federal Express Corporation, which processes an average of 3.3 million packages every day in their facility located by the airport.

Our project focuses on neighborhoods surrounding the Lamar Avenue Corridor, as they are the direct recipient**s** of many negative effects due to the presence of these industries. In conjunction with the National Center of Freight and Infrastructure Research and Education (CFIRE) at the University of Wisconsin-Madison and the University of Memphis (funded by the US Department of Transportation), our group created interactive maps to aid in a study of livability in the five freight-centric neighborhoods found in the Lamar Avenue Corridor. While Memphis as a whole benefits from the economic activity of the industrial presence in the city, there are also significant downsides felt by those who must shoulder the environmental burden produced by these facilities.

Our interactive map focusing on Lamar corridor displays numerous data pertaining to environmental and economic factors affecting the quality of life in Memphis, while our interactive historic timeline website provides a more visual means of understanding the events that helped shape the region of interest. Finally, a graphic containing the findings of our GIS analysis can be found in Appendix F.

Methodology

Properly displaying numerous sets of data in an accurate yet easily understood manner presents various difficulties. By using visual methods and relatively simple statistical techniques to guide our data classification, however, the user should be able to easily analyze and synthesize multiple cause and effect factors that impact neighborhoods in Memphis. Creating the interactive maps, we focused on the potential user groups' characteristics and goals, spatial and domain knowledge, and the potential user's mental models of the various interactions found in the Lamar Avenue Corridor. Moreover, when creating the map we followed design guidelines that can help increase usability of the map such as having direct access to the data layers, setting a proper map to non-map information ratio, and, overall, ensuring a focus on aesthetics (Haklay, 2010, 260-261).

Combining various data layers should reveal patterns that the user can use to create meaningful hypotheses that explain various problems found in and around the Lamar Avenue corridor. As described by Richard Field, "in most cases, more than just a single influence will cause a pattern" (2010, 335) and "graphs and maps are powerful tools in that they can simultaneously allow both an instant impression of the data and the display of detail." (2010, 319). Our website provides a resource to compare various influences of living conditions not only directly surrounding the Lamar Avenue corridor, but the entire city of Memphis as well. While nearly all of the data used in the website are publicly available and are possible to interact with using Geographic Information System (GIS) software, we recognize that the general public is not trained in the use of such software. (Geographical Information Systems are organized collections of data-processing methods which act on spatial data to enable patterns in those data to be extracted, understood, and visualized (Batty, 2010,408).)

Our website emulates such GIS functions as 'map algebra,' where combinations of data layers can provide a simple but powerful look at how different attributes can be combined (Batty, 2010, 412). As Batty also describes, spatial queries are a vital component of GIS software, allowing a trained user to access attributes directly from an area of interest (2010, 412). For example, using GIS software, we were able to perform spatial queries to narrow the 70,000 US tracts down to those contained in the Greater Memphis area, and in turn were able to bring these filtered data to our website. On the website, the public can easily produce a query of a census tract for further information by simply hovering the cursor; all polygons in the website will provide further information in an automatically-updated information panel.

Our website makes use of both raster and vector data. As described by Batty (2010, 410), "both raster and vector maps have attributes; the raster being associated with grid square which become a computer screen, the vector with irregular areas which are defined by assemblages of points and lines," the latter of which forms polygons. The satellite imagery and historical maps shown on the website are raster data, while the rest (points, lines and polygons) are vector data. Each of these types of data present their own concerns when creating an interactive map that can be displayed at various scales. For example, points may need to be clustered to prevent them from becoming indistinguishable from one another at a smaller scale, or lines may need to appear thicker as the user zooms out. Additionally, the opacity of polygons may need to be reduced in

order to allow for the user to see how various layers compare, but not reduced so far that they are not visible.

Furthermore, aspects of the interpretation of visual imagery come into play: "Visual imagery *always* produces cultural meaning...Cultural signs are also seldom static. They connect, and are continually connected, to other signs..." (Bartram, 2010, 135). As Bartram also comments, visual imagery conveys a 'mood' and 'atmosphere' (2010, 137); in the creation of this website, we attempted to use color to convey certain aspects of concern (such as with reds in regard to health risks), while refraining from the use of saturated color for other layers. American cultural symbols for such point locations as grocery stores and schools were thoughtfully considered and added (i.e. grocery carts were used to represent grocers and schoolhouses for schools), which also created the ability to easily distinguish among the various types of point data.

As described by Chris Perkins (2010, 363), a mapmaker must also determine how to utilize proper symbolization through a "regulated graphic language in which text and the visual properties of symbols are combined." Citing literature stating that quality maps will "induce the [viewer] to think about the substance rather than the methodology, graphic design, the technology of graphic production or something else," Perkins also raises the idea that a designer must continually make the message of a product the top priority (2010, 366). Indeed, our website endeavored to keep these principles in mind when developing a product for public dissemination.

Our website makes use of thematic mapping, which focus on one type of information (Perkins, 2010, 350). Additionally, understanding what kind of data and information are being represented is of utmost importance if the map-maker is going to create a product that properly presents a story; as Perkins states, one must understand that

> ...Objects in the map itself may be thought of as having different numerical qualities. These measurement levels are important for design. Nominal data show the presence or absence of information; ordinal data imply that a feature is larger or smaller (but do not indicate how much larger). Interval data involve ordering with known distances between observations – e.g. Fahrenheit measurement – whereas ratio measurement is an interval scale with a known starting point. … [Furthermore,] the map designer can use only a limited number of graphic variables [to convey the proper information about the data on display.] (2010, 364-365)

These twelve visual variables (location, size, crispness, resolution, transparency, color value, color saturation, color hue, texture, orientation, arrangement, and shape (MacEachren, 2004, 279)) must be thoughtfully applied to a visual so that the map will be effective when viewed by the public. Various aspects of color (hue, value, and saturation) were used in the display of the data layers. For example, saturated color was used to draw the user's attention to areas of especially high population density, while lower levels of population density were left in grayscale.

In addition to understanding how the data and information should be properly displayed in order to convey an accurate and easily understood message, there are many pitfalls to avoid when dealing with statistical data. For example, at times the apparent precision of an exact measurement [might] not reflect the accuracy of that measurement (Field, 2010, 321). In an effort to avoid giving the user a false impression of precision,

we decided to round figures to whole numbers when possible. (Appendix A reveals the often-used JavaScript methods “formatNumber,” used to lower the precision of a number to zero.) When deciding how to classify these data (the data found on the website), the use of the “quantiles” method was preferred, as it is easily understood: an equal number of observations fall into each class, meaning that the percentage of observations in each class will be the same (Slocum et. al., 2009, 62).

As Field describes, graphical representations of data should be 'honest' (i.e. not distort, censor, or exaggerate the data) and have a high data-to-ink ratio (Field, 2010, 331-332); Appendix D contains a statistical overview of the data used in the website in a table format, followed by a graphical representation in the form of histograms. Each histogram clearly and succinctly displays the distribution of the data for each layer used in the website, and most include how the data were 'binned' when classified. Appendix F contains an “infographic” displaying highlights of the data contained in the website as well as additional data pertaining to the Memphis and Lamar Avenue Corridor. Titled “Memphis and Lamar Avenue: Environmental Justice,” the “infographic” includes a bivariate map meant to aid in the comparison of the amount of polluters in a census tract with the percentage of African Americans living in the tract. This comparison is a form of bivariate analysis, meaning that it allows the viewer to analyze the effect of one variable on another (Field, 2010, 334).

The “Timeline” portion of our website displays some of the important events covered in our paper, which help provide a greater context for the problems facing the citizens of Memphis today. The multimedia included (pictures, historical maps, and links to sound clips) help add further insight to the topics covered in the paper, and help connect the viewer to the Memphis and Lamar-avenue corridor through local stories and images. In our paper and websites, we have endeavored to include not only the historical perspective of the white and upper class, but also a show factors in the continued plight of the underprivileged. Our paper attempts to merely introduce the reader to environmental justice and historical issues encountered by many minorities; our “Timeline” and interactive website are meant to be the focus of this project, where the user can find a tool to not only read about but rather explore some of the various factors creating problems of livability near the Lamar Avenue Corridor and in Memphis.

As Perkins states, “We all have a responsibility to make better maps and use them in a more critical way” (2010, 370). Indeed, our project as a whole is an attempt at improving the lives of those impacted by the environmental justice issues, including those problems created by the considerable freight activity in and around residential communities. We hope these websites will provide a resource to help inform the public, researchers, scientists, and other policy-makers who can in turn make a difference.

Turning to the technical side of the creation of our interactive website, we start with the fundamentals of web design. We will begin with the building blocks of web design: HTML and CSS. Together, HTML (Hypertext Markup Language) and CSS (Cascading Style Sheets) form the basis of building web sites. HTML, the core language of nearly all web content, provides the basic logical organizational structure of web pages (HTML.). CSS describes the presentation of websites, allowing for changes in colors, graphic layout, and fonts. CSS can also determine how the site is viewed on different types of devices, such as when the user is working with a mobile device (CSS.). The higher-level programming language JavaScript (a scripting language, not to be confused

with Java) allows for an object-oriented approach to website programming, which can be embedded directly into HTML code (Slocum, 2009, 247). (Object-oriented programming (OOP) is a programming paradigm that uses abstraction to create models based on the real world; JavaScript has strong object-oriented programming capabilities, even though some debates have taken place due to the differences in object-oriented JavaScript compared to other languages (Introduction to Object-Oriented JavaScript.).) JavaScript allows for dynamic content, such as animation and interactive content (JavaScript.).

JQuery, a JavaScript library, allows programmers to easily include additional functionality and features in a site, and interactive widgets such as calendars and menus (jQuery UI.). To increase usability, we were able to condense the display of our information with the use of a jQuery "accordion" to hold the data layer options in a space-saving manner. Leaflet, another JavaScript Library allows for the creation of interactive maps, with the programmer's choice of a basemap. It also allows for popups, the inclusion of vector layers (e.g. points or polygons), and image (raster) overlays (Leaflet Features.). GeoJSON, a file format using JavaScript Object Notation, encodes geographical features so that they can be included in mapping applications and packages such as Leaflet (GeoJSON -- JSON Geometry and Feature Description.).

As a result of the screen size and resolution difference for every user, we decided to work with Bootstrap, as it is a rather easily accessible open-source front-end framework that adds responsive functionality. Bootstrap, a collection of JS (JavaScript) tools, CSS stylesheets, and fonts for creating websites and web applications, allows for responsive website design. Building on the aforementioned languages and libraries, it provides a dynamic graphic layout based on the screen size and size and orientation of the browser window, and also can extend the functionality of interface elements such as input fields (Bootstrap.). Finally, to create a template for "simple and elegant web mapping applications" (Bootleaf.) we utilized Bootleaf, a combination of Bootstrap and Leaflet. With a slippy map (a term used to describe modern web maps which let you zoom and pan around (Slippy Map.)) and a basic sidebar that disappears when the browser window becomes narrow, Bootleaf provided a framework of basic interactivity to which we could add our own data.

The final product integrated many layers of technical and design considerations: The interested reader can find further information with the complete code of the website in Appendix A. For information on the sources of the data, one can find the metadata in Appendix B. (A metadata record is a file of information which captures the basic characteristics of a data or information resource. It represents "the who, what, when, where, why and how of the resource" (Geospatial Metadata.).) Appendix C contains the EPA Smart Location Database "User's Guide," which includes technical details regarding the derivation of data presented in the website. Appendix D contains a table displaying the statistics of the data, as well as histograms for each of the layers of data. Appendix E gives proper credit to the artists who designed icons used in the display of point data. Finally, Appendix F contains a summary of the findings of GIS analysis in an easy-to-read graphic meant to be used by the general public.

Lamar Avenue Corridor Studies

As an arterial road for both interstate and local freight, Lamar Avenue is one of the region's most important and congested corridors (Memphis Regional Freight Infrastructure Plan Executive Summary, 2010, 10). Lamar Avenue is approximately 7.5 miles long and consists of 30 intersections (Lamar Avenue Corridor Study: Final Report, 2-1.). Memphis International Airport, the Burlington Northern Santa Fe rail yard, and several important distribution centers are located along the corridor, making it a critically important thoroughfare for the city's commerce. Several studies were conducted to identify necessary transportation improvements to decrease congestion along the Lamar Avenue Corridor, with one of the most important studies being commissioned by the Tennessee Department of Transportation and overseen by Cambridge Systematics in collaboration with the University of Memphis and Kimley-Horn & Associates (Unlocking Lamar: Planners Mull Ways to Improve Transportation Corridor.). The Cambridge study focused on transportation improvements, and did not thoroughly examine other livability issues associated with water, air, and noise pollution. The paper stated that the monetary value for the recurrent delay for trucks is $19.82 per hour and truck air pollution costs are $0.039 per vehicle miles traveled (Lamar Avenue Corridor Study: Final Report, 8-6).

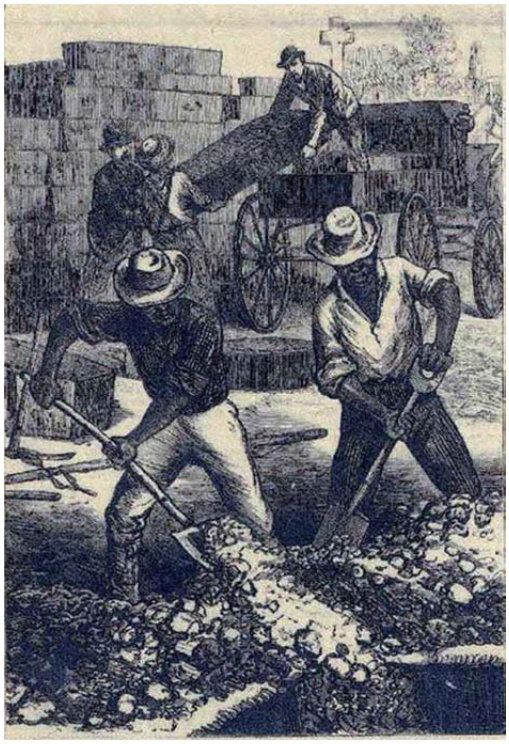
The Cambridge study also offered multiple alternatives to decrease congestion along Lamar Avenue, including upgrading it to an interstate, adding lanes, and diverting traffic. The University of Memphis also conducted a study on the Lamar Avenue corridor and produced recommendations to reduce traffic congestion. In contrast to the Cambridge Systematics research, this study examined the impact of the heavy concentration of industry on the surrounding neighborhoods. The principal finding of the study was that these neighborhoods suffered from a high degree of air pollution as well as an overall lack of vegetation and green space.

It is clear that these studies reflect the importance of Lamar Avenue as a critical artery for industry located in the area. While the University of Memphis study examines the impact of this industry on the surrounding neighborhoods, a broader context is necessary to understand the livability issues they face. Due to the "intersectionality" of racial and environmental concerns, these challenges echo the priorities of the environmental justice movement (where "Intersectionality" is used to describe the study of the intersections of multiple systems of oppression or discrimination between different minorities (Patricia Hill Collins: Intersecting Oppressions.)). This movement and the issues at hand are the direct product of decades of social and environmental development in Memphis. It is therefore imperative to examine the history of the city and these developments to properly contextualize the concerns of livability in the Lamar Avenue Corridor today.

History

Prior to the arrival of European settlers in the late eighteenth century, peoples of the Chickasaw Nation followed those who had inhabited the area since at least the Mississippian Period (900-1600 CE) (Federally Recognized Tribes Sign BPNM Floodway Programmatic Agreement.; Nations Hoop: Prehistory.) When Spanish troops recognized the strategic importance of the site's accessibility to the river and position above its floodplain, they successfully negotiated a treaty with the Chickasaw Nation allowing them to construct Fort San Fernando in 1795. Following the Pinckney Treaty of 1796, Spanish troops were forced to abandon their fort, leaving the site once again in the possession of the Chickasaw Nation. The city of Memphis was formally established in 1819, when General Andrew Jackson negotiated a treaty with the Chickasaw Nation for approximately $300,000, and Memphis subsequently became both an American military base and a civilian settlement (Biles, 1986, 7).

From the time of its founding, Memphis served as a transportation hub along the Mississippi River. Known as the Bluff City, it grew rapidly in its incipient stages. In 1834, a reporter in a local gazette hailed the city's progress stating, "It must undoubtedly become the emporium of one of the finest agricultural districts in the western country. Already it is a place of considerable business, and is improving faster than any town in the state" (Crutchfield, 2009, 117). This growth combined with racial tensions during the Civil War, causing violent conflict between the city's white population and the growing number of African Americans who sought refuge and opportunity in the city after President Lincoln's Emancipation Proclamation in 1863. Many black Baptists and Methodists formed societies in response to the violence, and rebuilt their churches, schools, and communities through these orders.



Memphis, unlike many southern cities, was not irreparably damaged by battles in the Civil War, and in fact experienced significant population growth. What Memphis lacked, however, was sufficient sanitation infrastructure. Memphis was not unique among industrial era cities for its lack of comprehensive sewer, water, and waste disposal systems, but its situation along the Mississippi

River made it highly susceptible to mosquito-borne diseases. Memphis suffered four debilitating yellow fever epidemics between 1867 and 1879, resulting in over 8,150 deaths (Rushing, 2009, 15). The third and worst outbreak occurred in 1878. Within ten days of the first casualty, “twenty-five thousand residents had fled Memphis, leaving about twenty thousand behind to take the brunt of the epidemic” (Crutchfield, 2009, 118). The epidemic was so widespread that “at one point in September, two hundred people died each and every day” (Crutchfield, 2009, 120).

Between the years 1865 and 1890, black fraternal orders played a role in local politics; more than ten blacks served on the city council, and two were elected to the state legislature in 1881 (Goings, 1998, 229). The African American community had grown in Memphis with at least three distinct groups: First, "The talented tenth," a group described by such writers as W.E.B Du Bois, included the individuals who had "...secured an education, made economic investments in the city, and achieved an elite status in the community. They utilized the political and judicial systems whenever they could, but believed...'character building'...would [create] a more positive perception of all African Americans [by whites]" (Goings, 1998, 228). A second group, the accommodationists, included "black professionals who refused to challenge segregation and racial discrimination in the city" and desired "harmony" between the races by accepting second-class citizenship for African Americans (Goings, 1998, 228). The third group "consisted of migrants who ignored attempts by the Memphis white community to keep blacks in their 'place'" and publicly resisted everyday racial indignities (Goings, 1998, 228). Though all three groups were joined by the common interest of addressing issues caused by racial persecution, tension and conflict could be found among the groups as they each very different opinions and attitudes about how to find solutions to issues of discrimination.

Despite the efforts of these groups, Memphis continued to see segregation, lynchings, and other violence by the city's white population; in *Black Tennesseans, 1900-1930*, it was stated that "fear and a dulling environment held resistance in check in West Tennessee" (Goings, 1998, 227). However, Memphis was attractive to African Americans because it offered an urban community with strong ties to a rural economy and had an ever-changing black population due to its location in the mid-South. More than half of the migrants were born in Mississippi, while at least one-fourth came from Arkansas, Alabama, and Louisiana. During the 1880s and 1890s, Memphis also saw an influx of white farmers. The consequent cultural mix included citizens on both sides of the racial tensions and from a variety of economic backgrounds. In 1900, Memphis was described as "...a strange paradox--a city modern in physical aspect but rural in background, rural in prejudice, and rural in habit" (Goings, 1998, 230). These attributes became evident as the twentieth century began and the Bluff City grew into the industrial age.

Expansion Into The Twentieth Century

This strange Southern city continued to grow into the twentieth century, but not without complications. Its rural prejudices and habits contributed to its notoriety, with Memphians settling disputes with firearms and white Memphians lynching African American Memphians at alarming rates. In the first decade of the century, Memphis became the murder capital of the nation with a homicide rate almost seven times the national average, and by 1916 this figure had nearly doubled (Biles, 1986, 15). The city, during this tumultuous time, found itself under the leadership of Edward Hull Crump, a young businessman who ran for mayor on a platform of reform. Crump left office in 1915, but remained strongly involved in Memphis politics. He and his allies orchestrated and controlled every election in the city until his death in 1954, and while a certain level of order was maintained, so was the status quo. Crump introduced economic reforms and kept the Ku Klux Klan out of the city's political system, but also ensured African Americans remained second-class citizens during his nearly fifty-year reign.

Under Crump's watchful eye, Memphis expanded steadily through the 1920s. At the start of the decade, it retained its title of being the nation's largest inland cotton market, but, as Biles states, "remained basically a one-crop town" (1986, 50-1). This economic model proved effective during World War I as cotton demand rose for war materials; but, after the war, market prices plummeted. They gradually recovered throughout the following decade, during which time the city diversified its commerce. The Memphis economy grew steadily as the Roaring Twenties rushed on with the emergence of several new banks and retailers. Office building construction soared, with one million square feet of commercial space becoming available between 1923 and 1929, and the city skyline grew accordingly with offices and hotels rising in rapid succession, including the iconic Hotel Peabody in 1925 (Sigafoos, 1979, 158-9). Memphis Harbor saw a doubling in tonnage coming through its port during this decade, and many businesses, including Sears, Piggly Wiggly, and Kroger, opened locations in the city (Sigafoos, 1979, 195). With the rapid expansion of Memphis, the Memphis Airport Commission made what would later turn out to be a crucial decision: after suggestions by Charles Lindbergh and Eddie Rickenbacker in 1929, the commission secured the site for what would become Memphis International Airport.

The Stock Market Crash of 1929 and ensuing Depression took its toll on Memphis in many of its business sectors. The cotton industry declined, but after two Agricultural Adjustment Acts passed by Congress in 1933 and 1938 that reimbursed farmers for losses, it began to recover. Historian Robert Sigafoos describes how it "did not become a healthy industry, but those involved appeared to gain greater control over their future" (1979, 178). Behind the scenes of these and many subsequent attempts at revival stood E.H. Crump. Elected to the U.S. House of Representatives in 1931, along with veteran Tennessee Senator Kenneth McKellar, the former mayor employed his political influence to bring federal funding and revival projects to Memphis. This represented one of the first efforts to assist homeowners in danger of mortgage foreclosure, including the Home Owners' Loan Corporation. Created by the Federal Home Loan Bank Board in 1933, it opened its Memphis office in July of that year. A federal loan insurance program and multiple public housing projects within Memphis quickly followed.

With public housing came segregation, and in 1940 Memphis's African American population were forced to live in substandard housing while their white contemporaries were favored by city planning commissions. Planners stated that, "It would be advantageous to the city if the bulk of the Negro population could be confined to definite districts that have already been established" (Sigafoos, 1979, 184). A 1940 report by the Works Progress Administration stated that 46, 7 of Memphis's 83,540 homes were substandard, and it was in these established districts that city planners sought to place African Americans by controlling who received property rights as bids were made throughout the city (Miller, Pozzetta, 1988, 114-5). The onset of World War II stalled the few government programs designed to alleviate this issue, and primed Memphis for civil strife in the following decades.

Fortunately, the war rapidly rejuvenated the Memphis economy that had languished for over a decade. Multiple Memphis-based industries and plants overhauled their systems for wartime output and hired unemployed Memphians by the dozens. The DuPont owned Chickasaw Ordnance Works produced explosives; Ford focused solely on airplane engines; Firestone switched to rubber life rafts and tires for army vehicles only; and the Continental Can Company made shell casings. Each of these industries boosted the Memphis economy and prepared it for continued growth in the post-war economic boom driven primarily by the housing market.

Postwar Memphis

Soldiers returning from Europe and the Pacific Theater purchased new suburban homes that required appliances emerging in the growing technological era. Home construction greatly benefited the Memphis-based E.L. Bruce Company, which became the world's leading producer of hardwood flooring during the 1950s. The growth of suburbs outside of cities to accommodate the housing demand necessitated a boom in automobile sales, which increased traffic so heavily the Tennessee Highway Department could not keep up with resurfacing needs (Johnson, 1978, 113).

Amidst this economic growth, Memphis race politics once again returned to the forefront of the city's actions. Expansion of the suburbs accentuated socioeconomic and racial divides, and while residents of various backgrounds lived in close proximity prior to 1940, the city's expansion made demarcations between black and white neighborhoods more visible (Miller, Pozzetta, 1988, 94). Henry Loeb III, Memphis native, Brown University graduate, and war veteran, quietly became involved in Memphis politics in the early 1950s through an appointment to the park commission, and was elected in 1955 to the city commission as an independent. Loeb quickly established a reputation for exposing scandals and corruption, helping him gain prominence in political circles.

At the same time in Memphis, individuals like O.Z. Evers and Jesse H. Turner were disrupting the status quo. They, along with fellow African American activists staged protests calling for equality. In 1956, a federal judge ordered the first integration of a Tennessee school district, but this decision was met with severe opposition from state leadership. Within a year the court order had been subverted by a law coordinated by the governor and members of the state legislature, further aggravating the divide between racial groups.

In June of 1959, Russell Sugarmon, a graduate of Rutgers University and Harvard Law School and a practicing attorney in Memphis, announced his candidacy for Henry Loeb's recently vacated city commission seat (Dowdy, 2010, 66-7). Loeb had declared he would oppose incumbent mayor Edmund Orgill in the upcoming mayoral election, and Sugarmon hoped to seize the opportunity and become the first African American elected to office in Memphis in the twentieth century. Sugarmon planned to run against a divided white ticket, and this troubled Loeb who, among others, worried an African American victory would upset the racial order dominant in Memphis for generations. Loeb vigorously petitioned against Sugarmon's campaign, which inspired several other African Americans to run for positions and ultimately brought Martin Luther King, Jr., and Mahalia Jackson to Memphis in support in 1959.

Sugarmon and the other African American candidates lost their campaigns and Loeb was elected mayor, but civil rights activists were not dismayed. Loeb's first term saw a strong increase in protests and activist work as African Americans fought for integration in schools, restaurants, libraries, and parks in Memphis. These events enraged the mayor who saw them as unnecessary expenditures of time and resources, and his negative opinion became well known publicly. As the election process mounted in 1963, amidst multiple African American victories for improved civil rights in Memphis and national support stemming from the Kennedy administration, Loeb felt he had been "robbed of his greatest political issue" (Dowdy, 2010, 85). A disheartened shell of his

former, reform seeking self, Loeb stepped down from his campaign and this city elected William B. Ingram as his successor.

Ingram created conflict throughout his term as mayor by challenging position appointments and strictly denying a motion to allow African Americans on the city commission. He also frequently butted heads with Claude Armour, the veteran fire and police commissioner. Loeb, sensing an opportunity to reenter the political sphere, openly challenged Ingram at the next election cycle, calling his administration a "five-headed, headless creature" (Dowdy, 2010, 115). Loeb defeated Ingram in the fall of 1967, and once again took office as mayor of Memphis. He had made concessions towards civil rights groups, causing some to be hopeful for his second term, but Loeb quickly showed little had changed.

In February of 1968, Echol Cole and Robert Walker, Jr., both sanitation workers in Memphis, died when the hydraulic press of their garbage truck malfunctioned and crushed them. Their deaths reignited a strike movement initially attempted in 1963 by the primarily African American sanitation workers' union. For decades the workers had been subjected to poor wages and working conditions, including the alarmingly dangerous trucks they were forced to ride in, standing in the rear between the press and the truck's back wall. Loeb, who purchased the trucks as public works commissioner in 1957, found himself in the crosshairs of the strike.

The mayor refused to budge on the sanitation workers' demands, and for weeks the strike languished. The situation escalated in a brief riot between police and protesters that included arrests, Mace, and nightsticks. Martin Luther King, Jr. visited on March 18, 1968, to encourage the workers to continue their efforts and told them to "escalate the struggle" (Dowdy, 2010, 127). He then left the city for a time and returned on March 28th with the intention of leading a march, but after tensions rose amongst the waiting crowd, vandalism and looting broke out, prompting police retaliation. King fled the scene with several aides while protestors and looters were beaten and arrested. Police pursued one individual, sixteen-year-old Larry Payne, incorrectly suspecting he was with a gang of looters. The officers followed Payne into a basement and ordered him out, and as he exited an officer fired his shotgun, killing him instantly. Lawmakers in Nashville heard of the ensuing violence and hurriedly passed legislation allowing mayors to set a curfew to combat civil unrest. Mayor Loeb quickly took advantage of this and declared martial law in the city of Memphis, with National Guard troops arriving to maintain it until April 1st.

The chaos of the march brought King a great deal of humiliation, and he left the city. Members of his staff convinced him to return, and on April 3rd he gave an impassioned speech before a crowd at Mason Temple, telling those gathered, "We've got to see it through" (Dowdy, 2010, 130). The next day, April 4, 1968, King was assassinated standing on the balcony of the Lorraine Motel. Violence

once again rocked the city, and the National Guard returned for a time. Mayor Loeb then received pressure from throughout the nation to settle the dispute, and he looked on as the nation decried Memphis's complacency towards civil rights.

During the 1960s, the Bluff City's economy continued to capitalize on the influx of businesses from the postwar boom, and many large corporations, such as Du Pont, Kellogg, and Kimberly-Clark employed thousands of Memphians. The city attracted a number of Fortune 500 companies due to its "pivotal position geographically within one of the nation's most productive agricultural regions" (Sigafoos, 1979, 295). The E.L. Bruce Company that rapidly expanded into the world's leading hardwood flooring producer in the postwar years began to decline after the Federal Housing Administration included wall-to-wall carpeting in its basic home loan when in 1966 it inadvertently made hardwood less desirable. However, many of the city's other homegrown industries began expanding in the 1970s (Sigafoos, 1979, 298).

Kemmons Wilson opened his first Holiday Inn in 1952 in Memphis, and in just eighteen years, after a merger with Wallace E. Johnson to form Holiday Inns, Incorporated, the company grew tremendously. There were 1,713 Holiday Inns throughout the nation by 1970, and this successful growth model was shared by many other Memphis-based organizations. Companies like Guardsmark, Orgill Brothers & Company, and Dunavant Enterprises all boomed in industries ranging from security services to cotton brokerage, and all were based in Memphis. Malone & Hyde, a wholesale and retail food firm, more than tripled its annual sales between 1970 and 1978 reaching nearly $1.4 billion (Sigafoos, 303). Many Memphis industries were expanding, and the city experienced a large influx of goods and revenue.

One of the most notable corporations to come out of this era proved to be the Federal Express Corporation founded in 1972 by Frederick Smith. Smith, still a year shy of thirty, provided the nation with a simple and fast package service that quickly caught on. In just six years the corporation boasted a $20 million net income, and Memphis served as its central hub. Over the following decades, Memphis International Airport grew to become the busiest cargo airport in the world.

The New Memphis

With the rise of globalization, the city of cotton trade became North America's distribution center. The airport, highways and rail yards of East Memphis soon attracted dozens of white, multi-story warehouses adorned with the stubs of truck-loading docks instead of its previous Art Deco flourishes. "Just as sitting at the center of the delta had made Memphis a nexus for the exchange and the barges and railroads carrying away cotton, so did sitting in a sweet spot of climate and time zones make the city irresistible" for companies looking to move freight around the country (Kasarda and Lindsay, 2011, 60). Memphis's most valuable commodity was not cotton but speed, with shipping employees working around the clock to load "jets [that] could sprint from the coasts and back by daybreak." Today, FedEx carries 75 percent of all U.S. air cargo, despite prices three or four times higher than its rivals (Kasarda and Lindsay, 2011, 60-61).

Being a center of international shipping, Memphis International Airport sees three hundred planes at its gates daily, carrying more than 3.3 million packages. It was the busiest cargo airport in the world for eighteen years running and 95 percent of its title is due to FedEx. As John D. Kasarda (2011) writes in *Aerotropolis: The Way We'll Live Next*,

> The city's iconic export now is a white box barely larger than a laptop, or a man's shirt, or a stack of DVDs, all of which arrive here along with stacks of overnight envelopes and then leave again on flights costing thousands of dollars per hour in flight time and fuel. Regardless of these contents' retail price, these packages are priceless to their owners, and they pour from the bellies of wide-body planes here by the millions each and every night.

Its trucks, planes, and trailers – not to mention its purple logo – permeate Memphis. When University of Memphis researchers sought to measure the airport's impact on the city in 2007: with more than $28 billion in earnings, the researchers discovered that it was indirectly responsible for nearly half of the local economy, and was responsible for about one out of every three jobs in the region (Study Verifies Memphis Airport's Potential as Aerotropolis.). Not only is it the largest private employer in a metropolitan area of more than a million people, it sits in a center of warehouses, trucking firms, factories, that even showed that during the severe recession of 2008 "the positive impacts of [the] Memphis International Airport [was] increasing... [providing an essential ingredient in stabilizing the local economy in a downturn" due to its global reach (An Economic Assessment of the Impact of the Memphis International Airport, 1.).

More telling are the companies that have moved to town since then just to take shelter in the shadow of FedEx. The airport, built on the edges of the city in the days when even Graceland was still a country home (it now sits only a few miles from the fence), has turned the city inside out. It is the de facto center of Memphis as well, with the hub at its core. It transformed the city into "America's Aerotropolis," as the Greater Memphis Chamber of Commerce has dubbed it. Historically, cities exist to exchange goods between each other from their hinterlands. In Memphis's case, this historically referred to the southeastern US, with Mississippi cotton being its largest source of trade. However, FedEx revolutionized this notion with a hub capable of serving every city in the United States overnight, every night, turning the entire country into one big

hinterland. As airports became all any city needed to trade with another, Memphis became the crossroads for many of America's goods. While some still crow about the city's rail lines and trucking fleets, they're only a piece of a larger network: FedEx was innovative because it created a new network limited only by the size and reach of its planes.

FedEx has continued to drive Memphis ever since its founding in 1972. The city, born of its strategic location along the Great American Waterway, continues to use the river, with barges perpetually passing through its harbor. Simultaneously, rail and ground transport bring commerce into and out of the city, connecting Chicago, New Orleans, New York, and the West. In a stroke of good fortune, the founders of the Bluff City chose a location optimal for air traffic: Memphis lies within a trapezoid in the central U.S. regarded by freight corporations as ideal for servicing the rest of the nation, as a jet can reach any part of the country in a matter of hours. Even delays due to weather have said to be rare. Without these advantages, FedEx would surely have found an alternative central hub.

Environmental Justice And Its History

Memphis's strong dependence on industry and its history of racial division still influence the city today. The Lamar Avenue Corridor began as primarily white suburban housing, which was followed by substandard African American developments. Many neighborhoods near Lamar Avenue are now impoverished and unfortunately not only plagued by crime but also the constant pollution of air, rail, and ground transport. Still tied to its past, Memphis now faces the challenge of balancing the historically integral role of industry with the relatively new emphasis on rights and equality for all citizens. The Bluff City must determine how to provide for its entire citizenry, while also bringing a high quality of life to those living near and working for its largest providers.

The topic of environmental justice issues represents the intersection of environmental and civil rights movements, which was founded on a principle of "people speaking for themselves" (p. 25, Bullard, 2007). As defined in the dictionary of human geography, environmental justice is the right of everyone to enjoy and benefit from a safe and healthy environment, regardless of race, class, gender or ethnicity (Gregory D., et al., 2009). Unfortunately, many communities of people of color as well as low-income have experienced environmental racism and lack of assistance from the public health communities, government, and businesses.

In order to find a better understanding of the current problems faced today by residents of Lamar Avenue, we begin with a historical perspective of the environmental justice movement. From the 19th to mid-20th century, environmental issues were concentrated within the conservationist and preservationist movements, which were primarily concerned with the use of natural resources. The movement began to change in the 1960s as Americans became increasingly aware of the extent of environmental damage wrought by industry, commercial interests, and human activity. Rachel Carson's Silent Spring, which describes the deleterious effect of the indiscriminate use of pesticides, marked the beginning of new-found concern for the environmental problems caused by modern use of chemicals and other toxins. The environmental movement soon included groups dedicated to addressing problems such as acid rain, hazardous waste disposal, and land use. However, these groups usually failed to address the challenges faced by poor, minority, and urban communities. In the mid-80s, members of the Sierra Club declined to address the conservation problems of special groups such as the urban poor and ethnic minorities, with a defeat of about three to one. Around this time, some even began to express concern that the mainstream environmental movement was in fact overshadowing troubles faced by minorities, or in some cases actually causing greater problems. For example, agricultural regulations decreased health risks for the general population, but increased health impacts on farm workers as newer pesticides were stronger while still on the fields before subsiding in intensity (Newton, 2009, 20-21).

In 1982 residents of Warren County, North Carolina attempted to protect their community from a waste disposal dump by using tactics championed by the civil rights movement, including civil disobedience and nonviolent protest. Four years earlier, the Ward Transformer Company of Raleigh "illegally and surreptitiously dumped 31,000 gallons of toxic polychlorinated biphenyls (PCBs) along 240 miles of roadways [by dripping it] in 14 North Carolina counties. Once discovered, the North Carolina state government was responsible for digging up and relocating 40,000 cubic yards of

contaminated soil" (Newton, 2009, 1). In violation of EPA regulations, the state dumped the toxic waste in Warren County, where the soil was susceptible to leaching and the water table was only about 7 feet below the landfill, a full 43 feet shallower than required. Residents immediately contested the proposal of disposing this hazardous waste in their community. The community made public appeals to national leaders of civil rights and environmental groups, noting that 75 percent of residents were African American and that residents lacked the proper resources to fight legal battles as Warren County ranked 97th in North Carolina's 100 counties in per capita income. However, the EPA ultimately ignored the objections of the residents, waving the environmental requirements and granting North Carolina a permit for the landfill. After prostrating their bodies in front of construction vehicles in a final effort to protect their community, 523 protesters were arrested. Soon, more than seven thousand truckloads of contaminated soil were deposited in Warren County: the site leached contaminants for the next 20 years, permanently damaging the local environment, including streams, lakes, and rivers (Newton, 2009, 1-3).

After the events in Warren County, a 1983 study revealed that three out of four of the largest landfills in the Southeast were located in predominantly poor and African American communities. In 1987, the Commission on Racial Justice of the United Church of Christ analyzed the entire United States and found similar results. According to the studies, three out of five of the largest hazardous waste sites in the US were located in predominantly African American or Latino communities. It also showed that 15 million African Americans and 8 million Hispanic Americans live in communities with one or more hazardous waste sites (Newton, 2009, 23-26).

The mid-1990s saw a new wave of environmental reform. President Clinton's administration achieved significant progress for the environmental justice movement, establishing the Office of Environmental Justice within the EPA and the National Environmental Justice Advisory Council (NEJAC). A number of new organizations were formed representing African American, Native American, and Hispanic communities. However, before 2003 over 75% of cases were rejected by the EPA when these organizations attempted to apply Title VI of the Civil Rights Act of 1964, which states that "no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance." Organizations that sought to protect communities from contamination also found further hardship when President Bush's administration reinterpreted the meaning of environmental justice to exclude low-income and minority populations, with a quote from a 2002 memo to the employees of the EPA reading "...the environmental justice program is not...designed specifically to address the concerns of minority communities and/or low-income communities" (Newton, 2009, 67). Additionally, the Bush administration did not "provide regional or program offices with standards for what constitutes a minority or low-income community," preventing the EPA's compliance with President Clinton's Executive Order 12898, which was created to protect those impacted by environmental concerns. Furthermore, no environmental justice bills proposed by the federal government even were able to become close to passage; "such bills often do not [leave] the committees to which they are assigned" (Newton, 2009, 27-31).

Environmental Justice, Underrepresented Communities, and Health

The principle of NIMBY, or Not In My BackYard, has exacerbated the disproportionate presence of hazard materials in lower-income communities. The NIMBY concept explains organized opposition to hazardous or polluting facilities in middle and upper class communities, where residents tend to have more political and social capital than low-income neighborhoods. When industrial facilities, hazardous waste dumps, and radioactive sites apply to be located in a city, resistance from minority and low-income neighborhoods often goes unheard. Governmental bodies such as city councils, planning departments, and zoning committees, who are responsible for granting permits are often represented by middle- to upper-class white males, who many claim overlook the objections of lower income communities. In many cases residents are also misled by intentional lack of information; for example, many communities are not informed of a proposed industrial facility until it is too late to contest its construction (Newton, 2009, 43-46). As was the case in Warren County, many lower-income residents also do not have the financial resources, time, or legal expertise necessary to prevent an industrial presence in or near their neighborhood, especially with the promise of protracted legal battles.

Opinions within African American and other minority communities on the environment are often misrepresented; while others state they are not concerned about environmental issues, this is simply not true. One survey of five largely African American communities showed that more than half the respondents had participated in environmental activism such as writing a letter or telephoning an official about an issue. In fact, one analysis showed that African American legislators are significantly more likely to support environmental legislation than their white counterparts: 75 to 85 percent of African American legislators supported environmental legislation as compared to 60 to 80 percent of white Democrats and 20 to 40 percent of white Republicans (Newton, 2009, 44-45). Another study showed that environmental activism in the African American community often occurred through other organizations such as churches instead of mainstream environmental groups (Newton, 2009, 44-45). In many ways, African Americans are also more likely to make lifestyle choices that are better for the environment when considering such topics as reduced consumption of meat and higher use of public transportation. After analyzing more than 20 years of data, Paul Mohai of the University of Michigan noted that, “environmental issues are not ‘luxury’ issues to African Americans. Survey results…demonstrate that environmental quality issues are a priority on many different levels” (Newton, 2009, 44-45).

As stated previously, Environmental Justice was founded on the principle of providing a voice to underrepresented communities (Bullard, p. 25). Minority communities often argue that lack of assistance from public health organizations and businesses is an example of environmental racism, and numerous studies have shown at that people of color are more likely to have greater health and environmental risks, regardless of income levels (Institute of Medicine). According to the National Law Journal, white communities are more likely to get better results for toxic waste cleanup, as well as tougher punishments than those in communities of color. Moreover, the majority of the nation’s environmental policies are beneficial to individuals with the higher education and income levels (Bullard, p. 27). In fact, research conducted by the

Associated Press in 2005 indicated that African American population is 79 percent more likely to live in neighborhoods with industrial pollution (AP).

