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Geographical Analysis of Hub City Transit

Joshua Adam Watts
University of Southern Mississippi

The University of Southern Mississippi

GEOGRAPHICAL ANALYSIS OF HUB CITY TRANSIT

by

Joshua Adam Watts

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Approved:

Dr. Joby Bass
Committee Chair

Dr. David Cochran

Dr. George Raber

Dr. Karen S. Coats
Dean of the Graduate School

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ABSTRACT

GEOGRAPHICAL ANALYSIS OF HUB CITY TRANSIT

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This study assess Hub City Transit, the public bus system of Hattiesburg, MS. Statistical analysis is used to determine how well the transit system serves low income areas of the city. A 0.5 mile buffer was applied to the bus routes to determine the coverage of the transit system. Areas of disorder along the routes were also assessed to analyze the landscape routes pass through. Lastly, an analysis of ridership on each route was performed to determine the most heavily used areas, as well as to assess where riders are going on each route.

The findings show that Hub City Transit is serving the low income demographic that they state they wish to serve. Also, ridership analysis suggests that the transit system is a truly needed service, as most riders seem to utilize it to get to health care facilities and grocery stores. An abundance of disorder in the landscape of the routes was found and in many areas these are the areas of highest ridership.

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CHAPTER I

INTRODUCTION

This study assesses and analyzes Hub City Transit, the public bus transportation system for Hattiesburg, MS, to assess accessibility and to provide a snapshot of the routes and riders. Much research has been done on public transit accessibility. Gan, Liu, and Ubaka (2005) assessed accessibility as well as the service region of public transportation in Florida. Nyerges (1995) utilized buffers within GIS to determine areas of accessibility. Murray (2003) developed a hybrid coverage model for expanding service access and increasing accessibility in Brisbane, Australia. Hub City Transit, according to city workers, seeks to serve those in lower income areas of the city. Using similar methods to previous research this project assess Hattiesburg's transit system.

There are four objectives for this research: statistical analysis of Hub City Transit's bus stop locations, analysis of accessibility to the routes, an assessment of disorder in the landscape along each route, and a visualization and analysis of ridership. Using census data, current routes, ridership, and infrastructure data the project assess how well Hattiesburg's public transit system performs and develop a picture of the riders as well as the landscape the routes pass through.

This project assesses the service of the transit system in Hattiesburg. Current routes, building data, socio-economic files, and ridership data contributed to the findings in this research. Data were not only used to determine how well the transit system serves those that it is aimed at, but also to determine who the bus routes do not serve. The project utilizes block group level census data obtained from the *Mississippi Automated Resource Information System* (*MARIS*) (2010) to determine areas of the city with a majority of low income households, low income defined as households making $20,000 or less. Statistical analysis was used to determine the relationship between the bus routes and low income areas to see if the transit system truly serves low income areas. A similar approach was used to determine which areas are underserved by Hub City Transit.

A second objective of the project was to create a visualization of ridership on Hub City Transit's routes that can then be analyzed. Using data obtained from Hattiesburg's GIS (Geographic Information Systems) department as well as data collected from riding the individual routes, a proportional line density map was created that shows which areas along the routes have the highest and lowest ridership. A thicker line representing higher ridership and a thinner line representing lower ridership.

Third, an assessment levels of disorder in the landscape the routes pass through. Describing the landscape and assessing levels of disorder gives an in depth view of the study site. This also shows how routes differ from one another as well as providing a glimpse of the low income areas Hub City Transit serves.

The last objective is to assess accessibility. To do this, a coverage map was created in GIS. A buffer was placed around the four fixed routes for the city to determine which areas have easy access to the routes. Buffers were set at roughly three blocks, or 0.5 miles from the routes. This was simply based on an estimate of how far someone would be willing to walk to get to a given bus stop. The map resulting from this analysis provides a visualization of which areas have easiest access to the city's bus routes.

Data were used not only to analyze how well Hub City Transit serves low income areas, but also to gain insight into who is using the routes and where they are going.

These analyses can help to determine how effective Hub City Transit is, and if it is a truly needed service in the city of Hattiesburg.

CHAPTER II

PUBLIC TRANSIT AND ACCESSIBILITY

In recent years, GIS has been utilized as a tool for the development and analysis of public transportation routes. A study by Gertman and Ritsema van Eck (1995) looked at GIS models and their potential to predict and assess public transit accessibility. At the turn of the century (Transit Agency Builds GIS to Plan Bus Routes 2003) Richmond, Virginia developed a GIS to help plan bus routes and to keep track of the 2,500 bus stops in Richmond and Chesterfield county. In 2002 when sniper attacks terrorized central Virginia, data provided by the GIS became crucial to police in identifying at risk bus stops.

Many studies have focused on accessibility to public transit, a measure of the ease with which people can reach their destinations or activities (Dalvi 1978). The *p*-median problem (the problem of locating *P,* facilities, relative to a set of customers such that the sum of the shortest demand weighted distance between customers and facilities is minimized) is generally what is addressed when GIS is used to analyze accessibility to public transportation. Gan et al. (Gan, Liu and Ubaka 2005) developed a program called the Florida Transit Geographic Information System, designed to determine those areas accessible by public transit, as well as to calculate the service region served by public transit. Using demographic data, their system can identify areas underserved by transit but meet minimum levels of housing and employment density.

Nyerges (1995) used GIS to analyze transit coverage in the Queen Anne Community of Seattle, quarter-mile buffers were created around transit routes using GIS to identify the streets served by the current system. If a street lay within one of the buffers, then people along that street are considered to have adequate access to the transit system. Murray and Wu (2003) examined modeling approaches for addressing accessibility concerns. Their goal was to minimize average access to a stop while improving travel speeds along the route by eliminating redundant stops.

Challuri (2006) took a similar approach to analyzing public transit accessibility. Within this study, access distance to transit stops and bus stop spacing was used as the basis to examine the inefficiencies, indicated by the redundancy in the number of bus stops. Based on the bus stop spacing standard of 300-600 meters, the study found that generally for all the routes examined, about 75% of the bus stops could be reduced for the 400 meter access standard. Challuri stated that the suggested reduction in the number of bus stops would not sacrifice the current level of geographic coverage and would not increase the average access distance to bus stops beyond the accepted standard of 400 meters. Shrestha and Zolnik (2013) produced similar findings about the overabundance of bus stops. They found that eliminating about 40% of in Fairfax, Virginia would improve travel time and reduce operating costs by about 23%.

Xiaobai Yao (2007) investigated the potential demand for public transit for commuting trips. Yao created a need index to measure potential demand, and also used self-organizing maps to find clusters of this potential demand. She next conducted a cross-examination analysis of the two methods. Existing transit network data were entered in GIS for spatial analysis. The results of both methods were compared and displayed in GIS for examination of spatial distribution of the potential demands. Results of the cross-examination showed that the need index was superior for its simplicity and higher level of measurement of potential demands.

Widener et al. (2015) examined the public transit system in order quantify access levels to healthy food vendors in Cincinnati. Transportation analysis zones (TAZs) within two miles of a bus stop were used and then analyzed to determine the number of healthy food vendors within them. This could be simply put as an assessment of how well the transit system serves the public by taking them to places they need to go.

Tao, Rohde, and Corcoran (2014) used smart card data, cards used as public transit passes, to analyze "spatial–temporal dynamics of UPT (urban public transport) passenger travel behavior," or where passengers are going. The researchers utilized GIS to create visualizations of the behavior of certain demographics such as adults, students, and seniors. Hadas and Ranjitkar (2012) analyzed the performance of public transit network connectivity based on passenger transfers.

Anderson and Khan (2014) analyzed the performance of rural public transit systems in Alabama. With a goal of improving the operations of rural systems, the researchers eliminated uncontrollable factors and provided a methodology for standardizing performance measures to asses these rural systems.

Cubukcu (2008) tested the hypothesis that physical and urban geographical characteristics are plausible explanatory factors for bus transit operation costs. Findings showed that site-specific factors and service characteristics were significant determinants in bus transit. "Total cost decreases with decreases with population density, average street segment length, the percentage of flat land and the size of the service area served by one route mile, and increases with larger service territory area and older fleet age."

Lei and Church (2010) argued, that while useful, studies that identified accessibility, demographics, and efficiency of service did not address all the issues. By analysis of the time of day, direction of trip, and detailed schedule information, Lei and Church argued that GIS could be better utilized to analyze public transit.

As society has become more dependent on the internet in daily life, GIS has been used to create apps and websites that inform potential riders of routes, arrival times, and nearest stops. Larger American cities such as Boston and San Francisco have mobile apps that provide real-time bus locations and arrivals (MBTA 2014) (SFMTA 2013). Zhong-Ren Peng and Ruihong Huang (2000) described a way of designing a Web-based transit information system that allows users to plan a trip itinerary and query service-related information, such as schedules and routes. Ziliaskopoulosa and Waller (2000) developed a similar system that sought to integrate spatio-temporal data and models for a wide range of transport applications such as city planning and engineering.

Within this project, ridership numbers are statistically analyzed. Pisarski (2003) sought to analyze and explain the difference in ridership numbers between the U.S. Census Bureau Decennial Census and the Federal Transit Administration (FTA). The study determined that other variables were needed to make the data match between the two sources. Findings showed that trends should be measured in the share of all transit trips that have a work purpose. For example: in the ratio of boardings to revenue boardings or the number of boardings per rider, in the private vehicle-transit intermodal linkage, in the linkage between "usual use" and "yesterday's use," and in the impact of occasional users on total transit ridership.

Polzin and Chu (2005) presented research that went beyond Pisarski, providing an overall look at the recent trend in transit’s modal share. By using various sources of data including both survey data results and field count data, Polzin and Chu sought to provide a more comprehensive look at transit ridership trends.

A 2008 paper (Zhou, et al. 2008) examined the effects of welfare subsidies on fixed route bus systems and flexible route systems. For each bus system, the decision variables including fare, headway, route spacing, and service zone area were optimally solved to analyze unconstrained, break-even and subsidy cases. Their findings showed subsidies affected both types of systems, but that low transit subsidies were preferable for fixed route systems and less preferable for flexible systems.

As this project tries to create a visualization of ridership along the routes, some considerations must be taken into account to correctly present the data. Gastner and Newman (2004) presented a diffusion based method for producing density-equalizing maps. Their considerations of scale and proportion when representing data on a map are useful even in the more simple form that this project will use.

How public transit is perceived, as well as the landscapes its routes pass through, has an effect on ridership. If routes run through areas with abandoned buildings, the sight of this abandonment has some effect on the riders. If nothing else it suggests that this area is undesirable to those who left it. J. B. Jackson (1972) points out that every ruin reveals a fragment of the landscape that became obsolete. Robert Sampson and Stephen Raudenbush (2004) examined what this abandonment, or disorder, means to people. Building on the "Broken Windows" theory proposed by Kelling and Wilson (1982), Sampson and Raudenbush concluded that the disorder was not the only thing that shaped people's perception of a given area, and that perhaps the associations of disorder with residents' perceptions of their meaning had a larger impact on the negative feelings residents had of an area. Yi-Fu Tuan stated (1979) that incidents such as the Watts riots in Los Angeles in 1965 shape how areas are perceived by outsiders. Incidents like this one are linked to racial perceptions that affect one's perception of the landscape.

Potential patrons' perception of the public transit system also has an effect on ridership. A 1994 study (Benjamin, et al.) examined public transit in small cities in the southeast United States. Questioning police departments and transit agencies, as well as drivers, passengers, and nearby residents of the public transit system in Greensboro, North Carolina, they found few incidents of violent crime on the transit systems and yet residents perceived the system as unsafe. Similar studies are found in the literature that show the same kinds of perception of the transit systems (Ingalls, Hartgen and Owens 1994; Smith and Clarke 2000).

CHAPTER III

METHODS

Research Questions

To assess Hub City Transit, both a qualitative and quantitative approach will be used. This research hopes to combine cultural/human geography with GIS by mapping and assessing income and demographic data within GIS, and determining the relationship between these variables and the transit system. Examining socio-economic data and its relationship to bus stop location will help to address the project's following research questions:

- What is the relationship between the number of bus stops and income within a block group?
- Who is the transit system best serving; who has easy access to bus stops?
- Where are the areas with the highest and lowest ridership along the transit system's four fixed routes?
- What do riders use the public transit system for? Where are they going?
- Is there a relationship between ridership and income?
- Is there a landscape of disorder along the bus routes, and if so where?

These questions will help to create a picture of the Hattiesburg's transit system and those it serves.

