THE EFFECT OF THE CLOSURE AND SUBSEQUENT REDEVELOPMENT OF A MILITARY BASE ON SURROUNDING SINGLE-FAMILY HOUSE PRICES: A CASE STUDY OF A U.S. NAVY MASTER JET BASE, NAVAL AIR STATION CECIL FIELD, JACKSONVILLE, FLORIDA

By

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A THESIS PRESENTED TO THE GRADUATE SCHOOL
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To my sons

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LIST OF ABBREVIATIONS

AFB	Air Force Base
BEA	Bureau of Economic Analysis
BRAC	Base Realignment and Closure
CBD	Central Business District
dbA	Decibals on the A Scale
DOD	Department of Defense
EIS	Environmental Impact Statement
FHA	Federal Housing Administration
FTP	File Transfer Protocol
GIS	Geographic Information System
GWR	Geographically Weighted Regression
JAA	Jacksonville Aviation Authority
JEDC	Jacksonville Economic Development Commission
MIRS	Mortgage Interest Rate Survey
MMT	Metro Market Trends, Inc.
MPF	Maritime Prepositioning Force
MSA	Metropolitan Statistical Areas
NAR	National Association of Realtors
NAS	Naval Air Station
NLS	Non-linear Least Squares
OLS	Ordinary Least Squares
PIN	Property Identification Number
REIS	Regional Economic Information System
RIMS	Regional Input-Output Multiplier System

TSLS	Two-Stage Least Squares
USMC	United States Marine Corps
VIF	Variance Inflation Factor

Abstract of Thesis Presented to the Graduate School
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Politicians frequently paint a picture of socioeconomic doom and gloom when a military base closure announcement is made that affects their constituency area. While a base closure can certainly have a negative impact on a surrounding community; a community's chance of surviving a base closure is very much dependent on the context of the area, its economic diversity and the local base redevelopment planning effort. Recent research on the effects of base closure indicates that a closure typically has a short-lived socioeconomic impact on a community until the community can redevelop the base and reap benefits from the redevelopment. Though communities can typically prosper shortly after a base closure, the same research indicates that the lingering negative effect of base closure is on the housing market. While the negative effect of base closure may very well be on the housing market, little research exists that demonstrates the housing price was actually affected by the base closure versus other economic impacts or shocks. This thesis tests the effect of the closure of Cecil Field Naval Air Station in Jacksonville, Florida on the surrounding communities' single-family housing prices.

This research tests the effects of the closure of Cecil Field on the Jacksonville single-family housing market through the use of a hedonic pricing model which is run through ordinary least squares regression and geographically weighted regression. Jacksonville, Florida is the home to three large Navy bases and other military support annexes. Cecil Field is within a ten minute drive from Jacksonville Naval Air Station which remains open today.

Because of the significance of Jacksonville Naval Air Station in the terms of military member family support with its commissary, exchange, large hospital and easy access to major highways, most military members of Cecil Field and their families chose to live closer to Jacksonville Naval Air Station. The results of this research indicate that the closure of Cecil Field had no impact on single-family housing prices due to its rural location and the fact that most of its members lived closer to Jacksonville Naval Air Station.

CHAPTER 1
INTRODUCTION

The United States has seen a decline in defense spending since the Cold War and has reshaped its military base footprint to adapt to a rapidly changing world and “better match facilities to forces” (U.S. Department of Defense, n.d.). To guide this process, Congress passed the Base Closure and Realignment Act of 1988, also known as Base Realignment and Closure (BRAC), to provide a bipartisan avenue for the Department of Defense (DOD) to reduce its footprint and realign remaining military bases and assets (U.S. Department of Defense, n.d.). The Base Closure and Realignment Act is intended to minimize political play in the decision making process (Dardia, McCarthy, Malkin, & Vernez, 1996, p. 1); however, when the initial BRAC slate is released by the Secretary of Defense for consideration by the presidentially appointed Base Closure and Realignment Commission lawmakers often hurl unfounded “predictions of dire consequences” as a result of an impending military base closure in the community they represent. (Bradshaw, 1999, p. 1)