The environmental justice framework may refer to unequal distribution to the harmful environmental exposures, as well as differentials in communities' abilities to resist the harmful practices in land use and industrial planning (Bullard, 2007, p.26). Proximity to wide spectrum of the hazards such as exposures to waste sites, industrial facilities, ambient air pollution, and transportation thoroughfares have many adverse effects on human health (Lee, p. 177). Moreover, the social factors such as employment status, access to health insurance, language ability, and access to social capital can also play a major role on the ability to oppose the environmental threats. Lack of healthcare can play a major role, because poor nutrition, poverty, and stress can exacerbate health problems (Lee, p. 181-182).

Memphis and Environmental Justice Issues

Looking at the six cities with the largest number of hazardous waste sites in the 1983 national study of US communities, Memphis ranked as the city with the highest percentage of African Americans (43.3%), and also had the highest number of hazardous waste sites at 173 (Newton, 2009, 24). An example of these sites is the Defense Distribution Depot of Memphis, located about a mile northwest of the Memphis International Airport. Built in the late 1940's for storage of numerous chemicals and munitions, it remained active until 1989. During this time, the 64-acre parcel of land was used for hazardous waste disposal, as well as maintaining or destroying extremely toxic chemical warfare materials, including several thousand pounds of mustard gas-filled German bombs and the potentially deadly blistering agent lewisite.

Additional hazardous waste included organic chlorinating agents, food stocks, paints, acids, herbicides, volatile organic solvents, and medical waste. In 1992 the site was placed on the EPA's National Priority List and became a superfund site, a list reserved for only the most serious uncontrolled or abandoned hazardous waste sites throughout the United States. Astonishingly, neither the Department of Defense nor the responsible contractors reportedly know all of the burial locations; a 2006 study attempted to use aerial photographs and historical documentation to discern where these locations might be (Greene, et al., 2006, 247). The community living next to the Defense Depot consistently voiced concern regarding health effects likely from neighborhood contamination from the site, with significant anxiety related to the fears of the community due to their lack of direct participation in the remediation and evacuation plans. In spite of anecdotal evidence of numerous cancers, deaths, birth defects, and miscarriages, the community's requests for testing were regarded as "unwarranted," with officials citing previous exposure assessments. However, upon investigation it was found these previous exposure assessments were not based on actual testing of soil, water, and air, but rather historical records.

Though members of the community desired research to prove a link to various health ailments, they also expressed fear that disturbing the soil at the site would potentially cause their neighbors to become sick or die; proper care and concern to the well-being of the nearby inhabitants was vital. In 2006, after receiving requests from local residents, professors from Howard University tested the soil for contaminants. Test sites included a creek which currently runs directly underneath the primary air-intake ducts of a local high school and which flows through the entire community. Though it had been used to dispose of chemicals and waste, it is now easily accessible to children and animals. Even now, in spite of being in the relatively cool range of 45-55 degrees Fahrenheit, the creek still maintains a distinct and pungent odor (Greene, et al., 2006, 247-250). Results of the study revealed significant amounts of organic compounds, an unidentified anion, and heavy metals (Greene, et al., 2006, 247-250). Indeed, the average concentration of chromium, a compound in fact known to cause cancer, was at levels at triple the EPA limit in all but one site (Greene, et al., 2006, 247-250).

In 2000, the Sierra Club began environmental justice programs in Memphis. Prior to the group's activism, most elected officials and residents were unaware of the surreptitious dumping of nuclear waste in two local landfills, which are also located over the Memphis Sands aquifer (Environmental Justice and Community Partnerships.). In

2006 alone, Shelby County (the county in which Memphis is located), received more than 1.6 million pounds of nuclear waste from around the country (Points to Ponder.). Shockingly, this nuclear waste has been dumped into landfills not constructed to contain hazardous toxic waste and radioactive materials; the landfills are lined with a material that lasts only 30 years in the best conditions, but that deteriorates from chemicals (Points to Ponder.). On a "toxic tour" conducted by an environmental justice Sierra Club organizer in 2006, participants witnessed various facilities emitting pollutants near neighborhoods, elementary schools, parks, and other locations of concern; in addition, participants could view smoke from the previous day's explosion and fire at an agricultural chemical plant (Ecology and Environmental Justice in Context: The Sierra Club's Toxic Tour of Memphis.). Memphis has a long history of the production of agricultural chemicals, where the facilities to produce, transport, and dispose of the chemicals form a ring around the historically black neighborhoods of Memphis. However, black residents were historically excluded from jobs that produced agricultural chemicals while black neighborhoods were heavily impacted by emissions and waste from these chemicals; concerns over chemical spills and accidents are of a constant concern in these areas (Ecology and Environmental Justice in Context: The Sierra Club's Toxic Tour of Memphis.).

Impacts of Transportation on Health

Air quality is a major concern to people of color since it is disproportionately concentrated across the nation: 65 percent of African Americans and 80 percent of Hispanics live in the counties with inadequate air qualities (Bullard, p. 41). According to the CDC, for the period between 2007 and 2009, the mortality rate per 1,000 persons with asthma is 75 percent higher for black people than white, and blacks had a higher asthma Emergency Room visit rate and a higher asthma hospitalization rate than whites (Haklay, 2010, 160). Transportation around the Lamar Avenue Corridor is of particular concern as transportation systems pollute the air and can make considerable extents of land unsuitable for human habitation (Balbus, Triola, p. 414). As almost all large trucks burn diesel fuel, low-income residential areas situated in close proximity to the roadways between major ports and urban or distribution centers are more likely to have high concentration of diesel exhaust emissions (Balbus, Triola, p. 42). Heavy truck traffic impacts respiratory health, which can reduce lung functions and exacerbates problems due to asthma and other respiratory illnesses; indeed, studies have shown correlations between living near roads with high traffic and being diagnosed with asthma, being hospitalized for asthma, and having outpatient visits for asthma (Balbus, Triola, p. 429).

Not only were long-term average concentrations of black smoke, NO2, and PM2.5 significantly related to mortality (Brunekreef et al, 2009), but living near a roadway also creates a nearly twofold increase of cardiovascular mortality (Balbus, Triola, p. 430). Furthermore, air toxins and particulates from transportation systems increase the risk of cancer with people who live in roadway vicinity. Several studies have indicated that primary source of cancer risk from air toxics is from diesel particulates, which contributes to 125,000 cancers in the United States (Balbus, Triola, p. 431; Bullard, p. 42). Adding further concern, a study in Denver showed that children residing in an area with high traffic concentration are six times increased risk of all types of cancers and eight times increased risk of leukemia (Balbus, Triola, p. 430).

Noise pollution has also had a very deleterious effect in urban environments, where the majority of African Americans are located. According to the Federal Highway Administration, at a distance of 50 feet, a medium truck traveling 50 miles per hour emits 80 dB of noise and a pickup truck emits 70 dB of noise (Balbus, Triola, p. 437). Airplanes and airports typically have noise levels between 80 and 100 dB, which can also affect people that live near them (Balbus, Triola, p. 438). Studies have proven that long-term exposure to noise levels above 70 dB can seriously damage hearing and affects human well-being (Rodrigue, 2013). Furthermore, the effect of noise pollution on children and youth has been proven to affect academic performance, leading to poor classroom behavior, irritation, and decreased reading comprehension (Balbus, Triola, p. 439). Finally, noise from transportation such as rail yards, airports, and ports can cause cardiovascular disease, as well as increased blood pressure, heart disease, changes in hormonal levels, and circulatory problems (Balbus, Triola, p. 438).

Runoff from roads, parking lots, and other surfaces can also pollute drinking water and further degrade the urban environment (Surface transportation policy project). Fuel, antifreeze, engine oil, rubber, metal deposits, and other hazardous particulates from aircraft, cars, trucks, and trains can impact hydrological conditions (Rodrigue, 2013). Lastly, the transportation sector currently accounts for 28 percent of greenhouse gas

emissions as well as 30-40 percent of air pollutants such as carbon monoxide and the ozone precursors nitrogen oxides and VOCs (Balbus, Triola, 2005, 426).

Conclusions

We begin with a look at the Greater Memphis area by inspecting our findings presented in the "infographic" found in Appendix F. Memphis consistently ranks in the top cities with the highest occurrence of Asthma, with more than 200 air polluters regulated by the EPA (Memphis and Lamar Avenue: Environmental Justice.). Furthermore, Memphis ranks in the lowest 20% of walkable cities (Living in Memphis.). As evidenced by the "Bike Score" layer in the website, transportation by bicycle can be difficult at best: most of the tracts near the Lamar corridor are ranked in the lowest quintile.

GIS analysis included using 2010 US Census data to find the median income for each census tract in the Greater Memphis area. Next, a count of how many facilities are regulated by the EPA for pollution in each census tract was determined. As the graph in the "infographic" shows, the highest number of polluting facilities ("polluters") were located in the lowest income areas, with the lowest preponderance of polluters occurring in the tracts with the highest income bracket.

Additionally, we see that three Superfund sites (the most toxic clean-up sites as defined by the EPA (Superfund Basic Information.)) are located in or around the Greater Memphis area. Using GIS software to analyze 2010 US Census Data (which provided demographic information) and EPA-defined Superfund locations, we determined that 91% of the population found in the tracts within 0.7 miles of the three sites were minorities; the pie chart shown provides more detail.

The bivariate map shown in the "infographic" displays the connection of the number of polluters in a census tract with the percentage of African Americans. Looking at the legend, we see that a directly proportional relationship would be found in the census tracts colored beige, tan, and brown, as these three are in the diagonal running from the lower-left to the upper-right. The colors of highest saturation represent an inversely proportional relationship, with the diagonal running from the upper-left to the lower-right. As we can see in the map, there are very few tracts with the highest pollution rate not correlating directly to a high proportion of African Americans. Radiating from the downtown area, we see a particularly high occurrence of tracts with the highest weighted pollution ranking with the highest percentage of African American inhabitants. Furthermore, multiple tracts near the Lamar Avenue Corridor show a direct correlation as well, including two tracts showing the highest rate of pollution with the highest percentage of African Americans.

We conclude that there are indeed environmental justice concerns in Lamar Avenue corridor area as well as in the Greater Memphis area, with the highest correlation being found in the tracts centered in the downtown area and the Lamar Avenue corridor (those with the highest and medium pollution rates) as well as with the tracts found farthest away from the downtown area (those with the lowest pollution rates). (For a fuller description of how the weighted pollution totals were calculated, please see "Weighted Pollution Data" in Appendix B.)

Looking more closely at the Lamar Avenue corridor area, we see that the history of the Memphis area has produced poverty-stricken areas of low food access for children and the elderly alike, as is evident with USDA and census income data presented on the website. With the advent of FedEx, hundreds of warehouses and freight facilities have

overwhelmed the area around Lamar Avenue (as can be seen with CFIRE data). Here we find that freight traveling by truck and train to these industrial locations is immense; as can be seen with the data found in the Highway Performance Monitoring System (HPMS) layer, portions of Lamar Avenue carry at least 36,000 trucks per day. As is evidenced by the rail line layer, a nearby rail yard has the capacity of an additional four rail lines, and as was previously mentioned freight continually moves around-the-clock. Obviously, concerns regarding involving air and noise pollution arise, as pollutants from exhaust and ambient noise from engines may endanger the long-term well-being of the people who reside near such areas, also previously discussed. Indeed, the National-Scale Air Toxics Assessments (NATA) data from the Environmental Protection Agency (EPA) shows an increased risk of respiratory disease and cancer surrounding Lamar Avenue.

From the perspective of transportation, we believe that the thoughtful application of changes to the timing of traffic-light patterns could decrease some air pollution incurred by idling. Additional measures could include the reconstruction of intersections to have a traffic bridge constructed to ensure a steady flow of vehicle movement, or the addition of lanes to Lamar Avenue as suggested by the Cambridge study (Lamar Avenue Corridor Study: Final Report, 8-12). Additionally, trucks could be restricted during certain hours of the day, where each truck could have an appointment time with a warehouse to prevent trucks from sitting in line. Newer technologies such as trucks that run on compressed natural gas also show promise to reduce harmful emissions as shown in the “infographic.” Current locations of alternative fuel stations are shown on our website, but if these new technologies were to become required by law in the Lamar Corridor Area, more locations would be vital for proper compliance by the freight industry.

Consistent with environmental justice concerns found around the country (and the world), it seems evident that industrial facilities have moved to lower-income areas where they could find land at lower prices. These facilities have further reduced the quality of life of these residents as they release toxics and other pollutants which pose health threats. (A “toxic” is defined as a chemical pollutant (to be differentiated from a “toxin,” which is produced by living cells or organisms) (Interview with Jim Holt and Dr. Jia regarding REACT, an extensive Air Monitor Project.).) As mentioned earlier, these already financially disadvantaged, lower-income families cannot afford to move away from these potentially dangerous polluters, especially as their house values may plummet after having an industrial facility move next door. However, as evidenced by the Income and Increased Health Risks layers in the website, the wealthiest residents in the Greater Memphis area able to move to less toxic areas, and also keep out industrial interests that would pollute their living situation.

For the less fortunate lower-income residents, there seems to be a need of regulatory measures to ensure their well-being. For example, when examining the zoning and neighborhood boundaries in Lamar Avenue with the website, it becomes apparent that there are numerous areas near Lamar Avenue where industrial facilities border residential neighborhoods, including those neighborhoods of particular interest to the study being conducted by National Center for Freight and Infrastructure Research and Education (CFIRE) at UW-Madison. One is left to wonder if changes in urban planning could have prevented such problems, and if the creation of buffer zones could alleviate some of the current troubles faced by the residents of Lamar Avenue. In the case of

rezoning certain locations to industrial, we must then consider the immense financial burden of relocation for hundreds if not thousands of residents who already face financial hardships. Would precautions be taken to prevent the cause of further difficulties for the people who live near Lamar Avenue?

Finally, we mention that this website may also help aid in the determination of a proper location for air monitors as part of the Reducing Exposure to Airborne Chemical Toxics (REACT) study. The REACT study is a comprehensive air toxics study to measure levels of toxic air pollutants in the Memphis area that is funded by the U.S. Environmental Protection Agency, where an air monitor will be placed in each census tract four times a year to measure air pollutants (Reducing Exposure to Airborne Chemical Toxics (REACT).). By locating schools within both the neighborhoods of interest to CFIRE and within each census tract, researchers can find secure and relevant site for each air monitor. In addition, the data classification of the Average Annual Daily Traffic data (from the Department of Transportation Highway Performance Monitoring System) and congested intersections found on the website can provide justification for the need of air monitors near particularly busy intersections. Mixing the traffic data, satellite view, and zoning data can also provide a clue as to where control areas would be located, so researchers can determine what the “normal” levels of chemicals present in the air are in locations of low traffic and low industry.

While our project at times seems to have raised as many questions as answers, our websites should be able to provide a resource to the community at large, where academics, researchers, policy-makers, students, and the general public alike can find a way to investigate and explore the many varied connections between policy, environmental factors, health, and livability.