Study Site

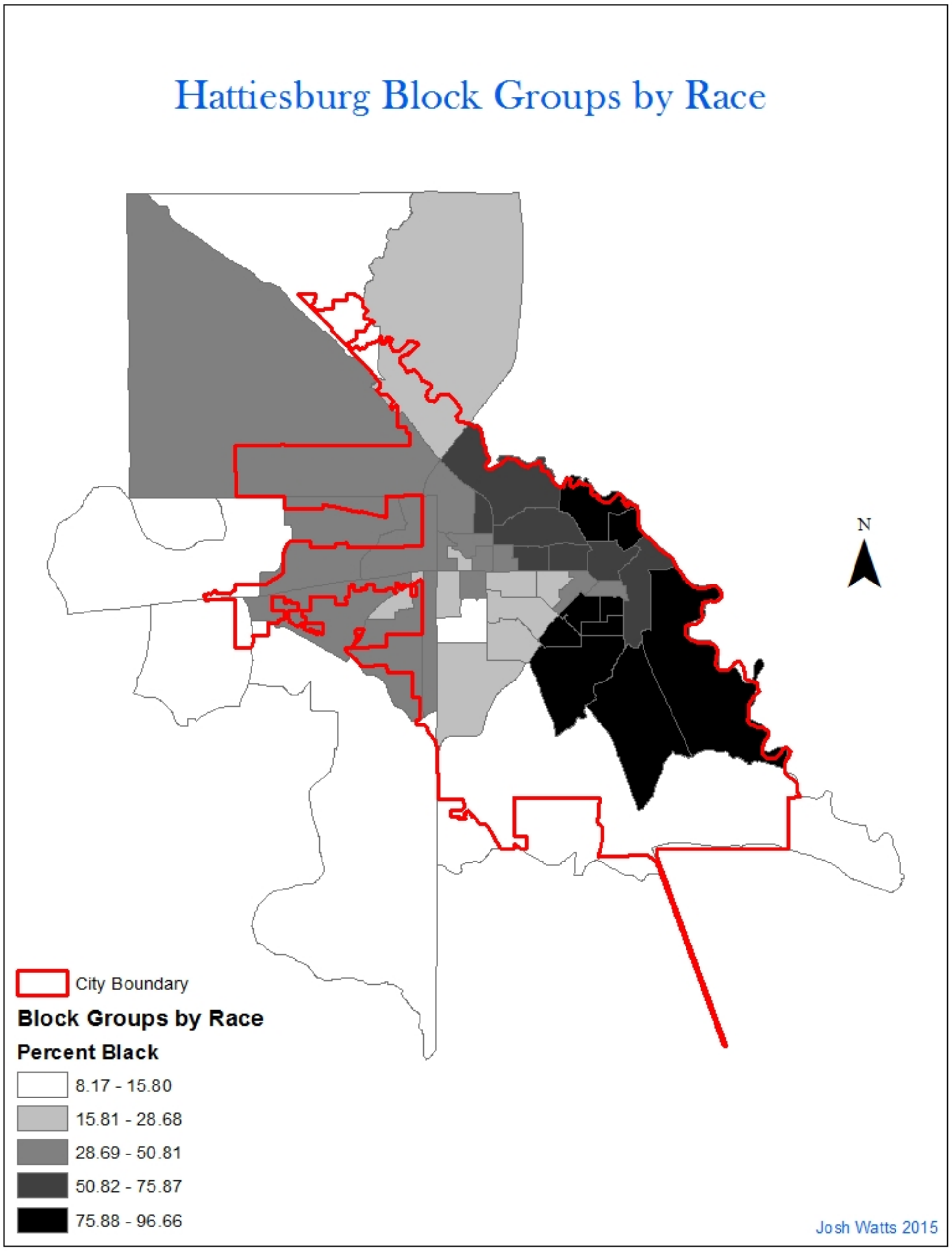

Figure 1. Block Groups by Race in Hattiesburg, MS.

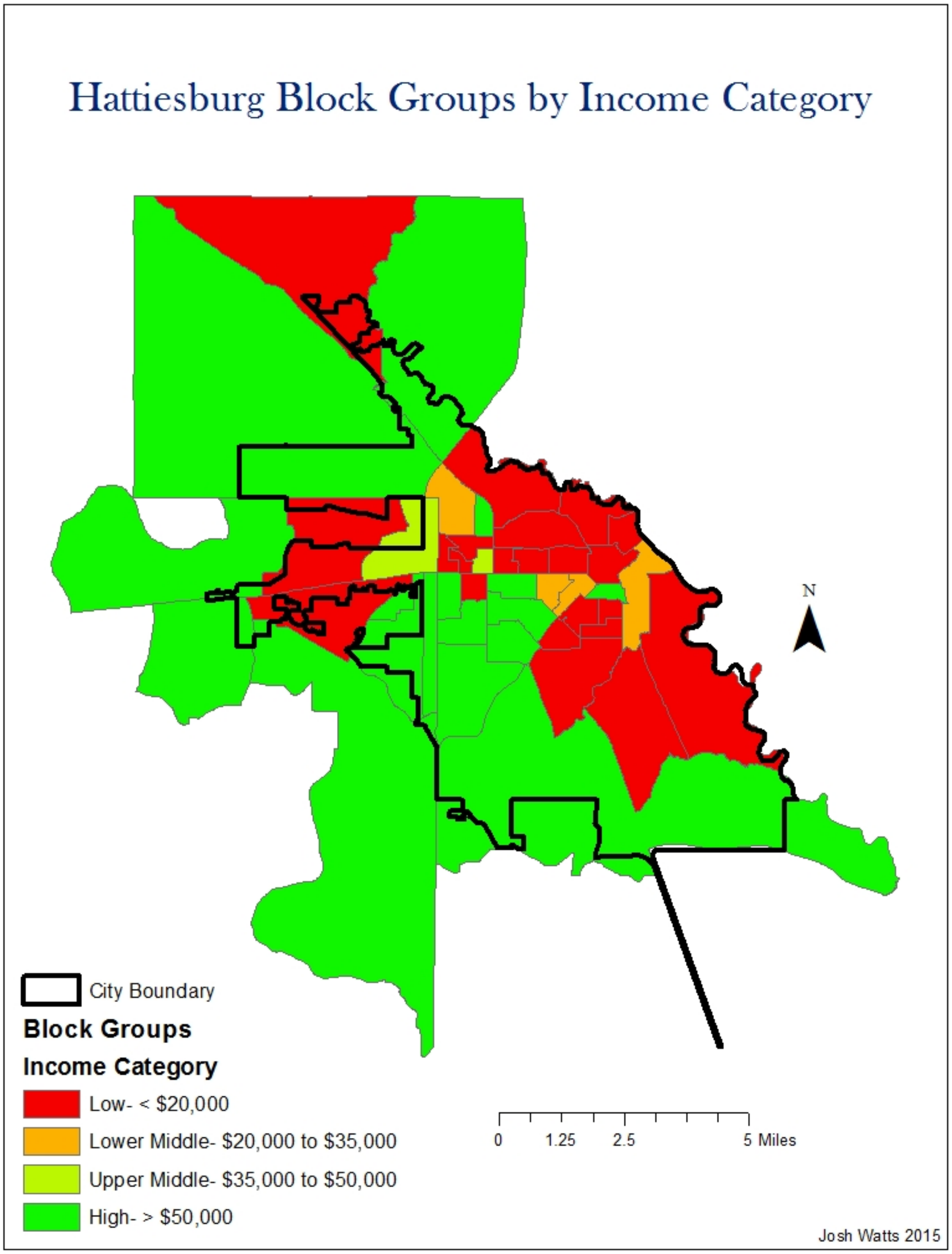

Figure 2. Block Groups by Income Category in Hattiesburg, MS.

Hattiesburg, MS was incorporated in 1884 and named after the wife of its founder, William H. Hardy (Historical Society 2014). It is located at the fork of the Leaf and Bouie Rivers. Initially founded as a site for a railroad station, the town was used largely as an intersection of railways for logging transportation. For its first two decades, Hattiesburg was devoted to one industry built on its primary natural resource, longleaf pine (*Pinus palustris*) (Morris 2014). Longleaf pine were used largely for lumber and turpentine during this time. This industry would grow Hattiesburg rapidly. By 1890 the population was 1,172 and it had reached 4,175 by 1900 (Morris 2014).

By 1914 Hattiesburg had twenty miles of paved roads, a modern water system, gas and electrical plants, and an eight-mile-long street car system. In 1910 the corporate limits had expanded from the crossing of the rail lines, in what is the downtown area today, to 31st Avenue. Most development until the 1930s was limited to the areas along Hardy Street. The 1960s saw Hattiesburg expand West to the Highway 49 bypass (Neff 1968). With the addition of I-59 the city continued to grow westward in the following decades. In the 1990s, Walmart and the Turtle Creek mall were built west of I-59 along Highway 98. This helped to expand the city further to the west, and today this area is known as West Hattiesburg.

As the timber industry began to decline, industrial companies began to take its place as the leading employer in Hattiesburg. Hercules Powder Company and Reliance Manufacturing Company were two of the largest companies to establish residence in the city in the 1920s and 1930s (Neff 1968). Reliance Manufacturing produced men's dress shirts while Hercules initially extracted rosin, pine oil, and turpentine from stumps of longleaf pine. When the U.S. entered World War II, Hercules began to aid in the manufacture of gun powder as well as over 250 other chemicals (Environmental Protection Agency 2011). These industries facilitated growth in Hattiesburg in the years after the timber industry's decline.

Historically, Hattiesburg's African American communities have been in lower lying areas near the Leaf River, East and South of downtown (Godby 1971). These areas were, somewhat predictably, more prone to flooding. Following the civil rights movement in the 1960s many African Americans began to move West into historically white neighborhoods. In turn, many white residents moved from their original neighborhoods even farther West into what is today Oak Grove and West Hattiesburg. This has contributed to the urban sprawl of the city which now not only stretches across Forrest County but also Lamar County to the west.

Hattiesburg still has clearly defined areas that are majority African American. These areas are generally east of Highway 49 and north of 7th Street as well as southeast of West Pine Street. Though many of these areas were once populated by white residents they now constitute the black community of Hattiesburg and contain a slightly different cultural landscape than areas of the city occupied by white residents.

According to city workers, it is these lower income, mostly African American, areas of the city that Hattiesburg's public transit system seeks to serve. Hattiesburg's Hub City Transit maintains four fixed bus routes within the city limits which, according to its website, provides transportation to 10,580 patrons. The transit system also provides a demand response program that serves 4,362 elderly and disabled residents (Hub City Transit 2014). Hub City Transit's fixed route service provides transportation to all citizens of the Hattiesburg area. Fixed routes run Monday through Friday. All routes start at 6:00 a.m. from the newly renovated Hattiesburg Intermodal Facility (Train Depot) at 308 Newman Street, and run until 6:30 p.m.

Methodology

The first step of the project was to gather household income data from MARIS that provides household income data by census block group using data from 2010 (United States Census Bureau 2014). Next, the project obtained data from Hattiesburg's Geographical Information Systems (GIS) Department. Hattiesburg's GIS department provided shapefiles of the city limits boundary, streets, buildings, major bus stops, and each route. Income data and data about each stop were used for statistical analysis. Each route's shapefile, as well as infrastructure data, along with data collected from observation, served to assess disorder along each route. These route's shapefiles were also used along with income data to visualize which block groups have easy access to the transit system. Finally, data showing on/off counts at each stop were utilized for analysis of ridership, creating a visualization of which sections of the route have highest ridership and where riders are going.

CHAPTER IV

ANALYSIS

Statistical Analysis

The first step of the project was to gather household income data from MARIS that provides household income data by census block group using data from 2010 census as well as data from The American Community Survey (ACS) compiled by MARIS. The ACS is an ongoing survey that provides data annually - giving communities the current information they need to plan investments and services (United States Census Bureau 2014). This survey provides yearly data to supplement the census administered every ten years. Next, data were obtained from Hattiesburg's Geographical Information Systems (GIS) Department. Hattiesburg's GIS department provided shapefiles of the city limits boundary, streets, buildings, and major bus stops. Data were then analyzed to test the following hypotheses:

1. There are more bus stops within low income areas of Hattiesburg than in higher income areas.
2. Low income areas are clustered within the city limits.
3. Bus stops are clustered within the city limits, specifically clustered in low income areas.
4. There is a significant relationship between the location of low income census block groups and the location of the transit system's bus stops.
5. The location of bus stops within the city of Hattiesburg can be explained by the location of low income census block groups.

Based on a cursory look at route location, low income areas and the transit system's major bus stops are clustered together, and the location of bus routes are influenced by the location of low income areas (HCT Bus Routes 2013).

Before obtaining shapefiles from the city that showed the location of the major bus stops, the stops for Route 1 along Hardy Street were plotted by riding the bus on its complete route and logging each point into a GPS system. The latitude and longitude of the stops was then uploaded into ArcMap and used to create a point shapefile that overlaid a map of the city. Though a point shapefile was eventually obtained from the city's GIS department that showed all the transit system's major stops, riding the bus proved an invaluable experience for the projects research. By riding the bus it was easy to see who was using the public transportation system and for what purposes. This proved extremely useful when analyzing the data since it was known that riders were using the bus to get to doctor's appointments, to and from work, grocery shopping, and to look for employment. During analysis when a high income block group was found to have a high number of stops it was easier to assess what the stops were servicing and if income area influenced the number of stops or if the stops could be explained by the locations the bus was taking low income patrons. For example, one block with high income that also contained a high number of stops also contained Forrest General Hospital and other medical facilities. Knowing that low income patrons were using the transit system to get to medical appointments made it easy to decide that household income was not the driving factor in the high number of stops in this block group.