The United States has been through five BRACs since the inception of the law, with the most recent BRAC decision in 2005. Case studies conducted on closures since the late 1960s indicate that the dire predictions of the politicians and the cities affected are, with some exceptions, often exaggerated, and that the communities surrounding the base and the host city return to status quo or prosper soon after the base closes (Bradshaw, 1999, p. 2). Though the effects of base closure are argued to be minor or short lived, Dardia et al. (1996) and Bradshaw (1999) found that the most negatively affected indicator of a base closure is commonly the sales and rental values of housing surrounding the base due to the mass outmigration of military members and their

families; leaving a void in demand within the housing market. Although base closure case studies exist that examine socioeconomic indicators such as population, labor force size, unemployment rates, school enrollment, housing values and municipal revenues; in depth research examining solely the base closure's effect on the housing market is lacking. The author was able to find one doctoral dissertation completed in 2009 which studies the effect of two base closures on housing prices. Because of the absence of such research, the author sought literature with a focus outside of the military base closure arena but closely synonymous with the community effects of a military base closure. Interestingly, literature was found that examines the building of sports stadiums and their effect on the surrounding housing market. While not completely synonymous with a base closure (the community does not experience the loss of thousands of military members and their families), much can be learned and applied to this study in terms of the methodology utilized.

This research will add a housing market focused component to existing base closure research and will provide more housing market data to future affected communities in order to assist them with their redevelopment plans and predictions of base closure effects on their community.

This thesis is a longitudinal case study of the closure of a U.S. Navy Master Jet Base, Naval Air Station (NAS) Cecil Field, located in Jacksonville (Duval County), Florida. NAS Cecil Field was slated for closure as a result of the 1993 BRAC decision and officially ceased air operations on September 30, 1999 (GlobalSecurity.org, n.d.). This thesis will study the effects of the closure on the surrounding community housing market; focusing on single-family house sales values. Though other indicators play into

the housing market, the author chose to focus on single-family house sales prices due to the ready availability of this data. Other data such as rental vacancies or vacant single-family homes was either unavailable for the study area or cost prohibitive to procure. Jacksonville is unique as compared to bases in formerly conducted case studies because, prior to the closure of NAS Cecil Field, it was home to three sizable naval bases which include NAS Jacksonville and Naval Station Mayport. It is also home to U.S. Marine Corps (USMC) Blount Island Command; a key logistics hub for the U.S. Marine Corps Maritime Prepositioning Force (MPF). This high naval concentration contributes to existing literature that is primarily based on Air Force and Army base closures which are typically solo bases in a surrounding community with or without a diverse economy. Jacksonville's extensive land area, diverse economy and high naval concentration conveys a different perspective to existing literature.

Problem Statement

This research is to address the problem that no in depth housing market analysis exists that attempts to ascertain where military member domicile concentrations exist in the surrounding community; and whether or not a military base closure had an effect on the single-family house housing market in the surrounding community. The research objective of this study is to measure the impact of the closure of master jet base, NAS Cecil Field on single-family house sales prices to determine if the Jacksonville housing market benefitted, suffered, or was indifferent due to the base closure. The questions to be asked are:

1) When the closure of Cecil Field was announced in 1993, was there an anticipatory effect on single-family house sales prices from the announcement to the actual closure in 1999?

a. Parcels occupied by single-family houses with a sales date between 1993 -1994 in Duval County

2) After Cecil Field closed and was turned over to the City of Jacksonville in 1999, what effect did the closure and redevelopment have on single-family house sales prices after the closure and in 2009?

a. Parcels occupied by single-family homes with a sales date between 1999-2000 and 2009 in Duval County

Professional Significance of the Problem

This study has professional significance because of its contribution to communities similar to Jacksonville, Florida that must endure and plan for the effects of the closure of a military base in their community in the future. Jacksonville's previously discussed uniqueness and this study's focus on housing prices in military concentration areas outside of the base fence line adds an additional dimension to existing case studies. Using this information, communities in a similar context to Jacksonville can better plan and prepare for an impending base closure.

Methodology

This research is a longitudinal case study on the former Naval Air Station Cecil Field which is primarily located in the southwest of the city of Jacksonville. The city of Jacksonville is in Duval County and the two are a consolidated government under one mayor. A small portion of the southern tip of the former base extends south of the Duval County border into Clay County.