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Appendix A

HTML, CSS, and JavaScript Code

Memphis-Lamar Avenue Corridor
Interactive Visualization Site
and
Historic Timeline Site

```
<!DOCTYPE html>
<html lang="en">
    <head>
        <meta charset="utf-8">
        <meta http-equiv="X-UA-Compatible" content="IE=edge">
        <meta name="viewport" content=
        "initial-scale=1,user-scalable=no,maximum-scale=1,width=device-width">
        <meta name="apple-mobile-web-app-capable" content="yes">
        <meta name="description" content="">
        <meta name="author" content="">
        <title>Lamar Corridor and Greater Memphis Interactive Map</title>

        <!-- Core CSS -->
        <link href="https://netdna.bootstrapcdn.com/bootstrap/3.0.2/css/bootstrap.min.css" rel=
        "stylesheet" type="text/css">
        <link href="https://netdna.bootstrapcdn.com/font-awesome/4.0.3/css/font-awesome.min.css"
         rel="stylesheet" type="text/css">
        <link href="assets/typeahead.js/typeahead.js-bootstrap.css" rel="stylesheet" type=
        "text/css">
        <link href="css/leaflet.css" rel="stylesheet" type="text/css">


        <!-- HTML5 shim and Respond.js IE8 support of HTML5 elements and media queries -->
        <!--[if lt IE 9]>
            <script src="//cdnjs.cloudflare.com/ajax/libs/html5shiv/3.6.2/html5shiv.js"></script>
            <script src="//cdnjs.cloudflare.com/ajax/libs/respond.js/1.2.0/respond.js"></script>
        <![endif]-->
    </head>

    <body>
        <div class="navbar navbar-inverse navbar-fixed-top">
            <div class="navbar-header">
                <button type="button" class="navbar-toggle btn" data-toggle="collapse"
                data-target=".navbar-collapse" style="height: 34px; padding: 5px 10px;
                margin-right: 10px;"><i class="fa fa-ellipsis-v" style="color: white"
                ></i></button>
                <button id="toggle" type="button" class="navbar-toggle btn" style="height:
                34px; padding: 5px 10px; margin-right: 10px;"><i id="toggleIcon" class="fa
                fa-check-square-o" style="color: white"></i></button>
                <a class="navbar-brand" href="#">Lamar Corridor</a>
            </div>
            <div class="navbar-collapse collapse" id="navbar-collapse">
                 <form class="navbar-form navbar-right">
                    <div class="links-565">
                        <button  type="image" id="reset" class="btn reset btn btn-primary" >
                        Reset Map</button>
                        <a href="img/infographic.png" target="_blank">
                            <img src="img/infographicButton2.png" alt="Infographic Button"
                            height="40px">
                        </a>
                        <a href="
                        https://mywebspace.wisc.edu/greenstreet/web/Memphis/examples/timeline.htm
                        l" target="_blank">
                            <img src="img/timelineButton2.png" alt="Timeline Button"height=
```

```
                    "40px">
                </a>
                <a href="data/statistics.pdf" target="_blank">
                    <img src="img/statisticsButton2.png" alt="Statistics Button"height=
                    "40px">
                </a>
                <a href="data/paperPDF.pdf" target="_blank">
                    <img src="img/paperButton2.png" alt="Project Paper Button" height=
                    "40px">
                </a>
                <a href="img/LamarAvenue-Map_Zoning_Schools.png" target="_blank">
                    <img src="img/mapGalleryButton2.png" alt="Map Gallery Button" height
                    ="40px">
                </a>
                <a href="data/Attributions.pdf" target="_blank">
                    <img src="img/attributionsButton2.png" alt="Attributions Button"
                    height="40px">
                </a>

            </div>
        </form>
    </div><!--/.navbar-collapse -->
</div>

<div id="sidebarAndMap">

    <!--container begins here-->
    <div class="row" id="container">
        <div class="col-sm-3 col-lg-3" id="sidebar" style="padding: 10px; overflow:
        auto;">


            <div class="tab-content" style="padding-top: 10px;">
                <div class="tab-pane active" id="layers">
                    <div class="panel-group">
                        <div class="panel panel-default">
                            <div class="panel-heading">
                                <a class="accordion-toggle" data-toggle="collapse"
                                data-parent="#accordion_" href="#overlay-layers">
                                   Greenprint
                                </a>
                            </div>
                            <div id="overlay-layers" class="panel-collapse collapse in">
                                <div class="panel-body" style="padding: 0px 15px;">
                                    <div class="checkbox">
                                        <label>
                                            <input type="checkbox" name="overlayLayers"
                                            id="geojson">
                                            Bike Score (Bikeability)
                                        </label>
                                    </div>
                                    <div class="checkbox">
                                        <label>
                                            <input type="checkbox" name="overlayLayers"
```

```
                                    id="brownfields">
                                    Brownfields (Downtown Memphis)
                                </label>
                            </div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name="overlayLayers"
                                    id="alterFuel" >
                                    Alternative Fuel Stations
                                </label>
                            </div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name="overlayLayers"
                                    id="grocers">
                                    Grocers
                                </label>
                            </div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name="overlayLayers"
                                    id="healthCenters2">
                                    Health Centers
                                </label>
                            </div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name="overlayLayers"
                                    id="hospitalsVar">
                                    Hospitals
                                </label>
                            </div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name="overlayLayers"
                                    id="parksVar">
                                    Parks
                                </label>
                            </div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name="overlayLayers"
                                    id="schoolsVar">
                                    Schools
                                </label>
                            </div>
                        </div>
                    </div>
                </div>
            <div class="panel panel-default">
                    <div class="panel-heading">
                        <a class="accordion-toggle" data-toggle="collapse"
                        data-parent="#accordion_" href="#overlay-layers2">
                           Historical Maps
```

```
                    </a>
                </div>
                <div id="overlay-layers2" class="panel-collapse collapse">
                    <div class="panel-body" style="padding: 0px 15px;">
                        <div class="checkbox">
                            <label>
                                <input type="checkbox" name="overlayLayers"
                                id="histMap">
                                Historical Map
                            </label>
                        </div>
                        <div class="checkbox">
                            <label>
                                <input type="checkbox" name="overlayLayers"
                                id="histMap2">
                                Historical Map 1922
                            </label>
                        </div>
                        <div class="checkbox">
                            <label>
                                <input type="checkbox" name="overlayLayers"
                                id="histMap3">
                                Historical Map 1964
                            </label>
                        </div>
                        <div class="checkbox">
                            <label>
                                <input type="checkbox" name="overlayLayers"
                                id="histMap5">
                                Historical Map 1936
                            </label>
                        </div>
                    </div>
                </div>
            </div>
            <div class="panel panel-default">
                <div class="panel-heading">
                    <a class="accordion-toggle" data-toggle="collapse"
                    data-parent="#accordion_" href="#overlay-layers3">
                       Aerotropolis
                    </a>
                </div>
                <div id="overlay-layers3" class="panel-collapse collapse">
                    <div class="panel-body" style="padding: 0px 15px;">
                        <div class="checkbox">
                            <label>
                                <input type="checkbox" name="overlayLayers"
                                id="aeroMap">
                                Aerotropolis Map
                            </label>
                        </div>
                    </div>
                </div>
            </div>
```

```
<div class="panel panel-default">
    <div class="panel-heading">
        <a class="accordion-toggle" data-toggle="collapse"
        data-parent="#accordion_" href="#overlay-layers4">
            Noise Maps
        </a>
    </div>
    <div id="overlay-layers4" class="panel-collapse collapse ">
        <div class="panel-body" style="padding: 0px 15px;">
            <div class="checkbox">
                <label>
                    <input type="checkbox" name="overlayLayers"
                    id="noiseMap">
                    FAA MEM Noise Map
                </label>
            </div>
            <div class="checkbox">
                <label>
                    <input type="checkbox" name="overlayLayers"
                    id="roadNoiseMap">
                    Road Noise Map
                </label>
            </div>
        </div>
    </div>
</div>
<div class="panel panel-default">
    <div class="panel-heading">
        <a class="accordion-toggle" data-toggle="collapse"
        data-parent="#accordion_" href="#overlay-layers5">
          Traffic Congestion
        </a>
    </div>
    <div id="overlay-layers5" class="panel-collapse collapse ">
        <div class="panel-body" style="padding: 0px 15px;">
            <div class="checkbox">
                <label>
                    <input type="checkbox" name="overlayLayers"
                    id="congestedIntersectionsVar1">
                    Intersection: "C" Rating
                </label>
            </div>
            <div class="checkbox">
                <label>
                    <input type="checkbox" name="overlayLayers"
                    id="congestedIntersectionsVar2">
                    Intersection: "D" Rating
                </label>
            </div>
             <div class="checkbox">
                <label>
                    <input type="checkbox" name="overlayLayers"
                    id="congestedIntersectionsVar3">
                    Intersection: "F" Rating
```

```
                        </label>
                    </div>
                </div>
            </div>
            <div class="panel panel-default">
                <div class="panel-heading">
                    <a class="accordion-toggle" data-toggle="collapse"
                    data-parent="#accordion_" href="#overlay-layers7">
                      Pollution
                    </a>
                </div>
                <div id="overlay-layers7" class="panel-collapse collapse">
                    <div class="panel-body" style="padding: 0px 15px;">
                        <div class="checkbox">
                        <label>
                            <input type="checkbox" name="overlayLayers" id=
                            "weightedEPApollutersVar">
                            Pollution Density
                        </label>
                        </div>
                         <div class="checkbox">
                        <label>
                            <input type="checkbox" name="overlayLayers" id=
                            "locationsFinedByEPAVar">
                            Locations Fined By EPA: Click on an icon for
                            more information
                        </label>
                    </div>
                    </div>
                </div>
            </div>
             <div class="panel panel-default">
                <div class="panel-heading">
                    <a class="accordion-toggle" data-toggle="collapse"
                    data-parent="#accordion_" href="#overlay-layers8">
                      Increased Health Risks
                    </a>
                </div>
                <div id="overlay-layers8" class="panel-collapse collapse">
                    <div class="panel-body" style="padding: 0px 15px;">
                        <div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name=
                                    "overlayLayers" id="NATAdata1Var">
                                    Respiratory Risks (EPA NATA 2005 Data)
                                </label>
                            </div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name=
                                    "overlayLayers" id="NATAdata2Var">
                                    Cancer Risks (EPA NATA 2005 Data)
```

```
                                    </label>
                                </div>

                            </div>
                        </div>
                    </div>
                </div>
                <div class="panel panel-default">
                    <div class="panel-heading">
                        <a class="accordion-toggle" data-toggle="collapse"
                        data-parent="#accordion_" href="#overlay-layers9">
                          Demographics
                        </a>
                    </div>
                    <div id="overlay-layers9" class="panel-collapse collapse">
                        <div class="panel-body" style="padding: 0px 15px;">
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name="overlayLayers"
                                    id="smartLocationDatabaseVar6">
                                    Population Density
                                </label>
                            </div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name="overlayLayers"
                                    id="incomeVar">
                                    Income
                                </label>
                            </div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name="overlayLayers"
                                    id="demographicsVar1">
                                    Percentage African American
                                </label>
                            </div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name="overlayLayers"
                                    id="demographicsVar2">
                                    Percentage Hispanic
                                </label>
                            </div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name="overlayLayers"
                                    id="demographicsVar3">
                                    Percentage Native American
                                </label>
                            </div>
                             <div class="checkbox">
                                <label>
                                    <input type="checkbox" name="overlayLayers"
```

```
                                    id="demographicsVar4">
                                    Percentage Asian American
                                </label>
                            </div>
                        </div>
                    </div>
                </div>
                <div class="panel panel-default">
                    <div class="panel-heading">
                        <a class="accordion-toggle" data-toggle="collapse"
                        data-parent="#accordion_" href="#overlay-layers10">
                          EPA Smart Location Database
                        </a>
                    </div>
                    <div id="overlay-layers10" class="panel-collapse collapse">
                        <div class="panel-body" style="padding: 0px 15px;">
                            <div>
                                <div class="checkbox">
                                    <label>
                                        <input type="checkbox" name=
                                        "overlayLayers" id=
                                        "smartLocationDatabaseVar1" >
                                        Housing Units Per Acre
                                    </label>
                                </div>
                                <div class="checkbox">
                                    <label>
                                        <input type="checkbox" name=
                                        "overlayLayers" id=
                                        "smartLocationDatabaseVar2" >
                                        Jobs Per Acre
                                    </label>
                                </div>
                                <div class="checkbox">
                                    <label>
                                        <input type="checkbox" name=
                                        "overlayLayers" id=
                                        "smartLocationDatabaseVar3" >
                                        Jobs Per Household
                                    </label>
                                </div>
                                <div class="checkbox">
                                    <label>
                                        <input type="checkbox" name=
                                        "overlayLayers" id=
                                        "smartLocationDatabaseVar4" >
                                        Zero Car Households
                                    </label>
                                </div>
                                <div class="checkbox">
                                    <label>
                                        <input type="checkbox" name=
                                        "overlayLayers" id=
                                        "smartLocationDatabaseVar5" >
```

```
                                        Low Wage Workers (Earning $1250/mo or
                                        less)
                                    </label>
                                </div>
                            </div>

                        </div>
                    </div>
                <div class="panel panel-default">
                    <div class="panel-heading">
                        <a class="accordion-toggle" data-toggle="collapse"
                        data-parent="#accordion_" href="#overlay-layers11">
                          USDA Food Atlas
                        </a>
                    </div>
                    <div id="overlay-layers11" class="panel-collapse collapse">
                        <div class="panel-body" style="padding: 0px 15px;">
                            <div>
                                <div class="checkbox">
                                    <label>
                                        <input type="checkbox" name=
                                        "overlayLayers" id="foodAtlasVar2" >
                                        Low-Income People with Low Food Access
                                        (urban: 1/2 mile, rural: 10 miles)
                                    </label>
                                </div>
                                <div class="checkbox">
                                    <label>
                                        <input type="checkbox" name=
                                        "overlayLayers" id="foodAtlasVar3" >
                                        Children Age 0-17 with Low Food Access
                                        at 1/2 Mile
                                    </label>
                                </div>
                                <div class="checkbox">
                                    <label>
                                        <input type="checkbox" name=
                                        "overlayLayers" id="foodAtlasVar4" >
                                        Seniors age 65+ with Low Food Access at
                                        1/2 Mile
                                    </label>
                                </div>
                                <div class="checkbox">
                                    <label>
                                        <input type="checkbox" name=
                                        "overlayLayers" id="foodAtlasVar5" >
                                        Housing units without vehicles, with
                                        low food access at 1/2 mile
                                    </label>
                                </div>

                            </div>
```

```
                </div>
            </div>
        </div>
        <div class="panel panel-default">
            <div class="panel-heading">
                <a class="accordion-toggle" data-toggle="collapse"
                data-parent="#accordion_" href="#overlay-layers12">
                  Zoning
                </a>
            </div>
            <div id="overlay-layers12" class="panel-collapse collapse">
                <div class="panel-body" style="padding: 0px 15px;">
                    <div>
                        <div class="checkbox">
                            <label>
                                <input type="checkbox" name=
                                "overlayLayers" id="zoningVar">
                                Memphis Zoning
                            </label>
                        </div>
                    </div>
                </div>
            </div>
        </div>
        <div class="panel panel-default">
            <div class="panel-heading">
                <a class="accordion-toggle" data-toggle="collapse"
                data-parent="#accordion_" href="#overlay-layers13">
                  EPA Monitor Locations
                </a>
            </div>
            <div id="overlay-layers13" class="panel-collapse collapse">
                <div class="panel-body" style="padding: 0px 15px;">
                    <div>
                        <div class="checkbox">
                            <label>
                                <input type="checkbox" name=
                                "overlayLayers" id=
                                "currentEPAMonitorVar">
                                Current EPA Monitor Location
                            </label>
                        </div>
                        <div class="checkbox">
                            <label>
                                <input type="checkbox" name=
                                "overlayLayers" id=
                                "proposedEPAMonitorsVar">
                                Proposed EPA Monitor Locations
                            </label>
                        </div>

                    </div>
                </div>
            </div>
```

```
</div>
<div class="panel panel-default">
    <div class="panel-heading">
        <a class="accordion-toggle" data-toggle="collapse"
        data-parent="#accordion_" href="#overlay-layers14">
          CFIRE Information
        </a>
    </div>
    <div id="overlay-layers14" class="panel-collapse collapse">
        <div class="panel-body" style="padding: 0px 15px;">
            <div>
                <div class="checkbox">
                    <label>
                        <input type="checkbox" name=
                        "overlayLayers" id="neighborhoodsVar">
                        Neighborhoods of Interest
                    </label>
                </div>
                <div class="checkbox">
                    <label>
                        <input type="checkbox" name=
                        "overlayLayers" id=
                        "lamarAreaFreightFacilitiesVar">
                        Lamar Area Freight Facilities
                    </label>
                </div>
                <div class="checkbox">
                    <label>
                        <input type="checkbox" name=
                        "overlayLayers" id="publicWarehousesVar">
                        Public Warehouses
                    </label>
                </div>
                <div class="checkbox">
                    <label>
                        <input type="checkbox" name=
                        "overlayLayers" id=
                        "proposedIntermodalYardVar">
                        Proposed Intermodal Yard (Collierville:
                        East of Lamar Ave)
                    </label>
                </div>
                <div class="checkbox">
                    <label>
                        <input type="checkbox" name=
                        "overlayLayers" id="warehousesVar">
                        Warehouses
                    </label>
                </div>
                <div class="checkbox">
                    <label>
                        <input type="checkbox" name=
                        "overlayLayers" id=
                        "distributionCentersVar">
```

```
                                    Distribution Centers
                                </label>
                            </div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name=
                                    "overlayLayers" id=
                                    "freightFacilitiesVar">
                                    Freight Facilities
                                </label>
                            </div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name=
                                    "overlayLayers" id="truckTerminalsVar">
                                    Truck Terminals
                                </label>
                            </div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name=
                                    "overlayLayers" id=
                                    "intermodalTerminalsVar">
                                    Intermodal Terminals
                                </label>
                            </div>



                        </div>
                    </div>
                </div>
            </div>
            <div class="panel panel-default">
                <div class="panel-heading">
                    <a class="accordion-toggle" data-toggle="collapse"
                    data-parent="#accordion_" href="#overlay-layers15">
                    Census Tracts
                    </a>
                </div>
                <div id="overlay-layers15" class="panel-collapse collapse">
                    <div class="panel-body" style="padding: 0px 15px;">
                        <div>
                            <div class="checkbox">
                                <label>
                                    <input type="checkbox" name=
                                    "overlayLayers" id="censusTractsVar">
                                    Shelby County 2013 Census Tracts
                                </label>
                            </div>
                        </div>
                    </div>
                </div>
            </div>
```

```
                        <div class="panel panel-default">
                            <div class="panel-heading">
                                <a class="accordion-toggle" data-toggle="collapse"
                                data-parent="#accordion_" href="#overlay-layers16">
                                Transportation
                                </a>
                            </div>
                            <div id="overlay-layers16" class="panel-collapse collapse">
                                <div class="panel-body" style="padding: 0px 15px;">
                                    <div>
                                        <div class="checkbox">
                                            <label>
                                                <input type="checkbox" name=
                                                "overlayLayers" id="railLinesVar">
                                                Rail Lines   (NTAD 2013)
                                            </label>
                                        </div>
                                        <div class="checkbox">
                                            <label>
                                                <input type="checkbox" name=
                                                "overlayLayers" id="railNodesVar">
                                                Rail Nodes   (NTAD 2013)
                                            </label>
                                        </div>
                                        <div class="checkbox">
                                            <label>
                                                <input type="checkbox" name=
                                                "overlayLayers" id="HPMSRoadsVar">
                                                Roads   (NTAD 2013: HPMS)
                                            </label>
                                        </div>


                                    </div>
                                </div>
                            </div>
                        </div>
                    </div> <!-- panel group div-->
                </div>
            </div>
        </div>

        <!--map begins here-->
        <div class="col-sm-9 col-lg-9" id="map">
            <!--
            <input type="image" id="reset" class="reset" src="img/resetButton.png"
            alt="Reset Button">
            -->
        </div>
        <!--map ends here-->
    </div>
    <!--container ends here-->
<div>
<!--sidebarAndMap ends here-->
```

```
        <div class="modal fade" id="legendModal">
            <div class="modal-dialog">
                <div class="modal-content">
                    <div class="modal-header">
                        <button type="button" class="close" data-dismiss="modal" aria-hidden=
                        "true">&times;</button>
                        <h4 class="modal-title">Map Legend</h4>
                    </div>
                    <div class="modal-body">
                        <p>Map Legend goes here...</p>
                    </div>
                </div><!-- /.modal-content -->
            </div><!-- /.modal-dialog -->
        </div><!-- /.modal -->

       <!--data layers stored as js-->

        <!--Shapefiles stored as GeoJSON files. (These contain all the data for the points,
        lines, and polygons.)-->
        <script type="text/javascript" src="data/greenprint_SLD.js"></script>
        <script type="text/javascript" src="data/shapefile2.js"></script>
        <script type="text/javascript" src="data/zoning.js"></script>
        <script type="text/javascript" src="data/neighborhoods.js"></script>
        <script type="text/javascript" src="data/parks.js"></script>
        <script type="text/javascript" src="data/shelbyCounty2013CensusTracts.js"></script>
        <script type="text/javascript" src="data/proposedIntermodalYard.js"></script>
        <script type="text/javascript" src="data/railLines.js"></script>
        <script type="text/javascript" src="data/HPMS_Roads_ShelbyCounty.js"></script>

        <script type="text/javascript" src="https://code.jquery.com/jquery-1.10.2.min.js"
        ></script>
        <script type="text/javascript" src=
        "https://netdna.bootstrapcdn.com/bootstrap/3.0.2/js/bootstrap.min.js"></script>
        <script type="text/javascript" src="assets/typeahead.js/typeahead.min.js"></script>
        <!--https://github.com/twitter/typeahead.js/-->
        <script type="text/javascript" src="js/leaflet.js"></script>


    </body>
</html>
```

```
html, body{
    height: 100%;
    margin: 0px;
}
body {
    padding-top: 50px;
}
label {
    font-weight: normal;
}
#sidebarAndMap{
    height:100%;

}
#sidebar, #container {
    height: 100%;
    margin: 0px;
}

.table {
    margin-bottom: 0px;
}

#map {
    height: 100%;
    margin: 0px;
    -webkit-box-shadow: 0 -1px 10px rgba(0,0,0,0.5);
    -moz-box-shadow: 0 -1px 10px rgba(0,0,0,0.5);
    box-shadow: 0 -1px 10px rgba(0,0,0,0.5);
}

.info {
    padding: 6px 8px;
    font: 14px/16px Arial, Helvetica, sans-serif;

    background: rgba(122,122,122,0.8);
    box-shadow: 0 0 15px rgba(0,0,0,0.2);
    border-radius: 5px;
}
.info h4 {
    margin: 0 0 5px;
    color: #777;
}

.legend {
    text-align: left;
    line-height: 18px;
    color: #555;
    background-color: white;
}
.legend i {
    width: 18px;
    height: 18px;
    float: left;
```

```
    margin-right: 8px;
    opacity: 0.7;
}

.BikeScoreInfo {
    padding: 6px 8px;
    font: 14px/16px Arial, Helvetica, sans-serif;

    background: white;
    box-shadow: 0 0 15px rgba(0,0,0,0.2);
    border-radius: 5px;
}
.BikeScoreInfo h4 {
    margin: 0 0 5px;
    color: #777;
}

.Neighborhoods{
     padding: 6px 8px;
    font: 14px/16px Arial, Helvetica, sans-serif;

    background: white;
    box-shadow: 0 0 15px rgba(0,0,0,0.2);
    border-radius: 5px;
}
.Neighborhoods h4 {
    margin: 0 0 5px;
    color: #777;
}

.weightedEPApollutersVarInfo {
padding: 6px 8px;
    font: 14px/16px Arial, Helvetica, sans-serif;
    background: white;
    box-shadow: 0 0 15px rgba(0,0,0,0.2);
    border-radius: 5px;
}
.weightedEPApollutersVarInfo h4 {
    margin: 0 0 5px;
    color: #777;
}

.Respiratory {
padding: 6px 8px;
    font: 14px/16px Arial, Helvetica, sans-serif;
    background: white;
    box-shadow: 0 0 15px rgba(0,0,0,0.2);
    border-radius: 5px;
}
.Respiratory h4 {
    margin: 0 0 5px;
    color: #777;
}
```

```
.Cancer_Risk {
    padding: 6px 8px;
    font: 14px/16px Arial, Helvetica, sans-serif;
    background: white;
    box-shadow: 0 0 15px rgba(0,0,0,0.2);
    border-radius: 5px;
}
.Cancer_Risk h4 {
    margin: 0 0 5px;
    color: #777;
}

.demographicsInfo2 {
    padding: 6px 8px;
    font: 14px/16px Arial, Helvetica, sans-serif;
    background: white;
    box-shadow: 0 0 15px rgba(0,0,0,0.2);
    border-radius: 5px;
}
.demographicsInfo2 h4 {
    margin: 0 0 5px;
    color: #777;
}

.FoodAtlas5 {
    padding: 6px 8px;
    font: 14px/16px Arial, Helvetica, sans-serif;
    background: white;
    box-shadow: 0 0 15px rgba(0,0,0,0.2);
    border-radius: 5px;
}
.FoodAtlas5h4 {
    margin: 0 0 5px;
    color: #777;
}

.demographicsInfo1 {
    padding: 6px 8px;
    font: 14px/16px Arial, Helvetica, sans-serif;
    background: white;
    box-shadow: 0 0 15px rgba(0,0,0,0.2);
    border-radius: 5px;
}
.demographicsInfo1 h4 {
    margin: 0 0 5px;
    color: #777;
}

.demographicsInfo3 {
    padding: 6px 8px;
    font: 14px/16px Arial, Helvetica, sans-serif;
    background: white;
    box-shadow: 0 0 15px rgba(0,0,0,0.2);
    border-radius: 5px;
```

```
}
.demographicsInfo3 h4 {
    margin: 0 0 5px;
    color: #777;
}

.demographicsInfo4 {
    padding: 6px 8px;
    font: 14px/16px Arial, Helvetica, sans-serif;
    background: white;
    box-shadow: 0 0 15px rgba(0,0,0,0.2);
    border-radius: 5px;
}
.demographicsInfo4 h4 {
    margin: 0 0 5px;
    color: #777;
}

.smartLocationDatabase1Info {

    padding: 6px 8px;
    font: 14px/16px Arial, Helvetica, sans-serif;
    background: white;
    box-shadow: 0 0 15px rgba(0,0,0,0.2);
    border-radius: 5px;
}
.smartLocationDatabase1Info h4 {
    margin: 0 0 5px;
    color: #777;
}

.FoodAtlas2 {
    padding: 6px 8px;
    font: 14px/16px Arial, Helvetica, sans-serif;
    background: white;
    box-shadow: 0 0 15px rgba(0,0,0,0.2);
    border-radius: 5px;
}
.FoodAtlas2 h4 {
    margin: 0 0 5px;
    color: #777;
}
.FoodAtlas3 {
    padding: 6px 8px;
    font: 14px/16px Arial, Helvetica, sans-serif;
    background: white;
    box-shadow: 0 0 15px rgba(0,0,0,0.2);
    border-radius: 5px;
}
.FoodAtlas3 h4 {
    margin: 0 0 5px;
    color: #777;
}
```

```
#loading {
    position: absolute;
    width: 220px;
    height: 19px;
    top: 50%;
    left: 50%;
    margin: -10px 0 0 -110px;
    z-index: 20001;
}
.navbar .navbar-brand {
    font-weight: bold;
    font-size: 22px;
    color: white;
    white-space: nowrap;

}
.navbar {
      background-color: #2f2f2f;
}
.navbar-collapse.in {
    overflow-y: hidden;
}
.tt-dropdown-menu {
    overflow: auto;
}
.tt-hint, .tt-query {
    display: block;
    width: 100%;
    height: 34px;
    padding: 6px 12px;
    font-size: 14px;
    border-radius: 4px;
}
.typeahead-header {
    margin: 0 5px 5px 5px;
    padding: 3px 0;
    border-bottom: 1px solid #ccc;
}
.search-container {
    width: 250px;
}
#searchbox {
    -webkit-border-top-left-radius: 4px;
    -webkit-border-bottom-left-radius: 4px;
    -moz-border-top-left-radius: 4px;
    -moz-border-bottom-left-radius: 4px;
    border-top-left-radius: 4px;
    border-bottom-left-radius: 4px;
}
.leaflet-popup-content {
    margin-top: 5px;
    margin-bottom: 5px;
    margin-left: 5px;
    margin-right: 5px;
```

```
}
.leaflet-popup-content-wrapper {
    border-radius: 5px;
}
.panel-heading a:hover {
    text-decoration: none;
}
@media (max-width: 992px) {
    .navbar .navbar-brand {
        font-size: 18px;
        float: left;

    }
    .search-container {
        width: 150px;
    }
    .leaflet-control-attribution {
        display: none;
    }
}
@media (max-width: 767px){
    .search-container {
        width: 100%;
    }
}
/* Print Handling */
@media print {
    .navbar, .toggle, #sidebar {
        display: none !important;

    }
}
```

```
var map;

$(document).ready(function() {
    $("[rel=tooltip]").tooltip();
    if (document.body.clientWidth <= 767) {
        $("#map").css("class", "col-sm-12 col-lg-12");
        $("#sidebar").css("display", "none");
    };
});
$(window).resize(function() {
    $(".tt-dropdown-menu").css("max-height", $("#container").height()-$(".navbar").height()-20);
    if (document.body.clientWidth <= 767) {
        $("#map").css("class", "col-sm-12 col-lg-12");
        $("#sidebar").css("display", "none");
    } else {
        $("#map").css("class", "col-sm-9 col-lg-9");
        $("#sidebar").css("display", "block");
    };
});

$("#toggle").click(function() {
    $("#toggle i").toggleClass("fa fa-check-square-o fa fa-map-marker");
    $("#map").toggleClass("col-sm-9 col-lg-9 col-sm-12 col-lg-12");
    $("#sidebar").toggle();
    if (document.body.clientWidth <= 767) {
        $("#map").toggle();
    };
    map.invalidateSize();
    return false;
});

////////How to remove basemap layers----------------------------------------------------------
$("input[name='basemapLayers']").change(function () {
    // Remove unchecked layers
    $("input:radio[name='basemapLayers']:not(:checked)").each(function () {
        map.removeLayer(window[$(this).attr("id")]);
    });
    // Add checked layer
    $("input:radio[name='basemapLayers']:checked").each(function () {
        map.addLayer(window[$(this).attr("id")]);
    });
});
///////End how to remove basemap layers----------------------------------------------------------


////////How to add/remove overlay layers----------------------------------------------------------
$("input:checkbox[name='overlayLayers']").change(function () {
    var layers = [];
    function sortByKey(array, key) {
        return array.sort(function (a, b) {
            var x = a[key];
            var y = b[key];
```

```
            return ((x < y) ? -1 : ((x > y) ? 1 : 0));
        });
    }
    if ($("#" + $(this).attr("id")).is(":checked")) {
        $("input:checkbox[name='overlayLayers']").each(function () {
            // Remove all overlay layers
            map.removeLayer(window[$(this).attr("id")]);
            if ($("#" + $(this).attr("id")).is(":checked")) {
                // Add checked layers to array for sorting
                layers.push({
                    "z-index": $(this).attr("z-index"),
                    "layer": $(this)
                });
            }
        });
        // Sort layers array by z-index
        var orderedLayers = sortByKey(layers, "z-index");
        // Loop through ordered layers array and add to map in correct order
        $.each(orderedLayers, function () {
            map.addLayer(window[$(this)[0].layer[0].id]);
        });
    } else {
        // Simply remove unchecked layers
        map.removeLayer(window[$(this).attr("id")]);

    }
});
////////End how to add/remove overlay layers----------------------------------------------------


//personalized vector basemap
var mapquestOSM =  L.tileLayer(
    'https://a.tiles.mapbox.com/v3/maira1991.gjkaio59/{z}/{x}/{y}.png',
    {attribution: 'Made with: <a href="http://mapbox.com">TileMill</a> Map data &copy; <a
    href="http://openstreetmap.org">OpenStreetMap</a> contributors'
    });

//satellite view basemap
var mapquestOAM = L.tileLayer(
'https://services.arcgisonline.com/ArcGIS/rest/services/World_Imagery/MapServer/tile/{z}/{y}/{x}'
, {

});

var baseLayers = {
    "Streets": mapquestOSM,
    "Imagery": mapquestOAM,
};

//Restrict Bounds
var southWest = new L.LatLng(34.787876, -90.3);
var northEast = new L.LatLng(35.326222, -89.4);
var theBounds = new L.LatLngBounds(southWest, northEast);
```

```
map = L.map("map", {
    zoom: 13,
    minzoom: 8,
    maxzoom: 24,
    maxBounds: theBounds,
    center: new L.LatLng(35.054, -89.908),
    layers: [mapquestOSM]
});

function zoomToFeature(e) {
    map.fitBounds(e.target.getBounds());
}

function makePercent(inputNum){
    //catch NaNs
    if(isNaN(inputNum)){
        return "0%";
    }

    var num = new Number(100 * inputNum);
    var percentage1;
    if (num >= 1){
        percentage1 = num.toPrecision(2) + "%";
    } else {
        percentage1 = num.toPrecision(1) + "%";
    }
    return percentage1;
}

function formatNumber(inputNum){
    if(isNaN(inputNum)){
        return "--";
    }
    return inputNum.toFixed(0);
}

function formatNumberTo2(inputNum){
    if(isNaN(inputNum)){
        return "--";
    }
    return inputNum.toFixed(2);
}

function roundToProperPrecision(number){
    if (number > 1){
        return formatNumber(number - 1);
    } else {
        return (number - .01);
    }
}

function formatInfoToCorrectPrecision(number){
    if(number > 1){
        return formatNumber(number);
```

```
    } else {
        return formatNumberTo2(number);
    }
}

function formatLegend(to){
    if (to > 0){
        return "&ndash;" + to;
    } else if (to == 0) {
        return "";
    } else {
        return "+";
    }
}

//-------------------------------------------------------------
//BikeScore Data
//geojson == bikescore
var geojson = L.geoJson(greenprint_SLD, {
    style: bikeScoreStyle,
    onEachFeature: onEachFeature_bikeScore,
    layer: "bikeScore"
});

function bikeScoreStyle(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: myGetColor_bikeScore(feature.properties.BikeScore_)
    };
}

function onEachFeature_bikeScore(feature, layer) {
    layer.on({
        mouseover: highlightFeature_bikeScore,
        mouseout: resetHighlight_bikeScore,
        click: zoomToFeature
    });
}

function highlightFeature_bikeScore(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
```

```
        layer.bringToFront();
    }
    bikeScoreInfo.update(layer.feature.properties);
}

function resetHighlight_bikeScore(e) {
    geojson.resetStyle(e.target);
    bikeScoreInfo.update();
}


function myGetColor_bikeScore(d) {
    return d > 80 ? '#2b83ba' :
           d > 60  ? '#abdda4' :
           d > 40  ? '#ffffbf' :
           d > 20  ? '#fdae61' :
                     '#d7191c';
}

// control that shows state info on hover
var bikeScoreInfo = L.control({position: 'bottomleft'});

bikeScoreInfo.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'BikeScoreInfo');
    this.update();
    return this._div;
};

bikeScoreInfo.update = function (props) {
    //this is a test
    this._div.id = "geojson";
    this._div.class = "geojsonTest";

    this._div.innerHTML = '<h4>Bike Score</h4>' +  (props ?
        '<b>' + formatNumber(props.BikeScore_) + '</b><br />'
        : 'Hover over a Tract');
};

//legend
var legend = L.control({position: 'bottomright'});

legend.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        grades = [80, 60, 40, 20, 0],
        labels = [],
        from, to;

    for (var i = 0; i < grades.length; i++) {
        from = grades[i];
        to = (grades[i - 1] - 1);

        labels.push(
            '<i style="background:' + myGetColor_bikeScore(from + 1) + '"></i> ' +
```

```
            from + (to ? '&ndash;' + to : '&ndash;100'));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('geojson').onclick = function() {
    if (this.className === 'active') {
        legend.removeFrom(map);
        bikeScoreInfo.removeFrom(map);

        this.className = '';
    } else {
        legend.addTo(map);
        bikeScoreInfo.addTo(map);

        this.className = 'active';
        }
}

//---------------------------------------------------------------------

var grocers = L.geoJson(null, {
    pointToLayer: function (feature, latlng) {
        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/shoppingCart24px.png",
                iconSize: [24, 24],
                iconAnchor: [12, 12],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {




        }

});
$.getJSON("data/grocers.js", function (data) {
    grocers.addData(data);
});

var healthCenters2 = L.geoJson(null, {
    pointToLayer: function (feature, latlng) {
        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/plus24px_2.png",
                iconSize: [24, 24],
```

```
                iconAnchor: [12, 12],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {
    }

});
$.getJSON("data/healthCenters.json", function (data) {
    healthCenters2.addData(data);
});


 var brownfields = L.geoJson(null, {
    pointToLayer: function (feature, latlng) {
        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/hexagon-24.png",
                iconSize: [24, 24],
                iconAnchor: [12, 12],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {
    }

});
$.getJSON("data/brownfields.json", function (data) {
    brownfields.addData(data);
});

//alternative fuel
var alterFuel = L.geoJson(null, {
    pointToLayer: function (feature, latlng) {
        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/wind-turbine-24.png",
                iconSize: [24, 24],
                iconAnchor: [12, 12],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
```

```
    onEachFeature: function (feature, layer) {
        }

});
$.getJSON("data/alternative_fuel_stations.json", function (data) {
    alterFuel.addData(data);
});

var hospitalsVar = L.geoJson(null, {
    pointToLayer: function (feature, latlng) {
        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/H_24px.png",
                iconSize: [24, 24],
                iconAnchor: [12, 12],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {

        }

});
$.getJSON("data/hospital.js", function (data) {
    hospitalsVar.addData(data);
});

//---------------------------------------------------------------
//Parks
var parksVar = L.geoJson(parks, {
    style: parksStyle,
    onEachFeature: onEachFeature_parksVar
});

function parksStyle(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'brown',
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: '#00b454'
    };
}

function onEachFeature_parksVar(feature, layer) {
    layer.on({
        mouseover: highlightFeature_parksVar,
        mouseout: resetHighlight_parksVar,
        click: zoomToFeature
```

```
    });
}

function highlightFeature_parksVar(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    parksInfo.update(layer.feature.properties);
}

function resetHighlight_parksVar(e) {

    parksVar.resetStyle(e.target);
    parksInfo.update();
}

// control that shows state info on hover
var parksInfo = L.control({position: 'bottomleft'});

parksInfo.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'Neighborhoods');
    this.update();
    return this._div;
};

parksInfo.update = function (props) {
    this._div.innerHTML = '<h4>Parks</h4>' +  (props ?
        '<b>' + props.NAME + '</b><br />'
        : 'Hover over a tract');
};

document.getElementById('parksVar').onclick = function() {
    if (this.className === 'active') {
        parksInfo.removeFrom(map);

        this.className = '';
    } else {
        parksInfo.addTo(map);

        this.className = 'active';
        }
    }

//schools
```

```
var schoolsVar = L.geoJson(null, {
    pointToLayer: function (feature, latlng) {
        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/school24px.png",
                iconSize: [24, 24],
                iconAnchor: [12, 12],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {
    }

});
$.getJSON("data/school.js", function (data) {
    schoolsVar.addData(data);
});

///////----------------------------------------------------------------
///////__________Traffic Congestion____________
///////----------------------------------------------------------------

var grade_C_Icon = L.icon({
    iconUrl: 'data/C.png',
    // shadowUrl: 'leaf-shadow.png',

    iconSize:     [38, 95], // size of the icon
    shadowSize:   [50, 64], // size of the shadow
    iconAnchor:   [22, 94], // point of the icon which will correspond to marker's location
    shadowAnchor: [4, 62],  // the same for the shadow
    popupAnchor:  [-3, -76] // point from which the popup should open relative to the iconAnchor
});

var grade_D_Icon = L.icon({
    iconUrl: 'data/D.png',
    // shadowUrl: 'leaf-shadow.png',

    iconSize:     [38, 95], // size of the icon
    shadowSize:   [50, 64], // size of the shadow
    iconAnchor:   [22, 94], // point of the icon which will correspond to marker's location
    shadowAnchor: [4, 62],  // the same for the shadow
    popupAnchor:  [-3, -76] // point from which the popup should open relative to the iconAnchor
});

var grade_F_Icon = L.icon({
    iconUrl: 'data/F.png',
    // shadowUrl: 'leaf-shadow.png',

    iconSize:     [38, 95], // size of the icon
    shadowSize:   [50, 64], // size of the shadow
```

```
    iconAnchor:   [22, 94], // point of the icon which will correspond to marker's location
    shadowAnchor: [4, 62],  // the same for the shadow
    popupAnchor:  [-3, -76] // point from which the popup should open relative to the iconAnchor
});

//Intersections with a c rating
 var congestedIntersectionsVar1 = L.geoJson(null, {


    pointToLayer: function (feature, latlng) {

        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/C_24px.png",
                iconSize: [24, 24],
                iconAnchor: [12, 12],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {
        }

});
$.getJSON("data/intersections_C.js", function (data) {
    congestedIntersectionsVar1.addData(data);
});

//Intersections with a D rating
var congestedIntersectionsVar2 = L.geoJson(null, {


    pointToLayer: function (feature, latlng) {

        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/D_24px.png",
                iconSize: [24, 24],
                iconAnchor: [12, 12],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {
        }

});
$.getJSON("data/intersections_D.js", function (data) {
```

```
    congestedIntersectionsVar2.addData(data);
});

//Intersections with an F rating
var congestedIntersectionsVar3 = L.geoJson(null, {


    pointToLayer: function (feature, latlng) {

        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/F_24px.png",
                iconSize: [24, 24],
                iconAnchor: [12, 12],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {
    }

});
$.getJSON("data/intersections_F.js", function (data) {
    congestedIntersectionsVar3.addData(data);
});

///////-------------------------------------------------------------------
///////__________POLLUTION____________
///////-------------------------------------------------------------------
var weightedEPApollutersVar = L.geoJson(shapefile2, {
    style: weightedEPApollutersStyle,
    onEachFeature: onEachFeature_weightedEPApollutersVar
});

function weightedEPApollutersStyle(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: myGetColor_weightedEPApolluters((feature.properties.Join_Count)/(feature.
        properties.Area_EPA))
    };
}

function onEachFeature_weightedEPApollutersVar(feature, layer) {
        layer.on({
            mouseover: highlightFeature_weightedEPApollutersVar,
            mouseout: resetHighlight_weightedEPApollutersVar,
            click: zoomToFeature
```

```
        });
    }

function highlightFeature_weightedEPApollutersVar(e) {
        var layer = e.target;

        layer.setStyle({
            weight: 5,
            color: '#f00',
            dashArray: '',
            fillOpacity: 0.7
        });

        if (!L.Browser.ie && !L.Browser.opera) {
            layer.bringToFront();
        }

        weightedEPApollutersVarInfo.update(layer.feature.properties);

}

function resetHighlight_weightedEPApollutersVar(e) {

    weightedEPApollutersVar.resetStyle(e.target);
    weightedEPApollutersVarInfo.update();
}


function myGetColor_weightedEPApolluters(d) {
    return d > 134100  ? '#99000d' :
           d > 19040  ? '#ef3b2c' :
                        '#fcbba1';
}

// control that shows state info on hover
var weightedEPApollutersVarInfo = L.control({position: 'bottomleft'});

weightedEPApollutersVarInfo.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'weightedEPApollutersVarInfo');
    this.update();
    return this._div;
};

weightedEPApollutersVarInfo.update = function (props) {
    this._div.innerHTML = '<h4>Pollution Density</h4>' +  (props ?
        '<b>Pollution Density Rank: ' + getPollutionDensityRank((props.Join_Count)/(props.
        Area_EPA)) + '<br />' + props.NAMELSAD10 + '</b><br />'
        : 'Hover over a tract');
};

function getPollutionDensityRank(pollutionDensityNumber){
    return pollutionDensityNumber > 134100  ? 'Highest' :
           pollutionDensityNumber > 19040  ? 'High' :
                        'Medium';
```

```
}

//legend
var weightedEPApollutersLegend = L.control({position: 'bottomright'});

weightedEPApollutersLegend.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        grades = [1341000, 19040, 0],
        ranking = ['Highest', 'High', 'Medium'],
        labels = [],
        from, to;

    for (var i = 0; i < grades.length; i++) {
        from = grades[i];
        rank = ranking[i];
        to = grades[i + 1];

        labels.push(
            '<i style="background:' + myGetColor_weightedEPApolluters(from + 1) + '"></i> ' +
            rank);
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('weightedEPApollutersVar').onclick = function() {
    if (this.className === 'active') {
        weightedEPApollutersLegend.removeFrom(map);
        weightedEPApollutersVarInfo.removeFrom(map);

        this.className = '';
    } else {
        weightedEPApollutersLegend.addTo(map);
        weightedEPApollutersVarInfo.addTo(map);

        this.className = 'active';
        }
    }

///////-------------------------------------------------------------------
//Locations Fined By EPA
//Version 1.0: The GeoJSON File here creates the error "Error: Invalid GeoJSON Object" (?)
//Something about polyline contains a point...
//(Known Bug: Will be fixed in version 1.1.)

 var locationsFinedByEPAVar = L.geoJson(null, {
    pointToLayer: function (feature, latlng) {
        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/caution22px.png",
                iconSize: [24, 24],
                iconAnchor: [12, 28],
```

```
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {
        cleanupCostVar = layer.feature.properties.CleanupCost;

        var popUpInfo = "<p style='font-family:arial;color:black;font-size:16px;''> "+ layer.
        feature.properties.Name + "</p>"+
        " <p style='font-family:arial;color:red;font-size:14px;font-weight:bold;''> Fine By
        EPA: "+
        layer.feature.properties.PenaltiesAndFines + "</p>";

        if (cleanupCostVar != ""){
            popUpInfo += " <p
            style='font-family:arial;color:red;font-size:14px;font-weight:bold;''> " +
            "Cleanup Cost: " + layer.feature.properties.CleanupCost + "</p>";
        }

        if(feature.properties && feature.properties.popUpInfo){
          popUpInfo += feature.properties.popUpInfo;
        }
        layer.bindPopup(popUpInfo);
    }

});
$.getJSON("data/finedByEPA.js", function (data) {
    locationsFinedByEPAVar.addData(data);
});

//-------------------------------------------------------------------------
///////-----------------------------------------------------------------
///////Increased Health Risks/EPA NATA Data
///////-----------------------------------------------------------------
function getNATARank(nataNumber){
    return  nataNumber > 12  ? 'Greatest Risk' :
            nataNumber > 11  ? 'Greatly Increased Risk' :
            nataNumber > 10  ? 'Increased Risk' :
                      'Least Risk';
}

//
var NATAdata1Var = L.geoJson(shapefile2, {
    style: NATArisk1Style,
    onEachFeature: onEachFeature_NATAdata1Var
});

function NATArisk1Style(feature) {
    return {
        weight: 2,
        opacity: 1,
```

```
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.5,
        fillColor: myGetColor_NATAdata1(feature.properties.NewResp)

    };
}

function onEachFeature_NATAdata1Var(feature, layer) {
        layer.on({
            mouseover: highlightFeature_NATAdata1Var,
            mouseout: resetHighlight_NATAdata1Var,
            click: zoomToFeature
        });
    }

function highlightFeature_NATAdata1Var(e) {
        var layer = e.target;

        layer.setStyle({
            weight: 5,
            color: myGetColor_NATAdata1(layer.feature.properties.NewResp),
            dashArray: '',
            fillOpacity: 0.7
        });

        if (!L.Browser.ie && !L.Browser.opera) {
            layer.bringToFront();
        }

        NATAdata1Info.update(layer.feature.properties);
}

function resetHighlight_NATAdata1Var(e) {
    NATAdata1Var.resetStyle(e.target);
    NATAdata1Info.update();
}

function myGetColor_NATAdata1(d) {
    return d > 12  ? '#99000d' :
           d > 11  ? '#ef3b2c' :
           d > 10  ? '#fc9272' :
                     '#f7f7f7';
}

// control that shows state info on hover
var NATAdata1Info = L.control({position: 'bottomleft'});

NATAdata1Info.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'Respiratory');
    this.update();
    return this._div;
};
```

```
NATAdata1Info.update = function (props) {
    this._div.innerHTML = '<h4>Respiratory Risk Based on Environmental Factors</h4>' +  (props ?
        '<b>' + getNATARank(props.NewResp) + '</b><br />'
        : 'Hover over a tract');
};

//legend
var NATAdata1Legend1 = L.control({position: 'bottomright'});

NATAdata1Legend1.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        grades = [12, 11, 10, 0],
        ranking = ['Greatest Risk', 'Greatly Increased Risk', 'Increased Risk', 'Least Risk'],
        labels = [],
        from, to;

    for (var i = 0; i < grades.length; i++) {
        from = grades[i];
        rank = ranking[i];
        to = grades[i + 1];

        labels.push(
            '<i style="background:' + myGetColor_NATAdata1(from + 1) + '"></i> ' + rank);
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('NATAdata1Var').onclick = function() {
    if (this.className === 'active') {
        NATAdata1Legend1.removeFrom(map);
        NATAdata1Info.removeFrom(map);

        this.className = '';
    } else {
        NATAdata1Legend1.addTo(map);
        NATAdata1Info.addTo(map);

        this.className = 'active';
        }
    }
//-------------------------------------------------------------------------
//EPA NATA Data 2
var NATAdata2Var = L.geoJson(shapefile2, {
    style: NATArisk2Style,
    onEachFeature: onEachFeature_NATAdata2Var
});

function NATArisk2Style(feature) {
    return {
        weight: 2,
        opacity: 1,
```

```
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.5,
        fillColor: myGetColor_NATAdata2(feature.properties.NewCanRi)
    };
}

function onEachFeature_NATAdata2Var(feature, layer) {
        layer.on({
            mouseover: highlightFeature_NATAdata2Var,
            mouseout: resetHighlight_NATAdata2Var,
            click: zoomToFeature
        });
    }

function highlightFeature_NATAdata2Var(e) {
        var layer = e.target;

        layer.setStyle({
            weight: 5,
            color: myGetColor_NATAdata2(layer.feature.properties.NewCanRi),
            dashArray: '',
            fillOpacity: 0.7
        });

        if (!L.Browser.ie && !L.Browser.opera) {
            layer.bringToFront();
        }

        NATAdata2Info.update(layer.feature.properties);
}

function resetHighlight_NATAdata2Var(e) {
        NATAdata2Var.resetStyle(e.target);
        NATAdata2Info.update();
}

function myGetColor_NATAdata2(d) {
    return d > 12  ? '#99000d' :
           d > 11  ? '#ef3b2c' :
           d > 10  ? '#fc9272' :
                     '#f7f7f7';
}

// control that shows state info on hover
var NATAdata2Info = L.control({position: 'bottomleft'});

NATAdata2Info.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'Cancer_Risk');
    this.update();
    return this._div;
};

NATAdata2Info.update = function (props) {
```

```
    this._div.innerHTML = '<h4>Cancer Risk Based on Environmental Factors</h4>' +  (props ?
        '<b>' + getNATARank(props.NewCanRi) + '</b><br />'
        : 'Hover over a tract');
};

//legend
var NATAdataLegend2 = L.control({position: 'bottomright'});

NATAdataLegend2.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        grades = [12, 11, 10, 0],
        ranking = ['Greatest Risk', 'Greatly Increased Risk', 'Increased Risk', 'Least Risk'],
        labels = [],
        from, to;

    for (var i = 0; i < grades.length; i++) {
        from = grades[i];
        rank = ranking[i];
        to = grades[i + 1];

        labels.push(
            '<i style="background:' + myGetColor_NATAdata2(from + 1) + '"></i> ' + rank);
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('NATAdata2Var').onclick = function() {
    if (this.className === 'active') {
        NATAdataLegend2.removeFrom(map);
        NATAdata2Info.removeFrom(map);

        this.className = '';
    } else {

        NATAdataLegend2.addTo(map);
        NATAdata2Info.addTo(map);

        this.className = 'active';
        }
    };

//income ============================================================
//Variable 5: Housing units without vehicles, with low food access at 1/2 mile
var incomeVar = L.geoJson(shapefile2, {
    style: incomeStyle,
    onEachFeature: onEachFeature_incomeVar
});

function incomeStyle(feature) {
    return {
        weight: 2,
```

```
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.5,
        fillColor: myGetColor_incomeVar(feature.properties.MedIncome)
    };
}

function onEachFeature_incomeVar(feature, layer) {
    layer.on({
        mouseover: highlightFeature_incomeVar,
        mouseout: resetHighlight_incomeVar,
        click: zoomToFeature
    });
}

function highlightFeature_incomeVar(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    incomeInfo.update(layer.feature.properties);
}

function resetHighlight_incomeVar(e) {
    incomeVar.resetStyle(e.target);
    incomeInfo.update();
}


function myGetColor_incomeVar(d) {
    return d > 100000 ? '#3288bd' :
           d > 75000 ? '#66c2a5' :
           d > 60000  ? '#abdda4' :
           d > 50000  ? '#e6f598' :
           d > 40000  ? '#fee08b' :
           d > 30000  ? '#fdae61' :
           d > 20000  ? '#f46d43' :
                      '#d53e4f';
}

// control that shows state info on hover
var incomeInfo = L.control({position: 'bottomleft'});

incomeInfo.onAdd = function (map) {
```

```
    this._div = L.DomUtil.create('div', 'FoodAtlas5');
    this.update();
    return this._div;
};

incomeInfo.update = function (props) {
    this._div.innerHTML = '<h4>Median Income</h4>' +  (props ?
        '<b>' + formatNumber(props.MedIncome) + '</b><br />'
        : 'Hover over a tract');
};

//legend
var incomeLegend = L.control({position: 'bottomright'});

incomeLegend.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        colorGrades = [100000, 75000, 60000, 50000, 40000, 30000, 20000, 0],
        labels = ["Median Income"],
        from, to;

    for (var i = 0; i < colorGrades.length; i++) {
        from = colorGrades[i];
        to = (colorGrades[i - 1]) - 1;

        labels.push(
            '<i style="background:' + myGetColor_incomeVar(from + 1) + '"></i> ' +
            from + (to ? '&ndash;' + to : '+'));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('incomeVar').onclick = function() {
    if (this.className === 'active') {
        incomeLegend.removeFrom(map);
        incomeInfo.removeFrom(map);

        this.className = '';
    } else {
        incomeLegend.addTo(map);
        incomeInfo.addTo(map);

        this.className = 'active';
        }
    }



//demographics ============================================================
//Percent African American
var demographicsVar1 = L.geoJson(shapefile2, {
    style: demographicsStyle1,
```

```
    onEachFeature: onEachFeature_demographicsVar1
});

function demographicsStyle1(feature) {

    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: myGetColor_demographicsVar1((feature.properties.DP0080004)/(feature.
        properties.DP0010001))
    };
}

function myGetColor_demographicsVar1(d) {
    return d > .9159 ? '#525252' :
           d > .7054  ? '#969696' :
           d > .2261  ? '#cccccc' :
                      '#f7f7f7';
}

function onEachFeature_demographicsVar1(feature, layer) {
    layer.on({
        mouseover: highlightFeature_demographicsVar1,
        mouseout: resetHighlight_demographicsVar1,
        click: zoomToFeature
    });
}

function highlightFeature_demographicsVar1(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    demographicsInfo1.update(layer.feature.properties);
}

function resetHighlight_demographicsVar1(e) {

    demographicsVar1.resetStyle(e.target);
    demographicsInfo1.update();
}
```

```
var demographicsInfo1 = L.control({position: 'bottomleft'});

demographicsInfo1.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'demographicsInfo1');
    this.update();
    return this._div;
};

demographicsInfo1.update = function (props) {

    this._div.innerHTML = '<h4>Percent African Amercian</h4>' +  (props ?
        '<b>' + makePercent(((props.DP0080004)/(props.DP0010001))) + " African American<br />" +
         props.NAMELSAD10 + '</b><br />'
        : 'Hover over a tract');
};

//Legend
var demographicsLegend1 = L.control({position: 'bottomright'});

demographicsLegend1.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        grades = [.9159, .7054, .2261, 0],
        percentages = [92, 71, 23, 0],
        labels = ["Percent African American"],
        from, to;

    for (var i = 0; i < grades.length; i++) {

        from = grades[i];
        percent = percentages[i];
        to = (percentages[i - 1] - 1);

        labels.push(
            '<i style="background:' + myGetColor_demographicsVar1(from + .0001) + '"></i> ' +
            percent + (to ? '&ndash;' + to : '&ndash;100'));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('demographicsVar1').onclick = function() {
    if (this.className === 'active') {
        demographicsLegend1.removeFrom(map);