ANOVA

The initial statistical analysis of the data to run was an ANOVA test with the household income data for each block group divided into low, lower middle, upper middle, and high income categories. ANOVA was run with the categorized block groups as the independent variable and the number of bus stops in each group as the dependent variable. This test served two purposes for the project, to test the difference between income categories and the number of bus stops in each block group, as well as providing a difference between each income category that help the project to decide how to define low income.

An ANOVA test was run several times with these variables. First, with income categories defined as low income less than $20,000, lower middle $20,000 to $35,000, upper middle $35,000 to $50,000, and high $50,000 and up. Next, with low income less than $25,000, lower middle $25,000 to $40,000, upper middle $40,000 to $60,000, and high as $60,000 and up. Then with only three income categories, low as less than $25,000, middle $25,000 to $60,000, and high $60,000 and up. Finally, low income as less than $30,000, middle $30,000 to $60,000, and high as $60,000 and up.

The largest mean difference between low and middle incomes was produced with low income defined as less than $20,000 with the difference between low and lower middle at 1.93 and 1.82 between low and upper middle. This provided a definition of low income at less than $20,000 for the project.

The next step with ANOVA was to determine if there was a significant difference of the number of bus stops in block groups between income categories. Running the analysis with initially produced the following results:

Table 1

ANOVA with All Block Groups

Number of Stops	*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Between Groups	179.860	3	59.953	1.204	.320
Within Groups	2042.140	41	49.808		
Total	2222.000	44			

With a significance of 0.320 the ANOVA initially showed that the null hypothesis would be accepted and there was no difference between the income categories. As already stated in the hypothesis tested for this project, it is expected that there would be a difference between categories. At this point knowledge of the data as well as insight from riding on Hub City Transit's Route 1 allowed for three high income block groups that contained a high number of stops to be eliminated from the analysis. These three blocks, 12, 13, and 14, are along Highway 49 between Hardy Street and Broadway Drive. Block 12 contains Forrest General hospital and other medical facilities, 13 contains a Fred's and Hudson's Salvage, and block 14 contains a Wal-Mart. Each of these blocks' high number of stops is explained by the places the bus is taking patrons, medical facilities and cheaper shopping options. For these blocks service, not household income, seems to be the driving factor in the high number of stops contained in them. Since the project is seeking to assess the stops explained by low income households, these three blocks are eliminated from the analysis and ANOVA is run again producing the following results:

Table 2

ANOVA with Block Groups 12, 13, and 14 Eliminated

Number of Stops	*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Between Groups	446.192	3	148.731	4.706	.007
Within Groups	1200.880	38	31.602		
Total	1647.071	41			

With a significance of 0.007 the null hypothesis is rejected and there is now a significant difference between the income categories with more stops lying in low income block groups. This confirms the tested hypothesis showing that here are more bus stops within low income areas of Hattiesburg than in higher income areas, as well as answering research question one.

Quadrat Analysis

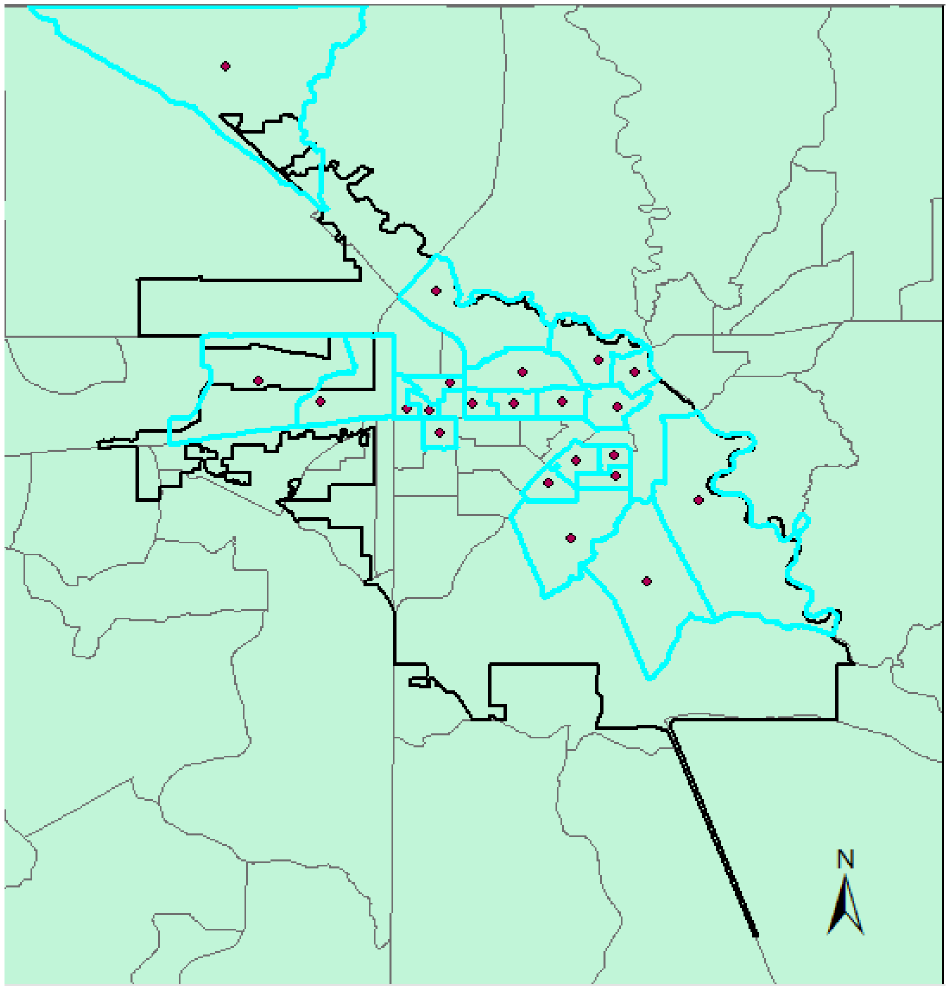

Figure 3. Quadrat Analysis – Low Income Block Groups.

Quadrat analysis was used to answer the second research question, are low income areas clustered within the city limits? First ArcMap was used to find the center of each block group to use as points for the analysis. Using only those block groups defined as low income (less than $20,000) a grid with twenty 1.5” x 1” cells was overlaid onto the map and the number of points falling into each cell were counted. In order to run the quadrat analysis and determine if low income block groups were clustered within the city limits, a spread sheet was then created and used to calculate the variance (VAR), variance-mean ratio (VMR), mean, and a p-value with the following results:

Table 3

Quadrat Analysis of Low Income Block Groups

Mean	**VAR**	**VMR**	**Chi-squared**	**P-value**
1.15	4.094736842	3.560640732	67.65217	2.24916E-7

With a variance greater than the mean, and a VMR greater than one the null hypothesis can be rejected indicating that the point pattern is more clustered than random. A very low p-value (2.24916E-07) also suggests a rejection of the null hypothesis. Low income block groups are clustered along the north side of Hardy Street and South of Hardy when east of Highway 49.

The same analysis was run on high income census blocks to determine if they were also clustered within the city limits producing the following:

Table 4

Quadrat Analysis of High Income Block Groups

Mean	**VAR**	**VMR**	**Chi-squared**	**P-value**
0.65	1.621052632	2.493927126	47.38461538	0.000314599

Again, with a variance greater than the mean, and a VMR greater than one the null hypothesis is rejected indicating that the point pattern is more clustered than random.

A very low p-value (0.000314599) also suggests a rejection of the null hypothesis. Within the city limits, high income block groups are mostly clustered south of Hardy Street between I-59 and Highway 49. Highlighted areas in Figure 4 show the high income block groups.

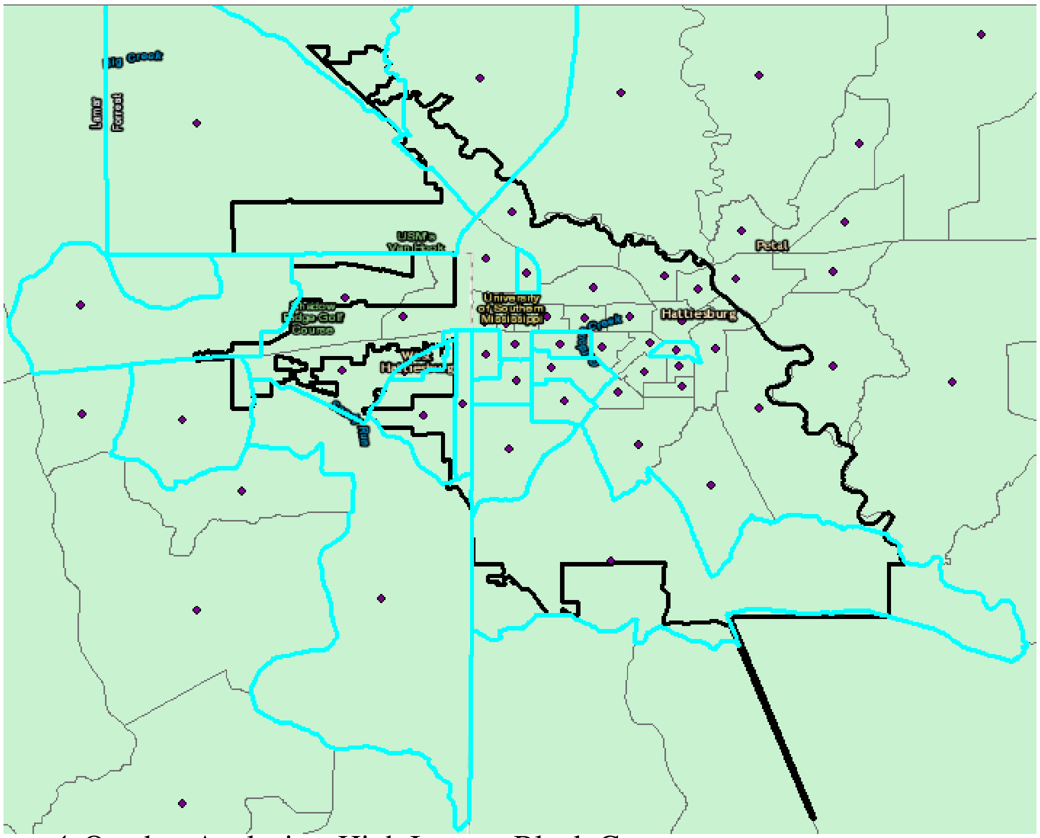

Figure 4. Quadrat Analysis – High Income Block Groups.

Nearest Neighbor Analysis

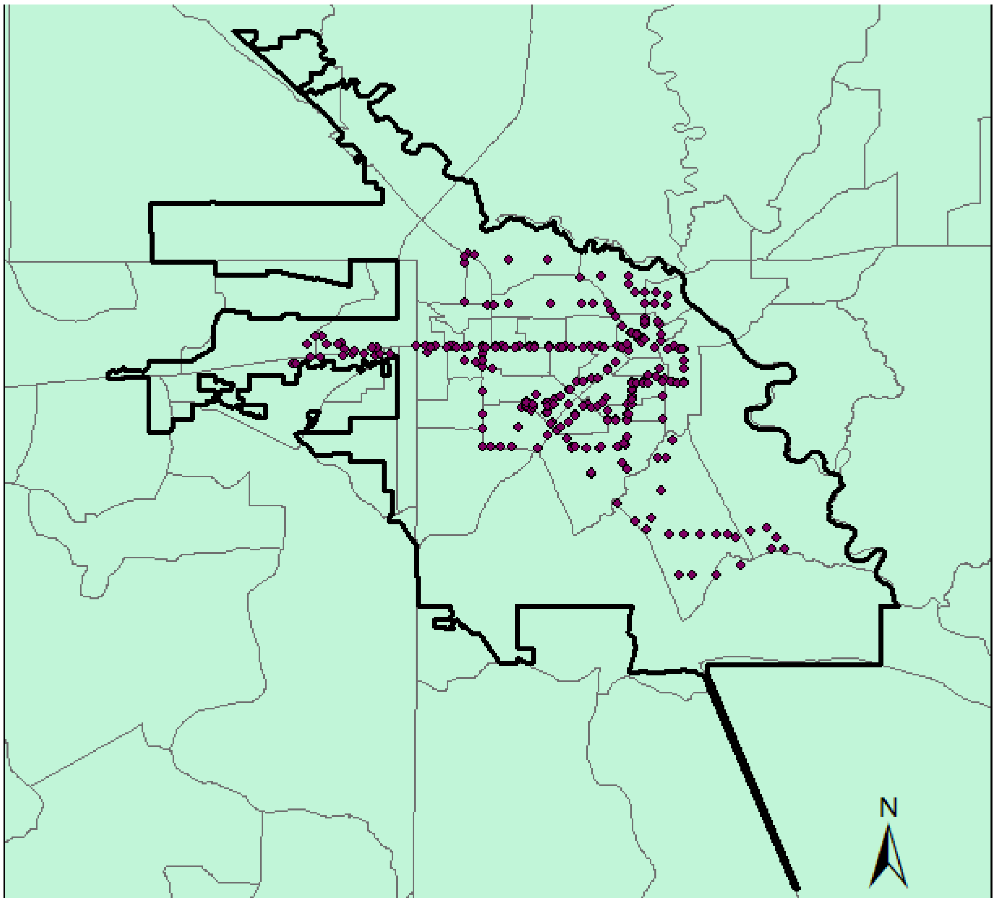

Figure 5. Bus Stops within Hattiesburg City Limits.