        demographicsInfo1.removeFrom(map);

        this.className = '';
    } else {
        demographicsLegend1.addTo(map);
        demographicsInfo1.addTo(map);

        this.className = 'active';
        }
```

```
    }

//--------------------------------------------------------------------
//Percent Hispanic
var demographicsVar2 = L.geoJson(shapefile2, {
    style: demographicsStyle2,
    onEachFeature: onEachFeature_demographicsVar2
});

function demographicsStyle2(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: myGetColor_demographicsVar2((feature.properties.DP0100002)/(feature.
        properties.DP0010001))
    };
}

function onEachFeature_demographicsVar2(feature, layer) {
        layer.on({
            mouseover: highlightFeature_demographicsVar2,
            mouseout: resetHighlight_demographicsVar2,
            click: zoomToFeature
        });
    }

function highlightFeature_demographicsVar2(e) {
        var layer = e.target;

        layer.setStyle({
            weight: 5,
            color: '#f00',
            dashArray: '',
            fillOpacity: 0.7
        });

        if (!L.Browser.ie && !L.Browser.opera) {
            layer.bringToFront();
        }

        demographicsInfo2.update(layer.feature.properties);
}

function resetHighlight_demographicsVar2(e) {
    demographicsVar2.resetStyle(e.target);
    demographicsInfo2.update();
}


function myGetColor_demographicsVar2(d) {
    return d > .06386225 ? '#525252' :
```

```
            d > .024913152  ? '#969696' :
            d > .010734326  ? '#cccccc' :
                      '#f7f7f7';
}

// control that shows state info on hover
var demographicsInfo2 = L.control({position: 'bottomleft'});

demographicsInfo2.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'demographicsInfo2');
    this.update();
    return this._div;
};

demographicsInfo2.update = function (props) {
    this._div.innerHTML = '<h4>Percent Hispanic</h4>' +  (props ?
        '<b>' + makePercent(((props.DP0100002)/(props.DP0010001))) + ' Hispanic<br />' + props.
        NAMELSAD10 + '</b><br />'
        : 'Hover over a tract');
};


//legend
var demographicsLegend2 = L.control({position: 'bottomright'});

demographicsLegend2.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        grades = [.06386225, .024913152, .010734326, 0],
        percentages = [6, 2, 1, 0],
        labels = ["Percent Hispanic"],
        from, to;

    for (var i = 0; i < grades.length; i++) {
        from = grades[i];
        percent = percentages[i];
        to = roundToProperPrecision_Demographics2(percentages[i - 1]);

        labels.push(
            '<i style="background:' + myGetColor_demographicsVar2(from + .00000001) + '"></i> ' +
            percent + (to ? '&ndash;' + to : '&ndash;44'));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

function roundToProperPrecision_Demographics2(number){
    if (number > 2){
        return formatNumber(number - 1);
    } else {
        return (number - .01);
    }
}
```

```
document.getElementById('demographicsVar2').onclick = function() {
    if (this.className === 'active') {
        demographicsLegend2.removeFrom(map);
        demographicsInfo2.removeFrom(map);

        this.className = '';
    } else {
        demographicsLegend2.addTo(map);
        demographicsInfo2.addTo(map);

        this.className = 'active';
        }
    }

//---------------------------------------------------------------

//Percent Native American
var demographicsVar3 = L.geoJson(shapefile2, {
    style: demographicsStyle3,
    onEachFeature: onEachFeature_demographicsVar3
});

function demographicsStyle3(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: myGetColor_demographicsVar3((feature.properties.DP0080005)/(feature.
        properties.DP0010001))
    };
}

function onEachFeature_demographicsVar3(feature, layer) {
        layer.on({
            mouseover: highlightFeature_demographicsVar3,
            mouseout: resetHighlight_demographicsVar3,
            click: zoomToFeature
        });
    }

function highlightFeature_demographicsVar3(e) {
        var layer = e.target;

        layer.setStyle({
            weight: 5,
            color: '#f00',
            dashArray: '',
            fillOpacity: 0.7
        });

        if (!L.Browser.ie && !L.Browser.opera) {
```

```
            layer.bringToFront();
        }

        demographicsInfo3.update(layer.feature.properties);
}

function resetHighlight_demographicsVar3(e) {

            demographicsVar3.resetStyle(e.target);
            demographicsInfo3.update();
}


function myGetColor_demographicsVar3(d) {
    return d > .003208293 ? '#525252' :
           d > .002132955  ? '#969696' :
           d > .001234315  ? '#cccccc' :
                     '#f7f7f7';
}

// control that shows state info on hover
var demographicsInfo3 = L.control({position: 'bottomleft'});

demographicsInfo3.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'demographicsInfo3');
    this.update();
    return this._div;
};

demographicsInfo3.update = function (props) {
    this._div.innerHTML = '<h4>Percent Native American</h4>' +  (props ?
        '<b>' + makePercent(((props.DP0080005)/(props.DP0010001))) + ' Native American<br />' +
        props.NAMELSAD10 + '</b><br />'
        : 'Hover over a tract');
};

//Legend
var demographicsLegend3 = L.control({position: 'bottomright'});

demographicsLegend3.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        grades = [.003208293, .002132955, .001234315, 0],
        percentages = [.3, .2, .1, 0],
        labels = ["Percent Native American"],
        from, to;

    for (var i = 0; i < grades.length; i++) {

        from = grades[i];
        percent = percentages[i];
        to = (percentages[i - 1] - .01);

        labels.push(
```

```
            '<i style="background:' + myGetColor_demographicsVar3(from + .000000001) + '"></i> '
             +
            percent + (to ? '&ndash;' + formatNumberTo2(to) : '&ndash;.8'));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('demographicsVar3').onclick = function() {
    if (this.className === 'active') {
        demographicsLegend3.removeFrom(map);
        demographicsInfo3.removeFrom(map);

        this.className = '';
    } else {
        demographicsLegend3.addTo(map);
        demographicsInfo3.addTo(map);

        this.className = 'active';
        }
    }

//---------------------------------------------------------------
//Percent Asian
var demographicsVar4 = L.geoJson(shapefile2, {
    style: demographicsStyle4,
    onEachFeature: onEachFeature_demographicsVar4
});

function demographicsStyle4(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: myGetColor_demographicsVar4((feature.properties.DP0080006)/(feature.
        properties.DP0010001))
    };
}

function onEachFeature_demographicsVar4(feature, layer) {
        layer.on({
            mouseover: highlightFeature_demographicsVar4,
            mouseout: resetHighlight_demographicsVar4,
            click: zoomToFeature
        });
    }

function highlightFeature_demographicsVar4(e) {
        var layer = e.target;

        layer.setStyle({
```

```
            weight: 5,
            color: '#f00',
            dashArray: '',
            fillOpacity: 0.7
        });

        if (!L.Browser.ie && !L.Browser.opera) {
            layer.bringToFront();
        }

        demographicsInfo4.update(layer.feature.properties);
}

function resetHighlight_demographicsVar4(e) {
    demographicsVar4.resetStyle(e.target);
    demographicsInfo4.update();
}


function myGetColor_demographicsVar4(d) {
    return d > .020234605 ? '#525252' :
           d > .008093357  ? '#969696' :
           d > .001719199  ? '#cccccc' :
                     '#f7f7f7';
}

// control that shows state info on hover
var demographicsInfo4 = L.control({position: 'bottomleft'});

demographicsInfo4.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'demographicsInfo4');
    this.update();
    return this._div;
};

demographicsInfo4.update = function (props) {
    this._div.innerHTML = '<h4>Percent Asian American</h4>' +  (props ?
        '<b>' + makePercent(((props.DP0080006)/(props.DP0010001))) + ' Asian<br />' + props.
        NAMELSAD10 + '</b><br />'
        : 'Hover over a tract');
};

//Legend
var demographicsLegend4 = L.control({position: 'bottomright'});

demographicsLegend4.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        grades = [.020234605, .008093357, .001719199, 0],
        percentages = [2, .8, .2, 0],
        labels = ["Percent Asian American"],
        from, to;

    for (var i = 0; i < grades.length; i++) {
```

```
        from = grades[i];
        percent = percentages[i];
        to = (percentages[i - 1] - .01);

        labels.push(
            '<i style="background:' + myGetColor_demographicsVar4(from + .000000001) + '"></i> '
             +
            percent + (to ? '&ndash;' + formatNumberTo2(to) : '&ndash;14'));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('demographicsVar4').onclick = function() {
    if (this.className === 'active') {
        demographicsLegend4.removeFrom(map);
        demographicsInfo4.removeFrom(map);

        this.className = '';
    } else {
        demographicsLegend4.addTo(map);
        demographicsInfo4.addTo(map);

        this.className = 'active';
        }
    };

//---------------------------------------------------------------
//end demographics

//EPA Smart Location Database=============================================
/////-----------------------------------------------------------------
/////EPA Smart Location Database----------------
/////-----------------------------------------------------------------

var smartLocationDatabaseVar1 = L.geoJson(greenprint_SLD, {
    style: smartLocationDatabaseStyle1,
    onEachFeature: onEachFeature_smartLocationDatabaseVar1
});

function smartLocationDatabaseStyle1(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: myGetColor_smartLocationDatabase1(feature.properties.COUNTHU10)
    };
}

function onEachFeature_smartLocationDatabaseVar1(feature, layer) {
```

```
    layer.on({
        mouseover: highlightFeature_smartLocationDatabaseVar1,
        mouseout: resetHighlight_smartLocationDatabaseVar1,
        click: zoomToFeature
    });
}

function highlightFeature_smartLocationDatabaseVar1(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    smartLocationDatabase1Info.update(layer.feature.properties);
}

function resetHighlight_smartLocationDatabaseVar1(e) {

    smartLocationDatabaseVar1.resetStyle(e.target);
    smartLocationDatabase1Info.update();
}


function myGetColor_smartLocationDatabase1(d) {
    return d > 916 ? '#252525' :
           d > 730  ? '#525252' :
           d > 615  ? '#737373' :
           d > 531  ? '#969696' :
           d > 452  ? '#bdbdbd' :
           d > 368  ? '#d9d9d9' :
                      '#f7f7f7';
}

// control that shows state info on hover
var smartLocationDatabase1Info = L.control({position: 'bottomleft'});

smartLocationDatabase1Info.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'smartLocationDatabase1Info');
    this.update();
    return this._div;
};

smartLocationDatabase1Info.update = function (props) {
    this._div.innerHTML = '<h4>Housing Units Per Acre</h4>' +  (props ?
        '<b>' + props.COUNTHU10 + '</b><br />'
        : 'Hover over a tract');
```

```
};

//legend
var smartLocationDatabaseLegend1 = L.control({position: 'bottomright'});

smartLocationDatabaseLegend1.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        grades = [916, 730, 615, 531, 452, 368, 0],
        labels = ["Housing Units Per Acre"],
        from, to;

    for (var i = 0; i < grades.length; i++) {
        from = grades[i];
        to = (grades[i - 1] - 1);

        labels.push(
            '<i style="background:' + myGetColor_smartLocationDatabase1(from + 1) + '"></i> ' +
            from + (to ? '&ndash;' + to : '+'));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('smartLocationDatabaseVar1').onclick = function() {
    if (this.className === 'active') {
        smartLocationDatabaseLegend1.removeFrom(map);
        smartLocationDatabase1Info.removeFrom(map);

        this.className = '';
    } else {
        smartLocationDatabaseLegend1.addTo(map);
        smartLocationDatabase1Info.addTo(map);

        this.className = 'active';
        }
    }

//--------------------------------------------------------------------------
//EPA Smart Location Database Variable 2: Jobs Per Acre

//Jobs Per Acre
var smartLocationDatabaseVar2 = L.geoJson(greenprint_SLD, {
    style: smartLocationDatabaseStyle2,
    onEachFeature: onEachFeature_smartLocationDatabaseVar2
});

function smartLocationDatabaseStyle2(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
```

```
        fillOpacity: 0.7,
        fillColor: myGetColor_smartLocationDatabase2(feature.properties.D1C)
    };
}

function onEachFeature_smartLocationDatabaseVar2(feature, layer) {
    layer.on({
        mouseover: highlightFeature_smartLocationDatabaseVar2,
        mouseout: resetHighlight_smartLocationDatabaseVar2,
        click: zoomToFeature
    });
}

function highlightFeature_smartLocationDatabaseVar2(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    smartLocationDatabase2Info.update(layer.feature.properties);
}

function resetHighlight_smartLocationDatabaseVar2(e) {

    smartLocationDatabaseVar2.resetStyle(e.target);
    smartLocationDatabase2Info.update();
}

function myGetColor_smartLocationDatabase2(d) {
    return d > 45.84 ? '#252525' :
           d > 12.44  ? '#525252' :
           d > 3.26  ? '#737373' :
           d > .86  ? '#969696' :
           d > .22  ? '#bdbdbd' :
           d > .046  ? '#d9d9d9' :
                     '#f7f7f7';
}

// control that shows state info on hover
var smartLocationDatabase2Info = L.control({position: 'bottomleft'});

smartLocationDatabase2Info.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'demographicsInfo2');
    this.update();
    return this._div;
};
```

```
smartLocationDatabase2Info.update = function (props) {
    this._div.innerHTML = '<h4>Jobs Per Acre</h4>' +  (props ?
        '<b>' + formatInfoToCorrectPrecision(props.D1C) + '</b><br />'
        : 'Hover over a tract');
};

//legend
var smartLocationDatabaseLegend2 = L.control({position: 'bottomright'});

smartLocationDatabaseLegend2.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        colorGrades = [45.84, 12.44, 3.26, .86, .22, .046, 0],
        rounded = [46, 12, 3, .86, .22, .05, 0],
        labels = ["Jobs Per Acre"],
        from, to;

    for (var i = 0; i < colorGrades.length; i++) {
        from = colorGrades[i];
        roundedNum = rounded[i];
        to = roundToProperPrecision(rounded[i - 1]);

        labels.push(
            '<i style="background:' + myGetColor_smartLocationDatabase2(from + .01) + '"></i> ' +
            roundedNum + (to ? '&ndash;' + to : '+'));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('smartLocationDatabaseVar2').onclick = function() {
    if (this.className === 'active') {
        smartLocationDatabaseLegend2.removeFrom(map);
        smartLocationDatabase2Info.removeFrom(map);

        this.className = '';
    } else {
        smartLocationDatabaseLegend2.addTo(map);
        smartLocationDatabase2Info.addTo(map);

        this.className = 'active';
        }
    }

//-------------------------------------------------------------------------
//EPA Smart Location Database Variable 3: Jobs Per Household

var smartLocationDatabaseVar3 = L.geoJson(greenprint_SLD, {
    style: smartLocationDatabaseStyle3,
    onEachFeature: onEachFeature_smartLocationDatabaseVar3
});
```

```
function smartLocationDatabaseStyle3(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: myGetColor_smartLocationDatabase3(feature.properties.D2A_JPHH)
    };
}

function onEachFeature_smartLocationDatabaseVar3(feature, layer) {
    layer.on({
        mouseover: highlightFeature_smartLocationDatabaseVar3,
        mouseout: resetHighlight_smartLocationDatabaseVar3,
        click: zoomToFeature
    });
}

function highlightFeature_smartLocationDatabaseVar3(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    smartLocationDatabase3Info.update(layer.feature.properties);
}

function resetHighlight_smartLocationDatabaseVar3(e) {
    smartLocationDatabaseVar3.resetStyle(e.target);
    smartLocationDatabase3Info.update();
}


function myGetColor_smartLocationDatabase3(d) {
    return d > 1.701 ? '#252525' :
           d > .673  ? '#525252' :
           d > .312  ? '#737373' :
           d > .149  ? '#969696' :
           d > .061  ? '#bdbdbd' :
           d > .022  ? '#d9d9d9' :
                       '#f7f7f7';
}

// control that shows state info on hover
var smartLocationDatabase3Info = L.control({position: 'bottomleft'});
```

```
smartLocationDatabase3Info.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'demographicsInfo2');
    this.update();
    return this._div;
};

smartLocationDatabase3Info.update = function (props) {
    this._div.innerHTML = '<h4>Jobs Per Household</h4>' +  (props ?
        '<b>' + formatJobsPerHouseholdToCorrectPrecision(props.D2A_JPHH) + '</b><br />'
        : 'Hover over a tract');
};

function formatJobsPerHouseholdToCorrectPrecision(number){
    if (number < 1){
        return formatNumberTo2(number);
    } else if (number > 1.7){
        return formatNumber(number);
    } else {
        return number.toFixed(1);
    }
}

//legend
var smartLocationDatabaseLegend3 = L.control({position: 'bottomright'});

smartLocationDatabaseLegend3.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        colorGrades = [1.701, .673, .312, .149, .061, .022, 0],
        rounded = [1.7, .7, .3, .15, .06, .02, 0],
        labels = ["Jobs Per Household"],
        from, to;

    for (var i = 0; i < colorGrades.length; i++) {
        from = colorGrades[i];
        roundedNum = rounded[i];
        to = (rounded[i - 1] - .01);

        labels.push(
            '<i style="background:' + myGetColor_smartLocationDatabase3(from + .01) + '"></i> ' +
            roundedNum + (to ? '&ndash;' + formatNumberTo2(to) : '+'));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('smartLocationDatabaseVar3').onclick = function() {
    if (this.className === 'active') {
        smartLocationDatabaseLegend3.removeFrom(map);
        smartLocationDatabase3Info.removeFrom(map);

        this.className = '';
```

```
    } else {
        smartLocationDatabaseLegend3.addTo(map);
        smartLocationDatabase3Info.addTo(map);

        this.className = 'active';
        }
    }

//--------------------------------------------------------------------------
//EPA Smart Location Database Variable 4: Zero Car Households

var smartLocationDatabaseVar4 = L.geoJson(greenprint_SLD, {
    style: smartLocationDatabaseStyle4,
    onEachFeature: onEachFeature_smartLocationDatabaseVar4
});

function smartLocationDatabaseStyle4(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: myGetColor_smartLocationDatabase4(feature.properties.AUTOOWN0/feature.
        properties.AreaKm)
    };
}

function onEachFeature_smartLocationDatabaseVar4(feature, layer) {
    layer.on({
        mouseover: highlightFeature_smartLocationDatabaseVar4,
        mouseout: resetHighlight_smartLocationDatabaseVar4,
        click: zoomToFeature
    });
}

function highlightFeature_smartLocationDatabaseVar4(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    smartLocationDatabase4Info.update(layer.feature.properties);
}

function resetHighlight_smartLocationDatabaseVar4(e) {
```

```
    smartLocationDatabaseVar4.resetStyle(e.target);
    smartLocationDatabase4Info.update();
}

function myGetColor_smartLocationDatabase4(d) {
    return d > 640.6 ? '#252525' :
           d > 181.61  ? '#525252' :
           d > 51.31  ? '#737373' :
           d > 14.33  ? '#969696' :
           d > 3.83  ? '#bdbdbd' :
           d > .846  ? '#d9d9d9' :
                     '#f7f7f7';
}

// control that shows state info on hover
var smartLocationDatabase4Info = L.control({position: 'bottomleft'});

smartLocationDatabase4Info.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'demographicsInfo2');
    this.update();
    return this._div;
};

smartLocationDatabase4Info.update = function (props) {
    this._div.innerHTML = '<h4>Zero Car Households <br> (per Sq Km<sup>2</sup>)</h4>' +  (props ?
        '<b>' + formatInfoToCorrectPrecision(props.AUTOOWN0/props.AreaKm) + '</b><br />'
        : 'Hover over a tract');
};

//legend
var smartLocationDatabaseLegend4 = L.control({position: 'bottomright'});

smartLocationDatabaseLegend4.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        colorGrades = [640.6, 181.61, 51.31, 14.33, 3.83, .846, 0],
        rounded = [641, 182, 51, 14, 4, 1, 0],
        labels = ["Zero Car Households (per Sq Km<sup>2</sup>)"],
        from, to;

    for (var i = 0; i < colorGrades.length; i++) {
        from = colorGrades[i];
        roundedNum = rounded[i];
        to = (rounded[i - 1] - 1);

        labels.push(
            '<i style="background:' + myGetColor_smartLocationDatabase4(from + 1) + '"></i> ' +
            roundedNum + formatLegend(to));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};
```

```
document.getElementById('smartLocationDatabaseVar4').onclick = function() {
    if (this.className === 'active') {
        smartLocationDatabaseLegend4.removeFrom(map);
        smartLocationDatabase4Info.removeFrom(map);

        this.className = '';
    } else {
        smartLocationDatabaseLegend4.addTo(map);
        smartLocationDatabase4Info.addTo(map);

        this.className = 'active';
        }
    }

//--------------------------------------------------------------------------
//EPA Smart Location Database Variable 5: Low Wage Workers

var smartLocationDatabaseVar5 = L.geoJson(greenprint_SLD, {
    style: smartLocationDatabaseStyle5,
    onEachFeature: onEachFeature_smartLocationDatabaseVar5
});

function smartLocationDatabaseStyle5(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: myGetColor_smartLocationDatabase5(feature.properties.R_PCTLOWWA)
    };
}

function onEachFeature_smartLocationDatabaseVar5(feature, layer) {
    layer.on({
        mouseover: highlightFeature_smartLocationDatabaseVar5,
        mouseout: resetHighlight_smartLocationDatabaseVar5,
        click: zoomToFeature
    });
}

function highlightFeature_smartLocationDatabaseVar5(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }
```

```
    smartLocationDatabase5Info.update(layer.feature.properties);
}

function resetHighlight_smartLocationDatabaseVar5(e) {
    smartLocationDatabaseVar5.resetStyle(e.target);
    smartLocationDatabase5Info.update();
}


function myGetColor_smartLocationDatabase5(d) {
    return d > .349 ? '#252525' :
           d > .309  ? '#525252' :
           d > .276  ? '#737373' :
           d > .249  ? '#969696' :
           d > .217  ? '#bdbdbd' :
           d > .194  ? '#d9d9d9' :
                       '#f7f7f7';
}

// control that shows state info on hover
var smartLocationDatabase5Info = L.control({position: 'bottomleft'});

smartLocationDatabase5Info.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'demographicsInfo2');
    this.update();
    return this._div;
};

smartLocationDatabase5Info.update = function (props) {
    this._div.innerHTML = '<h4>Low Wage Workers</h4>' +  (props ?
        '<b>' + makePercent(props.R_PCTLOWWA) + '</b><br />'
        : 'Hover over a tract');
};

//legend
var smartLocationDatabaseLegend5 = L.control({position: 'bottomright'});

smartLocationDatabaseLegend5.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        colorGrades = [.349, .309, .276, .249, .217, .194, 0],
        rounded = [35, 31, 28, 25, 22, 19, 0],
        labels = ["Percent Low Wage Workers"],
        from, to;

    for (var i = 0; i < colorGrades.length; i++) {
        from = colorGrades[i];
        roundedNum = rounded[i];
        to = (rounded[i - 1] - 1);

        labels.push(
            '<i style="background:' + myGetColor_smartLocationDatabase5(from + .01) + '"></i> ' +
            roundedNum + (to ? '&ndash;' + to : '+'));
```

```
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('smartLocationDatabaseVar5').onclick = function() {
    if (this.className === 'active') {
        smartLocationDatabaseLegend5.removeFrom(map);
        smartLocationDatabase5Info.removeFrom(map);

        this.className = '';
    } else {
        smartLocationDatabaseLegend5.addTo(map);
        smartLocationDatabase5Info.addTo(map);

        this.className = 'active';
        }
    }

//--------------------------------------------------------------------------
//EPA Smart Location Database Variable 6: Population Density

var smartLocationDatabaseVar6 = L.geoJson(greenprint_SLD, {
    style: smartLocationDatabaseStyle6,
    onEachFeature: onEachFeature_smartLocationDatabaseVar6
});

function smartLocationDatabaseStyle6(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: myGetColor_smartLocationDatabase6((feature.properties.TOTPOP10)/(feature.
        properties.AreaKm))
    };
}

function onEachFeature_smartLocationDatabaseVar6(feature, layer) {
    layer.on({
        mouseover: highlightFeature_smartLocationDatabaseVar6,
        mouseout: resetHighlight_smartLocationDatabaseVar6,
        click: zoomToFeature
    });
}

function highlightFeature_smartLocationDatabaseVar6(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
```

```
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    smartLocationDatabase6Info.update(layer.feature.properties);
}

function resetHighlight_smartLocationDatabaseVar6(e) {
    smartLocationDatabaseVar6.resetStyle(e.target);
    smartLocationDatabase6Info.update();
}


function myGetColor_smartLocationDatabase6(d) {
    return d >= 1843 ? '#ca0020' :
           d >= 1283  ? '#f4a582' :
           d >= 741  ? '#bababa' :
                       '#dadada';

}

// control that shows state info on hover
var smartLocationDatabase6Info = L.control({position: 'bottomleft'});

smartLocationDatabase6Info.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'demographicsInfo2');
    this.update();
    return this._div;
};

smartLocationDatabase6Info.update = function (props) {
    this._div.innerHTML = '<h4>Population Density</h4>' +  (props ?
        'Population per Km<sup>2</sup>: <b>' + formatNumber((props.TOTPOP10)/(props.AreaKm)) +
        '</b><br />'
        : 'Hover over a tract');
};

//legend
var demographicsLegend6 = L.control({position: 'bottomright'});

demographicsLegend6.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        grades = [1843, 1283, 741, 0],
        labels = ['Population per Km<sup>2</sup>'],
        from, to;

    for (var i = 0; i < grades.length; i++) {
        from = grades[i];
        to = (grades[i - 1] - 1);
```

```
        labels.push(
            '<i style="background:' + myGetColor_smartLocationDatabase6(from + 1) + '"></i> ' +
            from + (to ? '&ndash;' + to : '&ndash;11490'));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('smartLocationDatabaseVar6').onclick = function() {
    if (this.className === 'active') {
        demographicsLegend6.removeFrom(map);
        smartLocationDatabase6Info.removeFrom(map);

        this.className = '';
    } else {
        demographicsLegend6.addTo(map);
        smartLocationDatabase6Info.addTo(map);

        this.className = 'active';
        }
    }

//USDA Food Atlas=============================================
/////----------------------------------------------------------------------
/////USDA Food Atlas----------------
/////----------------------------------------------------------------------
//Variable 2: Low-Income People with Low Food Access (urban: 1/2 mile, rural: 10 miles)
var foodAtlasVar2 = L.geoJson(shapefile2, {
    style: foodAtlasStyle2,
    onEachFeature: onEachFeature_foodAtlasVar2
});

function foodAtlasStyle2(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: myGetColor_foodAtlasVar2(feature.properties.lalowihalf/feature.properties.
        AreaKm)
    };
}

function onEachFeature_foodAtlasVar2(feature, layer) {
    layer.on({
        mouseover: highlightFeature_foodAtlasVar2,
        mouseout: resetHighlight_foodAtlasVar2,
        click: zoomToFeature
    });
}
```

```
function highlightFeature_foodAtlasVar2(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    foodAtlas2Info.update(layer.feature.properties);
}

function resetHighlight_foodAtlasVar2(e) {
    foodAtlasVar2.resetStyle(e.target);
    foodAtlas2Info.update();
}


function myGetColor_foodAtlasVar2(d) {
    return d > 814 ? '#252525' :
           d > 501.1  ? '#525252' :
           d > 344.8  ? '#737373' :
           d > 223.6  ? '#969696' :
           d > 138.1  ? '#bdbdbd' :
           d > 60.78  ? '#d9d9d9' :
                      '#f7f7f7';
}

// control that shows state info on hover
var foodAtlas2Info = L.control({position: 'bottomleft'});

foodAtlas2Info.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'FoodAtlas2');
    this.update();
    return this._div;
};

foodAtlas2Info.update = function (props) {
    this._div.innerHTML = '<h4>Low-Income People with Low Food Access <br> (per Km
    <sup>2</sup>)</h4>' +  (props ?
        '<b>' + formatNumber(props.lalowihalf/props.AreaKm) + '</b><br />'
        : 'Hover over a tract');
};

//legend
var foodAtlasLegend2 = L.control({position: 'bottomright'});

foodAtlasLegend2.onAdd = function (map) {
```

```
    var div = L.DomUtil.create('div', 'info legend'),
        colorGrades = [814, 501.1, 344.8, 223.6, 138.1, 60.78, 0],
        rounded = [814, 501, 345, 224, 138, 61, 0],
        labels = ["Low-Income, Low Food Access <br> (per Km <sup>2</sup>)"],
        from, to;

    for (var i = 0; i < colorGrades.length; i++) {
        from = colorGrades[i];
        roundedNum = rounded[i];
        to = (rounded[i - 1] - 1);

        labels.push(
            '<i style="background:' + myGetColor_foodAtlasVar2(from + 1) + '"></i> ' +
            roundedNum + (to ? '&ndash;' + to : '+'));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('foodAtlasVar2').onclick = function() {
    if (this.className === 'active') {
        foodAtlasLegend2.removeFrom(map);
        foodAtlas2Info.removeFrom(map);

        this.className = '';
    } else {
        foodAtlasLegend2.addTo(map);
        foodAtlas2Info.addTo(map);

        this.className = 'active';
        }
    }
//--------------------------------------------------------------------------
//Variable 3: Children Age 0-17 with Low Food Access at 1/2 Mile

var foodAtlasVar3 = L.geoJson(shapefile2, {
    style: foodAtlasStyle3,
    onEachFeature: onEachFeature_foodAtlasVar3
});

function foodAtlasStyle3(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: myGetColor_foodAtlasVar3(feature.properties.lakidshalf/feature.properties.
        AreaKm)
    };
}

function onEachFeature_foodAtlasVar3(feature, layer) {
```

```
    layer.on({
        mouseover: highlightFeature_foodAtlasVar3,
        mouseout: resetHighlight_foodAtlasVar3,
        click: zoomToFeature
    });
}

function highlightFeature_foodAtlasVar3(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    foodAtlas3Info.update(layer.feature.properties);
}

function resetHighlight_foodAtlasVar3(e) {
    foodAtlasVar3.resetStyle(e.target);
    foodAtlas3Info.update();
}


function myGetColor_foodAtlasVar3(d) {
    return d > 385.895 ? '#252525' :
           d > 267.175  ? '#525252' :
           d > 199.639  ? '#737373' :
           d > 154.859  ? '#969696' :
           d > 116.374  ? '#bdbdbd' :
           d > 61.097  ? '#d9d9d9' :
                    '#f7f7f7';
}

// control that shows state info on hover
var foodAtlas3Info = L.control({position: 'bottomleft'});

foodAtlas3Info.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'FoodAtlas3');
    this.update();
    return this._div;
};

foodAtlas3Info.update = function (props) {
    this._div.innerHTML = '<h4>Children With Low Food Access <br> (per Km <sup>2</sup>)</h4>' +
      (props ?
        '<b>' + formatNumber(props.lakidshalf/props.AreaKm) + '</b><br />'
        : 'Hover over a tract');
```

```
};

//legend
var foodAtlasLegend3 = L.control({position: 'bottomright'});

foodAtlasLegend3.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        colorGrades = [385.895, 267.175, 199.639, 154.859, 116.374, 61.097, 0],
        rounded = [386, 267, 200, 155, 116, 61, 0],
        labels = ["Children With Low Food Access <br> (per Km <sup>2</sup>)"],
        from, to;

    for (var i = 0; i < colorGrades.length; i++) {
        from = colorGrades[i];
        roundedNum = rounded[i];
        to = (rounded[i - 1] - 1);

        labels.push(
            '<i style="background:' + myGetColor_foodAtlasVar3(from + 1) + '"></i> ' +
            roundedNum + (to ? '&ndash;' + to : '+'));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('foodAtlasVar3').onclick = function() {
    if (this.className === 'active') {
        foodAtlasLegend3.removeFrom(map);
        foodAtlas3Info.removeFrom(map);

        this.className = '';
    } else {
        foodAtlasLegend3.addTo(map);
        foodAtlas3Info.addTo(map);

        this.className = 'active';
        }
    }

//-------------------------------------------------------------------------
//Variable 4: Seniors age 65+ with Low Food Access at 1/2 Mile

var foodAtlasVar4 = L.geoJson(shapefile2, {
    style: foodAtlasStyle4,
    onEachFeature: onEachFeature_foodAtlasVar4
});

function foodAtlasStyle4(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
```

```
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: myGetColor_foodAtlas4(feature.properties.laseniorsh/feature.properties.AreaKm)
    };
}

function onEachFeature_foodAtlasVar4(feature, layer) {
    layer.on({
        mouseover: highlightFeature_foodAtlasVar4,
        mouseout: resetHighlight_foodAtlasVar4,
        click: zoomToFeature
    });
}

function highlightFeature_foodAtlasVar4(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    foodAtlas4Info.update(layer.feature.properties);
}

function resetHighlight_foodAtlasVar4(e) {
    foodAtlasVar4.resetStyle(e.target);
    foodAtlas4Info.update();
}


function myGetColor_foodAtlas4(d) {
    return d > 156.397 ? '#252525' :
           d > 105.892  ? '#525252' :
           d > 83.009  ? '#737373' :
           d > 64.443  ? '#969696' :
           d > 46.772  ? '#bdbdbd' :
           d > 24.712  ? '#d9d9d9' :
                    '#f7f7f7';
}

// control that shows state info on hover
var foodAtlas4Info = L.control({position: 'bottomleft'});

foodAtlas4Info.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'demographicsInfo2');
    this.update();
    return this._div;
```

```
};

foodAtlas4Info.update = function (props) {
    this._div.innerHTML = '<h4>Seniors with Low Food Access <br> (per Km <sup>2</sup>)</h4>' +
    (props ?
        '<b>' + formatNumber(props.laseniorsh/props.AreaKm) + '</b><br />'
        : 'Hover over a tract');
};

//legend
var foodAtlasLegend4 = L.control({position: 'bottomright'});

foodAtlasLegend4.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        colorGrades = [156.397, 105.892, 83.009, 64.443, 46.772, 24.712, 0],
        rounded = [156, 106, 83, 64, 47, 25, 0],
        labels = ["Seniors with Low Food Access <br> (per Km <sup>2</sup>)"],
        from, to;

    for (var i = 0; i < colorGrades.length; i++) {
        from = colorGrades[i];
        roundedNum = rounded[i];
        to = (rounded[i - 1] - 1);

        labels.push(
            '<i style="background:' + myGetColor_foodAtlas4(from + 1) + '"></i> ' +
            roundedNum + (to ? '&ndash;' + to : '+'));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('foodAtlasVar4').onclick = function() {
    if (this.className === 'active') {
        foodAtlasLegend4.removeFrom(map);
        foodAtlas4Info.removeFrom(map);

        this.className = '';
    } else {
        foodAtlasLegend4.addTo(map);
        foodAtlas4Info.addTo(map);

        this.className = 'active';
        }
    }

//-------------------------------------------------------------------------
//Variable 5: Housing units without vehicles, with low food access at 1/2 mile
var foodAtlasVar5 = L.geoJson(shapefile2, {
    style: foodAtlasStyle5,
    onEachFeature: onEachFeature_foodAtlasVar5
});
```

```
function foodAtlasStyle5(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.7,
        fillColor: myGetColor_foodAtlas5(feature.properties.lahunvhalf/feature.properties.AreaKm)
    };
}

function onEachFeature_foodAtlasVar5(feature, layer) {
    layer.on({
        mouseover: highlightFeature_foodAtlasVar5,
        mouseout: resetHighlight_foodAtlasVar5,
        click: zoomToFeature
    });
}

function highlightFeature_foodAtlasVar5(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    foodAtlas5Info.update(layer.feature.properties);
}

function resetHighlight_foodAtlasVar5(e) {

    foodAtlasVar5.resetStyle(e.target);
    foodAtlas5Info.update();
}


function myGetColor_foodAtlas5(d) {
    return d > 93.52 ? '#252525' :
           d > 41.417  ? '#525252' :
           d > 26.381  ? '#737373' :
           d > 10.530  ? '#969696' :
           d > 4.804  ? '#bdbdbd' :
           d > 1.118  ? '#d9d9d9' :
                      '#f7f7f7';
}
```

```
// control that shows state info on hover
var foodAtlas5Info = L.control({position: 'bottomleft'});

foodAtlas5Info.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'FoodAtlas5');
    this.update();
    return this._div;
};

foodAtlas5Info.update = function (props) {
    this._div.innerHTML = '<h4>Housing Units Without Vehicles <br> (per Km <sup>2</sup>)</h4>' +
      (props ?
        '<b>' + formatNumber(props.lahunvhalf/props.AreaKm) + '</b><br />'
        : 'Hover over a tract');
};

//legend
var foodAtlasLegend5 = L.control({position: 'bottomright'});

foodAtlasLegend5.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        colorGrades = [93.52, 41.417, 26.381, 10.530, 4.804, 1.118, 0],
        rounded = [94, 41, 26, 11, 5, 1, 0],
        labels = ["Housing Units Without Vehicles <br> (per Km <sup>2</sup>)"],
        from, to;

    for (var i = 0; i < colorGrades.length; i++) {
        from = colorGrades[i];
        roundedNum = rounded[i];
        to = roundToProperPrecision(rounded[i - 1]);

        console.log("this is to: " + to);

        labels.push(
            '<i style="background:' + myGetColor_foodAtlas5(from + 1) + '"></i> ' +
            roundedNum + outputForFoodAtlas5(to));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

function outputForFoodAtlas5(to){
    if (to > .99){
        return "&ndash;" + to;
    } else if (to == .99) {
        return "";
    } else {
        return "+";
    }
}

document.getElementById('foodAtlasVar5').onclick = function() {
```

```
    if (this.className === 'active') {
        foodAtlasLegend5.removeFrom(map);
        foodAtlas5Info.removeFrom(map);

        this.className = '';
    } else {
        foodAtlasLegend5.addTo(map);
        foodAtlas5Info.addTo(map);

        this.className = 'active';
        }
    }

//Zoning=============================================
/////-------------------------------------------------------------------
/////Zoning----------------
/////-------------------------------------------------------------------

var zoningVar = L.geoJson(zoning, {
    style: zoningStyle,
    onEachFeature: onEachFeature_zoningVar
});

function zoningStyle(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'white',
        dashArray: '3',
        fillOpacity: 0.4,
        fillColor: myGetColor_zoningVar(feature.properties.ZoneUse)
    };
}

function onEachFeature_zoningVar(feature, layer) {
    layer.on({
        mouseover: highlightFeature_zoningVar,
        mouseout: resetHighlight_zoningVar,
        click: zoomToFeature
    });
}

function highlightFeature_zoningVar(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
```

```
    }

    zoningInfo.update(layer.feature.properties);
}

function resetHighlight_zoningVar(e) {

    zoningVar.resetStyle(e.target);
    zoningInfo.update();
}

function myGetColor_zoningVar(d) {
    var zoneUse = d;

    //Agricultural
    if ((zoneUse == "Agricultural") || (zoneUse == "Argricultural")){
        return '#00b64f';
    }
    //Residential
    else if ((zoneUse == "Bluffview Resid") || (zoneUse == "Duplex") || (zoneUse == "Duplex
    Resident") || (zoneUse == "Mobile Home") || (zoneUse == "Neighborhood") || (zoneUse ==
    "Residence") || (zoneUse == "Residence/R-S15") || (zoneUse == "Residential") || (zoneUse ==
    "residential") || (zoneUse == "Town House")){
        return '#ffb400';
    }
    //Multi-Family
    else if ((zoneUse == "MULTI-FAMILY") || (zoneUse == "Multi-Family") || (zoneUse ==
    "Multi-Family Residential")){
        return '#ff9f00';
    }
    //Commercial
    else if ((zoneUse == "COMMERCIAL") || (zoneUse == "Commercial") || (zoneUse == "Commerical")
     || (zoneUse == "Neighborhood Com") || (zoneUse == "commercial")){
        return '#ff7d73';
    }
    //Industrial
    else if ((zoneUse == "INDUSTRY") || (zoneUse == "Indrustrial") || (zoneUse == "Industrial")
    || (zoneUse == "Industry")){
        return '#4b5cd7';
    }
    //Light Industrial
    else if ((zoneUse == "Light Industrial") || (zoneUse == "Industry") || (zoneUse == "Light
    Industrial")){
        return '#3aa6d0';
    }
    //Other
    else if ((zoneUse == "College") || (zoneUse == "College/Univ.") || (zoneUse == 'College or
    University')){
        return '#212121';
    } else if (zoneUse == "Flood Way"){
        return '#dedede';
    } else if (zoneUse == "Hospital"){
        return '#794050';
    } else if (zoneUse == "Institute"){
```

```
        return '#444444';
    } else if (zoneUse == "Mixed Use"){
        return '#777777';
    } else if ((zoneUse == "OFFICE") || (zoneUse == "Office")){
        return '#9040D5';
    } else if (zoneUse == "Parking"){
        return '#cccccc';
    } else if (zoneUse == "South Main His" || (zoneUse == 'South Main Historic Arts District')){
        return '#f35d65';
    } else if (zoneUse == "Tom Lee Park"){
        return '#396b39';
    }
    //?
    else if(zoneUse == null)                {
        return '#fff';
    }
}

function myGetZone(d) {
    var zoneUse = d;

    //Agricultural
    if ((zoneUse == "Agricultural") || (zoneUse == "Argricultural")){
        return 'Agricultural';
    }
    //Residential
    else if ((zoneUse == "Bluffview Resid") || (zoneUse == "Duplex") || (zoneUse == "Duplex
    Resident") || (zoneUse == "Mobile Home") || (zoneUse == "Neighborhood") || (zoneUse ==
    "Residence") || (zoneUse == "Residence/R-S15") || (zoneUse == "Residential") || (zoneUse ==
    "residential") || (zoneUse == "Town House")){
        return 'Residential';
    }
    //Multi-Family
    else if ((zoneUse == "MULTI-FAMILY") || (zoneUse == "Multi-Family") || (zoneUse ==
    "Multi-Family Residential")){
        return 'Multi-Family Residential';
    }
    //Commercial
    else if ((zoneUse == "COMMERCIAL") || (zoneUse == "Commercial") || (zoneUse == "Commerical")
     || (zoneUse == "Neighborhood Com") || (zoneUse == "commercial")){
        return 'Commercial';
    }
    //Industrial
    else if ((zoneUse == "INDUSTRY") || (zoneUse == "Indrustrial") || (zoneUse == "Industrial")
    || (zoneUse == "Industry")){
        return 'Industrial';
    }
    //Light Industrial
    else if ((zoneUse == "Light Industrial") || (zoneUse == "Industry") || (zoneUse == "Light
    Industrial")){
        return 'Light Industrial';
    }
    //Other
    else if ((zoneUse == "College") || (zoneUse == "College/Univ.") || (zoneUse == 'College or
```

```
    University')){
        return 'College or University';
    } else if (zoneUse == "Flood Way"){
        return 'Flood Way';
    } else if (zoneUse == "Hospital"){
        return 'Hospital';
    } else if (zoneUse == "Institute"){
        return 'Institute';
    } else if (zoneUse == "Mixed Use"){
        return 'Mixed Use';
    } else if ((zoneUse == "OFFICE") || (zoneUse == "Office")){
        return 'Office';
    } else if (zoneUse == "Parking"){
        return 'Parking';
    } else if (zoneUse == "South Main His" || (zoneUse == 'South Main Historic Arts District')){
        return 'South Main Historic Arts District';
    } else if (zoneUse == "Tom Lee Park"){
        return 'Tom Lee Park';
    }
    //?
    else if(zoneUse == null)               {
        return 'No Data';
    }
}

// control that shows state info on hover
var zoningInfo = L.control({position: 'bottomleft'});

zoningInfo.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'smartLocationDatabase1Info');
    this.update();
    return this._div;
};

zoningInfo.update = function (props) {
    this._div.innerHTML = '<h4>Memphis Unified Development Code (UDC) Zoning</h4>' +  (props ?
        '<b>Zone Use: ' + myGetZone(props.ZoneUse) + '</b><br />'
        : 'Hover over a tract');
};

//legend
var zoningLegend = L.control({position: 'bottomright'});

zoningLegend.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        grades = ['Agricultural', 'Commercial', 'Industrial', 'Light Industrial', 'Multi-Family
        Residential', 'Residential', '', 'College or University', 'Flood Way', 'Hospital',
        'Institute', 'Mixed Use', 'Office', 'Parking', 'South Main Historic Arts District',
        'Tom Lee Park'],
        labels = ["Zoning"],
        from, to;

    for (var i = 0; i < grades.length; i++) {
```

```
        from = grades[i];
        to = grades[i + 1];

        labels.push(
            '<i style="background:' + myGetColor_zoningVar(from) + '"></i> ' + (from));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('zoningVar').onclick = function() {
    if (this.className === 'active') {
        zoningLegend.removeFrom(map);
        zoningInfo.removeFrom(map);

        this.className = '';
    } else {
        zoningLegend.addTo(map);
        zoningInfo.addTo(map);

        this.className = 'active';
        }
    }

//EPA Monitors=============================================
/////----------------------------------------------------------------------
/////EPA Monitors----------------
/////----------------------------------------------------------------------
//Current EPA Monitor Location
var currentEPAMonitorVar = L.geoJson(null, {
    pointToLayer: function (feature, latlng) {
        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/EPA_Monitor24px.png",
                iconSize: [24, 24],
                iconAnchor: [12, 17],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {

        }

});
$.getJSON("data/currentEPAmonitor.js", function (data) {
    currentEPAMonitorVar.addData(data);
});

//Proposed EPA Monitor Locations
```

```
var proposedEPAMonitorsVar = L.geoJson(null, {
    pointToLayer: function (feature, latlng) {
        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/EPA_Monitor_Grey24px.png",
                iconSize: [24, 24],
                iconAnchor: [12, 17], //this is the middle of a 24x24 px PNG
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {
    }
});
$.getJSON("data/proposedEPAmonitors.js", function (data) {
    proposedEPAMonitorsVar.addData(data);
});


//Memphis CFIRE Data============================================
/////-----------------------------------------------------------------
/////Memphis CFIRE Data----------------
/////-----------------------------------------------------------------
//Neighborhoods
var neighborhoodsVar = L.geoJson(neighborhoods, {
    style: neighborhoodsStyle,
    onEachFeature: onEachFeature_neighborhoodsVar
});

function neighborhoodsStyle(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: myGetColor_neighborhoodsVar(feature.properties.Name),
        dashArray: '3',
        fillOpacity: 0.2,
        fillColor: myGetColor_neighborhoodsVar(feature.properties.Name)
    };
}

function onEachFeature_neighborhoodsVar(feature, layer) {
    layer.on({
        mouseover: highlightFeature_neighborhoodsVar,
        mouseout: resetHighlight_neighborhoodsVar,
        click: zoomToFeature
    });
}

function highlightFeature_neighborhoodsVar(e) {
    var layer = e.target;
```

```
    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.5
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    neighborhoodsInfo.update(layer.feature.properties);
}

function resetHighlight_neighborhoodsVar(e) {
    neighborhoodsVar.resetStyle(e.target);
    neighborhoodsInfo.update();
}


function myGetColor_neighborhoodsVar(d) {
    if (d == "Fox Meadows"){
        return '#00c5ff';
    } else if (d == "Parkway Village"){
        return '#2f57b5';
    } else if (d == "Hickory Hill"){
        return '#b030c7';
    } else if (d == "Oakville"){
        return '#31ab24';
    } else if (d == "Oakhaven"){
        return '#c45a29';
    } else {
        console.log("Error: Neighborhoods myGetColor. Data entered was: " + d + " Oh, it's the
        legend trying to populate.");
    }
}

// control that shows state info on hover
var neighborhoodsInfo = L.control({position: 'bottomleft'});

neighborhoodsInfo.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'Neighborhoods');
    this.update();
    return this._div;
};

neighborhoodsInfo.update = function (props) {
    this._div.innerHTML = '<h4>Neighborhoods</h4>' +  (props ?
        '<b>' + props.Name + '</b><br />'
        : 'Hover over a neighborhood');
};

//legend
var neighborhoodsLegend = L.control({position: 'bottomright'});
```

```
neighborhoodsLegend.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        grades = ['Fox Meadows', 'Hickory Hill', 'Oakville', 'Oakhaven', 'Parkway Village'],
        labels = ["Neighborhoods"],
        from, to;

    for (var i = 0; i < grades.length; i++) {
        from = grades[i];
        to = grades[i + 1];

        labels.push(
            '<i style="background:' + myGetColor_neighborhoodsVar(from) + '"></i> ' + from);
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('neighborhoodsVar').onclick = function() {
    if (this.className === 'active') {
        neighborhoodsLegend.removeFrom(map);
        neighborhoodsInfo.removeFrom(map);

        this.className = '';
    } else {
        neighborhoodsLegend.addTo(map);
        neighborhoodsInfo.addTo(map);

        this.className = 'active';
        }
    }

    //Lamar Area Freight Facilities
    var lamarAreaFreightFacilitiesVar = L.geoJson(null, {
        pointToLayer: function (feature, latlng) {
            return L.marker(latlng, {
                icon: L.icon({
                    iconUrl: "img/freight_16px.png",
                    iconSize: [16, 16],
                    iconAnchor: [8, 8],
                    popupAnchor: [0, -25],
                    opacity: 0.5
                }),

                riseOnHover: true
            });
        },
        onEachFeature: function (feature, layer) {
        }

    });
    $.getJSON("data/lamarAreaFreightFacilities.js", function (data) {
```

```
    lamarAreaFreightFacilitiesVar.addData(data);
});

//Public Warehouses
var publicWarehousesVar = L.geoJson(null, {
    pointToLayer: function (feature, latlng) {
        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/publicWarehouse_46px.png",
                iconSize: [46, 46],
                iconAnchor: [23, 23],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {
    }
});
$.getJSON("data/publicWarehouses.js", function (data) {
    publicWarehousesVar.addData(data);
});

//Warehouses
var warehousesVar = L.geoJson(null, {
    pointToLayer: function (feature, latlng) {
        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/warehouse_30px.png",
                iconSize: [30, 30],
                iconAnchor: [15, 15],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {
    }

});
$.getJSON("data/warehouses.js", function (data) {
    warehousesVar.addData(data);
});

//Distribution Centers
var distributionCentersVar = L.geoJson(null, {
    pointToLayer: function (feature, latlng) {
        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/distributionCenter_30px.png",
```

```
                iconSize: [30, 30],
                iconAnchor: [15, 15],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {
    }

});
$.getJSON("data/distributionCenters.js", function (data) {
    distributionCentersVar.addData(data);
});

//Freight Facilities
var freightFacilitiesVar = L.geoJson(null, {
    pointToLayer: function (feature, latlng) {
        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/freight_24px.png",
                iconSize: [24, 24],
                iconAnchor: [12, 12],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {
    }

});
$.getJSON("data/freightFacilities.js", function (data) {
    freightFacilitiesVar.addData(data);
});

//Truck Terminals
var truckTerminalsVar = L.geoJson(null, {
    pointToLayer: function (feature, latlng) {
        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/truckFrontView_30px.png",
                iconSize: [30, 30],
                iconAnchor: [15, 15],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
```

```
        },
        onEachFeature: function (feature, layer) {
        }

    });
    $.getJSON("data/truckTerminals.js", function (data) {
        truckTerminalsVar.addData(data);
    });

    //Intermodal Terminals
    var intermodalTerminalsVar = L.geoJson(null, {
        pointToLayer: function (feature, latlng) {
            return L.marker(latlng, {
                icon: L.icon({
                    iconUrl: "img/intermodalTerminal_40px.png",
                    iconSize: [40, 40],
                    iconAnchor: [20, 20],
                    popupAnchor: [0, -25],
                    opacity: 0.5
                }),

                riseOnHover: true
            });
        },
        onEachFeature: function (feature, layer) {
        }

    });
    $.getJSON("data/intermodalTerminals.js", function (data) {
        intermodalTerminalsVar.addData(data);
    });

//Proposed Intermodal Yard
var proposedIntermodalYardVar = L.geoJson(proposedIntermodalYard, {
    style: proposedIntermodalYardStyle,
    onEachFeature: onEachFeature_proposedIntermodalYardVar,
    layer: "bikeScore"
});

function proposedIntermodalYardStyle(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: '#451700',
        dashArray: '3',
        fillOpacity: 0.9,
        fillColor: '#451700'
    };
}

function onEachFeature_proposedIntermodalYardVar(feature, layer) {
    layer.on({
        mouseover: highlightFeature_proposedIntermodalYardVar,
        mouseout: resetHighlight_proposedIntermodalYardVar,
```

```
        click: zoomToFeature
    });
}

function highlightFeature_proposedIntermodalYardVar(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0.7
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    proposedIntermodalYardInfo.update(layer.feature.properties);
}

function resetHighlight_proposedIntermodalYardVar(e) {

    proposedIntermodalYardVar.resetStyle(e.target);
    proposedIntermodalYardInfo.update();
}

// control that shows state info on hover
var proposedIntermodalYardInfo = L.control({position: 'bottomleft'});

proposedIntermodalYardInfo.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'Neighborhoods');
    this.update();
    return this._div;
};

proposedIntermodalYardInfo.update = function (props) {
    this._div.innerHTML = '<h4>Proposed Intermodal Yard</h4>' +  (props ?
        '<b>' + "(No Information to Display)" + '</b><br />'
        : '(Site is East of Lamar Ave, by Collierville)');
};

//legend
var proposedIntermodalYardLegend = L.control({position: 'bottomright'});

proposedIntermodalYardLegend.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        grades = ["Proposed Site"],
        labels = [],
        from, to;

    for (var i = 0; i < grades.length; i++) {
        from = grades[i];
```

```
        to = grades[i + 1];

        labels.push(
            '<i style="background:' + '#1240ab' + '"></i> ' +
            from);
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('proposedIntermodalYardVar').onclick = function() {
    if (this.className === 'active') {
        proposedIntermodalYardLegend.removeFrom(map);
        proposedIntermodalYardInfo.removeFrom(map);

        this.className = '';
    } else {
        proposedIntermodalYardLegend.addTo(map);
        proposedIntermodalYardInfo.addTo(map);

        this.className = 'active';
        }
    }

//Shelby County 2013 Census Tracts==========================================
/////----------------------------------------------------------------
/////Shelby County 2013 Census Tracts----------------
/////----------------------------------------------------------------
var censusTractsVar = L.geoJson(shelbyCounty2013CensusTracts, {
    style: censusTractsStyle,
    onEachFeature: onEachFeature_censusTractsVar
});

function censusTractsStyle(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'black',
        dashArray: '3',
        fillOpacity: 0,
        fillColor: '#fff'
    };
}

function onEachFeature_censusTractsVar(feature, layer) {
    layer.on({
        mouseover: highlightFeature_censusTractsVar,
        mouseout: resetHighlight_censusTractsVar,
        click: zoomToFeature
    });
}

function highlightFeature_censusTractsVar(e) {
```

```
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    censusTractsInfo.update(layer.feature.properties);
}

function resetHighlight_censusTractsVar(e) {
    censusTractsVar.resetStyle(e.target);
    censusTractsInfo.update();
}

// control that shows state info on hover
var censusTractsInfo = L.control({position: 'bottomleft'});

censusTractsInfo.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'Neighborhoods');
    this.update();
    return this._div;
};

censusTractsInfo.update = function (props) {
    this._div.innerHTML = '<h4>Census Tracts</h4>' +  (props ?
        '<b>' + props.NAMELSAD + '</b><br />'
        : 'Hover over a tract');
};

document.getElementById('censusTractsVar').onclick = function() {
    if (this.className === 'active') {
        censusTractsInfo.removeFrom(map);

        this.className = '';
    } else {
        censusTractsInfo.addTo(map);

        this.className = 'active';
        }
    }

//Transportation=============================================
/////-----------------------------------------------------------------
/////NTAD 2013 Data---------------
/////-----------------------------------------------------------------
//Rail Lines
var railLinesVar = L.geoJson(railLines, {
```

```
    style: railLinesStyle,
    onEachFeature: onEachFeature_railLinesVar
});

function railLinesStyle(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: 'black',
        dashArray: '3',
        fillOpacity: 0,
        fillColor: '#fff'
    };
}

function onEachFeature_railLinesVar(feature, layer) {
    layer.on({
        mouseover: highlightFeature_railLinesVar,
        mouseout: resetHighlight_railLinesVar,
        click: zoomToFeature
    });
}

function highlightFeature_railLinesVar(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    railLinesInfo.update(layer.feature.properties);
}

function resetHighlight_railLinesVar(e) {

    railLinesVar.resetStyle(e.target);
    railLinesInfo.update();
}

// control that shows state info on hover
var railLinesInfo = L.control({position: 'bottomleft'});

railLinesInfo.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'Neighborhoods');
    this.update();
    return this._div;
};
```

```
function isRRowner2(prop){
    console.log("this is the prop: " + prop);
    if (prop == null){
        return "";
    } else {
        return ", " + prop;
    }
}

railLinesInfo.update = function (props) {
    this._div.innerHTML = '<h4>Rail Lines: Owner(s)</h4>' +  (props ?
        '<b>' + props.RROWNER1 + isRRowner2(props.RROWNER2) + '</b>' : 'Hover over a rail line');
};

document.getElementById('railLinesVar').onclick = function() {
    if (this.className === 'active') {
        railLinesInfo.removeFrom(map);

        this.className = '';
    } else {
        railLinesInfo.addTo(map);

        this.className = 'active';
        }
    }

//Rail Nodes ----------------------------------------
var railNodesVar = L.geoJson(null, {
    pointToLayer: function (feature, latlng) {
        return L.marker(latlng, {
            icon: L.icon({
                iconUrl: "img/trainNode_40px.png",
                iconSize: [40, 40],
                iconAnchor: [20, 20],
                popupAnchor: [0, -25],
                opacity: 0.5
            }),

            riseOnHover: true
        });
    },
    onEachFeature: function (feature, layer) {
    }

});
$.getJSON("data/railNodes.js", function (data) {
    railNodesVar.addData(data);
});

//HPMS 2013 Roads -----------------------------------
var HPMSRoadsVar = L.geoJson(HPMS_Roads_ShelbyCounty, {
    style: HPMSRoadsStyle,
    onEachFeature: onEachFeature_HPMSRoadsVar
```

```
});

function HPMSRoadsStyle(feature) {
    return {
        weight: 2,
        opacity: 1,
        color: myGetColor_HPMSRoadsVar(feature.properties.AADT),
        dashArray: '3',
        fillOpacity: 0,
    };
}

function onEachFeature_HPMSRoadsVar(feature, layer) {
    layer.on({
        mouseover: highlightFeature_HPMSRoadsVar,
        mouseout: resetHighlight_HPMSRoadsVar,
        click: zoomToFeature
    });
}

function highlightFeature_HPMSRoadsVar(e) {
    var layer = e.target;

    layer.setStyle({
        weight: 5,
        color: '#f00',
        dashArray: '',
        fillOpacity: 0
    });

    if (!L.Browser.ie && !L.Browser.opera) {
        layer.bringToFront();
    }

    HPMSRoadsInfo.update(layer.feature.properties);
}

function resetHighlight_HPMSRoadsVar(e) {
    HPMSRoadsVar.resetStyle(e.target);
    HPMSRoadsInfo.update();
}

function myGetColor_HPMSRoadsVar(d) {
    return d > 45850 ? '#a50026' :
           d > 27560  ? '#cb181d' :
           d > 20400  ? '#f46d43' :
           d > 14590  ? '#fee08b' :
           d > 9760  ? '#ffffbf' :
           d > 5071  ? '#80cdc1' :
                       '#01665e';
}

// control that shows state info on hover
var HPMSRoadsInfo = L.control({position: 'bottomleft'});
```

```
HPMSRoadsInfo.onAdd = function (map) {
    this._div = L.DomUtil.create('div', 'Neighborhoods');
    this.update();
    return this._div;
};

HPMSRoadsInfo.update = function (props) {
    this._div.innerHTML = '<h4>Roads: Annual Average Daily Traffic</h4>' +  (props ?
        '<b>' + props.AADT + '</b><br />'
        : 'Hover over a road');
};

var HPMSRoadsLegend = L.control({position: 'bottomright'});

HPMSRoadsLegend.onAdd = function (map) {

    var div = L.DomUtil.create('div', 'info legend'),
        colorGrades = [45850, 27560, 20400, 14590, 9760, 5071, 0],
        labels = ["Roads: Annual Average Daily Traffic"],
        from, to;

    for (var i = 0; i < colorGrades.length; i++) {
        from = colorGrades[i];
        to = (colorGrades[i - 1] - 1);

        labels.push(
            '<i style="background:' + myGetColor_HPMSRoadsVar(from + 1) + '"></i> ' +
            from + (to ? '&ndash;' + to : '+'));
    }

    div.innerHTML = labels.join('<br>');
    return div;
};

document.getElementById('HPMSRoadsVar').onclick = function() {
    if (this.className === 'active') {
        HPMSRoadsLegend.removeFrom(map);
        HPMSRoadsInfo.removeFrom(map);

        this.className = '';
    } else {
        HPMSRoadsLegend.addTo(map);
        HPMSRoadsInfo.addTo(map);

        this.className = 'active';
        }
    }

//=========================================================================
//Maps
var imageUrl = 'data/memphis-mai.jpg',
imageBounds = [[35.1103840,-89.8361912], [34.9837303,-90.0655094]];
var aeroMap = new L.imageOverlay(imageUrl, imageBounds);
```

```
var imageUrl2 = 'data/memphis-mai-geo2.jpg',
imageBounds2 = [[35.0454088,-90.1457564], [35.2232353,-89.8214767]];
var histMap = new L.imageOverlay(imageUrl2, imageBounds2);

var imageUrl3 = 'data/memphis19222.jpg',
imageBounds3 = [[35.0827598,-90.0882017], [35.1741897,-89.9436465]];
var histMap2 = new L.imageOverlay(imageUrl3, imageBounds3);

var imageUrl4 = 'data/memphis-mai-geo-5.jpg',
imageBounds4 = [[35.0825584,-90.1097809], [35.2091090,-89.9812029]];
var histMap3 = new L.imageOverlay(imageUrl4, imageBounds4);

var imageUrl5 = 'data/memphis-mai-geo-5.jpg',
imageBounds5 = [[35.0825584,-90.1097809], [35.2091090,-89.9812029]];
var histMap4 = new L.imageOverlay(imageUrl5, imageBounds5);

var imageUrl7 = 'data/noiseMap.jpg',
imageBounds7 = [[34.9695283,-90.0360770], [35.1288098,-89.8997338]];
var noiseMap = new L.imageOverlay(imageUrl7, imageBounds7);

var imageUrl8 = 'data/noiseMap2.jpg',
imageBounds8 = [[34.9712526,-90.0570429], [35.1056856,-89.8122187]];
var roadNoiseMap = new L.imageOverlay(imageUrl8, imageBounds8);

var imageUrl10 = 'data/memphis1936.jpg',
imageBounds10 = [[35.0544923,-90.1409757], [35.2219070,-89.8800621]];
var histMap5 = new L.imageOverlay(imageUrl10, imageBounds10);

//============================================================================


var layerControl = L.control.layers(baseLayers, {

}).addTo(map);

// Larger screens get expanded layer control
if (document.body.clientWidth <= 767) {
    var isCollapsed = true;
} else {
    var isCollapsed = false;
};

$("#navbar-collapse").on("shown.bs.collapse", function () {
    $(".navbar-collapse.in").css("max-height", $(document).height()-$(".navbar-header").height
    ());
    $(".navbar-collapse.in").css("height", $(document).height()-$(".navbar-header").height());
});

// Placeholder hack for IE
if (navigator.appName == "Microsoft Internet Explorer") {
    $("input").each( function () {
        if ($(this).val() == "" && $(this).attr("placeholder") != "") {
            $(this).val($(this).attr("placeholder"));
```

```
            $(this).focus(function () {
                if ($(this).val() == $(this).attr("placeholder")) $(this).val("");
            });
            $(this).blur(function () {
                if ($(this).val() == "") $(this).val($(this).attr("placeholder"));
            });
        }
    });
}

function uncheckAll(){
var w = document.getElementsByTagName('input');
for(var i = 0; i < w.length; i++){
if(w[i].type=='checkbox'){
  w[i].checked = false;
}
}
}
$(':checkbox:checked').removeAttr('checked');
```

```
<!DOCTYPE html>
<html lang="en"><!--
     -->
  <head>
    <title>Timeline Memphis TN</title>
    <meta charset="utf-8">
    <meta name="description" content="TimelineJS example">
    <meta name="apple-mobile-web-app-capable" content="yes">
    <meta name="apple-touch-fullscreen" content="yes">
    <meta name="viewport" content="width=device-width, initial-scale=1.0, maximum-scale=1.0">
    <!-- Style-->
    <style>
      html, body {
       height:100%;
       padding: 10px;
       margin: 0px;

      }
      *{
     -webkit-box-sizing: border-box;
     -moz-box-sizing: border-box;
      box-sizing: border-box;
    }


    </style>
    <script src="js/d3.v3.min.js"></script>
    <script type="text/javascript" src="../compiled/js/storyjs-embed.js"></script>

    <!-- HTML5 shim, for IE6-8 support of HTML elements--><!--[if lt IE 9]>
    <script src="https://html5shim.googlecode.com/svn/trunk/html5.js"></script><![endif]-->
  </head>
  <body>
      <!-- BEGIN Timeline Embed -->

      <div id="timeline-embed"></div>


        <script type="text/javascript">
            var dataObject;
            var dataset = [];
            d3.csv("data/help.csv", function(data) {
                populateTimeline(data);
            });

            function populateTimeline(data){
                for(var c=0; c<data.length; c++){
                    var row = data[c];
                    dataset.push({
                        startDate: row.StartDate,
                        endDate: row.EndDate,
                        text: row.Text,
                        headline: row.Headline,
                        tag: row.Type,
```

```
                    asset: {
                        media: row.Media
                        },
                    author:row.Author,
                    instit: row.Institution,
                    geo: row.states
                });
                //console.log(dataset);
            }
        }

        var dataObject = {
                timeline: {
                    headline:"Lamar Avenue Timeline",
                    type:"default",
                    text:"<p>Memphis, TN</p>",
                    asset: {
                        media:"img/LamarAve.jpg",

                    },
                    "date": dataset
                }
            }

        var timeline = createStoryJS({
            type: 'timeline',
            embed_id: "timeline-embed",
             width: "100%",
         height: "100%",
         start_zoom_adjust: 0,
         start_at_slide: 0,
         source: dataObject
        });

    </script>

    <!-- END Timeline Embed-->
  </body>
</html>
```