There are 270 major bus stops in Hattiesburg according to the data provided by the city. Each of these stops was used to determine its nearest neighbor. Initially the stops were measured in miles within ArcMap, but it became clear that feet needed to be used as many of the stops were so close to each other. Using these distances the nearest neighbor analysis was conducted with all census block groups and with blocks 12, 13, and 14 eliminated, to determine the average nearest neighbor distance ($\overline{NND}$), average nearest neighbor distance in a random pattern ($\overline{NND}_R$), the standardized nearest neighbor index (R), the test statistic (Z_n), and a p-value.

Table 5

Nearest Neighbor Analysis of Bus Stops.

	With All Block Groups	Without Block Groups 12, 13, and 14
$\overline{\boldsymbol{NND}}_R$	1182.2249	1313.0643
$\overline{\boldsymbol{NND}}$	483.5644	502.0284
R	0.409029	0.3823
Z_n	-1.59887	-4.5703
P-VALUE	0.0548	0.000

With the $\overline{NND}$ less than $\overline{NND}_R$ and an R of less than 1, bus stops are said to be clustered in both cases. However, with all census blocks included the p-value is 0.0548 suggesting that the spacing does not differ significantly from a random pattern. When the blocks containing high numbers of stops not influenced by household income are removed the p-value becomes 0.000 and thus the stops are now said to be clustered within the city limits and significantly different from a random pattern. Bus stops appear to be clustered in the same areas as the low income block groups from the quadrat analysis.

Correlation

According to ANOVA there is a significant difference in the number of bus stops in low income areas and higher income areas. The nearest neighbor and quadrat analysis show that low income areas and bus stops are both clustered within the city of Hattiesburg. A correlation analysis was the next step for the project to give a more balanced, quantitative measure of the association between the variables. Again, with the income categories as the independent variable and the number of stops as the dependent a correlation was run in SPSS. Since the independent variable is categorical a Spearman's correlation was run on all block groups and again without blocks 12, 13, and 14.

Table 6

Correlation Analysis with All Block Groups

		Income Category	Number of Stops
Income Category	Correlation Coefficient	1.000	-.428**
	Sig. (2-tailed)		.004
	N	44	44
Number of Stops	Correlation Coefficient	-.428**	1.000
	Sig. (2-tailed)	.004	
	N	44	45

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7

Correlation Analysis without Block Groups 12, 13, and 14

		Income Category	Number of Stops
Income Category	Correlation Coefficient	1.000	-.617**
	Sig. (2-tailed)		.000
	N	42	42
Number of Stops	Correlation Coefficient	-.617**	1.000
	Sig. (2-tailed)	.000	
	N	42	42

**. Correlation is significant at the 0.01 level (2-tailed).

Both tests produced a significance less than 0.05 indicating a rejection of the null hypothesis that there is no relationship between the two variables. With blocks 12, 13, and 14 removed the correlation changes from -.428 to -.617 showing a greater correlation between the variables. The negative correlation number indicates that as income increases the number of bus stops decreases. This confirms the tested hypothesis that there is a significant relationship between the variables and also indicates the same results provided by ANOVA, that low income block groups contain more stops than high income groups.

Regression

In order to answer the last research question, how much do low income areas explain the location of Hub City Transit's bus stops, a regression analysis was run. A bivariate regression was run with the income categories as the independent variable and number of bus stops as the dependent variable. The null hypothesis is that no significant relationship exists between low income census blocks and the number of bus stops while the alternate hypothesis states that a significant relationship does exist between these two variables. Once again the test was run with all block groups and without the three unaffected by household income with the following results:

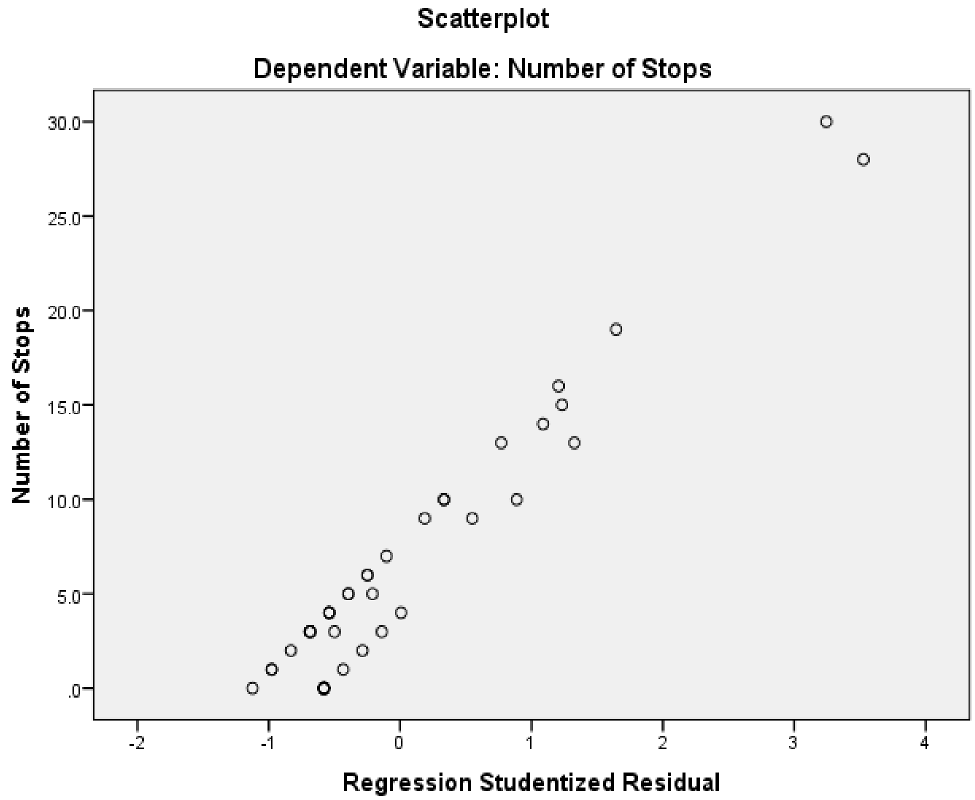

Figure 6. Regression Scatterplot with All Block Groups.

- y= 8.966 + (-1.253)x
- Sig.- 0.052
- R^2= 0.062
- Largest negative residual is-7.713 (block 34)
- Largest positive residual is 24.046 (block 13)

With all census blocks included the significance level of 0.052 indicates that the null is accepted and that there is no significant relationship between the variables. The R^2 of 0.062 for this test indicates that only 6% of the variance in the number of bus stops is explained by the income categories. Fairly large residuals were produced in the analysis, with the largest negative residual being block 34, a block in the northern most part of the city limits that is low income and contains no bus stops. This negative residual can be said to be overestimated, basically the analysis shows that block should contain a certain number of stops, however it has none. As block 34 is a rather large block with only a small portion of the city limits within it, it is perhaps not worth the resources it would take to run a route in that portion of the city. The largest positive residual is block 13, one of the high income blocks with a large number of stops. Block 13 can be said to be underestimated, the analysis assumes it would have a certain number of stops but it has more than assumed. Knowing that the results are skewed towards higher income with blocks 12, 13, and 14 present the test was run again with these blocks excluded.

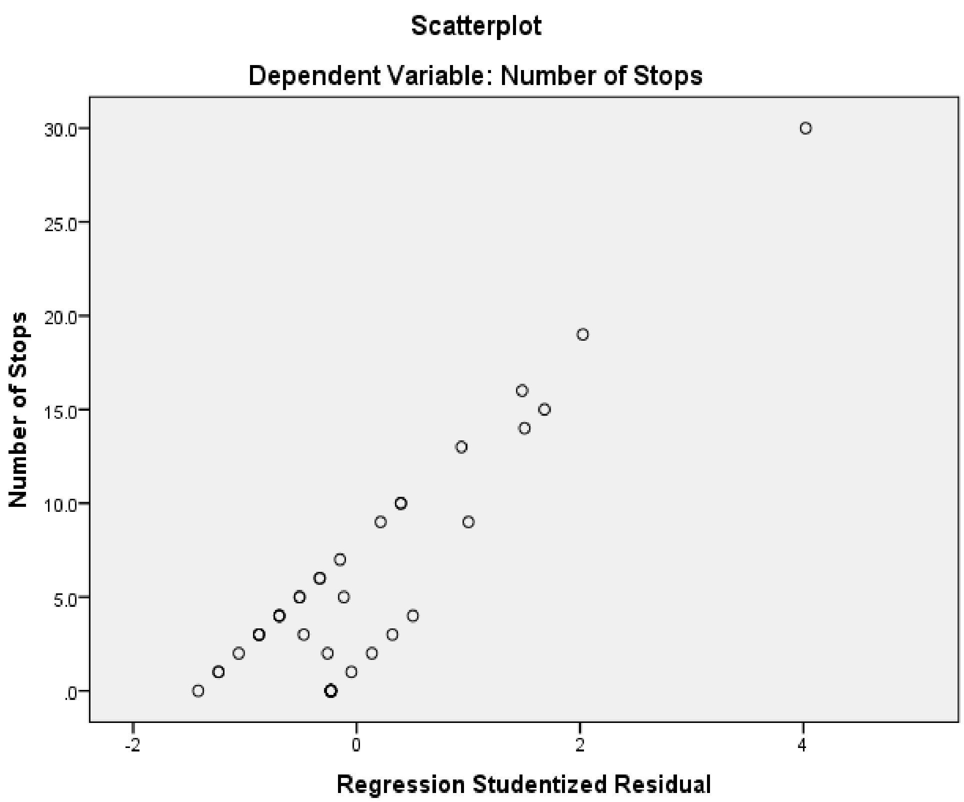

Figure 7. Regression Scatterplot without Block Groups 12, 13, and 14.

- y= 10.007 + (-2.188)x

- Sig.= .001
- R^2= .228
- Largest negative residual is -7.8192 (block 34)
- Largest positive residual is 22.1808 (block 50)

After removing the three blocks the results show that there is a significance of 0.001 indicating rejection of the null. Without blocks 12, 13, and 14 there is a significant relationship between the variables and now the R^2 shows that 22% of the variance in bus stops is explained by income. The R^2 would likely increase dramatically if all census blocks that were high income and judged to be influenced by service, not household income, were removed. Again block 34 is the largest negative residual, but now block 50 becomes the largest positive. Block 50 contains the Train Depot, the starting and stopping point for all routes, as well as a large number of low income households. Regression analysis underestimated how many stops block 50 would contain.

When I initially started working with this data and analyzing Hub City Transit I expected to find that the city was not providing adequate service to those needing public transportation. I suppose I was thinking I would analyze the data and find deficiencies and be able to tell the city what they needed to fix. This likely says more about my ego than anything else, however after working with the data for some time it became clear that the city was actually serving the demographic that it was aiming for.

Hub City Transit Accessibility

Each of Hub City Transit's four routes were analyzed to determine the proximity of the routes to low income block groups. Block Group Level Household Income (ACS 2006-2010), came from Mississippi Automated Resource Information System (MARIS).

These block groups were used to determine the proximity of the routes to low income areas.

Using data generated from statistical analysis allowed the project identify low income block groups that could be targeted in the analysis of proximity. For the assessment of each route's proximity to low income households a buffer was run on the routes at 0.5 miles (0.8 km). This allowed for the visualization of routes and their intersection with individual census blocks groups. Low income block groups were selected in ArcMap for easier visualization.

Only one low income block group that falls within the city limits is not covered by the 0.5 mile buffer of Hub City Transit's routes. This block group is also identified in the regression analysis as the largest negative residual. Regression analysis showed that this block group should contain a certain number of bus stops based on its low income status, however it has no stops. As stated in the regression analysis, this is a large block group with only a small portion of the city limits within it which may lead the city to feel it would not be worth the resources to run a route to this area.

The low income block groups farthest East and West within the city limits have the next least amount of coverage by the transit system. On the eastern side of the city, the low income block group is largely not residential and thus the has less need for the transit system in that regard. Turtle Creek Mall falls into this block group and is squarely within the buffer providing shopping opportunities to riders. Similarly, the western most low income block group does not contain a large residential area. Its western border is the Leaf River and it largely contains industrial buildings as well as the Hattiesburg Sewage

Lagoons. Residential areas within this block group are mostly in the Palmer's Crossing area within the 0.5 mile buffer and served by the transit system.

High income block groups are largely skirted by the buffer, except those in the center of the city limits or are surrounded by low income areas. Again reflecting the statistical analysis, several of the high income areas that do fall within the buffer are mostly explained by the service the transit system carries riders and not the income of the block group. This is the case with the areas near Forrest General Hospital and the Walmart on Highway 49.

The figure below shows that the majority of low income block groups within the city limits are covered by the 0.5 mile buffer of Hub City Transit's four fixed routes. This analysis further corroborates the statistical analysis, showing that the public transit system largely covers the low income block groups.