Appendix B

Metadata

Greenprint –
Mid-South Greenprint Geoportal: Geoportal Data Explorer.
http://geoportal.memphis.edu/greenprint/catalog/download/index.html. Last Accessed 13 February 2014.

Historical Maps –
University of Memphis McWherter Government Publications Library University, and the University of Memphis Preservation and Special Collections Department.
Dates Vary.

Aerotropolis –
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Road Noise Map: Compatibility of Freight Transportation and Land Use in
Memphis Aerotropolis, 2012, 73.
http://www.memphis.edu/ifti/pdfs/cifts_compatibility_freight_transportation_land_use.pdf. Last Accessed 13 February 2014.

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1) Data from the EPA "Enviromapper" site were gathered by "Category," which included "Air," "Water," "Waste," "Land," "Toxics," and "Radiation."
2) A facility was counted once for each type of pollution it emitted; this total for each facility is called the "Facility Weighted Total." Each facility could have a weighted total of up to six. If a facility emitted air and water pollution (and no other type of pollution), it would have a weighted total of two.
3) The sum of the weighted total for each facility within a census tract was calculated, providing the "Census Tract Weighted Total."

Census Tract Weighted Total = $\sum$ (Facility Weighted Total)

(where each Facility Weighted Total is geographically located within the bounds of the Census Tract of interest)

4) Each 2010 census tract within Greater Memphis was then normalized by area (by dividing each weighted total for a census tract by the area in square meters).
5) The normalized data from step 4 was then grouped into three classes using the quantile statistical method.

Increased Health Risks –
US Environmental Protection Agency 2005 National-Scale Air Toxics Assessment. http://www.epa.gov/ttn/atw/nata2005/. Last Accessed 13 February 2014.

Demographics (for "Population Density," see EPA Smart Location Database.) –
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http://www.epa.gov/dced/smartlocationdatabase.htm. Last Accessed 13 February 2014.
For further information on the EPA Smart Location Database, please see the "EPA User's Guide" at their website (listed above).

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Appendix C

Extract from the US Environmental Protection Agency
Smart Location Database User Guide

Smart Location Database

Version 2.0 User Guide

Updated: November 5, 2013

Authors:

Kevin Ramsey, Ph.D.
U.S. EPA Of ice of Sustainable Communities
&
Alexander Bell, AICP
Renaissance Planning Group

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Background

The Environmental Protection Agency's (EPA) Smart Location Database (SLD) was developed to address the growing demand for data products and tools that consistently compare the location efficiency of various places. The SLD summarizes several demographic, employment, and built environment variables for every Census block group (CBG) in the United States.[1] The attributes measured serve as indicators of the commonly cited "D" variables that have been shown in the transportation research literature to be related to travel behavior.[2] The Ds include concepts such as residential and employment *density*, land use *diversity*, *design* of the built environment, access to *destinations*, and *distance* to transit. SLD variables can be used as inputs to travel demand models, baseline data for scenario planning studies, and combined into composite indicators characterizing the relative location efficiency of CBG within U.S. metropolitan regions.

This report contains a detailed description of the data sources and methodologies used to calculate each of the variables contained in the SLD. It also discusses any known limitations associated with variables in the SLD. More information about the environmental significance of several individual variables contained in the SLD will be available in the form of fact sheets developed for EPA's EnviroAtlas[3]. Links to these fact sheets will be added to this document as they become available.

Prior versions of the SLD

A previous version of the SLD (version 0.2b) was released by EPA in early 2012. This report describes a completely new version of the SLD (version 2, herein referred to as simply the SLD) intended to replace the prior release. This updated SLD features new geographic boundaries (Census 2010 block groups), new data sources, new variables, and new methods of calculation. Due to these changes, it is not appropriate to directly compare values across the two datasets.

[1] SLD version 2.0 uses 2010 Census TIGER/Line polygons for defining block group boundaries.
[2] For a review of the research literature summarizing the relationship between built environment variables and travel behavior see Ewing and Cervero (2001; 2010), Kuzmyak et al. (2003), National Research Council (2009).
[3] www.epa.gov/research/enviroatlas

Accessing the Smart Location Database

The SLD is a free resource available to the public for download, web service, or viewing online. Options are described below:

Download:

The SLD can be downloaded as a single file geodatabase at EPA's Environmental Dataset Gateway[4]. Users who only wish to download data for a single state, metro region, or locality can use EPA's Clip and Ship tool[5].

Web service:

The SLD is available as an Esri mapping service, REST, SOAP, WMS, and KML. See the SLD web service[6] for details.

Viewing online:

Several variables from the SLD are available for viewing online. Go to http://www.epa.gov/smartgrowth/smartlocationdatabase.htm for details.

Variables available in the Smart Location Database

Table 1 lists all of the variables available in the SLD. SLD variables are grouped into topic areas.

Table 1 – Variables included in the Smart Location Database

Field	Description	Data source(s)	Coverage
Administrative			
GEOID10	Census block group 12-digit FIPS code	2010 Census TIGER/Line	Entire U.S.
TRACTCE10	Census tract FIPS code in which CBG resides	2010 Census TIGER/Line	Entire U.S.
CFIPS	County FIPS code	2010 Census TIGER/Line	Entire U.S.
SFIPS	State FIPS code	2010 Census TIGER/Line	Entire U.S.
CSA	Combined Statistical Area Code	US Census	Entire U.S.
CSA_Name	Name of CSA in which CBG resides	US Census	Entire U.S.
CBSA	FIPS for core based statistical area (CBSA) in which CBG resides	US Census	Entire U.S.
CBSA_Name	Name of CBSA in which CBG resides	US Census	Entire U.S.
CBSA-wide statistics (same value for all block groups within the same CBSA (metropolitan area))			
CBSA_Pop	Total population in CBSA	US Census	Entire U.S.
CBSA_Emp	Total employment in CBSA	Census LEHD, 2010	Entire U.S. (except PR)
CBSA_Wrk	Total number of workers that live in CBSA	Census LEHD, 2010	Entire U.S. (except PR)

[4] http://goo.gl/JCpdr
[5] http://edg.epa.gov/clipship/
[6] http://geodata.epa.gov/ArcGIS/rest/services/OA/SmartLocationDatabase/MapServer

Area			
Ac_Tot	Total geometric area of the CBG	2010 Census TIGER/Line	Entire U.S.
Ac_Unpr	Total land area in acres that is not protected from development (i.e., not a park or conservation area)	Census, Navteq parks, PAD-US	Entire U.S.
Ac_Water	Total water area in acres	Census, Navteq Water and Oceans	Entire U.S.
Ac_Land	Total land area in acres	Census, Navteq Water and Oceans	Entire U.S.
Demographics			
CountHU	Housing units, 2010	2010 decennial Census	Entire U.S.
HH	Households (occupied housing units), 2010	2010 decennial Census	Entire U.S.
TotPop	Population, 2010	2010 decennial Census	Entire U.S.
P_WrkAge	Percent of population that is working aged, 2010	2010 decennial Census	Entire U.S.
AutoOwn0	Number of households in CBG that own zero automobiles, 2010	ACS, 2010 decennial Census	Entire U.S.
Pct_AO0	Percent of zero-car households in CBG	ACS	Entire U.S.
AutoOwn1	Number of households in CBG that own one automobile, 2010	ACS, 2010 decennial Census	Entire U.S.
Pct_AO1	Percent of one-car households in CBG	ACS	Entire U.S.
AutoOwn2p	Number of households in CBG that own two or more automobiles, 2010	ACS, 2010 decennial Census	Entire U.S.
Pct_AO2p	Percent of two-plus-car households in CBG	ACS	Entire U.S.
Workers	# of workers in CBG (home location), 2010	Census LEHD, 2010	Entire U.S. (except PR)
R_LowWageWk	# of workers earning $1250/month or less (home location), 2010	Census LEHD, 2010	Entire U.S. (except PR)
R_MedWageWk	# of workers earning more than $1250/month but less than $3333/month (home location), 2010	Census LEHD, 2010	Entire U.S. (except PR)
R_HiWageWk	# of workers earning $3333/month or more (home location), 2010	Census LEHD, 2010	Entire U.S. (except PR)
R_PctLowWage	% LowWageWk of total #workers in a CBG (home location), 2010	Census LEHD, 2010	Entire U.S. (except PR)
Employment			
TotEmp	Total employment, 2010	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E5_Ret10	Retail jobs within a 5-tier employment classification scheme (LEHD: CNS07)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E5_Off10	Office jobs within a 5-tier employment classification scheme (LEHD: CNS09 + CNS10 + CNS11 + CNS13 + CNS20)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E5_Ind10	Industrial jobs within a 5-tier employment classification scheme (LEHD: CNS01 + CNS02 + CNS03 + CNS04 + CNS05 + CNS06 + CNS08)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)

E5_Svc10	Service jobs within a 5-tier employment classification scheme (LEHD: CNS12 + CNS14 + CNS15 + CNS16 + CNS19)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E5_Ent10	Entertainment jobs within a 5-tier employment classification scheme (LEHD: CNS17 + CNS18)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E8_Ret10	Retail jobs within an 8-tier employment classification scheme (LEHD: CNS07)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E8_Off10	Office jobs within an 8-tier employment classification scheme (LEHD: CNS09 + CNS10 + CNS11 + CNS13)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E8_Ind10	Industrial jobs within an 8-tier employment classification scheme (LEHD: CNS01 + CNS02 + CNS03 + CNS04 + CNS05 + CNS06 + CNS08)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except MA, PR)
E8_Svc10	Service jobs within an 8-tier employment classification scheme (LEHD: CNS12 + CNS14 + CNS19)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E8_Ent10	Entertainment jobs within an 8-tier employment classification scheme (LEHD: CNS17 + CNS18)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E8_Ed10	Education jobs within an 8-tier employment classification scheme (LEHD: CNS15)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E8_Hlth10	Health care jobs within an 8-tier employment classification scheme (LEHD: CNS16)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E8_Pub10	Public administration jobs within an 8-tier employment classification scheme (LEHD:CNS20)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E_LowWageWk	# of workers earning $1250/month or less (work location), 2010	Census LEHD, 2010	Entire U.S. (except MA and PR)
E_MedWageWk	# of workers earning more than $1250/month but less than $3333/month (work location), 2010	Census LEHD, 2010	Entire U.S. (except MA and PR)
E_HiWageWk	# of workers earning $3333/month or more (work location), 2010	Census LEHD, 2010	Entire U.S. (except MA and PR)
E_PctLowWage	% LowWageWk of total #workers in a CBG (work location), 2010	Census LEHD, 2010	Entire U.S. (except MA and PR)
D1 - Density			
D1a	Gross residential density (HU/acre) on unprotected land	Derived from other SLD variables	Entire U.S.
D1b	Gross population density (people/acre) on unprotected land	Derived from other SLD variables	Entire U.S.
D1c	Gross employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c5_Ret10	Gross retail (5-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c5_Off10	Gross office (5-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c5_Ind10	Gross industrial (5-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)

D1c5_Svc10	Gross service (5-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c5_Ent10	Gross entertainment (5-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Ret10	Gross retail (8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Off10	Gross office (8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Ind10	Gross industrial (8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Svc10	Gross service (8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Ent10	Gross entertainment (8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Ed10	Gross education(8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Hlth10	Gross health care (8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Pub10	Gross retail (8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1d	Gross activity density (employment + HUs) on unprotected land	Derived from other SLD variables	Entire U.S. (PR does not reflect employment)
D1_Flag	Flag indicating that density metrics are based on total CBG land acreage rather than unprotected acreage	Derived from other SLD variables	Entire U.S. (PR does not reflect employment)
D2 - Diversity			
D2a_JpHH	Jobs per household	Derived from other SLD variables	Entire U.S. (except PR)
D2b_E5Mix	5-tier employment entropy (denominator set to observed employment types in the CBG)	Derived from other SLD variables	Entire U.S. (except PR)
D2b_E5MixA	5-tier employment entropy (denominator set to the static 5 employment types in the CBG)	Derived from other SLD variables	Entire U.S. (except PR)
D2b_E8Mix	8-tier employment entropy (denominator set to observed employment types in the CBG)	Derived from other SLD variables	Entire U.S. (except PR)
D2b_E8MixA	8-tier employment entropy (denominator set to the static 8 employment types in the CBG)	Derived from other SLD variables	Entire U.S. (except PR)
D2a_EpHHm	Employment and household entropy	Derived from other SLD variables	Entire U.S. (except PR)
D2c_TrpMx1	Employment and Household entropy (based on vehicle trip production and trip attractions including all 5 employment categories)	Derived from other SLD variables	Entire U.S. (except PR)
D2c_TrpMx2	Employment and Household Entropy calculations, based on trips production and trip attractions including 4 of the 5 employment	Derived from other SLD variables	Entire U.S. (except PR)

	categories (excluding industrial)		
D2c_TripEq	Trip productions and trip attractions equilibrium index; the closer to one, the more balanced the trip making	Derived from other SLD variables	Entire U.S. (except PR)
D2r_JobPop	Regional Diversity. Standard calculation based on population and total employment: Deviation of CBG ratio of jobs/pop from regional average ratio of jobs/pop	Derived from other SLD variables	Entire U.S. (except PR)
D2r_WrkEmp	Household Workers per Job, as compared to the region: Deviation of CBG ratio of household workers/job from regional average ratio of household workers/job	Derived from other SLD variables	Entire U.S. (except PR)
D2a_WrkEmp	Household Workers per Job, by CBG	Derived from other SLD variables	Entire U.S. (except PR)
D2c_WrEmIx	Household Workers per Job Equilibrium Index; the closer to one the more balanced the resident workers and jobs in the CBG.	Derived from other SLD variables	Entire U.S. (except PR)
D3 – Design			
D3a	Total road network density	NAVSTREETS	Entire U.S.
D3aao	Network density in terms of facility miles of auto-oriented links per square mile	NAVSTREETS	Entire U.S.
D3amm	Network density in terms of facility miles of multi-modal links per square mile	NAVSTREETS	Entire U.S.
D3apo	Network density in terms of facility miles of pedestrian-oriented links per square mile	NAVSTREETS	Entire U.S.
D3b	Street intersection density (weighted, auto-oriented intersections eliminated)	NAVSTREETS	Entire U.S.
D3bao	Intersection density in terms of auto-oriented intersections per square mile	NAVSTREETS	Entire U.S.
D3bmm3	Intersection density in terms of multi-modal intersections having three legs per square mile	NAVSTREETS	Entire U.S.
D3bmm4	Intersection density in terms of multi-modal intersections having four or more legs per square mile	NAVSTREETS	Entire U.S.
D3bpo3	Intersection density in terms of pedestrian-oriented intersections having three legs per square mile	NAVSTREETS	Entire U.S.
D3bpo4	Intersection density in terms of pedestrian-oriented intersections having four or more legs per square mile	NAVSTREETS	Entire U.S.

D4 –Transit			
D4a	Distance from population weighted centroid to nearest transit stop (meters)	GTFS; TOD Database 2012	Participating GTFS transit service areas/TOD Database locations
D4b025	Proportion of CBG employment within ¼ mile of fixed-guideway transit stop	TOD Database 2012, SLD unprotected area polygons	Entire U.S.
D4b050	Proportion of CBG employment within ½ mile of fixed-guideway transit stop	TOD Database 2012, SLD unprotected area polygons	Entire U.S.
D4c	Aggregate frequency of transit service within 0.25 miles of block group boundary per hour during evening peak period	GTFS	Participating GTFS transit service areas
D4d	Aggregate frequency of transit service (D4c) per square mile	Derived from other SLD variables	Participating GTFS transit service areas
D5 – Destination Accessibility			
D5ar	Jobs within 45 minutes auto travel time, time-decay (network travel time) weighted	NAVSTREETS	Entire U.S. (except PR)
D5ae	Working age population within 45 minutes auto travel time, time-decay (network travel time) weighted	NAVSTREETS	Entire U.S.
D5br	Jobs within 45-minute transit commute, distance decay (walk network travel time, GTFS schedules) weighted	NAVSTREEETS GTFS	Participating GTFS transit service areas (except PR)
D5be	Working-age population within 45-minute transit commute, time decay (walk network travel time, GTFS schedules) weighted	NAVSTREETS GTFS	Participating GTFS transit service areas
D5cr	Proportional Accessibility to Regional Destinations - Auto: Employment accessibility expressed as a ratio of total MSA accessibility	Derived from other SLD variables	Entire U.S. (except PR)
D5cri	Regional Centrality Index – Auto: CBG D5cr score relative to max CBSA D5cr score	Derived from other SLD variables	Entire U.S.
D5ce	Proportional Accessibility to Regional Destinations - Auto: Working age population accessibility expressed as a ratio of total CBSA accessibility	Derived from other SLD variables	Entire U.S.
D5cei	Regional Centrality Index – Auto: CBG D5ce score relative to max CBSA D5ce score	Derived from other SLD variables	Entire U.S.
D5dr	Proportional Accessibility of Regional Destinations - Transit: Employment accessibility expressed as a ratio of total MSA accessibility	Derived from other SLD variables	Participating GTFS transit service areas
D5dri	Regional Centrality Index – Transit: CBG D5dr score relative to max CBSA D5dr score	Derived from other SLD variables	Participating GTFS transit service areas
D5de	Proportional Accessibility of Regional Destinations - Transit: Working age population accessibility expressed as a ratio of total MSA	Derived from other SLD variables	Participating GTFS transit service areas

	accessibility		
D5dei	Regional Centrality Index – Transit: CBG D5de score relative to max CBSA D5de score	Derived from other SLD variables	Participating GTFS transit service areas

Data Sources

This section summarized each of the data sources used to develop the SLD. These include several Census datasets (TIGER/Line, 2010 summary file 1, American Community Survey, and Longitudinal Employer-Household Dynamics), NAVTEQ highway/streets and parks data, Protected Areas Database of the United States (PAD-US), fixed-guideway transit station locations from the TOD Database, and local transit service data shared in the General Transit Feed Specification (GTFS).

Block ground boundaries

EPA obtained CBG boundaries from 2010 Census TIGER/Line shapefiles and combined them into a single national ArcGIS feature class. TIGER2010_bg10 is the basic geographic dataset to which all SLD variables are appended. It represents the 2010 geographic boundaries of all CBGs in the United States. EPA also obtained 2010 block group "centers of population"[7] from the Census. These centroids were used in geoprocessing routines developed for spatially derived variables, notably the distance to transit and regional accessibility measures. Finally, the US Census provides tables relating county and county equivalent areas to core based statistical areas (CBSA) and combined statistical areas (CSA). EPA used these tables to associate block groups with their respective metropolitan areas based on county location.

2010 Census

EPA obtained basic population, demographic, and housing data for CBG from the 2010 Census Summary File 1 (SF1).[8] SF1 contains data compiled from the 2010 Decennial Census questions. EPA's Office of Environmental Information tabulated 2010 SF1 data for all U.S. CBG in two tables SF1HOUBG and SF1POPBG. SF1HOUBG contains data on housing units, occupancy and tenure. SF1POPBG contains data on population, race, ethnicity, age, and sex.

American Community Survey (ACS)

EPA obtained additional socioeconomic and demographic variables from the 2006-2010 ACS Five-Year Estimates. The ACS summary file tabulates variables that are not included in the Census SF1 for 2010 – such as household automobile ownership.

Longitudinal Employer-Household Dynamics (LEHD)

US Census LEHD Origin-Destination Employment Statistics (LODES) tables summarize employment at the census block level for all 50 states, the District of Columbia, Puerto Rico and the US Virgin Islands. However, the territories and the Commonwealth of Massachusetts are not "regular production"

[7] http://www.census.gov/geo/reference/centersofpop.html
[8] http://www.census.gov/2010census/data/

partners in LEHD, and some data for these jurisdictions are not available[9]. LODES version 6.X utilizes 2010 Census block boundaries. The latest update (version 6.1) is an augmentation of version 6.0 and includes two previously un-reported job types that represent federal employment.[10]

The SLD references the LODES Work Area Characteristics (WAC) tables for employment tabulations. Variables concerning the home location of workers by wage level were obtained from the LODES Residence Area Characteristics (RAC). The structures and field definitions of the RAC and WAC datasets are identical and displayed for reference in Table 2.

Table 2: LODES Work/Residence Area Characteristics (variables summarized in the SLD)

Pos	Variable	Type	Len	Explanation
1	h_geocode	Char	15	Residence/Workplace Census Block Code
2	C000	Num	8	Total Number of Jobs
6	CE01	Num	8	Number of jobs with earnings $1250/month or less
7	CE02	Num	8	Number of jobs with earnings $1251/month to $3333/month
8	CE03	Num	8	Number of jobs with earnings greater than $3333/month
9	CNS01	Num	8	Number of jobs in NAICS sector 11 (Agriculture, Forestry, Fishing and Hunting)
10	CNS02	Num	8	Number of jobs in NAICS sector 21 (Mining, Quarrying, and Oil and Gas Extraction)
11	CNS03	Num	8	Number of jobs in NAICS sector 22 (Utilities)
12	CNS04	Num	8	Number of jobs in NAICS sector 23 (Construction)
13	CNS05	Num	8	Number of jobs in NAICS sector 31-33 (Manufacturing)
14	CNS06	Num	8	Number of jobs in NAICS sector 42 (Wholesale Trade)
15	CNS07	Num	8	Number of jobs in NAICS sector 44-45 (Retail Trade)
16	CNS08	Num	8	Number of jobs in NAICS sector 48-49 (Transportation and Warehousing)
17	CNS09	Num	8	Number of jobs in NAICS sector 51 (Information)
18	CNS10	Num	8	Number of jobs in NAICS sector 52 (Finance and Insurance)
19	CNS11	Num	8	Number of jobs in NAICS sector 53 (Real Estate and Rental and Leasing)
20	CNS12	Num	8	Number of jobs in NAICS sector 54 (Professional, Scientific, and Technical Services)
21	CNS13	Num	8	Number of jobs in NAICS sector 55 (Management of Companies and Enterprises)
22	CNS14	Num	8	Number of jobs in NAICS sector 56 (Administrative and Support and Waster Management and Remediation Services)
23	CNS15	Num	8	Number of jobs in NAICS sector 61 (Educational Services)
24	CNS16	Num	8	Number of jobs in NAICS sector 62 (Health Care and Social

[9] EPA later obtained several Massachusetts employment variables from Metropolitan Area Planning Council. See Info USA below for details.

[10] More information about LODES data can be found at http://lehd.did.census.gov/data/. More information about NAICS (North American Industry Classification System) can be found at http://www.census.gov/eos/www/naics/.

Table 2: LODES Work/Residence Area Characteristics (variables summarized in the SLD)

Pos	Variable	Type	Len	Explanation
				Assistance)
25	CNS17	Num	8	Number of jobs in NAICS sector 71 (Arts, Entertainment, and Recreation)
26	CNS18	Num	8	Number of jobs in NAICS sector 72 (Accommodation and Food Services)
27	CNS19	Num	8	Number of jobs in NAICS sector 81 (Other Services [except Public Administration])
28	CNS20	Num	8	Number of jobs in NAICS sector 92 (Public Administration)

InfoUSA

Midway through the development of the SLD version 2.0 EPA obtained several employment variables for Massachusetts to compensate for the lack of data availability in the LEHD. Metropolitan Area Planning Council (MAPC) shared these data with EPA. The original data source for these variables is InfoUSA[11], 2011. These data were obtained after the drive-time accessibility analysis and therefore employment accessibility by automobile (D5ar) is not summarized for Massachusetts.

NAVTEQ

EPA has a license to use several NAVTEQ data layers[12] (release date 2011 Q3) including NAVSTREETS for developing spatially derived variables such as intersection density and automobile accessibility metrics. The NAVSTREETS dataset is a detailed nationwide street network with rich attribute information, include functional class and speed categories, direction of travel restrictions, vehicular and pedestrian restrictions, tags for highway ramps and other variables of interest for developing a multimodal travel network and characterizing network design. Additional NAVTEQ layers that were used to support the SLD update include water features and land use layers that were referenced in calculating CBG developable area.

PAD-US

The US Geological Survey (USGS) developed the Protected Areas Database[13] as an inventory of the protection status of public lands and voluntarily provided private conservation lands across the U.S. EPA used data from PAD-US version 1.3 to identify land area protected from development.

TOD Database

The Center for Transit Oriented Development (CTOD) maintains an inventory of existing, planned, and proposed fixed-guideway transit station locations throughout the country as of 2011. Fixed-route transit systems included are heavy rail, light rail, commuter rail, streetcars, bus rapid transit (with dedicated right of way) and cable cars. The database also includes some Amtrak stations that serve commuters. These data can be viewed online in the Transit Oriented Development (TOD) Database.[14] EPA obtained

[11] http://www.infousa.com/
[12] http://www.navteq.com/products_data.htm
[13] http://gapanalysis.usgs.gov/padus/
[14] http://toddata.cnt.org/

the locations of all existing fixed-guideway transit stations. Table 7 in Appendix A lists all metropolitan regions with existing fixed-guideway transit service featured in the TOD Database.

GTFS

Local transit agencies can use GTFS (or General Transit Feed Specification[15]) to share transit schedules and associated geographic information in a common format. GTFS files contain stop locations, stop times, routes and trips, and other attributes of the transit network. EPA obtained GTFS data for use in metrics summarizing transit service availability, frequency, and accessibility to destinations via transit. Not all transit agencies share their data in this format. But the vast majority of large transit agencies do so. Table 8 in Appendix A lists the 231 transit agencies whose data was analyzed to produce SLD metrics. EPA obtained GTFS data during the months of December, 2012 and January, 2013.

Technical Approach

This section summarizes the derivation of all variables in the SLD including the methodologies used for internally and spatially derived variables. The discussion is organized by variable category (see Table 1 for category headings and a full list of variables).

Administrative

All administrative variables were joined directly from 2010 Census data. Metropolitan area groupings were derived from the Census CBSA/CSA table downloaded from the US Census website. The table reflects 2009 CSA and CBSA groupings by combined state-county FIPS code. The CSA, CSA_Name, CBSA, and CBSA_Name fields were populated by grouping CBGs according to their state and county IDs and matching these to the CSA/CBSA table.

Demographic

Demographic variables were joined directly from 2010 Census data. These include population and residential activity in each CBG as well as residential-location-based socioeconomic variables. Variables about worker earnings feature the prefix "R_" to reflect that they summarize workers by home/residence location rather than work location.

- Population (TotPop) and housing units (CountHU) were tabulated from the SF1POPBG and SF1HOUBG tables, respectively.
- P_WrkAge was referenced from the SF1POPBG table's PCT_AGE_GT17 field. This field represents the proportion of the population greater than age 17.
- Auto ownership fields were derived from the ACS table B25044 and were calculated in two steps. First, percent auto ownership fields were calculated as the share of all households having zero cars (Pct_AO0), one car (Pct_AO1), or two or more cars (Pct_AO2p) with respect to total households reported in the ACS table. These percent auto ownership rates were then

[15] Learn more about the GTFS at https://developers.google.com/transit/gtfs/. Agencies can post raw GTFS files for public download on the GTFS data exchange (http://www.gtfs-data-exchange.com/). A full listing of agencies that do and do not share their data in GTFS format is available at City-Go-Round (http://www.citygoround.org/agencies/).

applied to the CountHU10 field of the Demographics table to ascertain the number of households estimated to own zero cars (AutoOwn0), one car (AutoOwn1), or two or more cars (AutoOwn2p). The process was conducted in this order because isolated discrepancies were observed between the total number of households reported in the ACS table and the corresponding figure in the SF1HOUBG table. The SF1HOUBG table was given precedence, and only the auto ownership rates were taken directly from the ACS table.

The number of workers was summarized from LEHD RAC tables, which report employment based on worker residence.

The LEHD RAC tables were also referenced to produce wage stratification variables for each CBG based on worker residence. High wage workers earn more than $3,333 per month while low wage workers earn $1,250 or less per month. Medium wage workers are in between. The total number of workers comprised by each wage group was tabulated for each CBG in the R_LowWageWk, R_MedWageWk, and R_HighWageWk fields. The share of total workers comprised by low wage workers for each CBG is reported in the R_PctLowWage field.

Appendix D-1

Data Layer Statistics

Pollution
Weighted Tracts
Weighted Tracts/Shape Area
Percent African American -- Infographic
Demographics
Population Density
Population Density: Area in SqKm
Percent African American
Percent Hispanic
Percent Native American
Percent Asian
Smart Location Database
Housing Units Per Acre
Jobs per Acre (7 classes)
Jobs per Household
Zero Car Households
Zero Car Households, Normalized by Area
Percent Low Wage Workers
USDA Food Atlas
Low-Income People with Low Food Access (urban: 1/2 mile, rural: 10 miles)
Low-Income People with Low Food Access (urban: 1/2 mile, rural: 10 miles), Normalized by Area
Children Age 0-17 with Low Food Access at 1/2 Mile
Children Age 0-17 with Low Food Access at 1/2 Mile, Normalized by Area
Seniors age 65+ with Low Food Access at 1/2 Mile
Seniors age 65+ with Low Food Access at 1/2 Mile, Normalized by Area
Housing units without vehicles, with low food access at 1/2 mile
Housing units without vehicles, with low food access at 1/2 mile, Normalized by Area
Greenprint
Bike Score
Variable 1: Bike Score (Equal Interval)
DOT NTAD HPMS: Departement of Transportation National Transporation Atlas Database Highway Performance Monitoring System
AADT: Average Annual Daily Traffic

Count	Mimimum	Maximum	Sum	Mean	Median	Standard Deviation	Area Unit
218	0	393	5560	26	14	47	
218	0	829000	16630000	76290	39930	111300	Decimal Degrees
217	0.01215	1	124.1	0.5718	0.7053	0.3504	
696	0	0.01149	0.9479	0.001362	0.001287	0.0009922	Square Meters
696	0	11490	947900	1362	1287	992.2	Square Kilometers
217	0.01215	1	124.1	0.5718	0.7053	0.3504	
217	0	0.439423451	11.2954938	0.052052967	0.024913151	0.069634322	
217	0	0.008342304	0.514307228	0.002370079	0.002132954	0.001626604	
217	0	0.142195032	3.52105851	0.016226076	0.008093356	0.021745813	
696	0	3838	450505	647.277299	564.5	370.731906	
696	0	171.510859	1516.856873	2.179392	0.421413	8.795956	
696	0	23264	29878.46157	42.928824	0.219153	892.736856	
696	0	589	42798	61.491379	32	81.815709	
696	0	2257.46822	59935.9852	86.1149213	22.4627352	165.698841	Square Kilometers
696	0	0.45879	186.42544	0.267853	0.259715	0.067525	
218	0	4236.350341	245409.0576	1125.729622	947.285167	807.443479	
218	0	2123	84770	388.9	298.2	362.6	Square Kilometers
218	0	3542.000043	170510.0105	782.156012	649.546199	602.468623	
218	0	1028.15909	46516.9843	213.380662	171.717307	159.738402	Square Kilometers
218	0	1086.000003	66834.54265	306.580471	253.915288	233.412782	
218	0	474.398041	18532.0576	85.0094388	72.2234409	64.0589106	Square Kilometers
218	0	653.959668	21652.66765	99.324164	63.324366	108.293813	
218	0	544.456373	9704.88023	44.5177992	15.7933553	72.747949	Square Kilometers
704	0.003496	100	13799.18602	19.601117	15.418719	16.377097	
704	0.003496	100	13799.18602	19.601117	15.418719	16.377097	
6060	0	168160	166744276	27515.5571	17960	31619.42107	

Data Info
Join_Count
Join_Count/Shape_Area
DP0080004/DP0010001 (African American/Total)
TOTPOP10/ShapeArea6 (Census 2010 Population/Area in Square Meters)
TOTPOP10/AreaKm (Census 2010 Population/Area in Square Kilometers)
DP0080004/DP0010001 (African American/Total)
DP0100002/DP0010001 (Hispanic/Total)
DP0080005/DP0010001 (Native America/Total)
DP0080006/DP0010001 (Asian/Total)
CountHU10
D1C
D2A_JPHH
AUTOOWN0
AUTOOWN0/AreaKm
R_PCTLOWWA
lalowihalf
lalowihalf/AreaKm
lakidshalf
lakidshalf/AreaKm
laseniorsh
laseniorsh/AreaKm
lahunvhalf
lahunvhalf/AreaKm
BikeScore_
BikeScore_
AADT

Classification Method	Number of Classes
Geometrical Interval	3
Geometrical Interval	3
Manual	3
Quantile	4
Quantile	4
Quantile	4
Quantile	4
Quantile	4
Quantile	4
Quantile (Standard Deviation would have worked, but this is easily understood and also sorts the data well)	7
Geometric(al) Interval	7
Quantile (Data were confusing, only showed one bar)	7
Geometric(al) Interval	7
Geometric(al) Interval	7
Quantile (Standard Deviation would have worked, but this is easily understood and also sorts the data well)	7
Quantile	7
Quantile	7
Quantile	7
Quantile	7
Quantile	7
Quantile	7
Quantile (Geometric Interval would have worked, but this is easily understood and also sorts the data well)	7
Quantile (Geometric Interval would have worked, but this is easily understood and also sorts the data well)	7
Quantile	7
Equal Interval	5
Quantile	7

Class 1 Range	Class 2 Range	Class 3 Range	Class 4 Range
0 to 1	2 to 15	16 to 393	
0-19030 (0-19030.9172)	19040-134000 (19030.9173-134034.063)	134100-829000 (134034.064-828993.92)	
0-.4 (.01215-.4)	.4001-.7	.7001-1	
0-.0007409	.0007410-.001282	.001283-.001842	.001843-.01149
0-740.9	741.0-1282	1283-1842	1843-11490
0-.226 (.01215-.226)	.2261-.7053	.7054-.9158	.9159-1
0-.010734325	.010734326-0.024913151	.024913152-.063862249	.06386225-.439423451
0-.001234314	.001234315-.002132954	.002132955-.003208292	.003208293-.008342304
0-.001719198	.001719199-.008093356	.008093357-.020234604	.020234605-.142195032
0-367	368-451 (367.000001-451)	452-530 (451.000001-530)	531-614 (530.000001-614)
0-.045891	.045892-.217542	.217543-.859583	.859584-3.261066
0-.022444	.022445-.061082	.061083-.148551	.148552-.312253
0-5.489973	5.489974-16.107626	16.107627-36.642256	36.642257-76.3564
0-.846108096	.846108097-3.82668856	3.82668857-14.3263634	14.3263635-51.3135119
0-.1944	.194401-.21747	.217471-.249060	.249061-.276150
0-327.288589	327.28859-596.137141	596.137142-857.381957	857.381958-1070.407812
0-60.77	60.78-138.0	138.1-223.5	223.6-344.7
0-213.708300	213.708301-390.26774	390.267741-548.785318	548.785319-760.999995
0-61.0973757	61.0973758-116.373586	116.373587-154.859279	154.859280-199.639011
0-76.278710	76.278711-149.998712	149.998713-226.891962	226.891963-291
0-24.7118831	24.7118832-46.7719612	46.7719613-64.4429019	64.4429020-83.0093025
0-7.236052	7.236053-21.783720	21.783721-45.985056	45.985057-83.727183
0-1.11847525	1.11847526-4.80379662	4.80379663-10.5301198	10.5301199-26.3812755
0.003496-5.943446	5.943447-10.561543	10.561544-14.214155	14.214156-17.234693
0-19	20-39	40-59	60-79
0-5071	5071-9760	9760-14590	14590-20400

Class 5 Range	Class 6 Range	Class 7 Range
615-729 (614.000001-729)	730-915 (729.000001-915)	916-3838 (915.000001-3838)
3.261067-12.243542	12.43543-45.841491	45.841492-171.510859
.312254-.672652	.672653-1.701398	1.701399-23264
76.356401-153.163885	153.163886-301.710198	301.710199-589
51.3135120-181.607942	181.607943-640.595434	640.595435-2257.46822
.276151-.309210	.309211-.34871	.348711-.45879
1070.407813-1409.531771	1409.531772-2054.612715	2054.612716-4236.350341
344.8-501.0	501.1-813.9	814.0-2123
760.999996-1057.000004	1057.000005-1378.714400	1378.714401-3542.000043
199.639012-267.175324	267.175325-385.894729	385.894730-1028.15909
291.000001-387.143965	387.143966-546.481054	546.481055-1086.000003
83.0093026-105.891663	105.891664-156.397056	156.397057-474.398041
83.727184-130.456910	130.456911-210.974546	210.974547-653.959668
26.3812756-41.4171751	41.4171752-93.5195299	93.5195300-544.456373
17.234694-21.647119	21.647120-31.766989	31.766990-100
80-100		
20400-27560	27560-45850	45850-168160

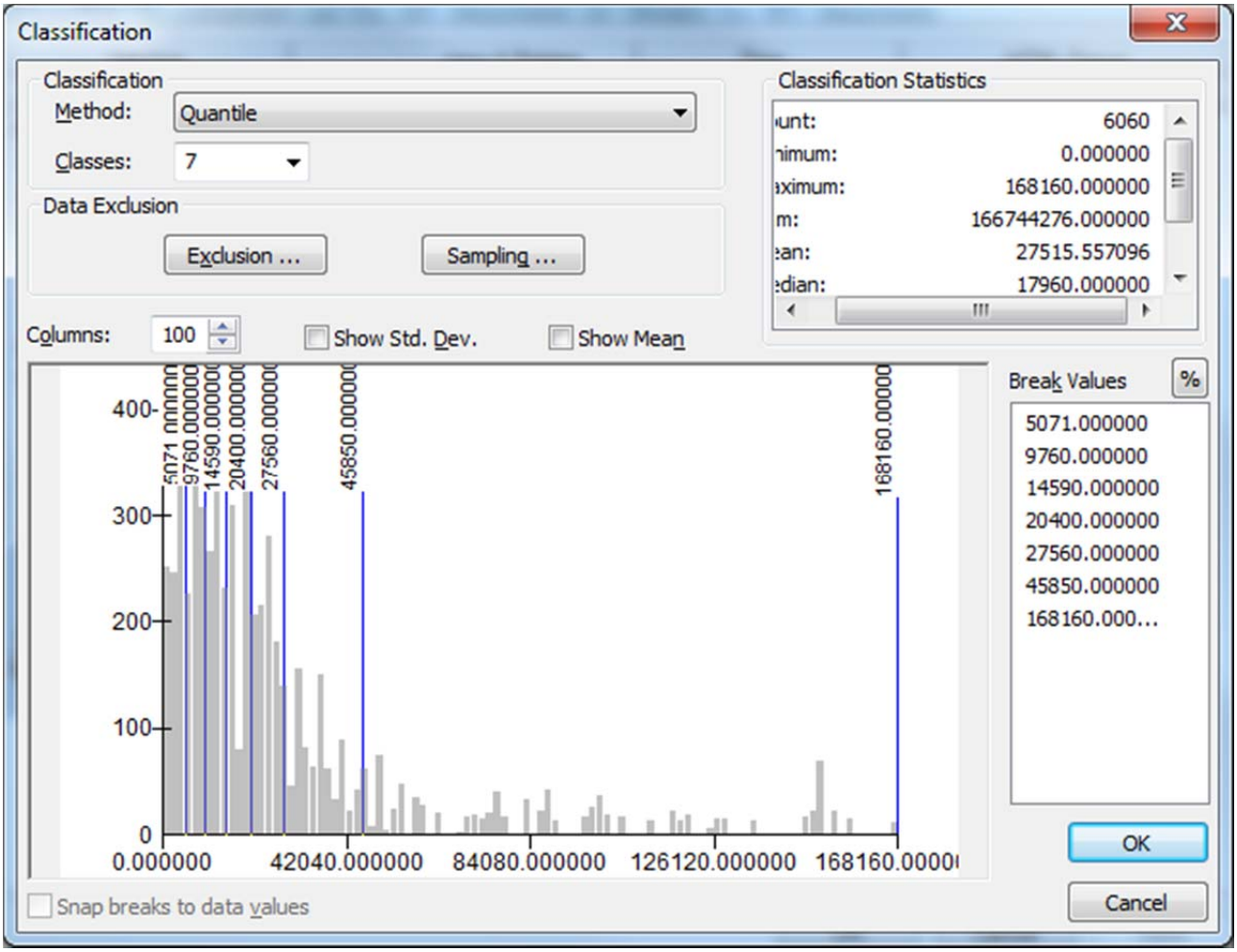
Appendix D-2

Histograms

The following data ranges are only for the census tracts shown for each respective data layer in the website.

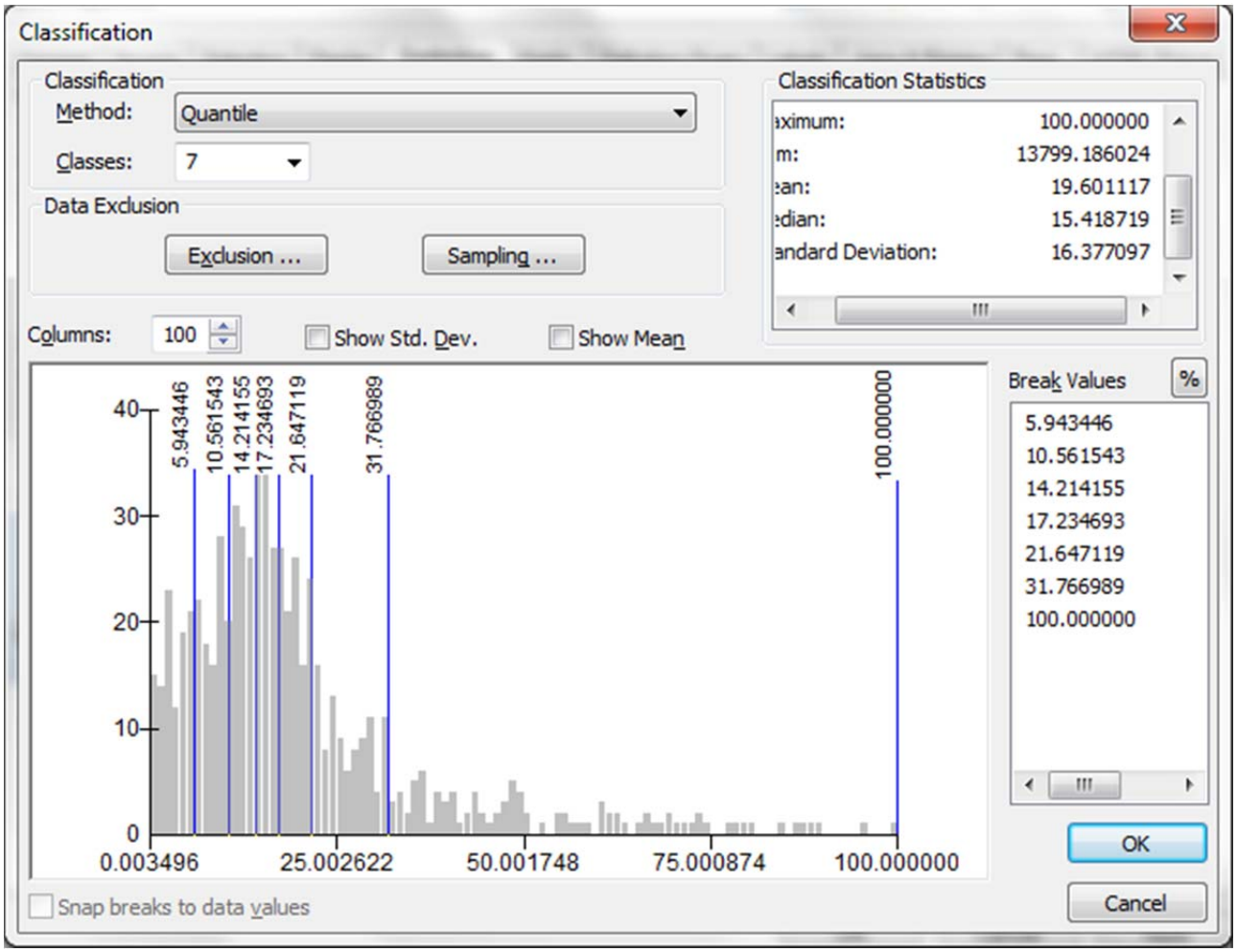
AADT (Average Annual Daily Traffic)

(From Department of Transportation, National Transportation Atlas Database 2013, Highway Performance Monitoring System.)



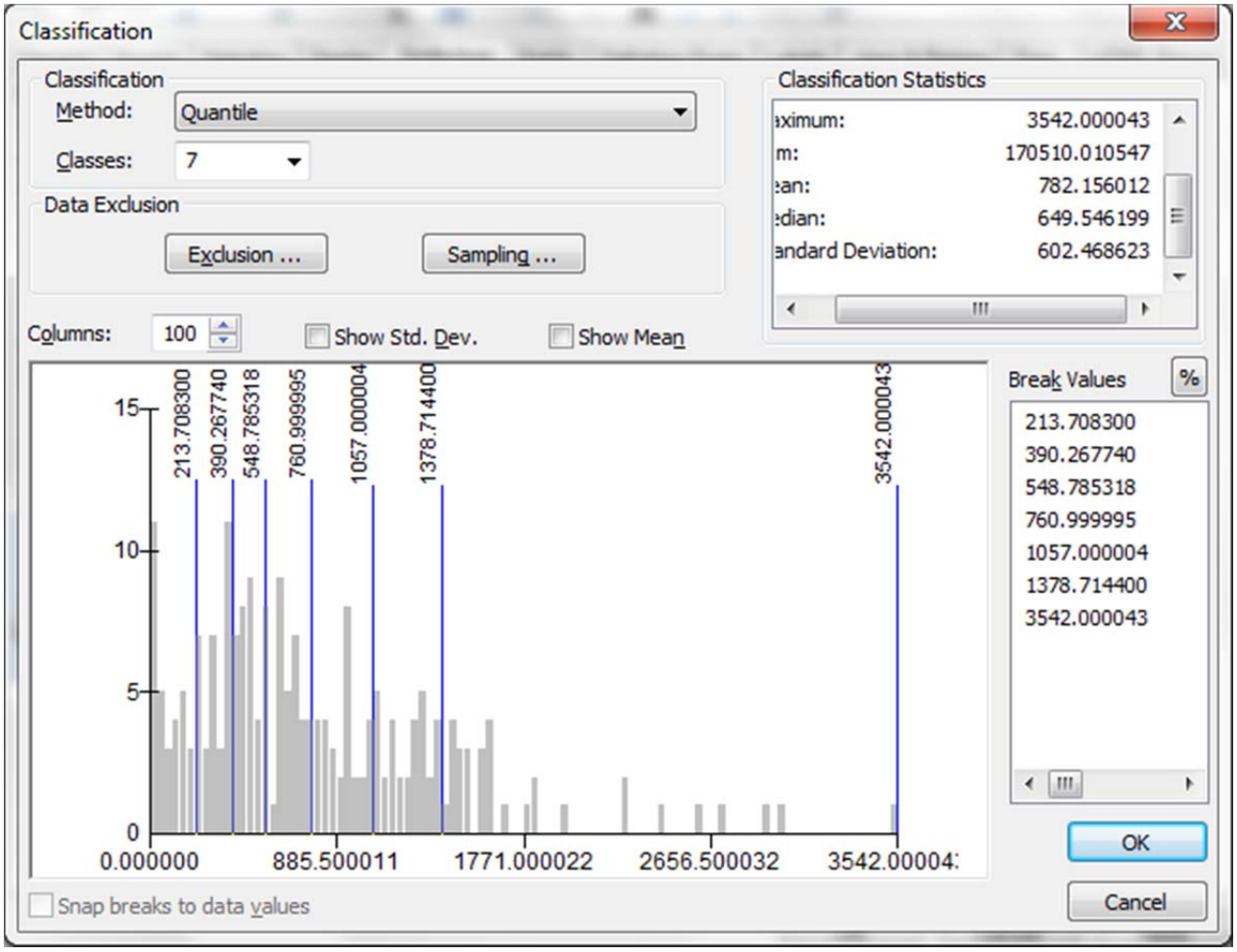
BikeScore

From Mid-South Greenprint Geoportal: Geoportal Data Explorer.



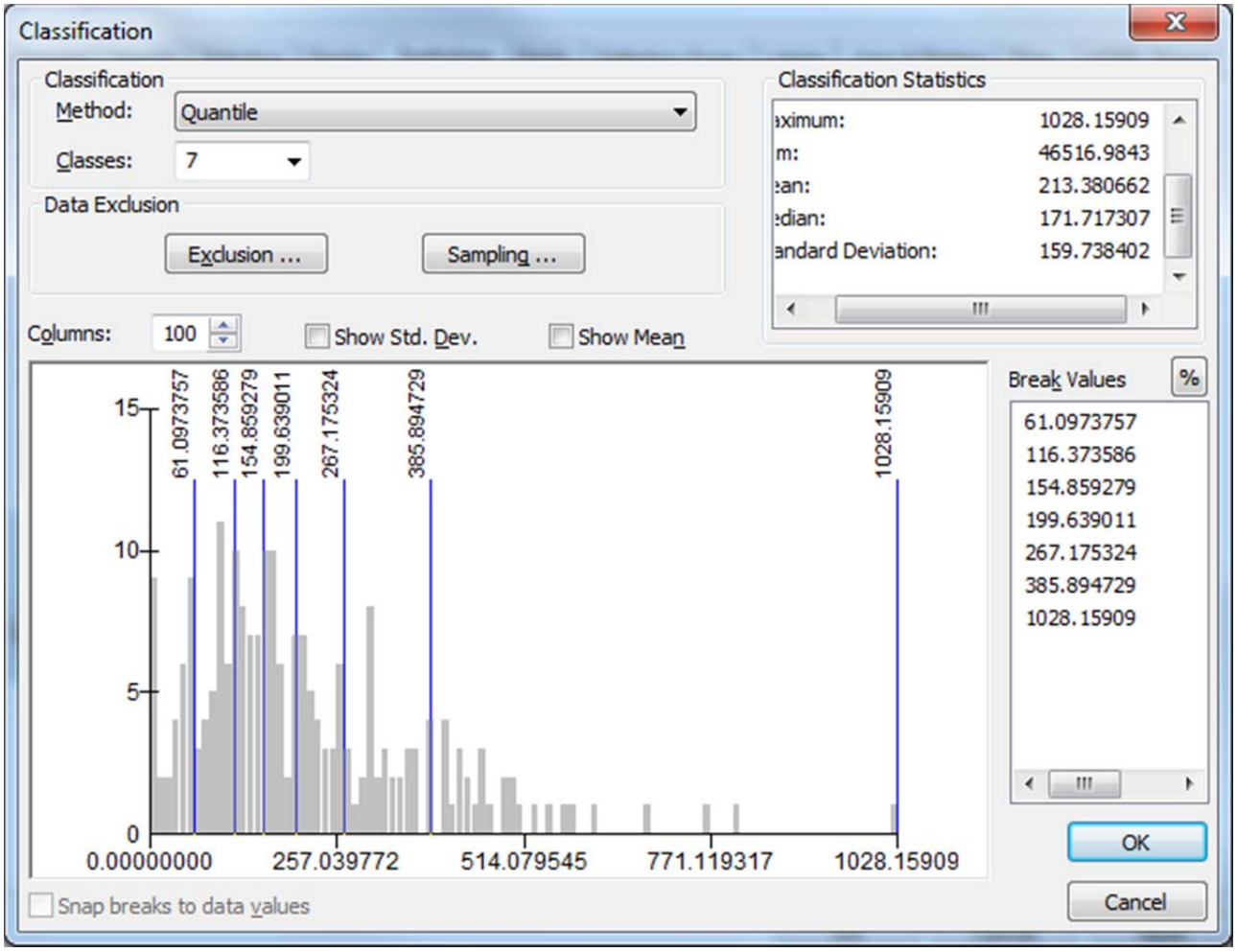
Children with Low Food Access

From US Department of Agriculture Economic Research Service, Food Access Research Atlas 2010.



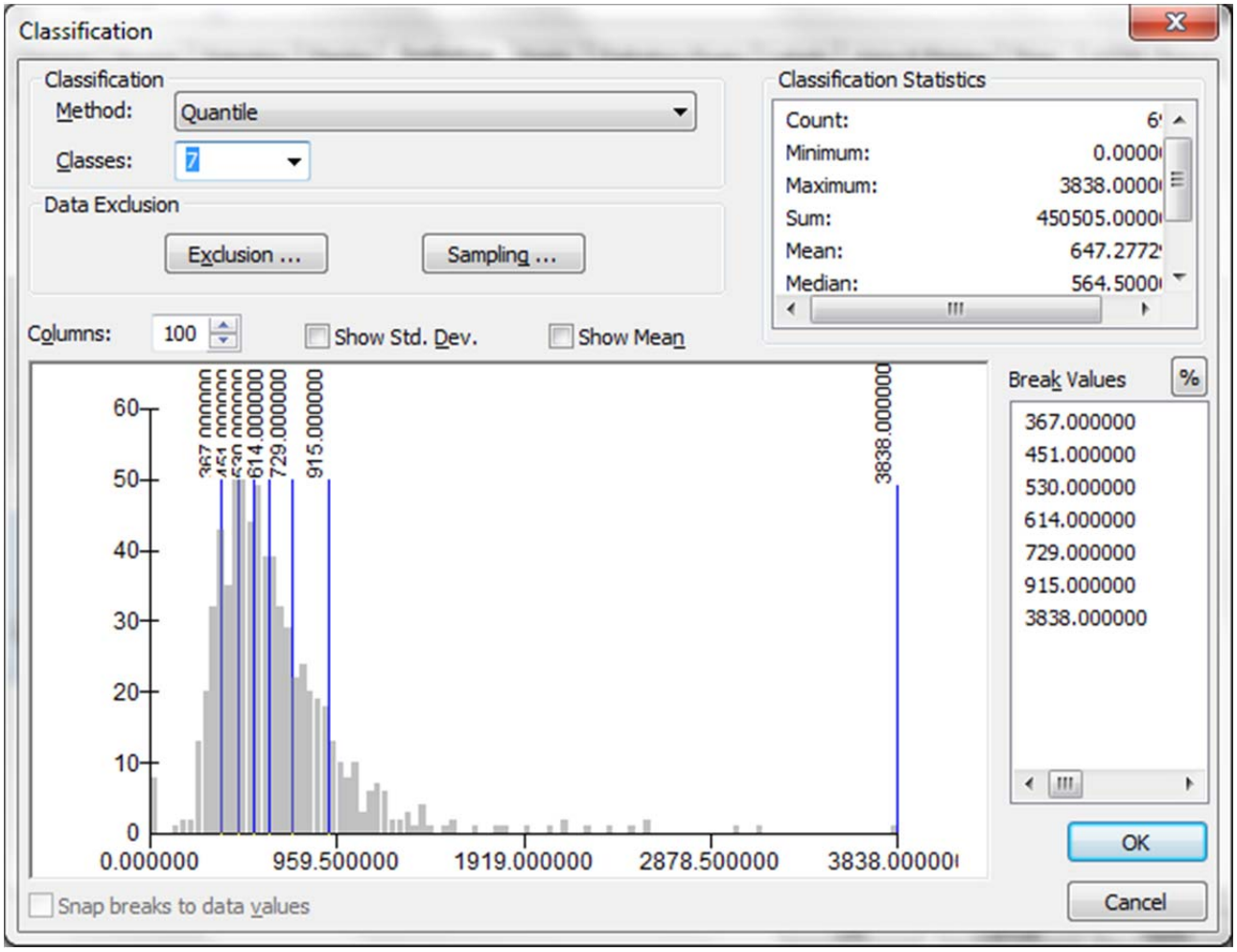
Children with Low Food Access, Normalized by Area

US Department of Agriculture Economic Research Service, Food Access Research Atlas 2010.



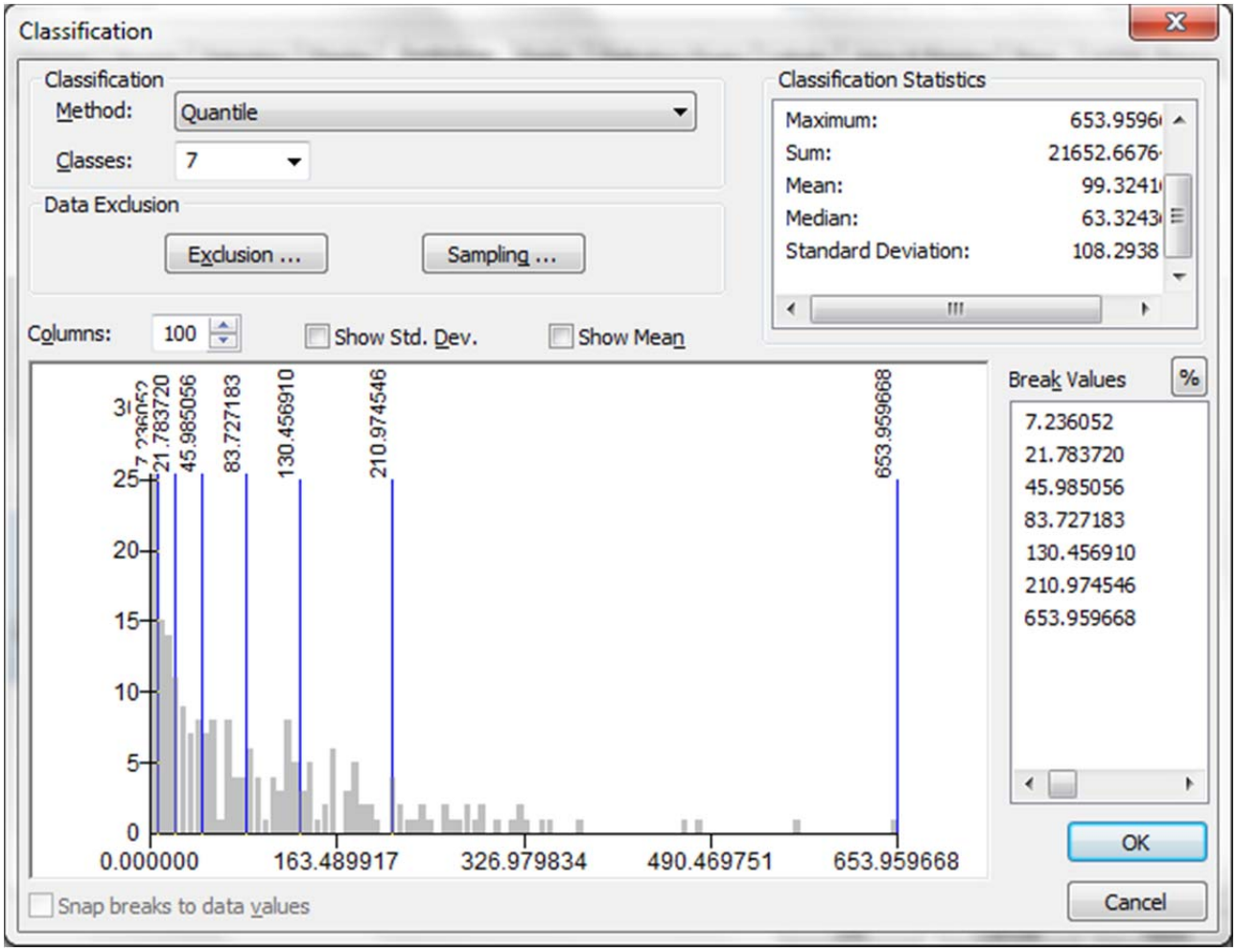
Housing Units Per Acre

From EPA Smart Growth Project, Smart Location Database 2013.



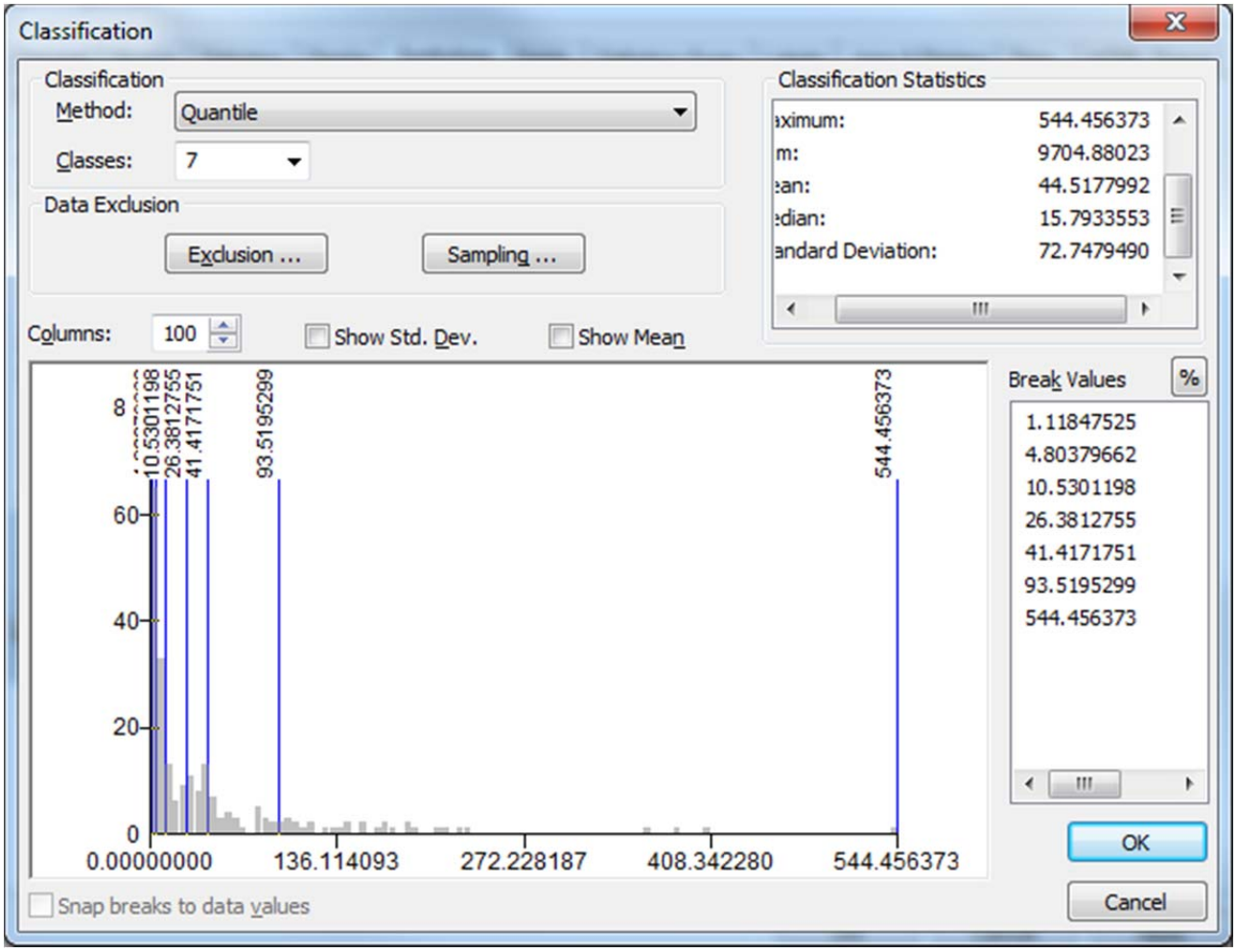
Housing Units Without Vechicles

From EPA Smart Growth Project, Smart Location Database 2013.



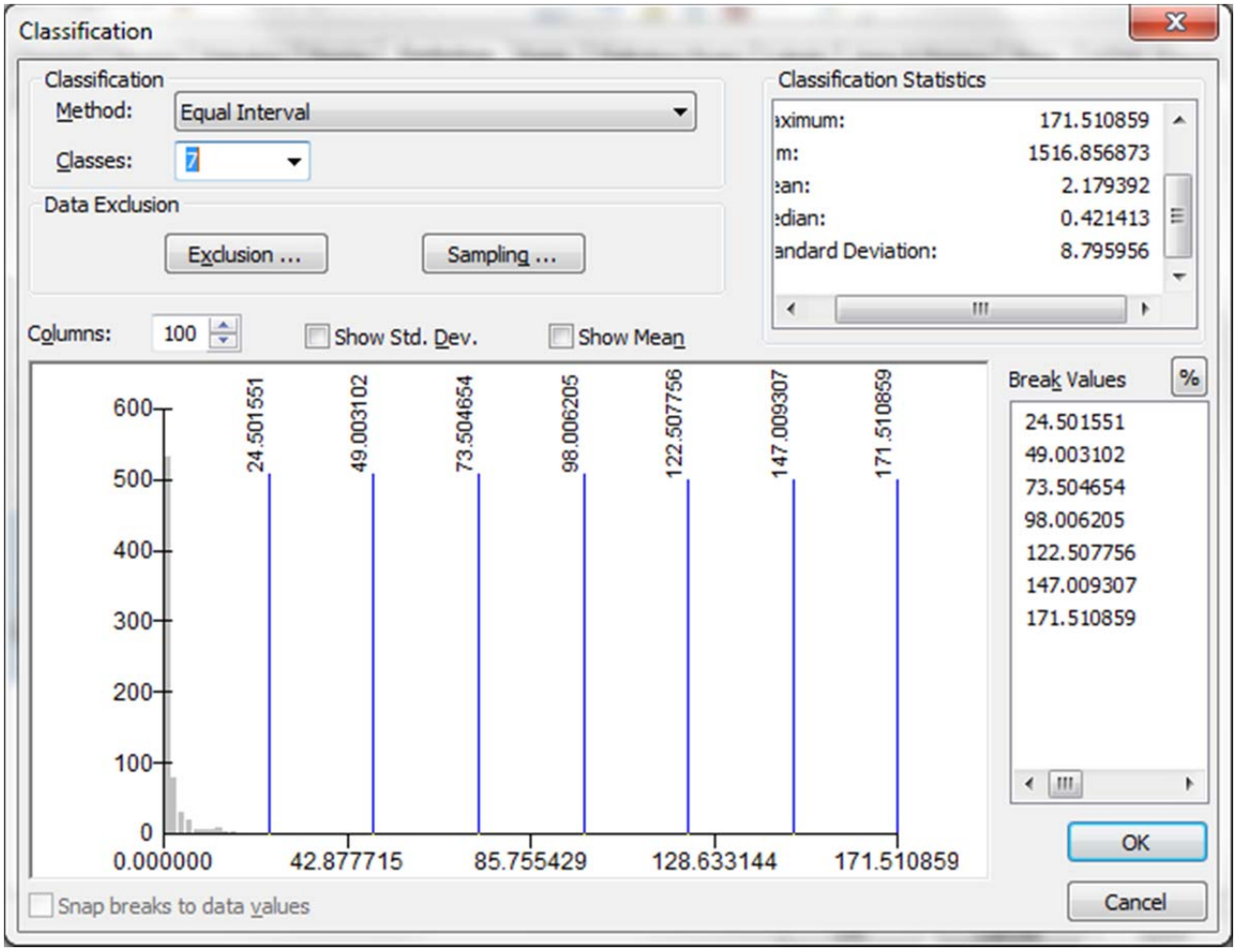
Housing Units Without Vehicles, Normalized By Area

From EPA Smart Growth Project, Smart Location Database 2013.



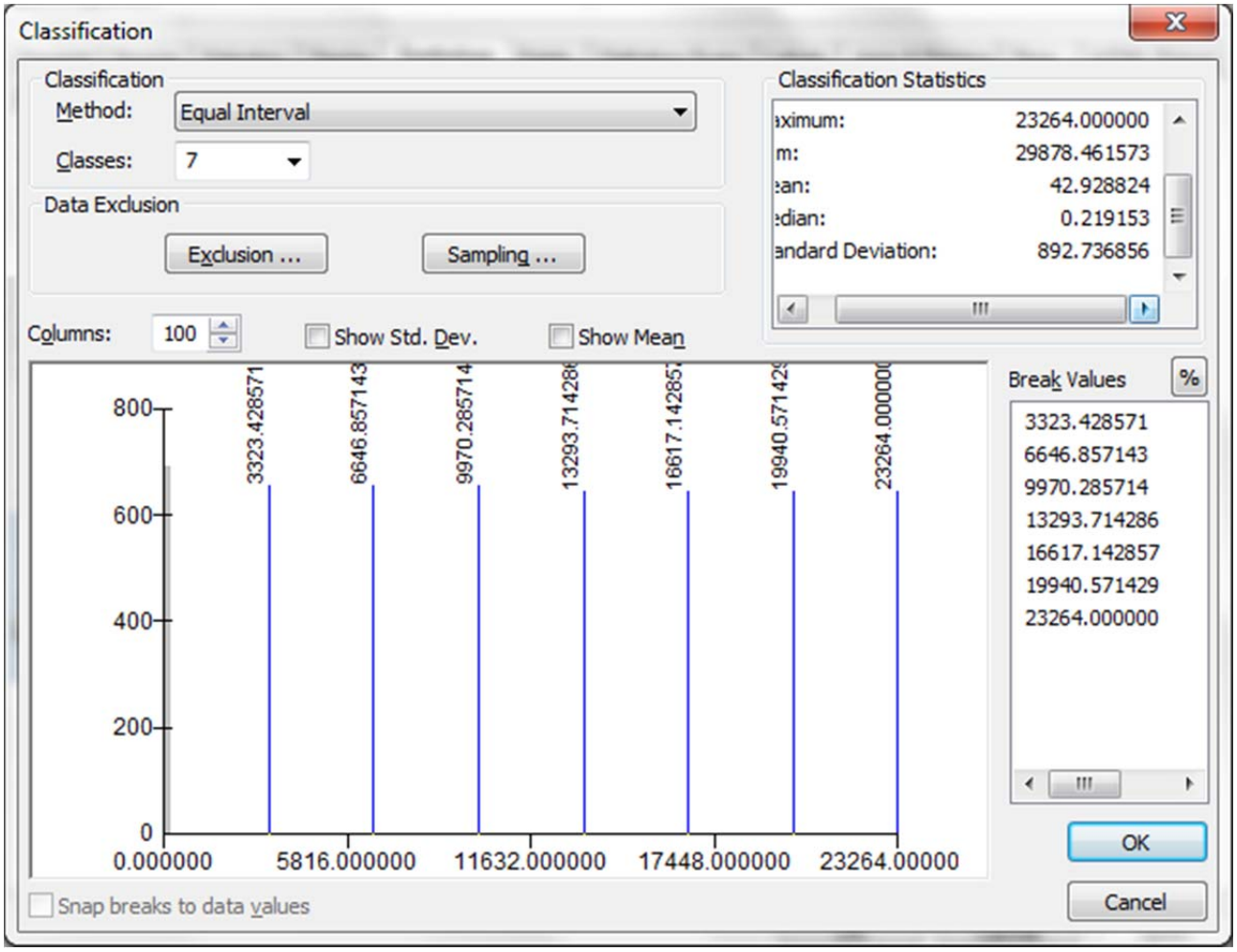
Jobs Per Acre

From EPA Smart Growth Project, Smart Location Database 2013.