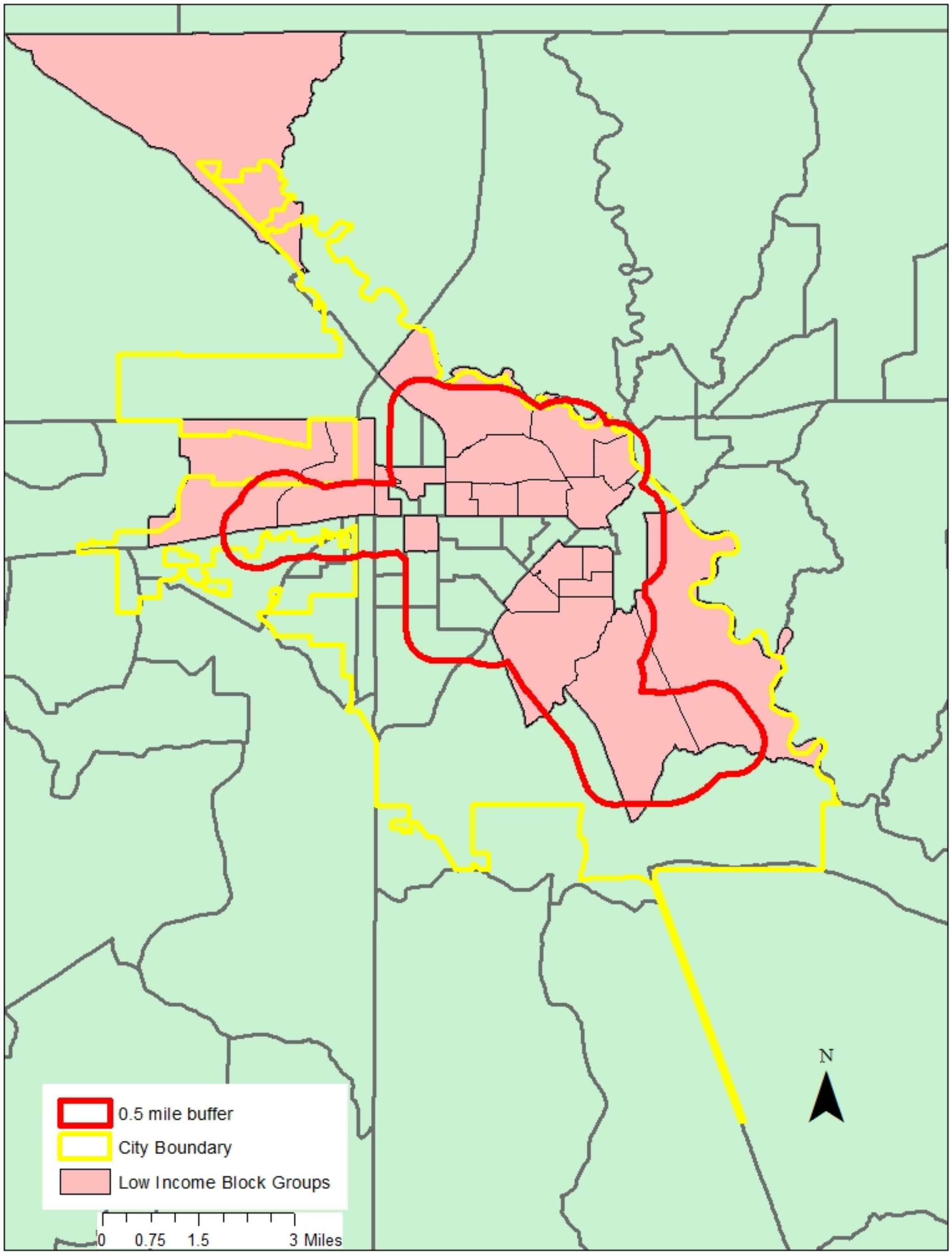

Figure 8. 0.5 Mile Buffer of Hub City Transit Bus Routes.

Statistical analysis run on the bus stops and low income block groups of the city has shown that there is a significant correlation between the location of Hub City Transit's bus stops and low income areas. This project seeks to determine if a landscape of disorder exists in these low income areas along each route. According to the "broken windows" theory (Kelling and Wilson 1982), areas of disorder are linked to crime and urban decay (Kelling and Coles 1996). Given that disorder leads to a negative perception of an area (Sampson and Raudenbush 2004), determining whether a landscape of disorder is present along Hub City Transit's routes may provide a small picture of how public transportation is viewed in Hattiesburg.

Using a method similar to Sampson and Raudenbush (2004), areas along the routes were analyzed for physical disorder, social disorder, commercial building security, alcohol/tobacco advertising, and bars/liquor stores. Physical disorder was assessed based on garbage and litter on streets, sidewalks and in yards, as well as abandoned buildings. Social disorder was defined as the presence of adults loitering, drinking in public, public intoxication, and any illegal activity that may be observed. Commercial building security was judged on the presence of security fences and gates, and bars on windows. Alcohol/tobacco sales and bars/liquor stores were assessed by a simple yes or no survey if these signs are present in a given location.

Riding along each route, notes were taken about the landscape using the parameters defined above. Notes were made about which indications of disorder were present (physical, social, commercial building security, alcohol/tobacco ads, and bars/liquor stores), if any, and where they were along each route. Disorder was noted such as: abandoned building- corner of Edwards and Lurilyne.

With this method there is a certain amount of subjectivity. Even with defined parameters, how much disorder is seen in the landscape depends on the observer. Are a few scraps of paper on the side of the road counted as litter? What one observer perceives as trash in a given yard may not be the same to another. However, a complete replication of the methods of Sampson and Raudenbush was impractical for this project. Sampson and Raudenbush perform what they called Systematic Social Observation (SSO) by equipping a SUV with video recorders on either side. This allowed them to better assess disorder in a more systematic, and less subjective, manner. One abandoned building or a single liquor store present in a neighborhood cannot really be indicative of disorder in an area. With this in mind, it was decided that at least three of the indicators of disorder needed to be present within two city blocks, or an indicator needed to be a prominent part of the block. For instance, one city block may only have one abandoned building, but if that is the most prominent feature in the area then that block can be said to contain physical disorder.

Route 1- Hardy Street

Of the four fixed routes maintained by Hub City Transit, only one had no major indicators of disorder. This route runs from the train depot down town, then along Hardy Street/Highway 98 towards West Hattiesburg, and approximately five miles away turns around at Walmart and Turtle Creek Mall. Hardy Street/Highway 98 is the major thoroughfare for the city of Hattiesburg and contains many of the major retail stores in the town. Perhaps this explains its absence of disorder.

There were some indicators of disorder along this route, but they were isolated and no two consecutive city blocks along this route contained three or more indicators.

For instance, an abandoned building is present along Route 1 directly across from a bus stop a the public library where Hardy Street, Green Street, and Second Avenue converge. A few liquor stores are also present along this route but again there is no area where three or more indicators of disorder are within two city blocks along Route 1.

Route 2- Dabbs and Cloverleaf

Hub City Transit's Route 2 leaves the train depot and runs roughly southwest to South twenty-eighth avenue and then up to Forrest General Hospital. From the hospital it has stops at the Walmart on Highway 49 and the Cloverleaf Mall. After leaving the Broadway Drive and Highway 49 area near Walmart it follows approximately the same route back to the train depot.

Shortly after leaving the depot and arriving in the Williams Street and Mcinnis Avenue area the route contains a significant amount disorder until it reaches 28th Avenue. Mcinnis Street contained the first major sign of disorder along this route. Near the Aspire Center, which teaches work skills to students, an abandoned and dilapidated building surrounded by a security fenced topped with barbed wire has trash piled in the back near the fence. Across the street from this building were a couple of houses with trash in the yards and adults sitting on porches in the middle of the day.

From Mcinnis Avenue until turning on 28th Avenue, Route 2 showed met criteria for physical and social disorder, commercial security, as well as the presence of alcohol/tobacco ads and bar/liquor stores. A few streets, such as Dabbs, contained indicators of disorder along their entire length. At least the entire length that the bus route followed. One indicator of social disorder was perhaps the most interesting to note. During the inbound trip, the return to the train depot, a school on Martin Luther King

Avenue was letting out. As the children were walking home from the school, in fairly large groups, one man could be seen in the crowd of children carrying a liquor bottle as he walked.

Figure 9 below shows a map of the Dabbs and Cloverleaf bus route with the areas of disorder noted in green. As the figure shows, disorder does not cross over West Pine Street and Broadway Drive, the Cloverleaf portion of the route. The disorder also ends abruptly at 28th Avenue on the western most portion of the route.

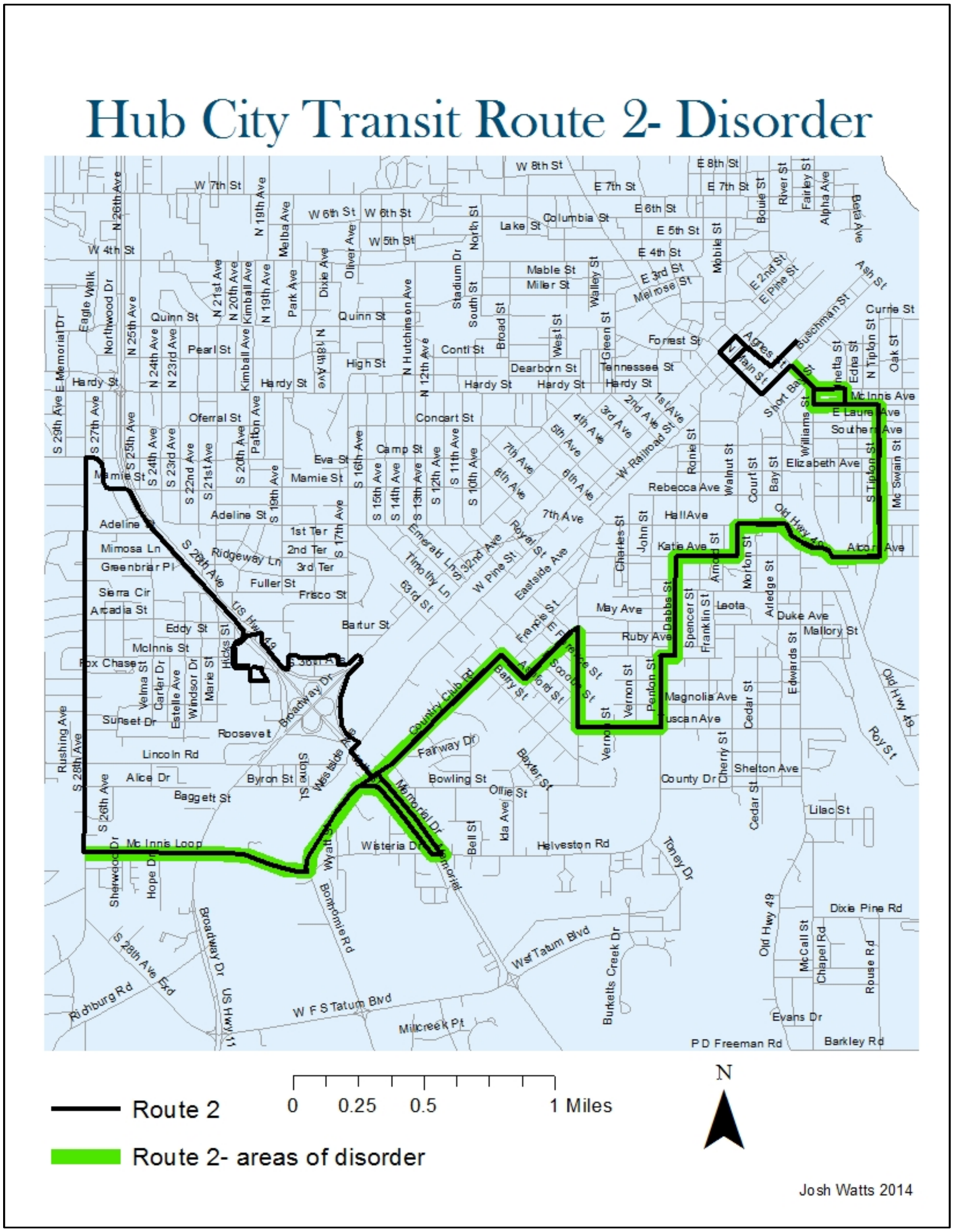

Figure 9. Disorder along Route 2- Dabbs and Cloverleaf.

Figure 10. Disorder on South Tipton Street along Route 2 (Photo by author).

Route 3- Mobile and Broadway

Route 3 is essentially two routes. The Mobile Street portion runs roughly northwest from the train depot with its major stops at East 9th and Fairley, the Forrest County Health Department on Highway 49, and West 7th and North 31st. Indicators of disorder were present from the Mobile Street area until reaching the intersection of Glendale Avenue on Highway 42. From Glendale on, the rest of Highway 42 showed few indications of disorder and none that could be said to meet the requirement of three or more within two city blocks. In fact, disorder seemed to be absent along this route until reaching the intersection of Meadowlane Drive on West 7th Street. Even here the indications of disorder that met the requirements of three indicators within two blocks only last for a quarter mile. Disorder did not truly appear on the route until reaching the area near the Hercules Powder Company Plant just west of North Street on 7th. A landscape of disorder continued along 7th Street until turning on Main. Main Street showed signs of disorder for a little more than half a mile. Once Main Street crossed over Jackson Street into what can be thought of as the true downtown area there were no more signs of disorder along the route as it travels back to the train depot.

The second portion of Route 3, the Broadway section, which runs to the Cloverleaf Mall and 49 Plaza contains few indications of disorder and no consecutive three within two blocks. As seen with Route 2, disorder seems to stop just southeast of West Pine Street.

Below, Figure 11 shows the landscape of disorder present along Route 3. It is interesting to note that the areas of disorder from Mobile to Highway 42 is roughly parallel to the disorder on 7th and Main. As noted above, disorder on 7th Street is rare until reaching Hercules Powder Company. On Highway 42 the border for disorder is Glendale Avenue, this intersection is directly behind Hercules. It appears that Hercules and downtown Hattiesburg are the starting and stopping points for disorder in this area.

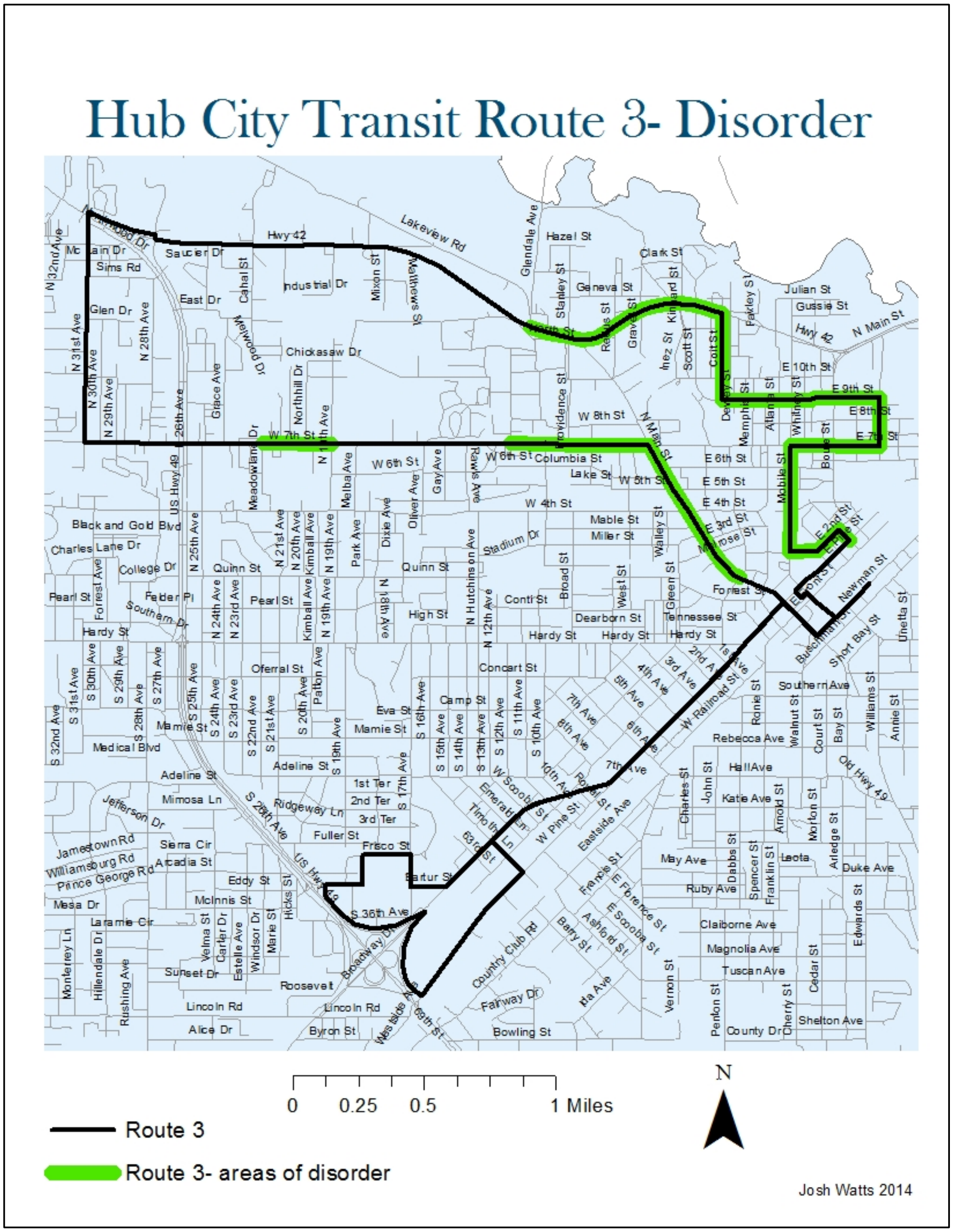

Figure 11. Disorder along Route 3- Mobile and Broadway.

Figure 12. Abandoned Building with Graffiti on East 7th Street along Route 3 (Photo by author).

Route 4- Palmer's Crossing

The Palmer's Crossing route is the longest of Hub City Transit's four fixed routes. It is also the route with the lowest ridership. In 2009 a private assessment company concluded that the route should be discontinued because more money is spent keeping the route in service than it brings in (Davila 2012). Mayor Johnny Dupree, whose political platform stresses the importance of access and infrastructure, is heavily invested in the neighborhood's accessibility, and did not allow these recommendations to be fulfilled. Much of this route also passes through some of the lowest income areas of the city, so it is perhaps no surprise that disorder is present on much of the route.

Starting in the James and Edwards Street area, Route 4 has some of the most indications of disorder of the four routes. The entire length of Edwards Street, which becomes Old Highway 49 around Lilac Street, contains evidence of disorder. On Edwards one of the most striking indications of disorder is a large industrial building that appears abandoned. This building, Dews Foundry, takes up a large section of the land bordering Edwards Street. A cursory look at the company's website (Foundry 2014) makes it seem that the company is still open at this address. This suggests that disorder may even have an effect on companies such as Dews Foundry. If a landscape of disorder is present then perhaps even commercial entities see no need to improve on their "broken windows."

After turning off Edwards/Old 49, Route 4 turns on Old Airport Road and makes its way to Stepts Avenue where a landscape of disorder is present and several signs declaring "no trespassing" and "beware of dog" can be seen. These signs suggest that one of Sampson and Raudenbush's conclusions may hold true: that the presence of minorities is a sign of disorder, even by other minorities of the same race.

Disorder ends at Highway 49 and again does not cross into the West Pine and Broadway area of the city. Interestingly, Halveston Road and W.S.F Tatum Boulevard contain no indicators of disorder. This roads are east of Highway 49 and south of West Pine, an area where disorder has generally been found, but do not contain three indicators within two consecutive blocks.

Figure 13 shows disorder along the Palmer's Crossing route which lies south of downtown, southeast of West Pine, and east of 49.

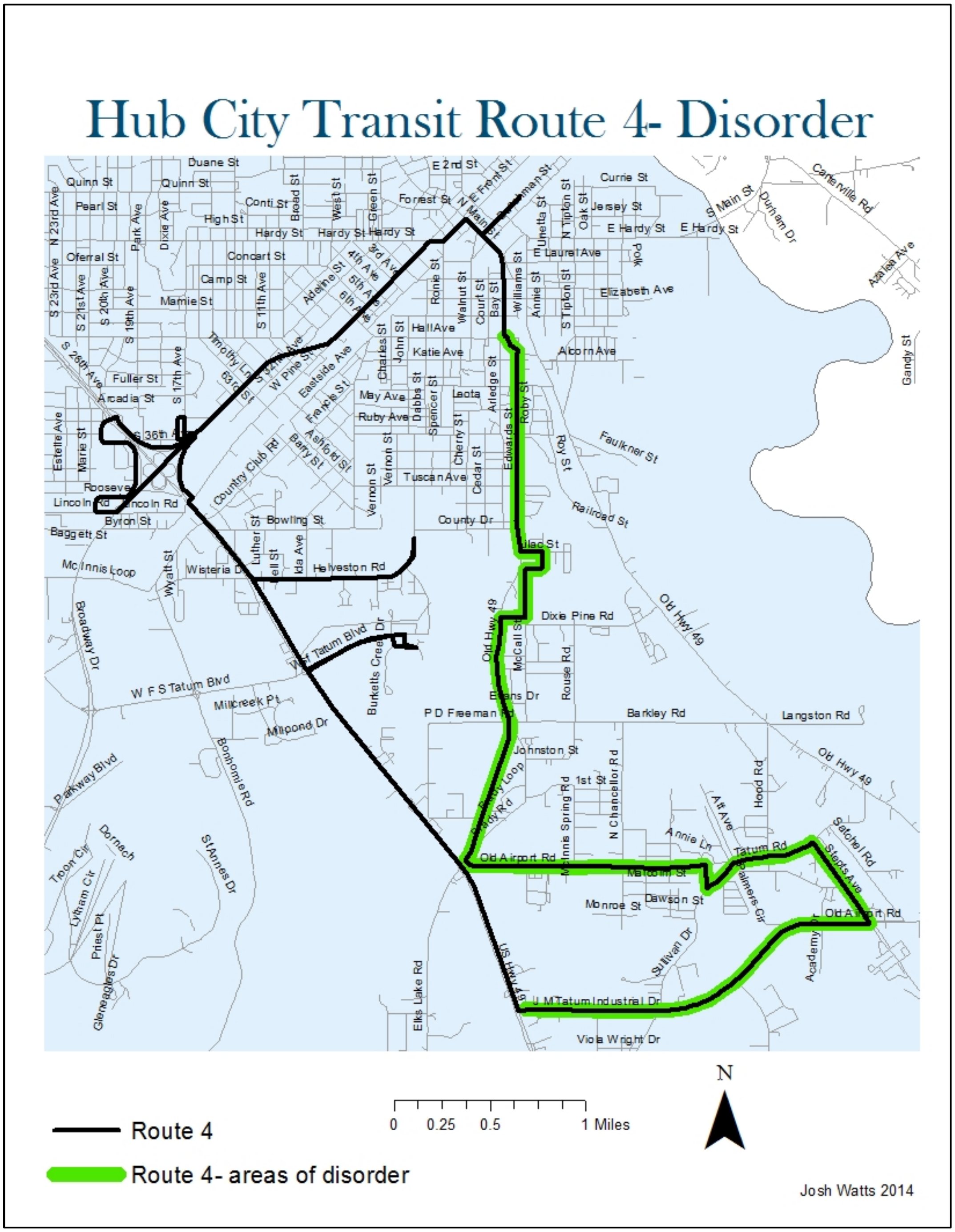

Figure 13. Disorder along Route 4- Palmer's Crossing.

Figure 14. Bars on Windows and Alcohol Advertisements on Edwards Street (Photo by author).

Figure 15. Dews Foundry Facing Edwards Street (Photo by author).

Figure 16. Trash on Stepts Avenue (Photo by author).

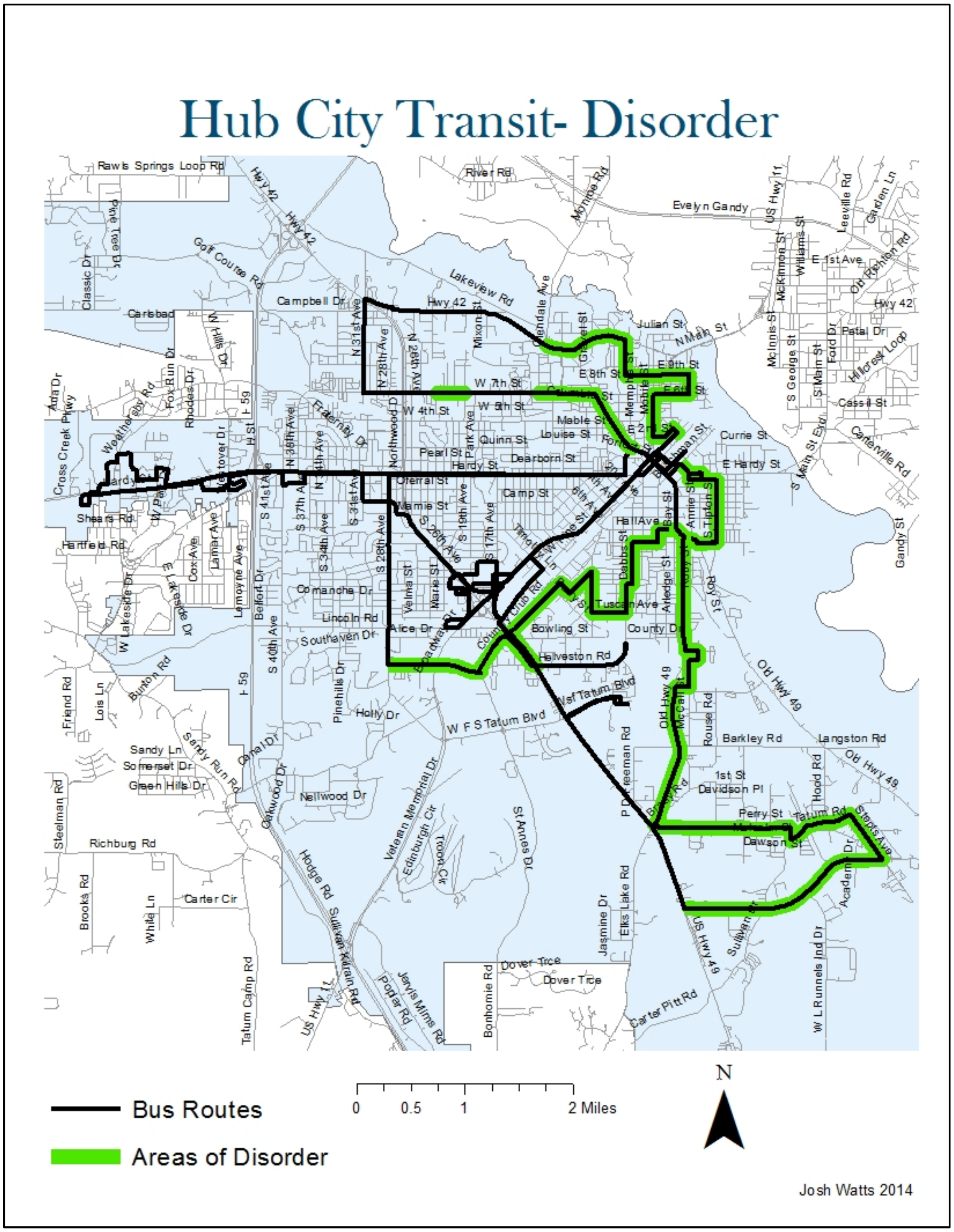

Figure 17. Areas of Disorder Along All of Hub City Transit's Routes.