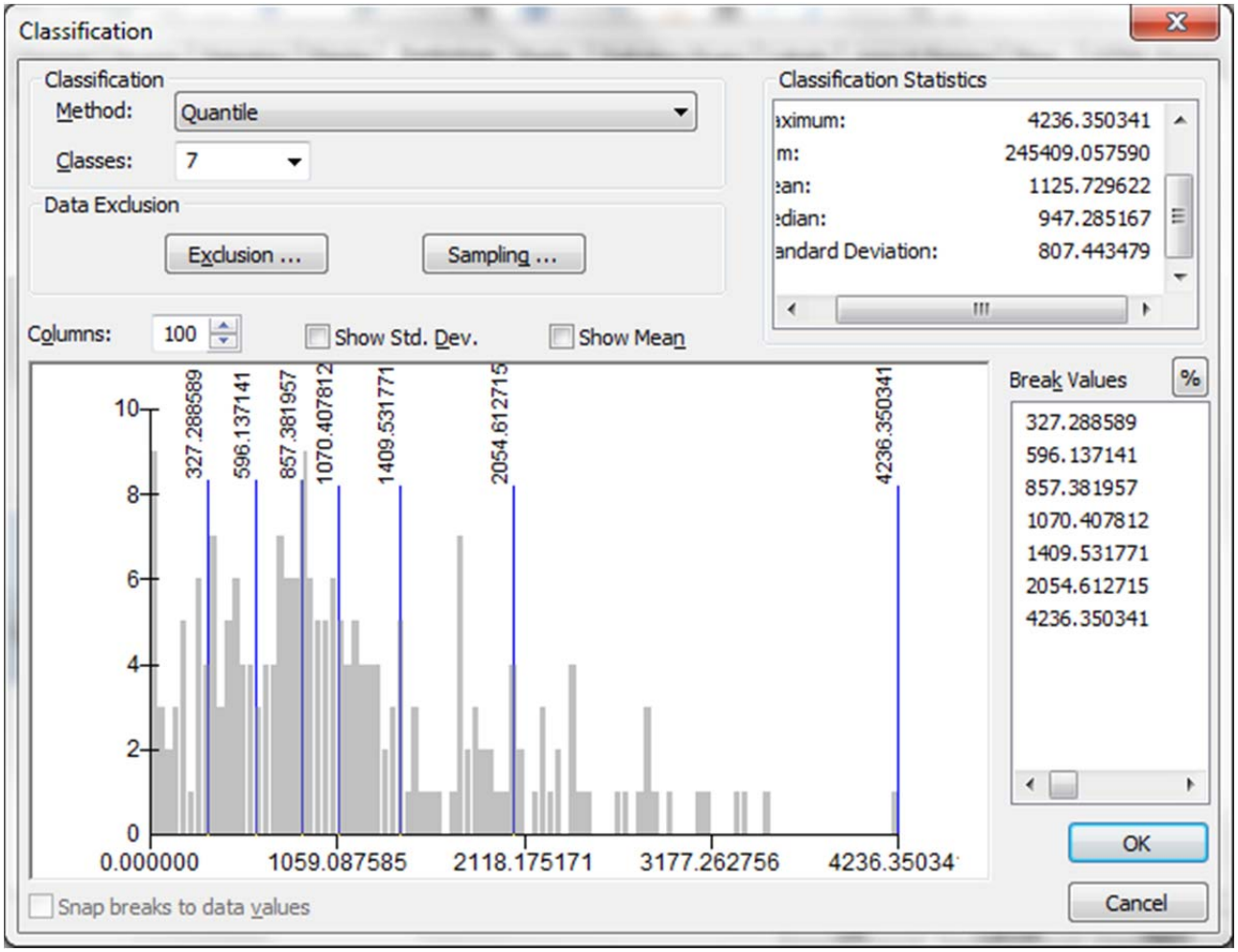
Jobs Per Household

From EPA Smart Growth Project, Smart Location Database 2013.



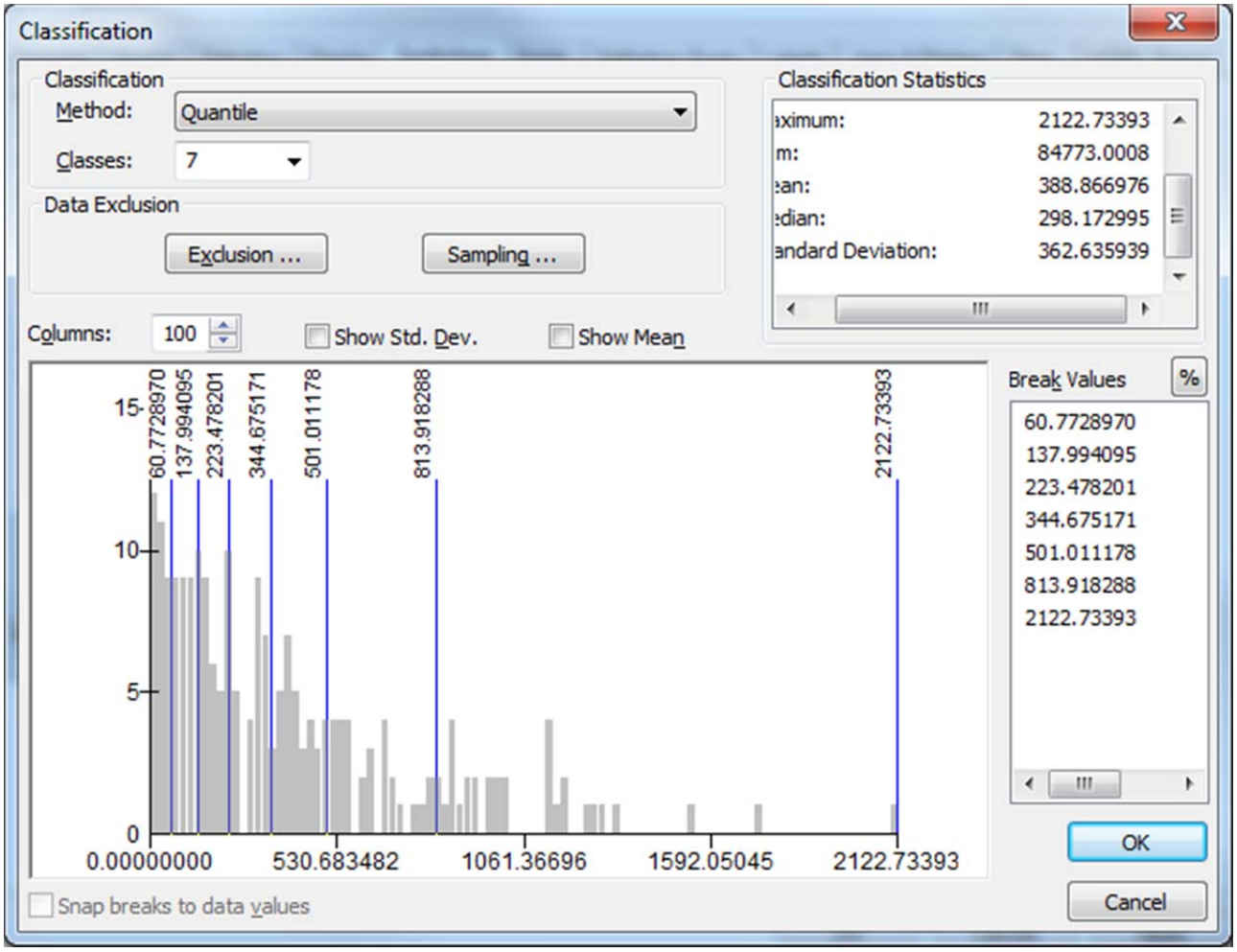
Low-Income People with Low Food Access

From US Department of Agriculture Economic Research Service, Food Access Research Atlas 2010.



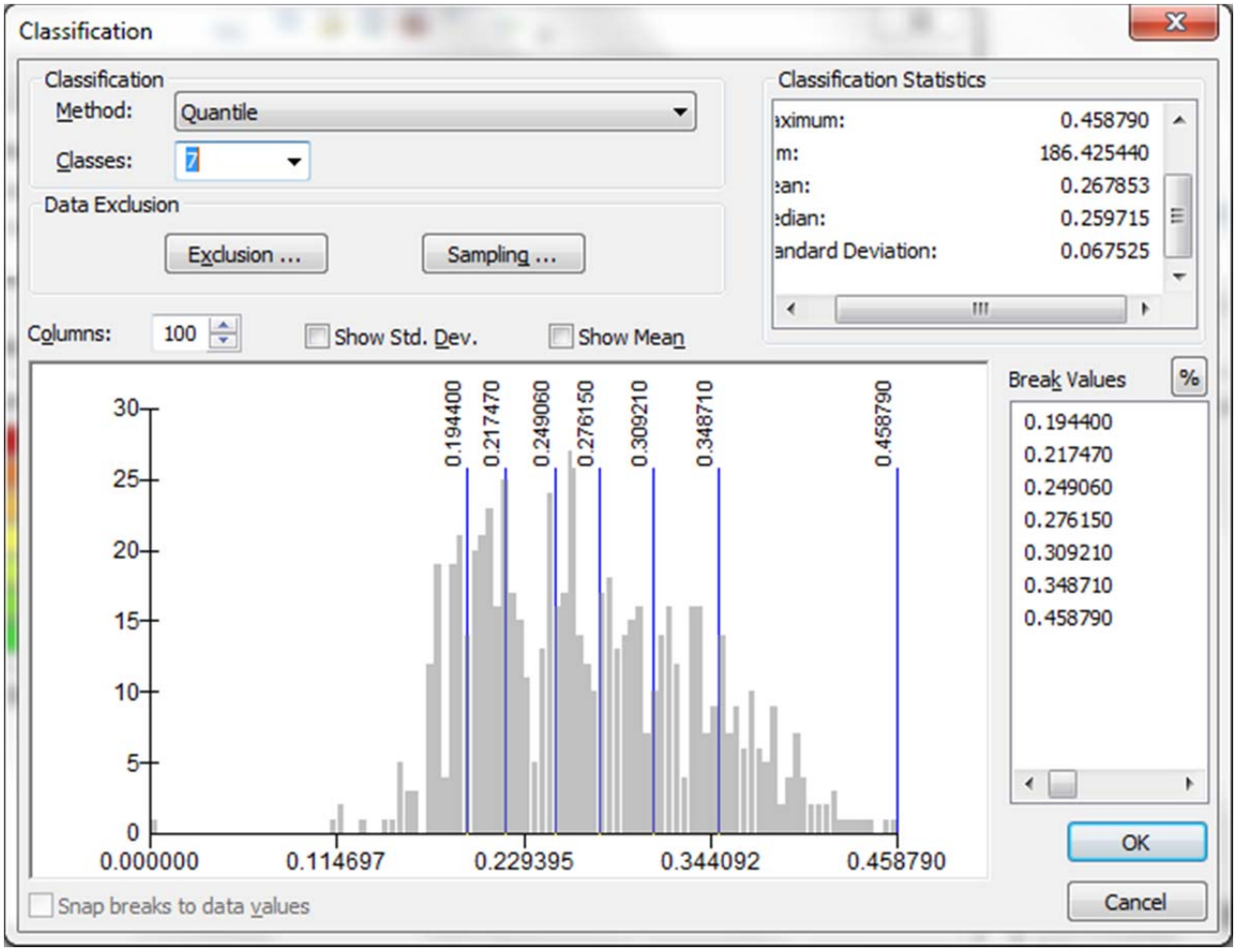
Low-Income People With Low Food Access, Normalized By Area

From US Department of Agriculture Economic Research Service, Food Access Research Atlas 2010.



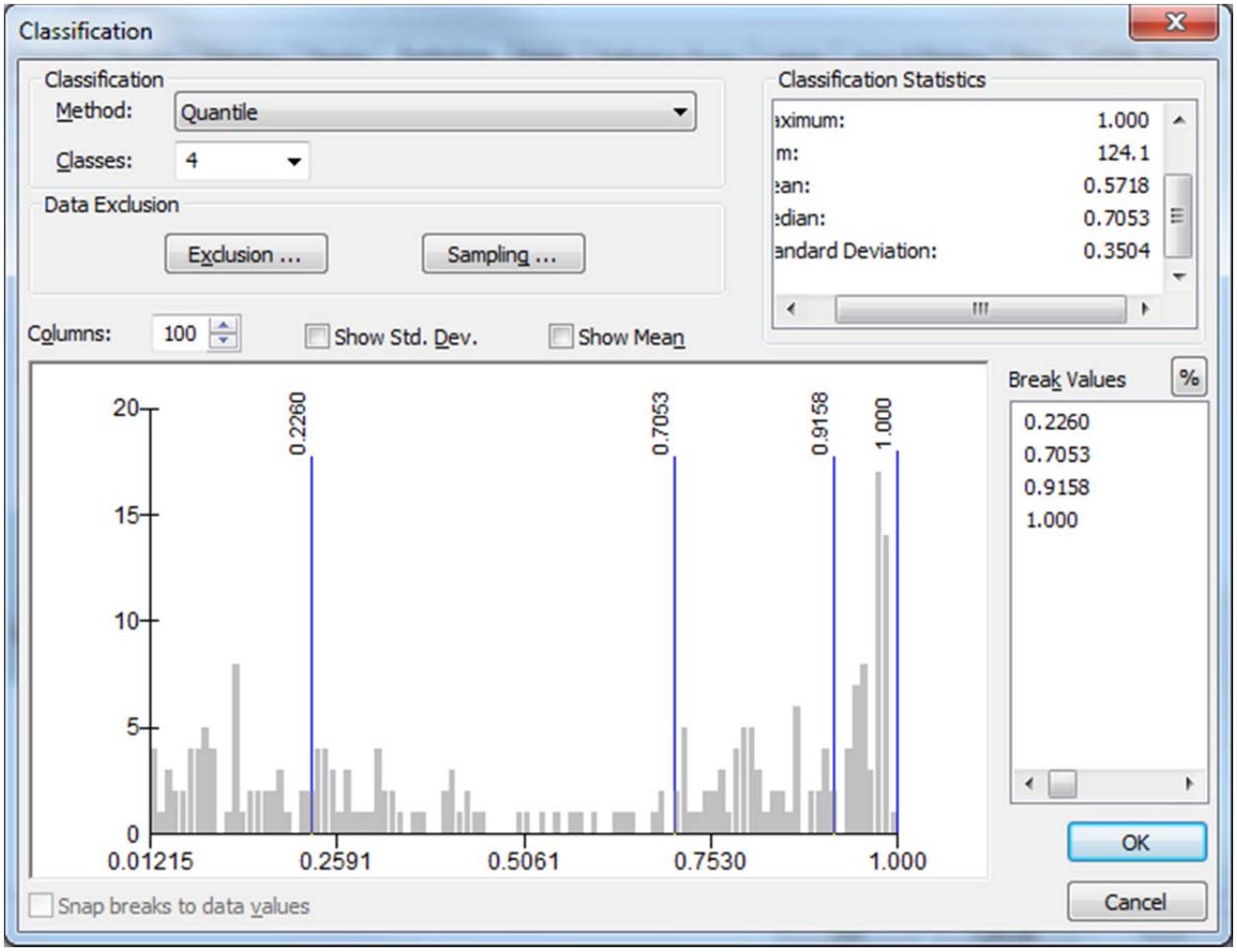
Percent Low Wage Workers

From US Department of Agriculture Economic Research Service, Food Access Research Atlas 2010.



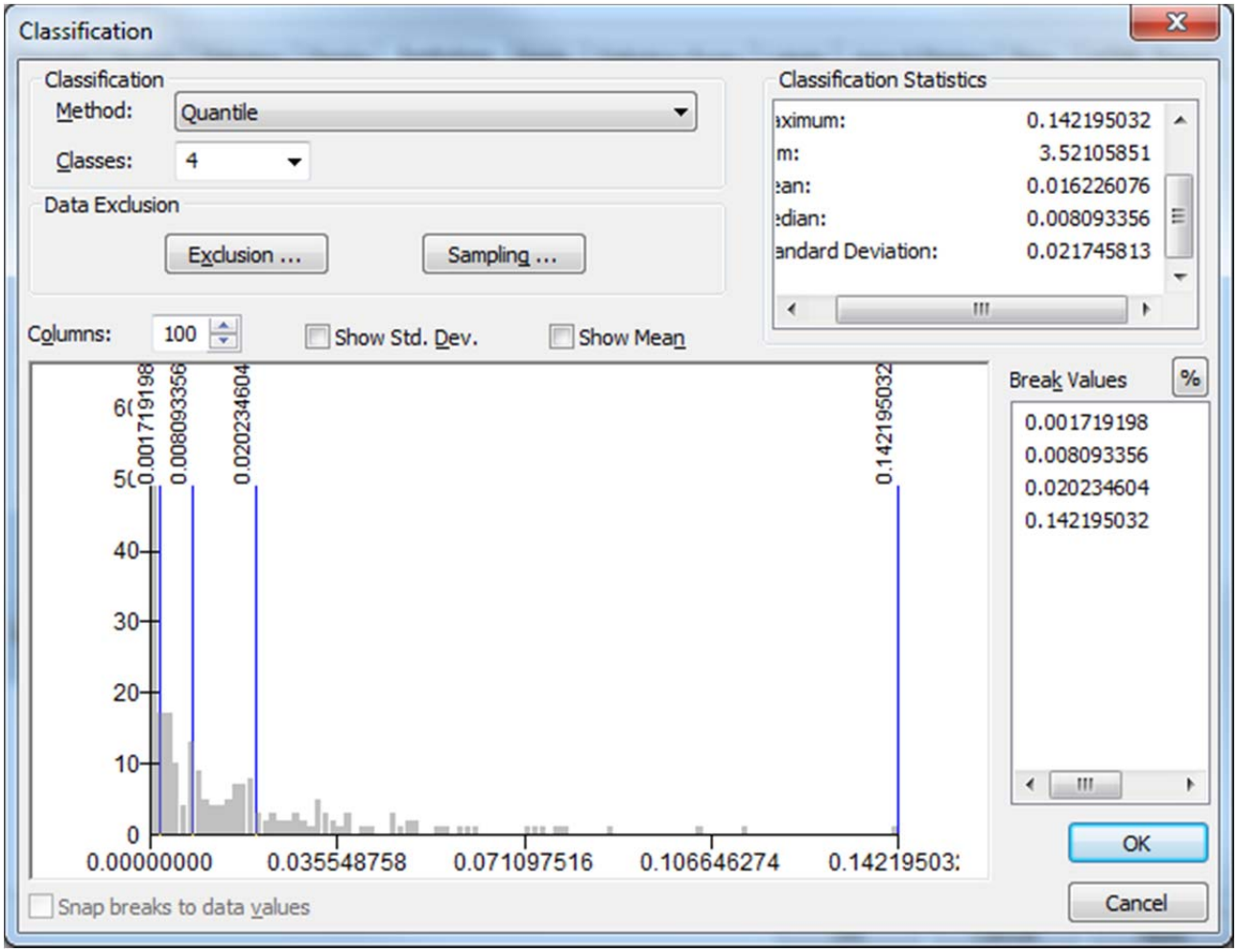
Percentage African American

From US Census TIGERLine Shapefiles and TIGER/Line Files (2010 Data).



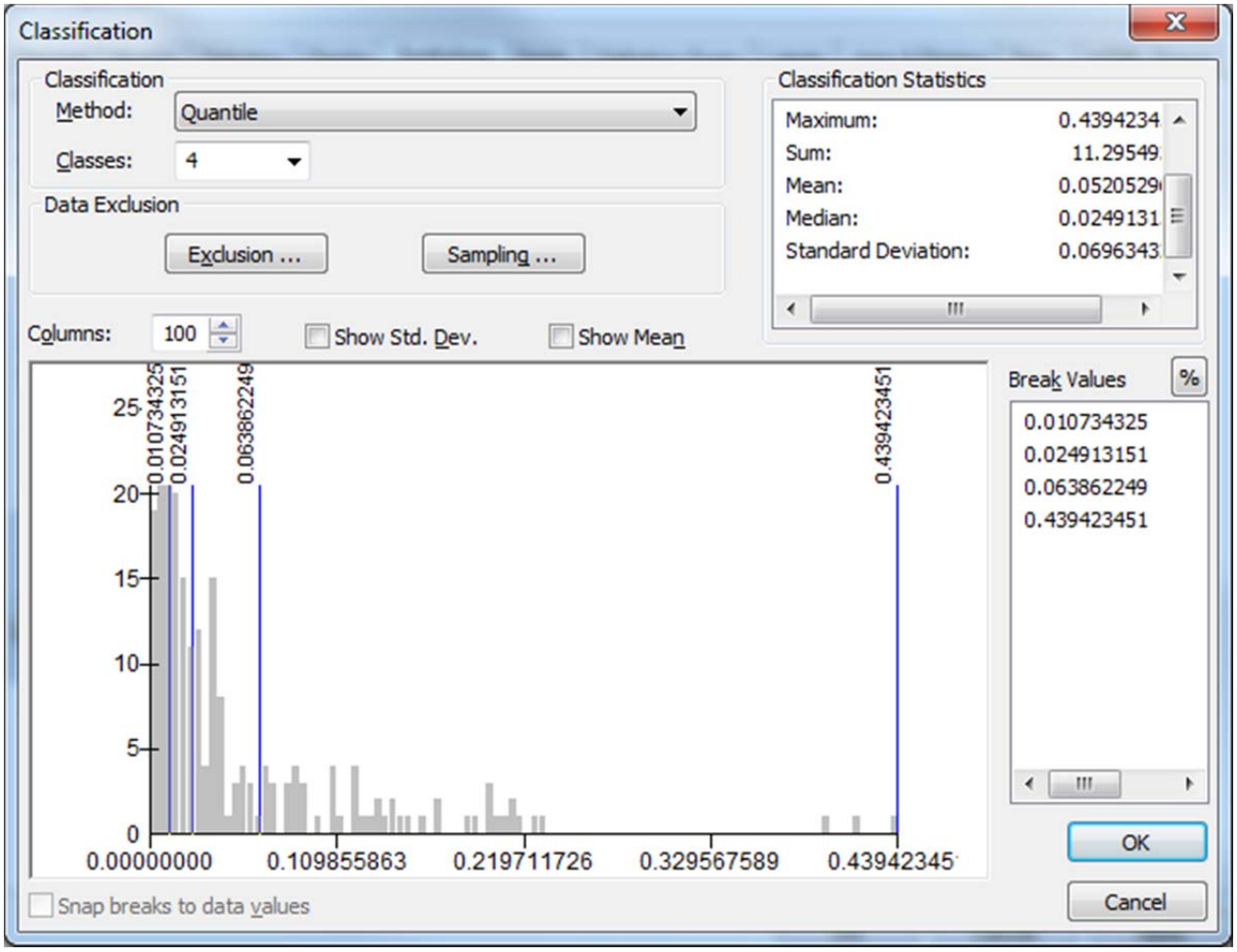
Percentage Asian

From US Census TIGERLine Shapefiles and TIGER/Line Files (2010 Data).



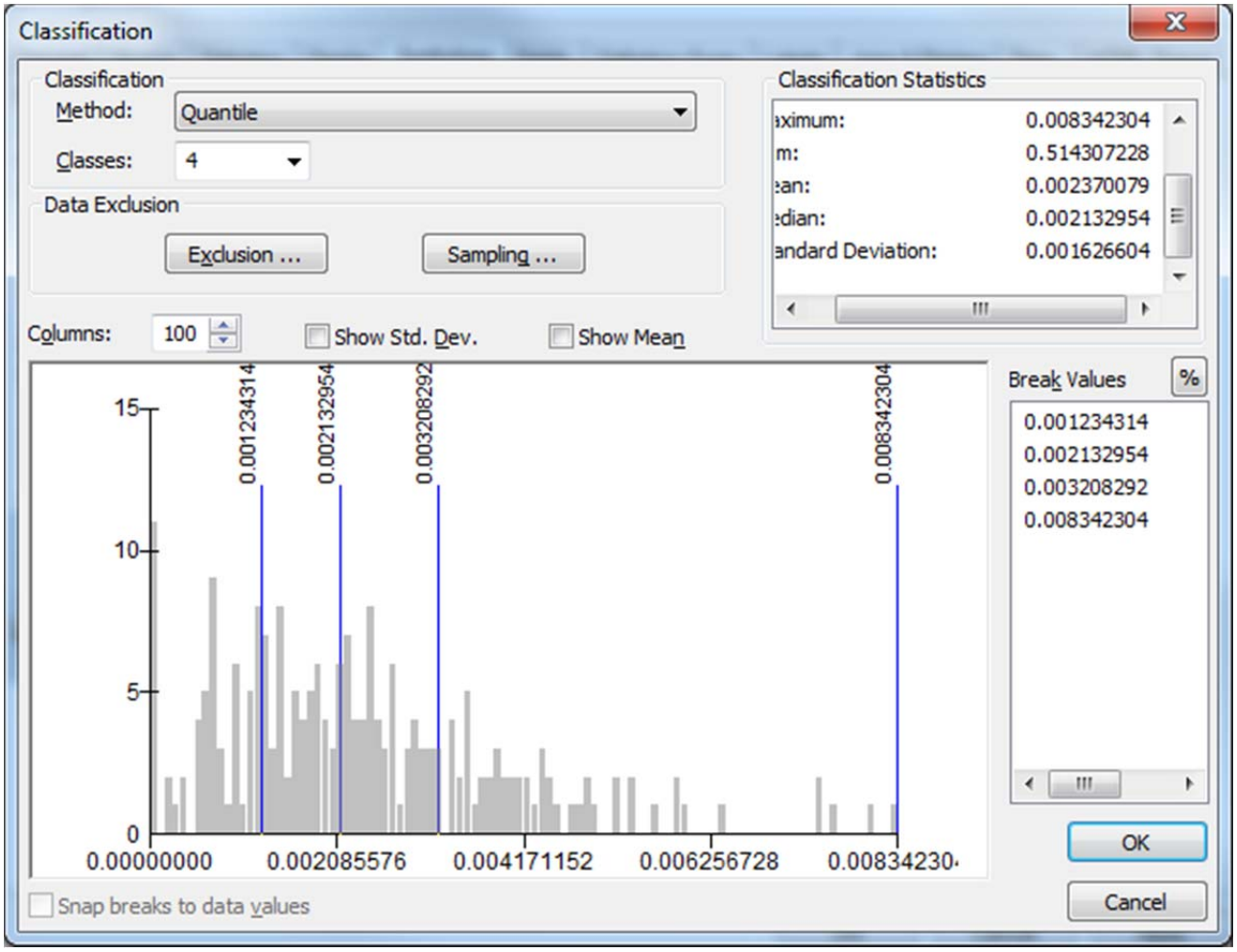
Percent Hispanic

From US Census TIGERLine Shapefiles and TIGER/Line Files (2010 Data).



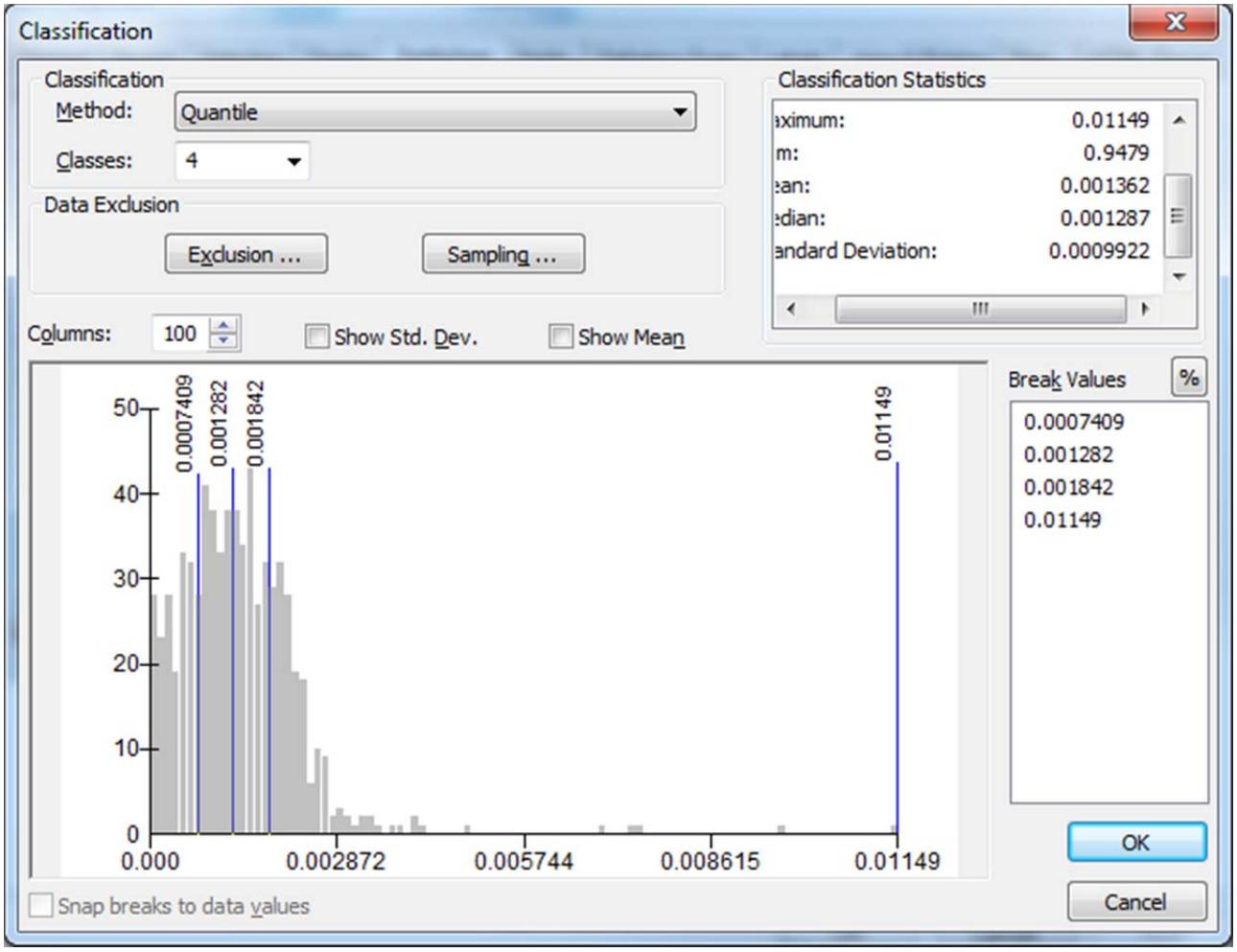
Percent Native American

From US Census TIGERLine Shapefiles and TIGER/Line Files (2010 Data).



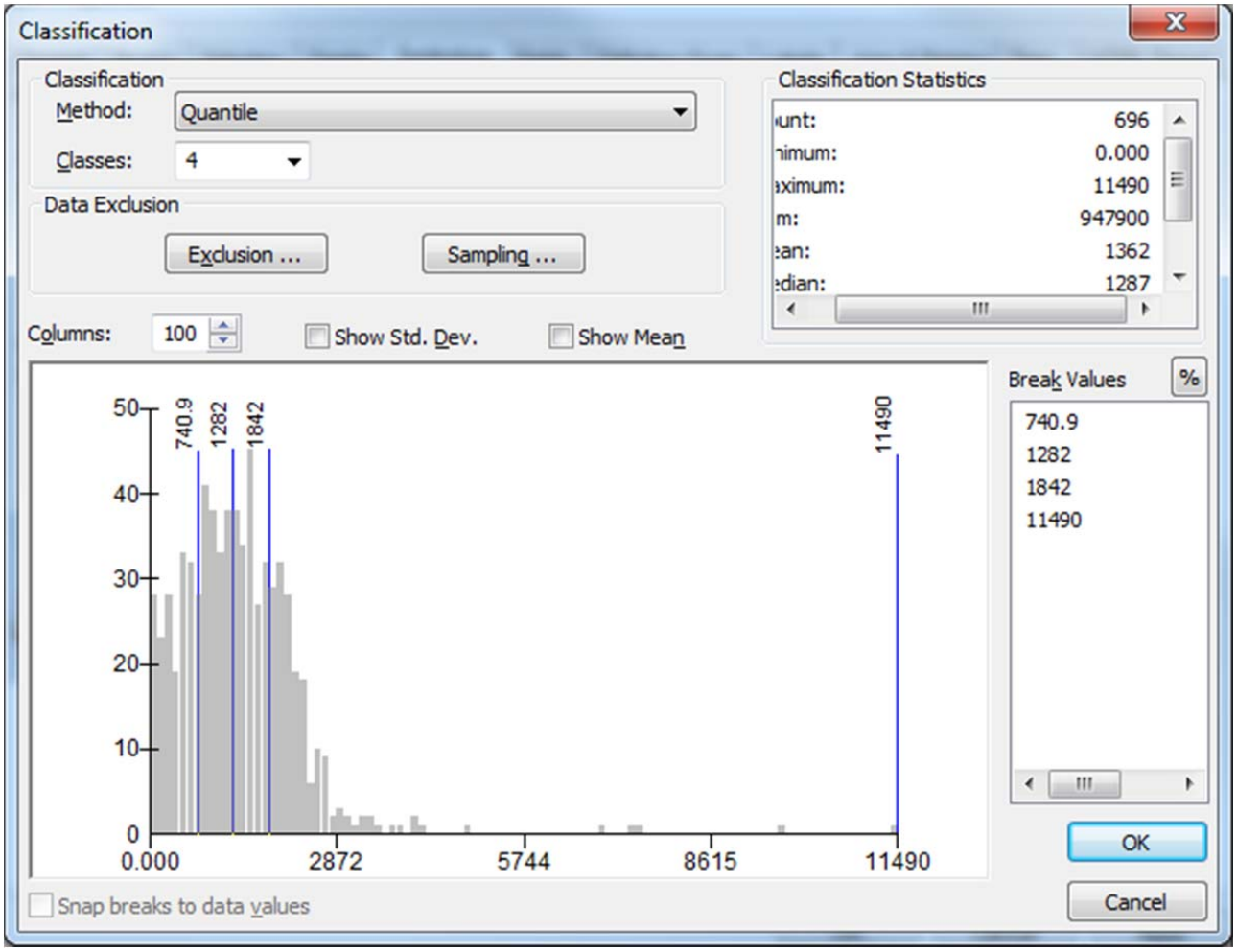
Population Density

From EPA Smart Growth Project, Smart Location Database 2013.



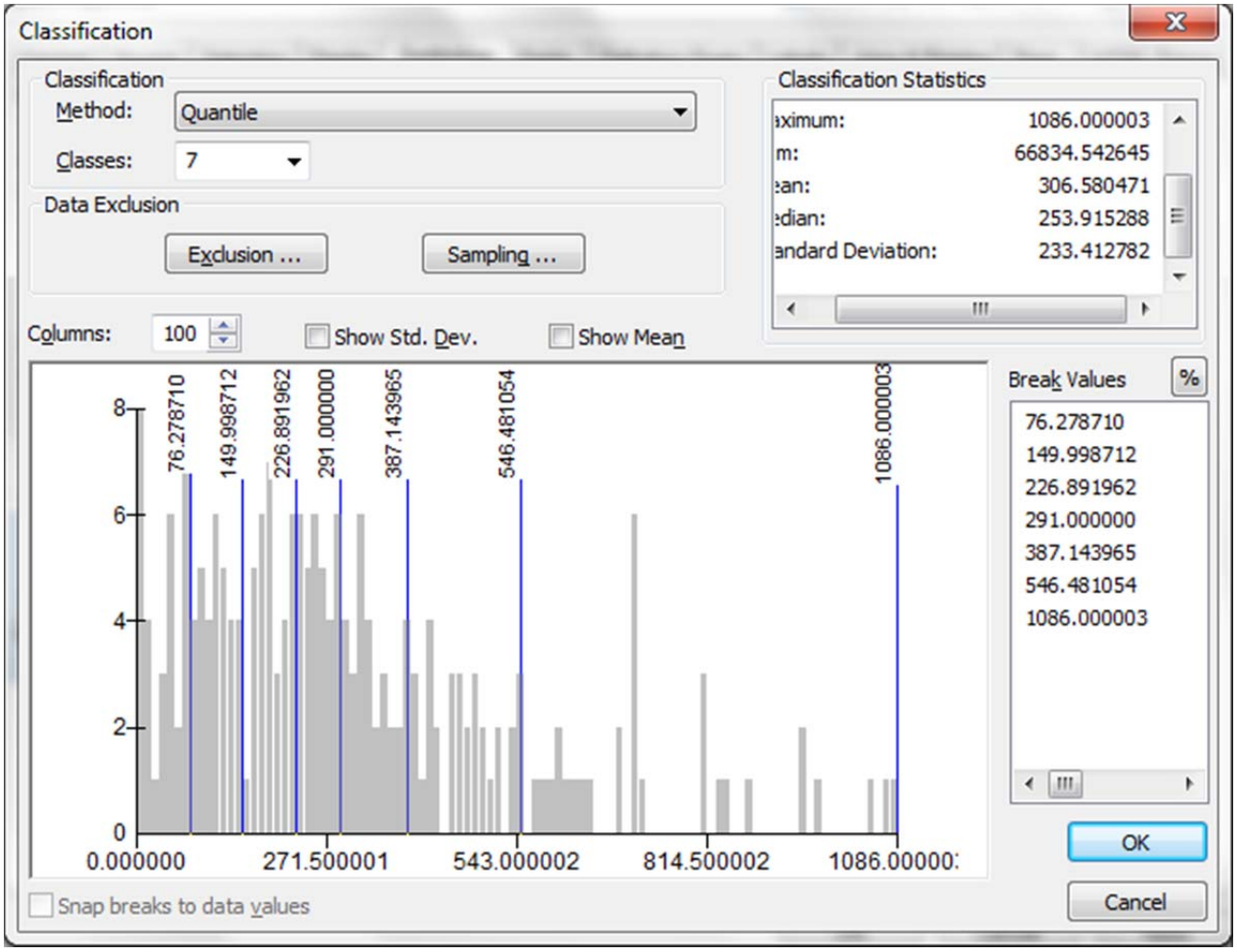
Population Density, With Area in Square Kilometers

From EPA Smart Growth Project, Smart Location Database 2013.



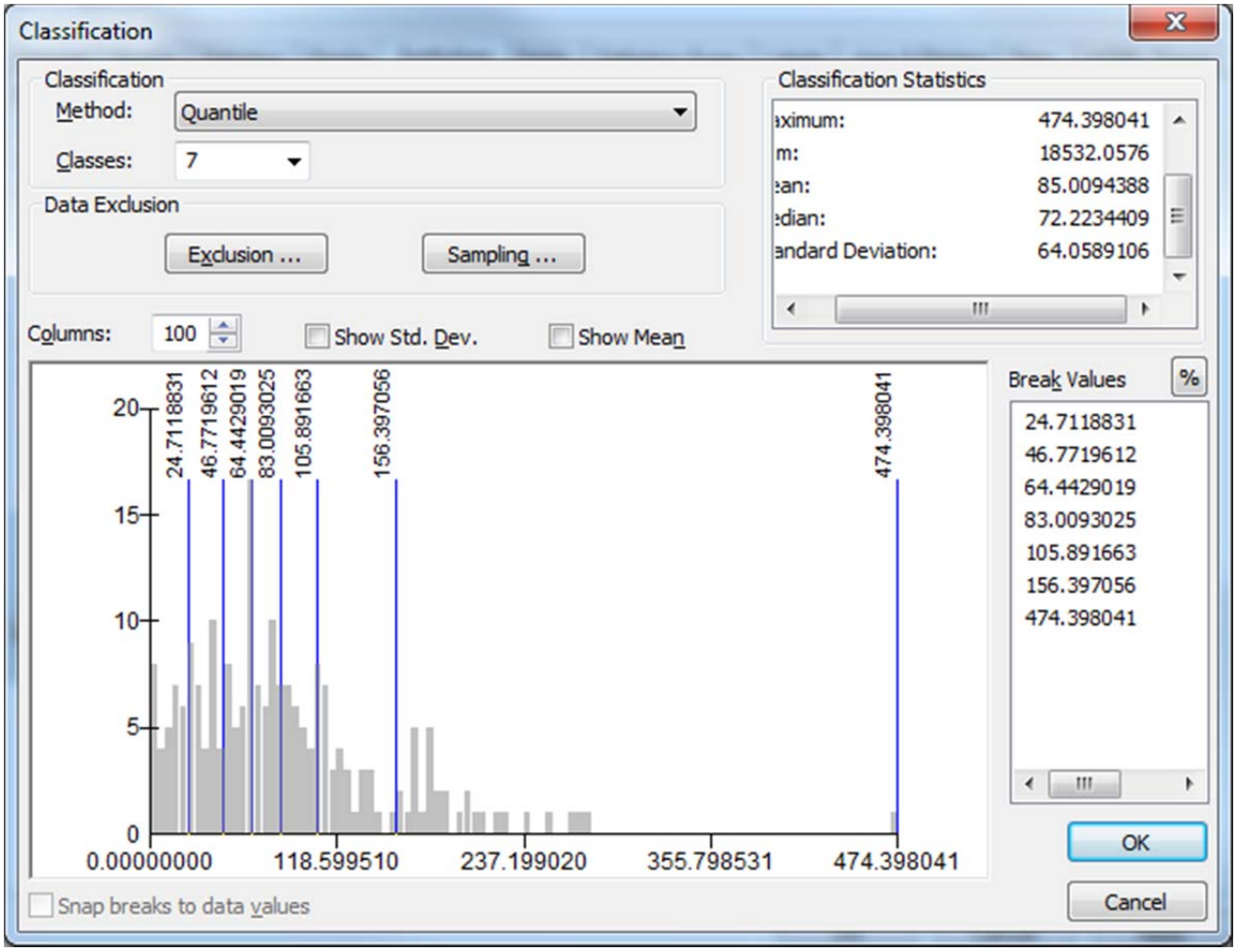
Seniors With Low Food Access

From US Department of Agriculture Economic Research Service, Food Access Research Atlas 2010.