Ridership

Ridership numbers obtained from the city were used to create a proportional line density map showing which stops are utilized the most and which sections of the routes have the highest ridership. Numbers reflect riders observed on one day during an assessment of on/off counts conducted by the city along each route. These ridership numbers were analyzed to see which areas of the city have the highest ridership to determine where riders are going and what they are using the transit system for.

The first step in this analysis was to digitize each route and create a shapefile in ArcMap that contained data showing how many riders were on the bus from one stop to another. Data provided by the city of Hattiesburg showed on/off counts for each stop but did not keep a running total of how many riders were on the bus throughout the route. Using a provided carryover number at the train depot, the first and last stop for each route, plus the number on minus the number off a starting number was obtained for each route. From there the on/off counts were used to determine how many riders were present in each segment. A field was added to the attribute table of this shapefile that contained the number of riders in each segment. This field was used as the value for the graduated symbols in symbology. The finished product showed a heavier line in segments with higher ridership and a thinner line in segments with lower ridership. Colors for these symbols were also adjusted to better visualize the difference in ridership on the map.

Examining Route 1, running mostly along Hardy Street, it is easy to see where riders are going. Mainly riders utilize Route 1 for trips to the medical complexes, Forrest General and Wesley, as well as grocery stores. The most used stops on this route are at Turtle Creek Mall, Walmart, Forrest General Hospital, Dirt Cheap and Corner Market

Grocery, and Winn-Dixie. Walmart's bus stop had the most significant change in riders, from twenty-two to four, eighteen riders got off the bus at Walmart. Forrest General Cancer Center saw the next most significant change, with seven riders getting on at this stop.

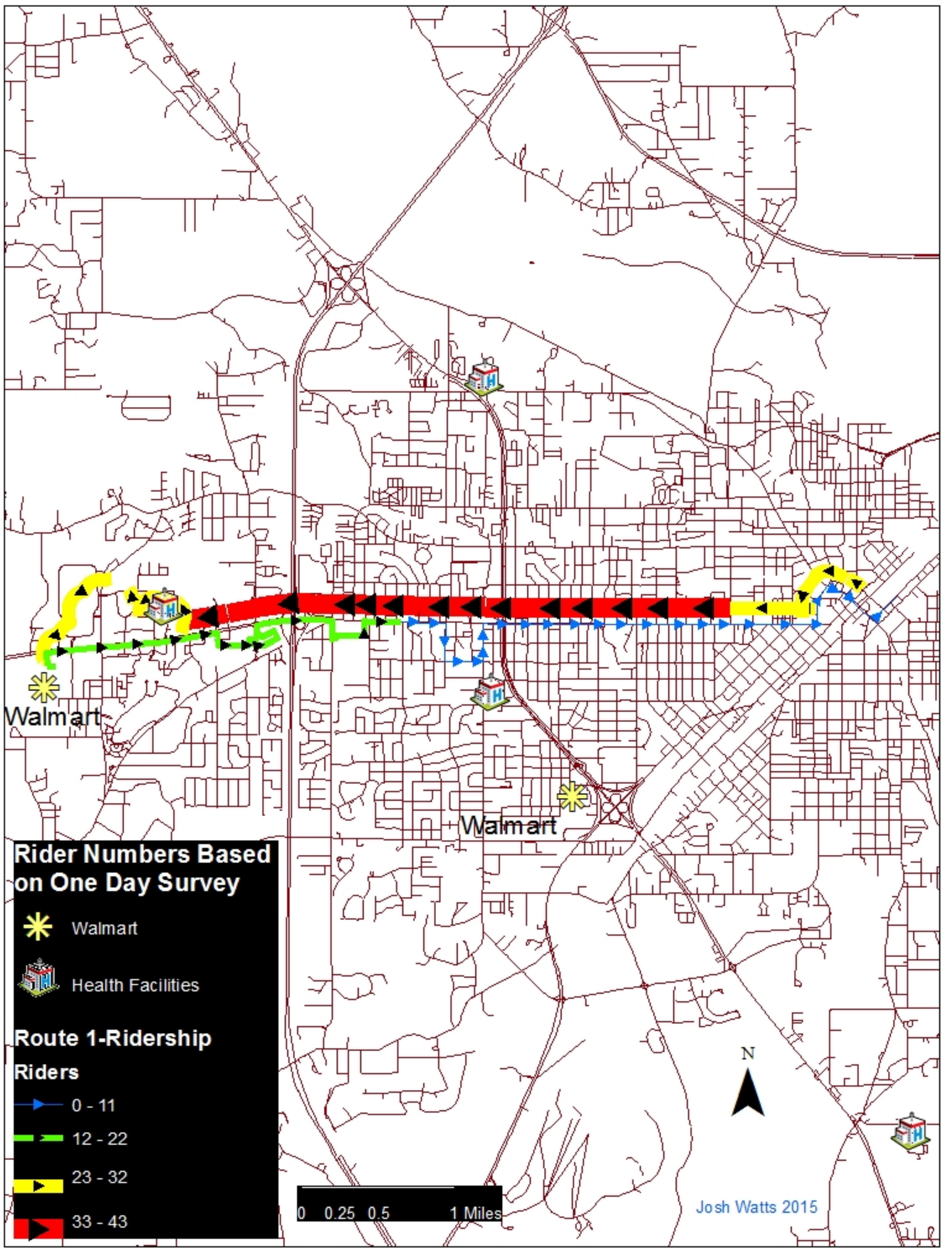

Figure 18. Hub City Transit Route 1 - Ridership.

Route 2, Dabbs/Cloverleaf, shows similar patterns to Route 1 in that the most used stops are at Walmart and Forrest General. Changes in ridership on this route are not as dramatic as they are on Route 1. Total number of riders present only changes by five at the most. These changes are at Walmart and the stop directly across from it at a dialysis center. Riders on Route 2 are also using the transit system to get to and from Walmart and the doctor. With Route 2 there are slightly more riders when the route is inbound back to the train depot. Much of the Dabbs/Cloverleaf route runs through sections of disorder. Given that more riders are riding inbound it is possible that many riders are using this as a connecting route and may not live in the areas of disorder along Route 2. Since most of the residential areas riders are exposed to on this route show signs of disorder, this route may be giving riders the impression that more disorder exists than actually does because this is what they see in their commute.

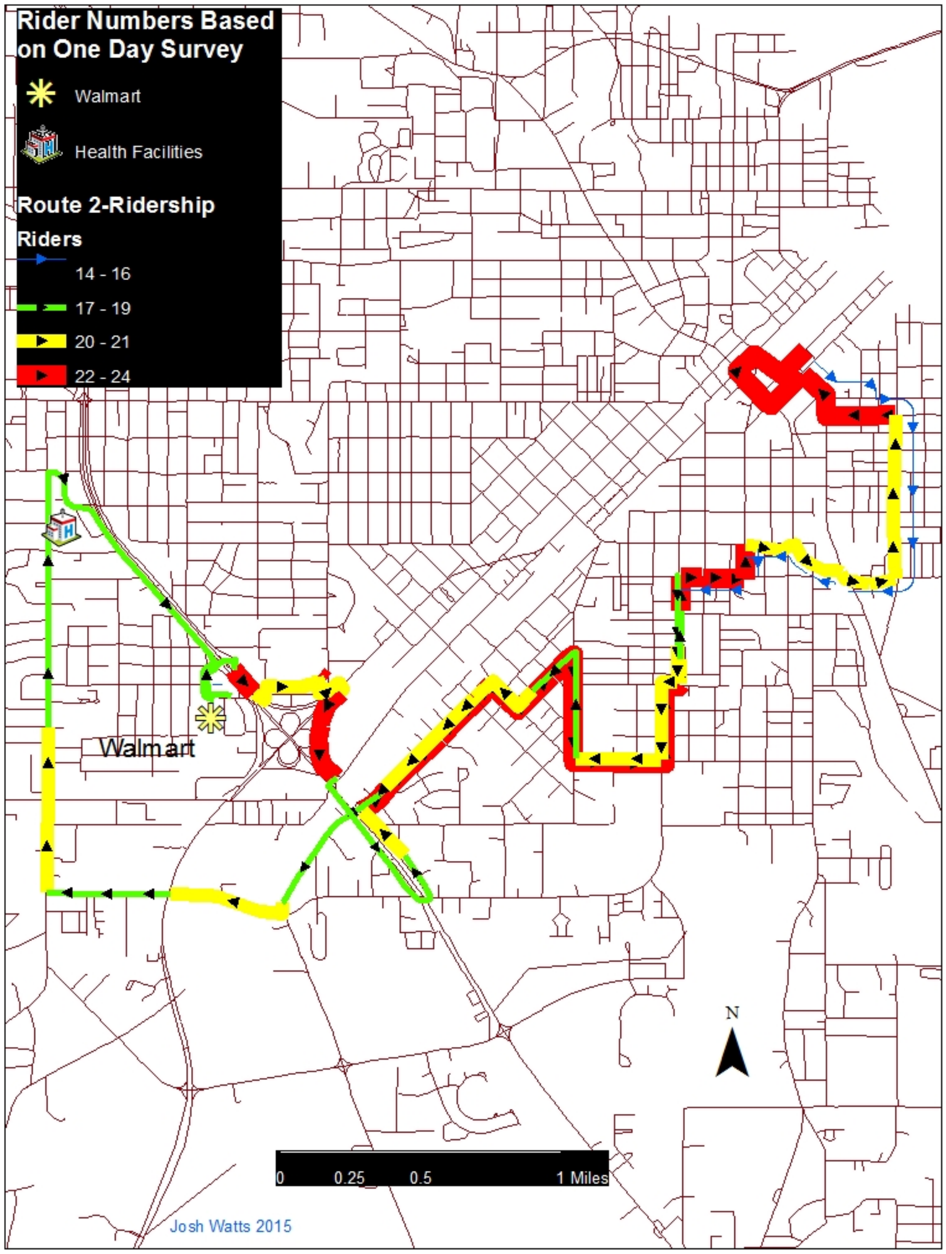

Figure 19. Hub City Transit Route 2 - Ridership.

The most heavily used stops along Route 3 are near the Health Department, bargain stores such as Dirt Cheap, and at the corner of West Pine and 6th Avenue near several attorney's offices and Brittany Arms Apartments. Stops at the Health Department and the attorney's offices are also very near apartment complexes that may have an impact on the number of riders in these segments. West Pine and 6th sees the biggest changes in ridership with six riders getting off at this intersection. Without talking to these individual riders it is really impossible to determine if they are using the transit system to get to and from their residence or if they are using the services of the attorneys in this area.

Route 3 is divided up into what is technically two routes. The portion that serves the Mobile Street area to the north comes back to the train depot and then runs down Broadway. Mobile Street's portion of the route is dominated by disorder and so presents some of the same issues as Route 2 where disorder constitutes much of what riders see in their commute.