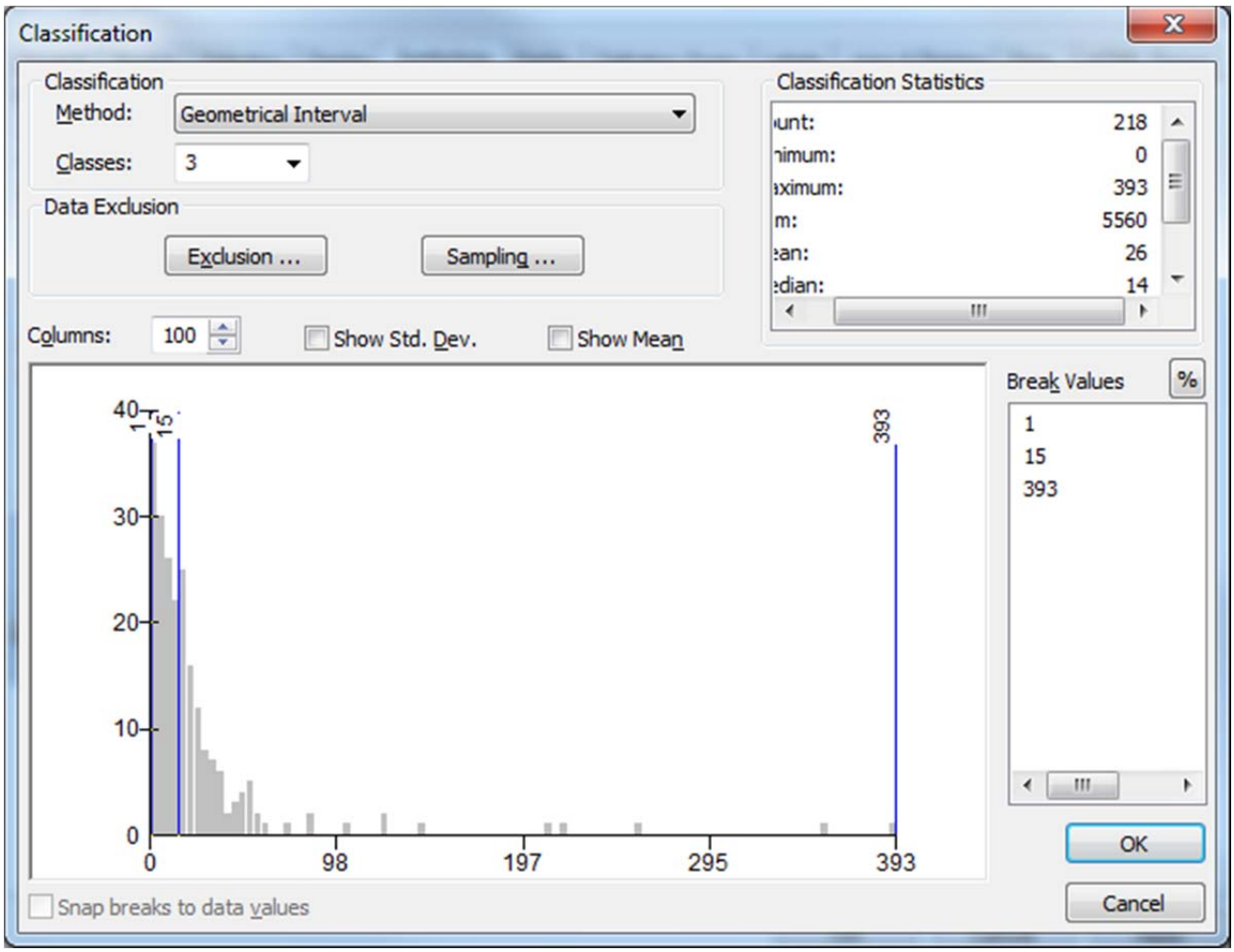
Seniors With Low Food Access, Normalized By Area

From US Department of Agriculture Economic Research Service, Food Access Research Atlas 2010.



"Weighted Pollutors" Ranking

From the Environmental Protection Agency Enviromapper (Search of "Memphis, TN").



Derivation of the "Weighted" Pollution Data Layer:

1) Data from the EPA "Enviromapper" site were gathered by "Category," which included "Air," "Water," "Waste," "Land," "Toxics," and "Radiation."
2) A facility was counted once for each type of pollution it emitted; this total for each facility is called the "Facility Weighted Total." Each facility could have a weighted total of up to six. If a facility emitted air and water pollution (and no other type of pollution), it would have a weighted total of two.
3) The sum of the weighted total for each facility within a census tract was calculated, providing the "Census Tract Weighted Total."

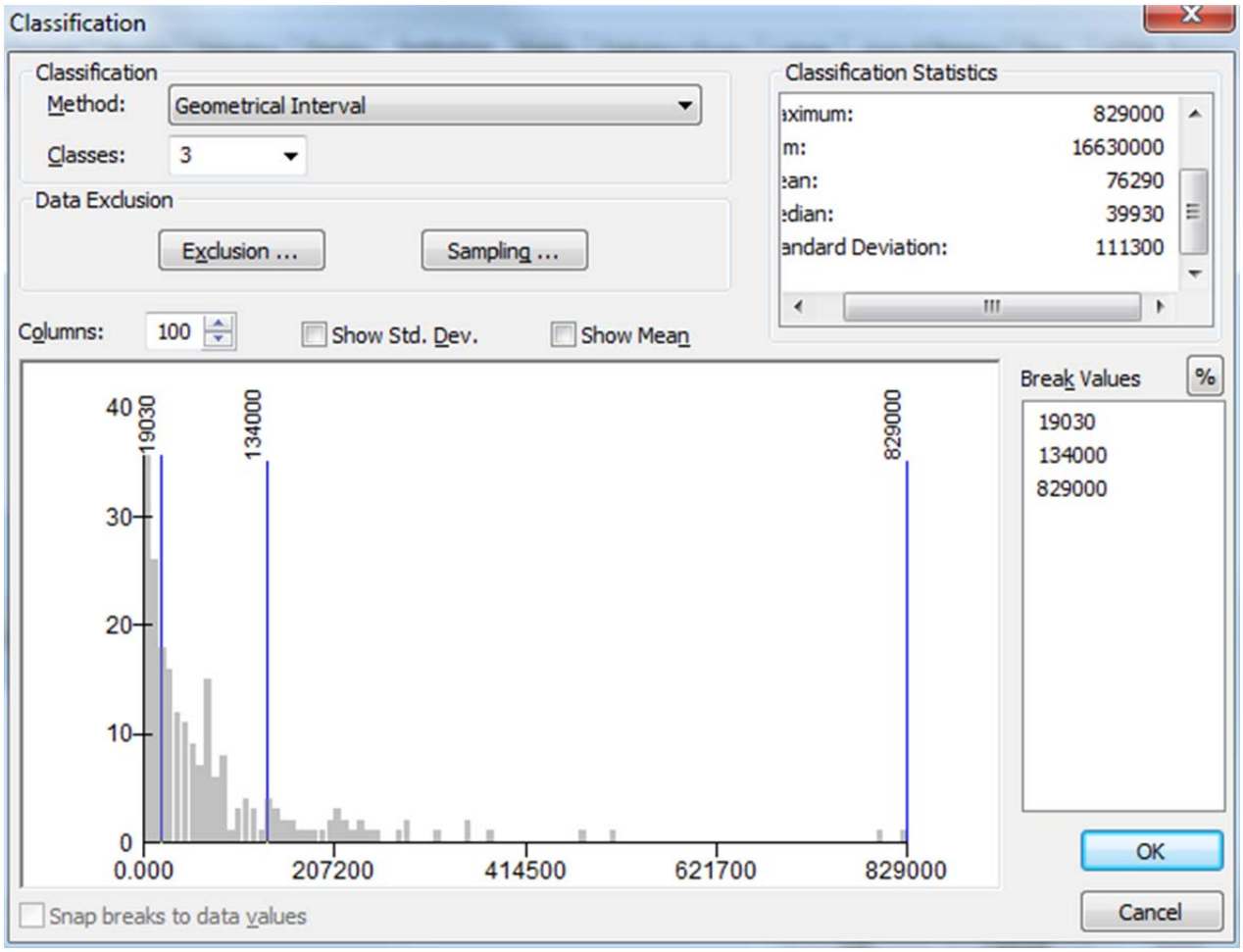
Census Tract Weighted Total = $\sum$ (Facility Weighted Total)

(where each Facility Weighted Total is geographically located within the bounds of the Census Tract of interest)

4) Each 2010 census tract within Greater Memphis was then normalized by area (by dividing each weighted total for a census tract by the area in square meters).
5) The normalized data from step 4 was then grouped into three classes using the quantile statistical method.

"Weighted Pollutors" Ranking, Normalized By Area

From the Environmental Protection Agency Enviromapper (Search of "Memphis, TN").



Derivation of the "Weighted" Pollution Data Layer:

1) Data from the EPA "Enviromapper" site were gathered by "Category," which included "Air," "Water," "Waste," "Land," "Toxics," and "Radiation."
2) A facility was counted once for each type of pollution it emitted; this total for each facility is called the "Facility Weighted Total." Each facility could have a weighted total of up to six. If a facility emitted air and water pollution (and no other type of pollution), it would have a weighted total of two.
3) The sum of the weighted total for each facility within a census tract was calculated, providing the "Census Tract Weighted Total."

Census Tract Weighted Total = $\sum$ (Facility Weighted Total)

(where each Facility Weighted Total is geographically located within the bounds of the Census Tract of interest)

4) Each 2010 census tract within Greater Memphis was then normalized by area (by dividing each weighted total for a census tract by the area in square meters).
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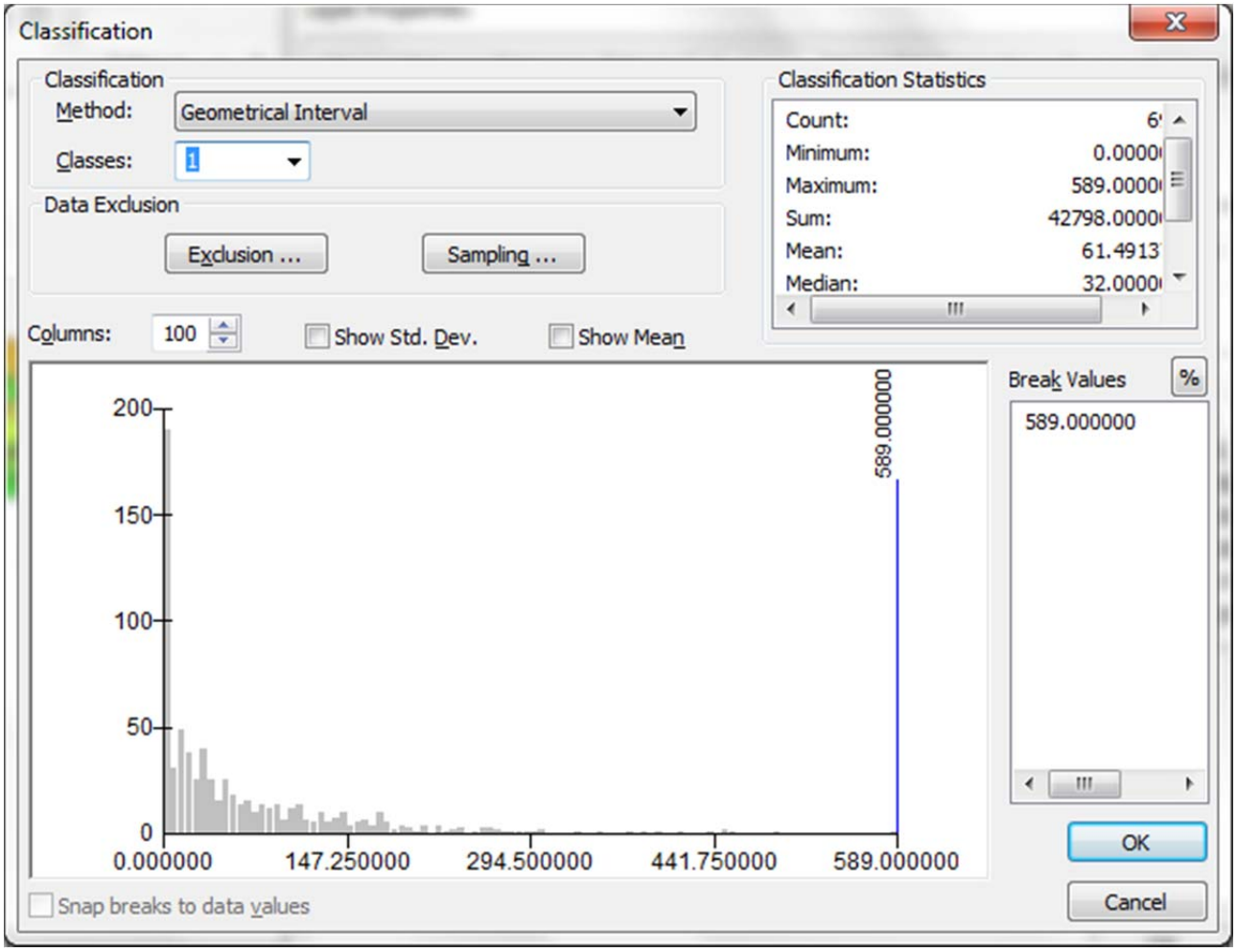
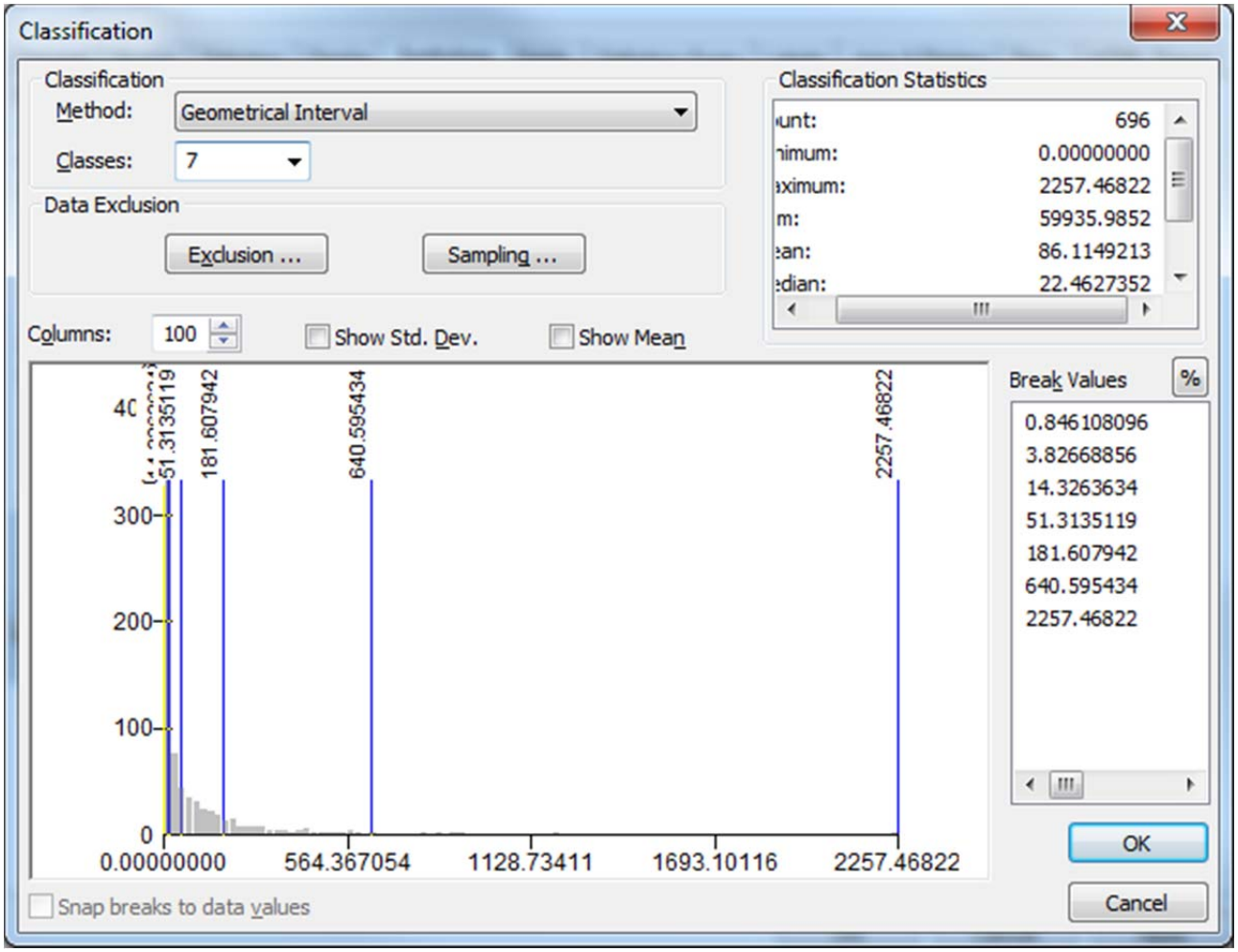
Zero Car Households

From EPA Smart Growth Project, Smart Location Database 2013.



Zero Car Households, Normalized By Area

From EPA Smart Growth Project, Smart Location Database 2013.



Appendix E

Attributions

We would like to thank the people for their significant contributions to our project and to the website.

- Maria Hart (National Center for Freight and Infrastructure Research and Education, UW-Madison)
- Dr. Stephanie Ivey (National Center for Freight and Infrastructure Research and Education, University of Memphis)
- Stephen Wilson (Federal Aviation Administration, Memphis Airports District Office)
- Brian O'Boyle (The Department of Transportation: Surface Transportation Board)
- Dr. Kevin Ramsey (EPA Smart Growth Project, Smart Location Database)
- Nathan Ron-Ferguson (Senior GIS Project Coordinator at the Center for Partnerships in GIS, University of Memphis)
- Nancy Baker (Memphis Heritage)
- Frank Stewart (Shelby County Register Archives)
- Wayne Dowdy (Memphis Public Library Archives)
- Perveen K Rustomfram (The University of Memphis: Government Publications Library)
- Ed Frank (Curator of the University of Memphis Libraries Preservation and Special Collections Department)
- Christopher Ratliff (The University of Memphis: University of Memphis Libraries Preservation and Special Collections Department)
- Dr. Goudsouzian (University of Memphis History Department)
- Dr. Crawford (University of Memphis History Department)

- And Last, But Certainly Not Least,
- Professor William Gartner (University of Wisconsin-Madison)

We would like to thank the following graphic designers and The Noun Project for their contribution to the website.

Icons

Caution designed by José Hernandez from the Noun Project
(Note: the background color was changed to red.)

Shopping Cart designed by Derrick Snider from the Noun Project

Plus designed by P.J. Onori from the Noun Project

School designed by Paul Souders from the Noun Project

Triangle designed by Renee Ramsey-Passmore from the Noun Project

Star designed by Molly Bramlet from the Noun Project

Circle designed by Renee Ramsey-Passmore from the Noun Project

Building designed by Nate Eul from the Noun Project

Train Car designed by Phil Laver from the Noun Project

Truck designed by Jeremy J Bristol from the Noun Project
(side view)

Truck designed by David Waschbüsch from the Noun Project
(front view)

Crane designed by Claire Taylor from the Noun Project

Star designed by Alex S. Lakas from the Noun Project

Appendix F

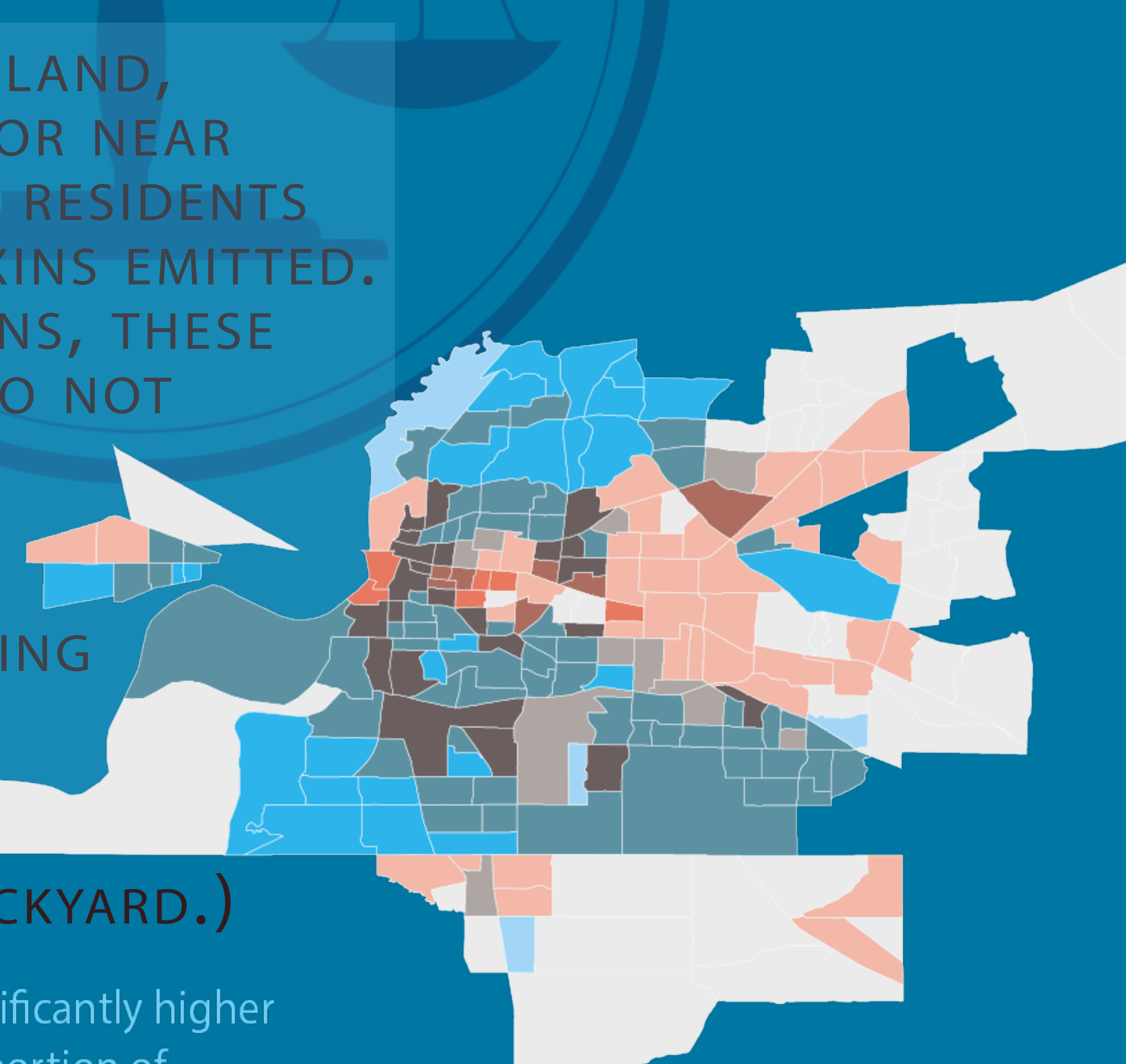
Infographic

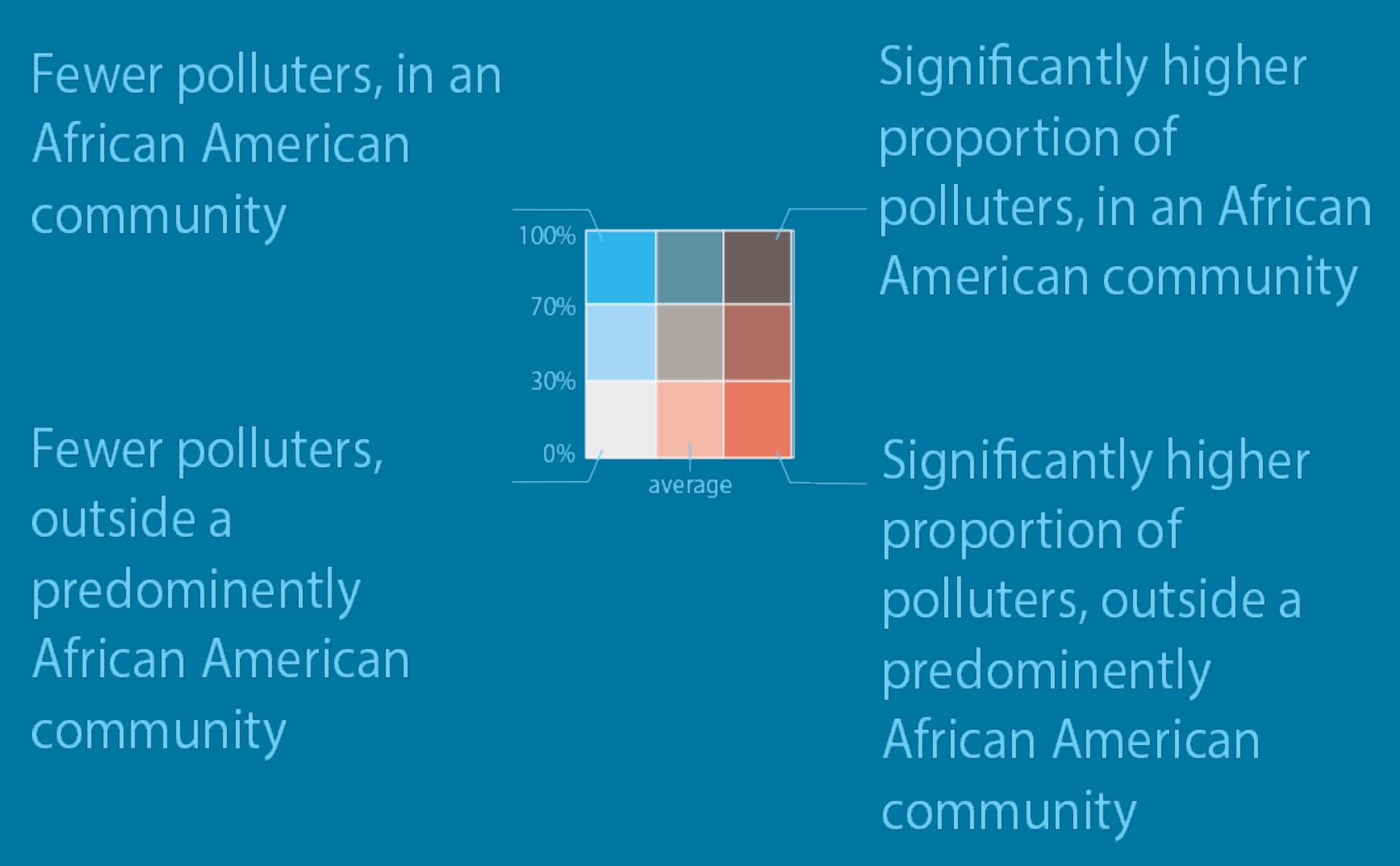
Memphis and Lamar Avenue: Environmental Justice
Author: Alexis Greenstreet

Memphis and Lamar Avenue: Environmental Justice

Searching for inexpensive land, industry often locates in or near low-income areas, leaving residents with health risks from toxins emitted. Without proper regulations, these disadvantaged residents do not have the the necessary resources to fight incoming factories and other toxic emittors, leaving some to feel NIMBY can become PIMBY.

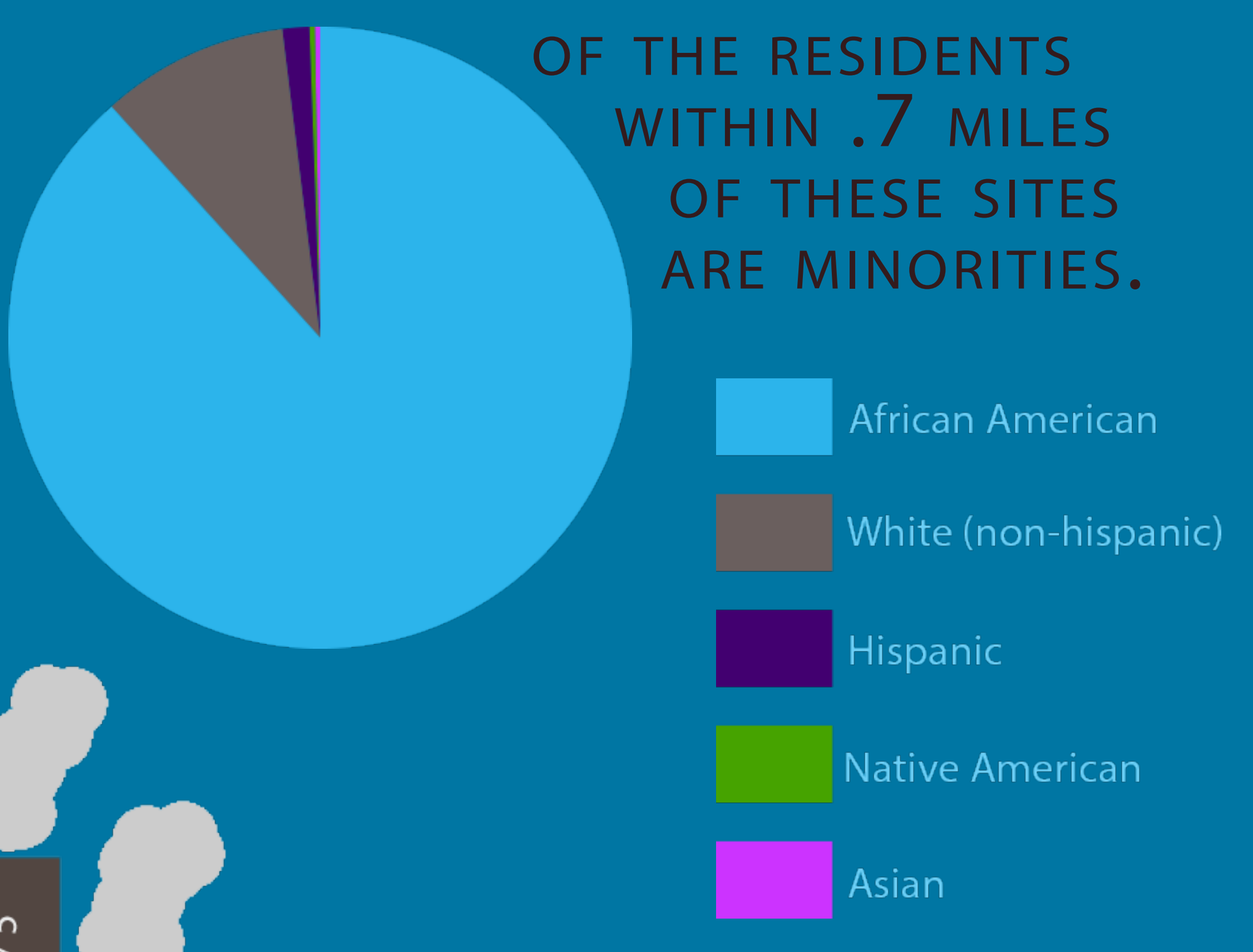
(Place In Minority's Backyard.)



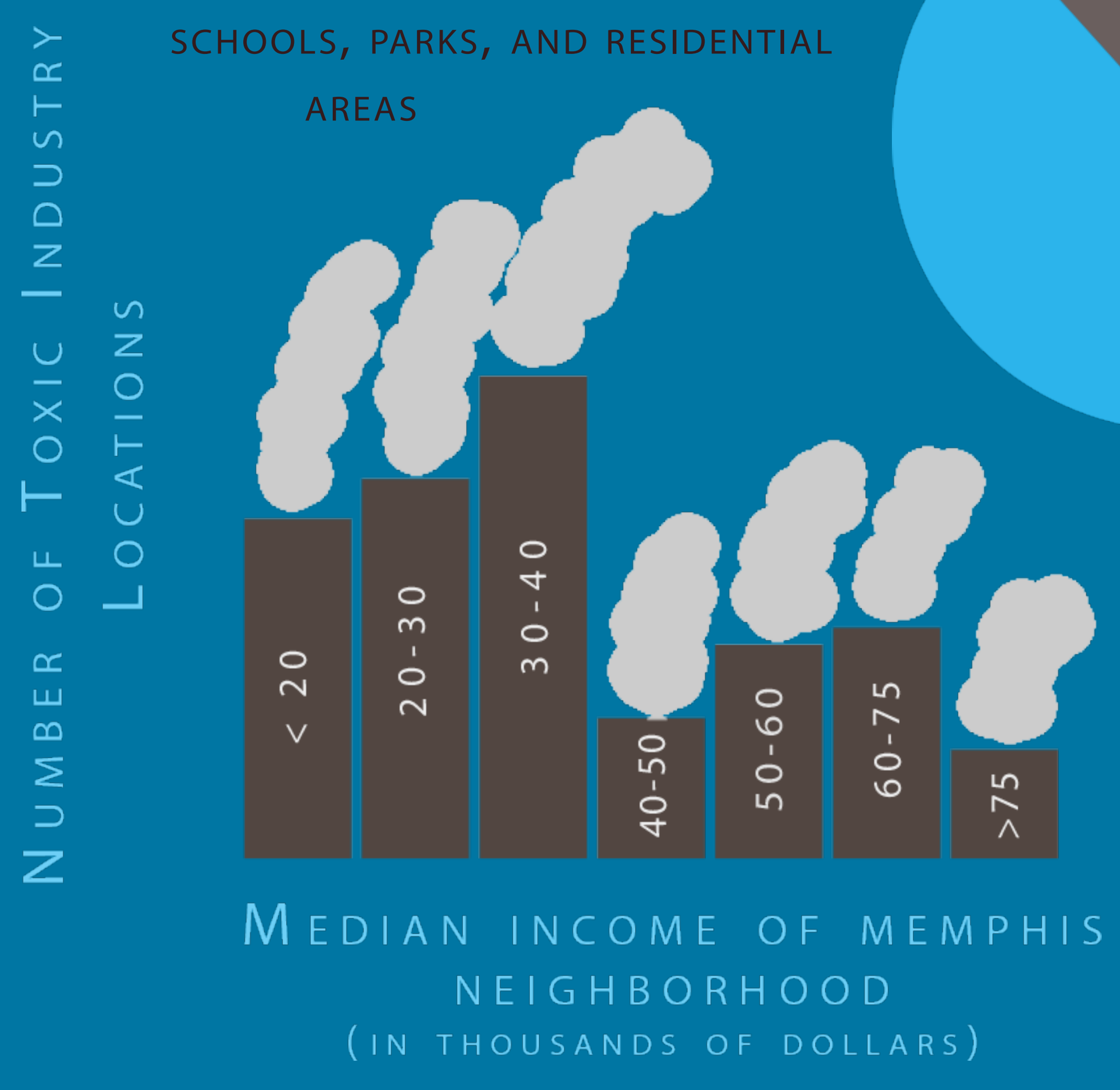


Three superfund sites, the most toxic clean-up sites as defined by the EPA, are located in or near Memphis.

91% of the residents within .7 miles of these sites are minorities.



In some underprivileged Memphis neighborhoods, dangerous chemicals are produced near public elementary schools, parks, and residential areas



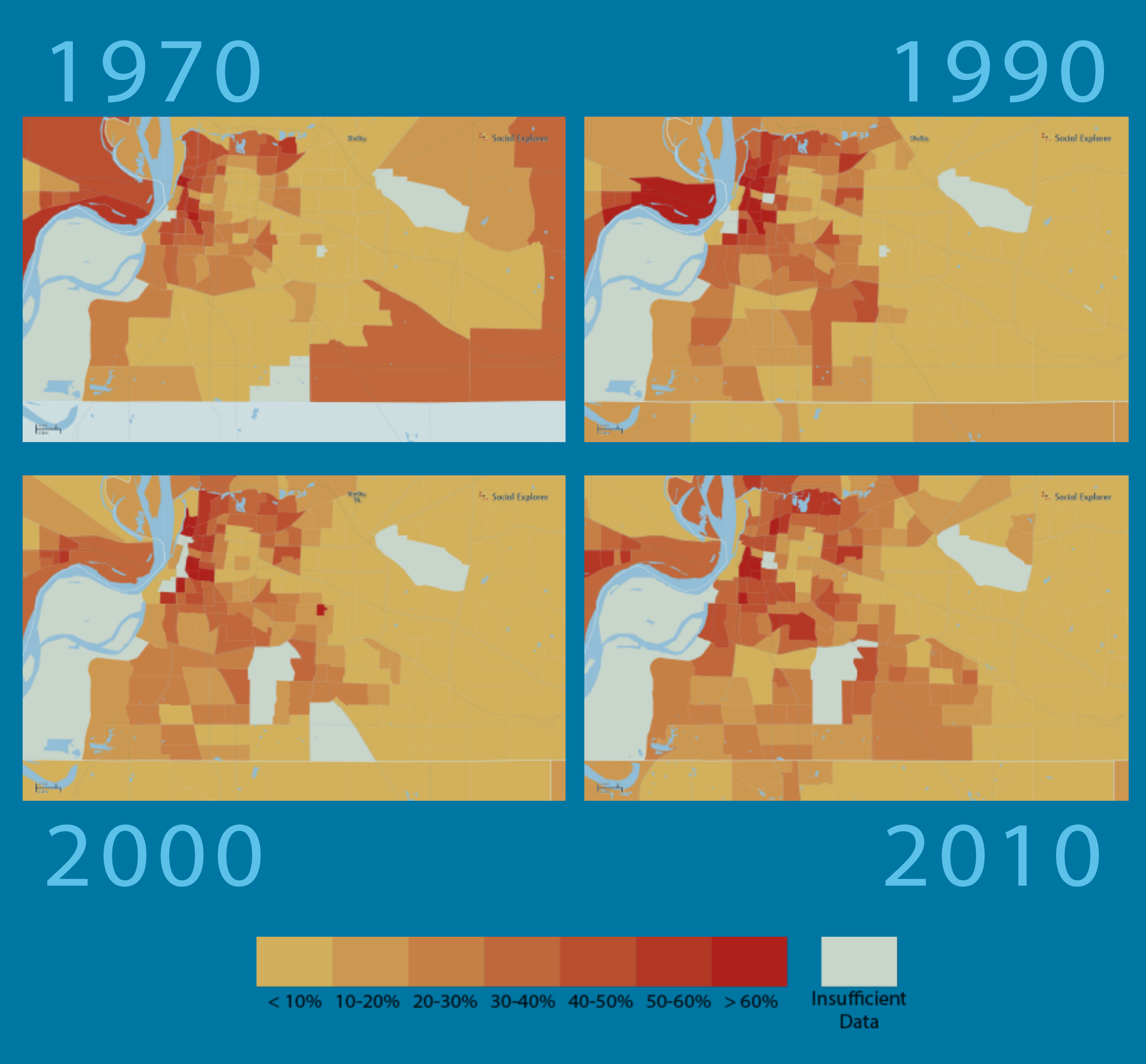
In 2010, their median income was **$25,139**

Memphis ranks in the lowest 20% of walkable cities

3 out of 4 people in Memphis don't have a park within a 10 minute walk

Only 1 in 4 people in Memphis can access their job by public transportation within 90 minutes

A look over time at families in poverty in Memphis



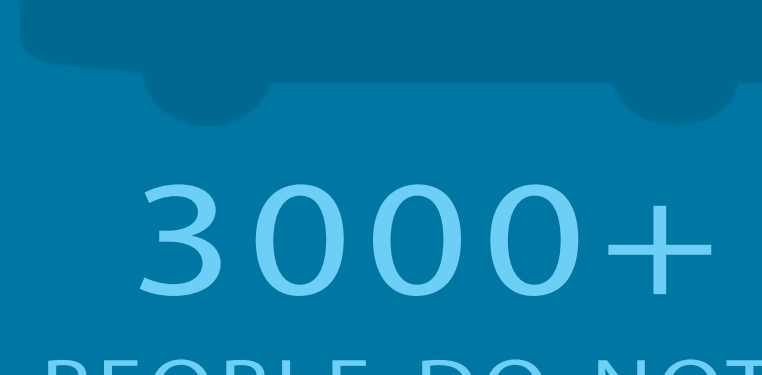
In 2012, Memphis ranked **#1** asthma capitol in the US, with more than 200 air polluters regulated by the EPA and ranked 4th highest out of 5 in diabetes occurence by the CDC

Lamar Avenue Corridor

The Lamar Avenue corridor contains hundreds of industrial locations emitting pollutants every day. Residents also live with round-the-clock noise pollution from the 2nd busiest cargo airport in the world, with the "SuperHub" of FedEx located at the nearby Memphis International airport.

24% relied on food stamps in 2011

People in the area immediately surrounding the densest area of industry have a significantly increased risk of cancer, with a rank of 4 out of 5 by the EPA's NATA scale.



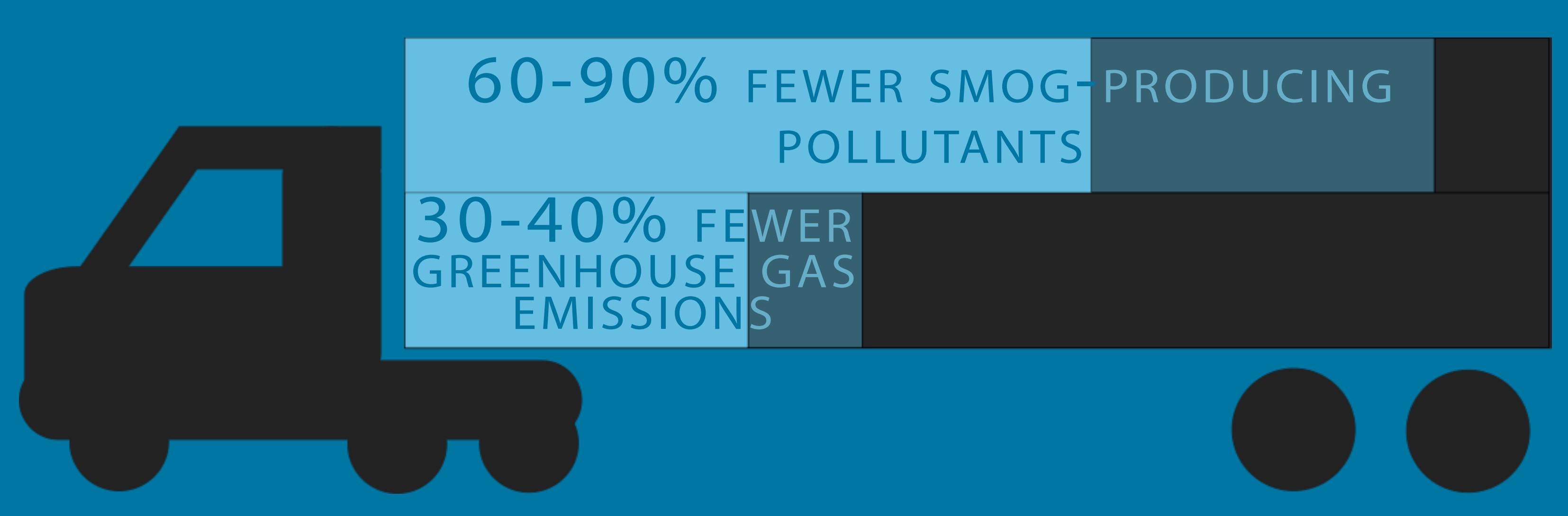
3000+ people do not have a car

1 out of 2 people rent their housing

17% in 2011 did not have health insurance and had low access to a grocery store

Possible solutions for the future?

By switching to compressed natural gas, trucks could emit...



Author: Alexis Greenstreet

Data: EPA (2013), EPA National-Scale Air Toxics Assessments (2005), American Community Survey (2010,2011), USCenter for Disease Control (2012), US Census (1970, 1990, 2000, 2010), USDA food atlas (2012), WalkScore (2013), ParkScore (2013), AsthmaCapitals (2012), Brookings Institution: metropolitan policy program (2013) (Public transportation)