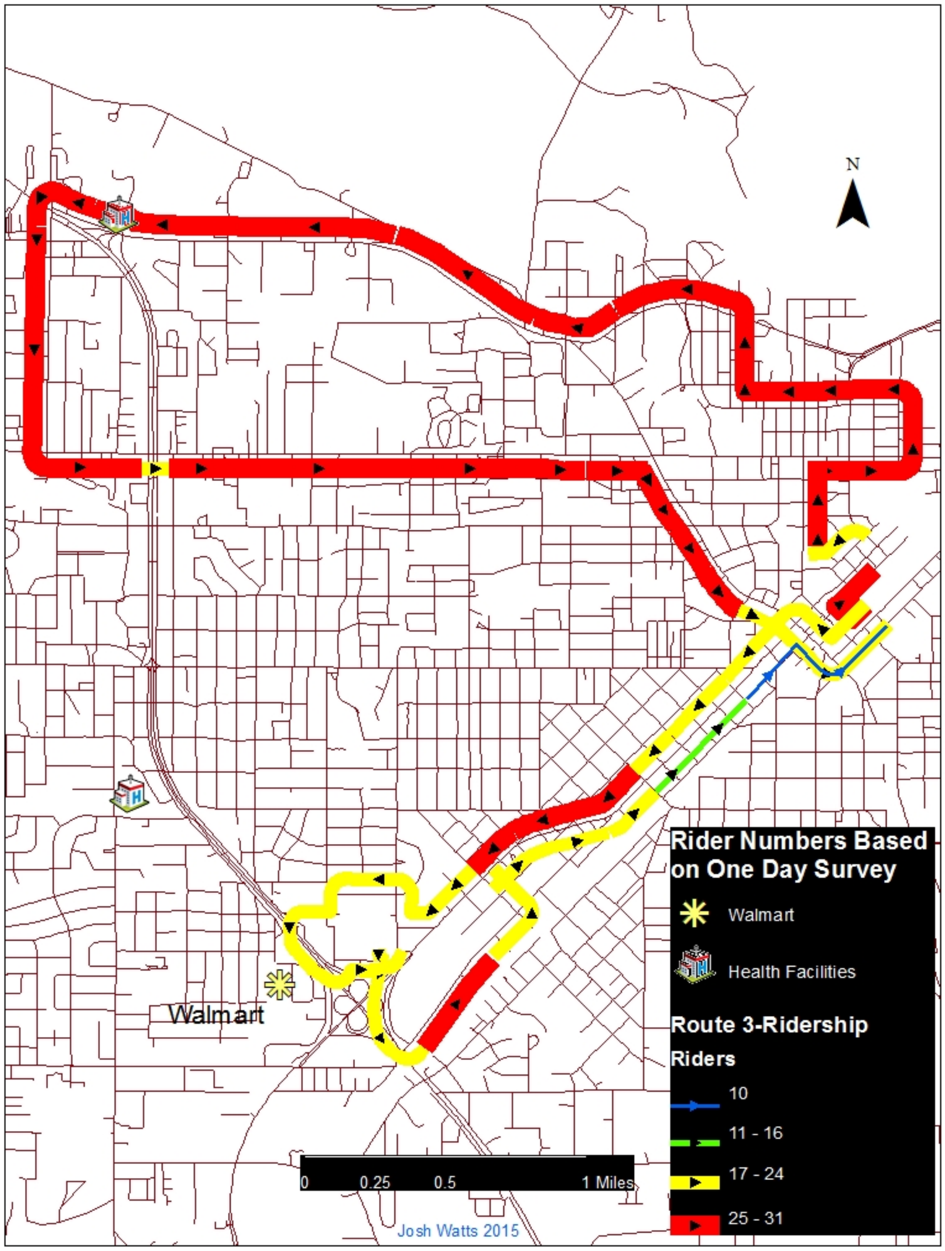

Figure 20. Hub City Transit Route 3 - Ridership.

Route 4, Palmer's Crossing, stops have the most use at residential areas, as well as the stop on Old Airport Road which serves the Family Health Center, Women's Health Center and Southeast Mississippi Mental Health Center. Given that this route serves some of the lowest income households in the city (Davila 2012), it is not surprising that some of the most used stops are at places of residence. The stop that has the highest change in ridership is the same as it is for Route 3. Again, this stop is near an apartment complex as well as several attorney's offices and it is difficult to say which the destination of the riders is.

Much like Route 2 and 3, a large portion of Route 4 runs through areas of disorder. These three routes provide a view of the city that contains much disorder. Areas of high ridership also tend to be areas of disorder. This likely influences riders' idea of the city of Hattiesburg. Disorder is a large part of what riders see on each route which likely means their idea of the city is largely influenced by disorder.

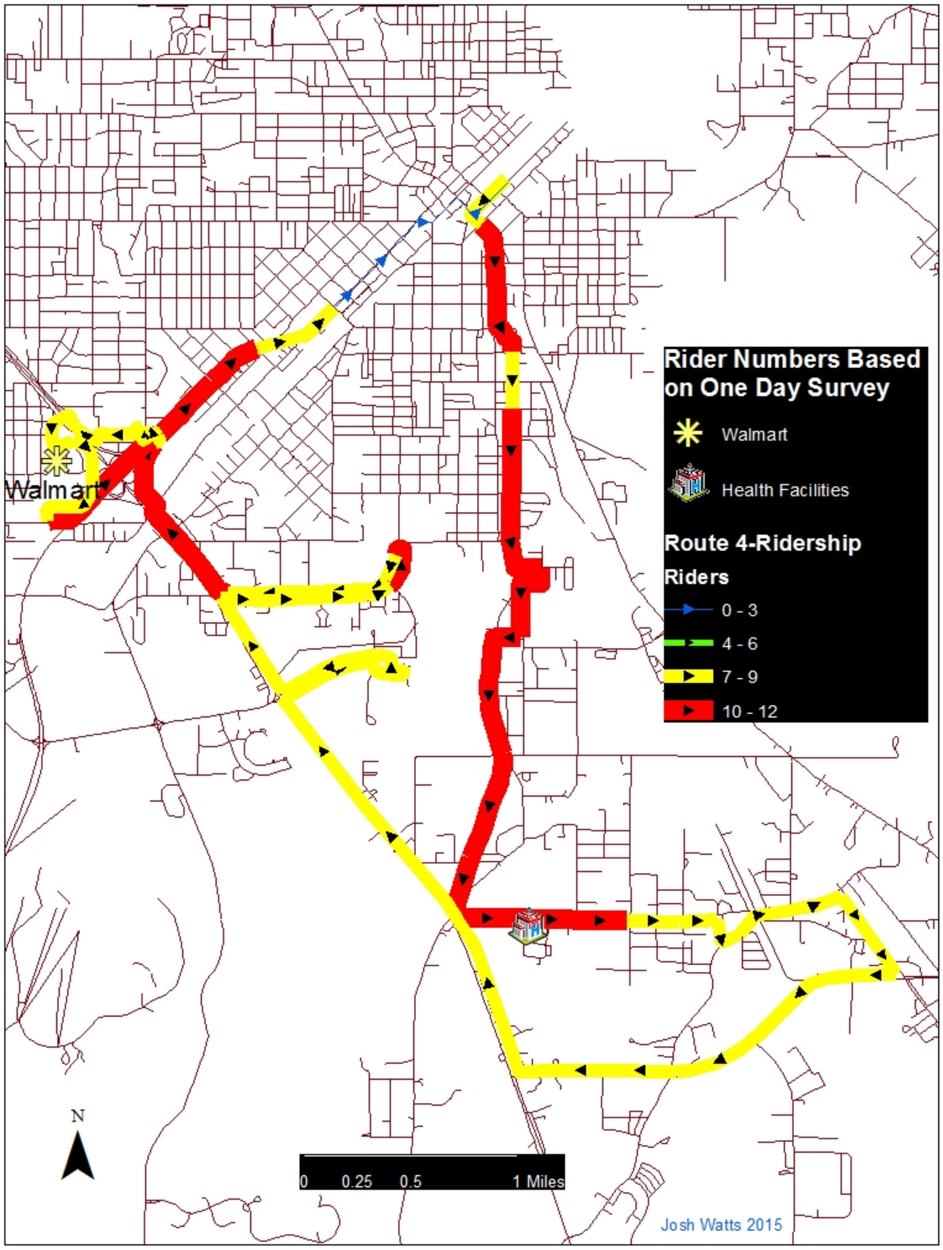

Figure 21. Hub City Transit Route 4 - Ridership.

It is interesting to note which areas of high ridership align with areas of disorder. This likely colors riders' perception of the city. If most riders are going to and from areas of disorder then they will be more likely to view the city as an area of disorder.

CHAPTER V

DISCUSSION

The fact that poor people ride the bus is not a surprising result of analysis. However, it is encouraging to note that Hub City Transit is truly serving the demographic that they aim to serve, especially given that this demographic has a real need for public transit. Also interesting are the low income areas that have a landscape of disorder as well as high ridership such as along Routes 3 & 4.

After statistical analysis of the bus stops and the household income data, ANOVA shows that there is a difference in the number of bus stops in low income block groups as compared to higher income areas. Nearest neighbor and quadrat analysis show both low income areas and bus stops are clustered within the city limits and are clustered in the same areas. High income block groups are also clustered within the city, but are largely outside of the cluster of bus stops. These high income areas do however fall within the coverage of the 0.5 mile buffer of the routes. The correlation and regression show a significant relationship between the variables and that 22% of the variance in bus stop numbers can be explained by the income categories. ANOVA, correlation, and regression would all likely show more significant numbers if all block groups that contain bus stops explained more by service than household income were removed from the analysis. Also, much of the same analysis could be run on just those stops explained by the service they are transporting patrons to, to determine how many of the stops are based on this and not income. Analysis conducted in this project can offer a starting point for further investigation as well as quantitative data that can lead towards more qualitative research questions.

Analysis of the 0.5 mile buffer of the transit system's four fixed routes shows that the system does provide adequate coverage of the low income areas of the city. This analysis also aligns with the statistical analysis showing the low income block group to the north is left out of Hub City Transit's coverage. Other low income block groups not covered to a large degree by the buffer do not have large residential areas. High income areas covered by the buffer can be explained by the service the public transit is carrying riders to rather than income, much like the statistical analysis.

It is not surprising that the most disorder is found in low income areas of the city mostly populated by minorities. However, an assessment of disorder along Hub City Transit's routes does provide a picture of the landscape of the city of Hattiesburg. Figure 4 above shows all four of Hub City Transit's four fixed routes and their areas of disorder. One of the most interesting things that the map indicates is not only the areas of disorder, but the areas that might have once been called the "wrong side of the tracks." Hattiesburg still has railroad tracks in use which do indeed form part of the border for where disorder is seen, since these tracks partly run parallel to and just southeast of West Pine. However, some areas that were once more affluent now fall within the landscape of disorder. The portion of West 7th and Main Street that shows signs of disorder were once neighborhoods with well to do residents. With this map one can visualize the areas that now indicate disorder, and where the borders of this landscape lie.

Further study comparing demographics, crime, and income data with this landscape of disorder could provide a more in-depth look at causes of disorder and why these areas are where they are. Studying the bus routes provides transects of the city but also misses many areas that could be further analyzed. This analysis does however provide a visualization of disorder and the divide in the city of Hattiesburg.

With the analysis of ridership, the most interesting note is how often riders seem to utilize the public transit system for trips to medical facilities. This suggests that the route is truly needed by riders. Finding that the transit system is for trips to the local bar or liquor store would not suggest the same need by the public.

When compared with the disorder maps, maps of ridership show that many of the areas with high ridership numbers are also areas of disorder. The “broken windows” theory, as well as the research conducted by Sampson and Raudenbush, suggests that disorder breeds disorder. With this in mind it is interesting that riders of Hub City Transit likely have a view of the city largely dominated by disorder. Disorder is mostly contained to certain areas, if these areas have the highest ridership then riders may only view Hattiesburg as an area of disorder.

CHAPTER VI

CONCLUSION

Accessibility assessment for public transit is certainly not a new field of study, but for Hattiesburg this research comes at a time when the city is assessing the transit routes. This study hopes that data generated can be used by the city to better assess need and use of the transit system.

This study has is in some respects limited, most notably by time. Given more time ridership could be better assessed by riding each route over an extended period at different times of the day to get an average of riders on each route and an average of on/off counts at each stop. With more time a more in depth analysis of disorder in the landscape could be undertaken with a more quantitative approach. More time would allow the project to more accurately replicate the study conducted by Sampson and Raudenbush. The research is also limited by available data. Income data from the census is only available down to the block group level which does not provide as good a picture of the exact population as block level data would. Small areas of low income may be left out of analysis if the overall income of a block group is high. Block level data most likely excludes income data for purposes of anonymity, however it would provide a more detailed look at the city and the distribution of income levels.

Looking at Hub City Transit has allowed for analysis of Hattiesburg and its residents in ways not initially evident for the project. Bus routes can be used as a transect of the city, allowing for the study of several areas within the same project. It has also been interesting to note how race and economics can be studied using the public transit system. Low income minorities utilize Hattiesburg's transit system the most, so the study of the transit system has also been a study of race and economics within the city. Analysis has shown a clearly defined divide exists between income and race in the city. That these boundaries are so clear and rarely cross was somewhat surprising to see, or better put, surprising that they are so easily seen in created maps. It would be interesting to see if other southern cities have the same divide seen in the layout of bus routes.

Hub City Transit's focus on low income areas of the city seems to be missing some demographics that could utilize the system. If the transit system was advertised and aimed at everyone, then it seems that they may attract more riders on some routes that would help pay for the under used routes where riders that utilize the service truly need it. Another observation, many of the bus stops seem very close together. When riding a route there are sometimes stops one block from each other. In the event that someone was waiting at each stop, an unlikely event admittedly, then the bus would be stopping far too frequently. Perhaps stops could be spaced out more and placed in only places best accessed by everyone in a given radius.

It is encouraging to see that the public transit system is serving the low income demographic it aims at, as well as providing a service truly needed by certain residents of the city. The study of Hub City Transit has provided a unique view of the city of Hattiesburg, and has allowed for analysis outside of the bus system itself.

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