This research will be conducted utilizing data of public record and data purchased from a vendor. All data will be imported into a geographic information system (GIS) software package for analysis and presentation. Parcel data for Duval County, to

include property identification number (PIN) and geographic shape file, were obtained from the Florida Department of Revenue file transfer protocol (FTP) website. Additional parcel data, to include PIN and effective year built, were obtained from the Florida Geographic Data Library maintained at the University of Florida. The ZIP code boundary geographic shape file was obtained from the United States Census Bureau website. Proprietary transactional data, to include all single-family home sales recorded, were purchased from Metro Market Trends, Inc. located in Pensacola, Florida.

This research will test a single dependent variable which is the single-family house sales price. There are three causes, or independent variables. The first independent variable is the announcement in 1993 of the impending closure of NAS Cecil Field. The second independent variable is the closure of NAS Cecil Field in 1999. The third independent variable is the subsequent redevelopment of NAS Cecil Field. Many explanatory variables act on the dependent variable and they are: lot size, bathrooms, bedrooms, structure age, income, median age, percent of high school dropouts, financing cost, distance to major arterial roads, distance to schools, distance to waterfront, distance to hospitals, distance to commercial land uses, distance to industrial land uses, distance to Cecil Field and zip codes that Cecil Field personnel lived at.

The dependent variable will be tested: (1) one calendar prior to the base closure; (2) the calendar year of and the calendar year following the announcement of the base closure; (3) the calendar year of and the calendar year following the final air operations at NAS Cecil Field; (4) the year prior to the authoring of this thesis to determine the impact of Jacksonville's redevelopment of Cecil Field on the dependent variable.

Organization of Thesis

This thesis focuses on measuring the impacts on the Duval County single-family housing market from the closure of NAS Cecil Field to determine if the single-family housing market benefitted, suffered losses, or was indifferent to the base closure. In Chapter Two the theoretical framework is assembled by reviewing literature on previous base closure case studies to ascertain the economic effects of base closure. Then literature on housing pricing methodologies is analyzed in order to build the methodology for this thesis. Chapter Three details the history of Cecil Field and the data and methodology for this case study. Chapter Four presents the results and the significant findings. Chapter Five discusses the results and analyzes them as they pertain to Cecil Field. Chapter Six concludes the study with a review of the research questions and findings, limitations of the research and suggestions for future research.

CHAPTER 2
THEORETICAL FRAMEWORK

As this research attempts to answer the question of what effect the closure of Cecil Field had on the single-family housing market in the surrounding community it is necessary to engage the literature associated with the socioeconomic impacts of military base closures which lead to the focus question of this research. From there literature on housing market pricing and the various methodologies used by researchers will be analyzed in search of a methodology fitting for the research question of this thesis.

Effects of Base Closure

The economic impact of the closure of a military base can potentially be positive, negative, or neutral on the surrounding community. Dardia et al. (1996, p. 14) argue that communities with diverse agglomeration economies fare better than communities with a military base as a single-source economic base. No matter if their economy is diverse or not, politicians and local officials often argue through economic predictions that the closure of a military base in their community will have a negative socioeconomic impact. Others not tied to the communities affected argue through post-closure case studies that a base closure can stimulate the economy through redevelopment of the closed base and that often the community is left better off than when the base was operational or that any negative impacts are localized immediately around the base and dissipate within the next few years.

Base Closure and Multipliers

As lawmakers and local officials attempt to persuade the Base Closure and Realignment Commission, hereinafter Commission, to spare their district's military base

from closure, the socioeconomic picture forecasted is often bleak. The bleak picture is typically painted by the communities through the use of multipliers (Dardia et al., 1996, p. 9). A multiplier is a ratio that represents the direct and indirect effects on employment or income when one job is created or lost and assumes that goods and services are being provided from within the community to support that one job, therefore creating or removing additional jobs (Dardia et al., 1996, p. 9). “Assumptions about the extent to which incomes are spent within a community can lead to very different assessments of the impacts from the loss of that income” (Cowan & Webel, 2005, p. 2). For example, communities that choose a higher multiplier (indicating that more goods and services are being provided to the base from inside the community or region) will predict a more negative effect on overall employment and income in the community if one job is lost on the military base. However, a rural agricultural community typically cannot supply the goods and services necessary to support a military base and the base must look outside of the community for those goods and services (Bradshaw, 1999, p. 9). Therefore a rural community that chooses multipliers based on goods and services being supplied from within the community will artificially inflate the forecasted negative effects of base closure on their community. Based on the author’s experience, dependent on the type of base and its mission, military bases may receive most of their supplies through logistics chains with hubs outside of the region. This can affect the income or employment multiplier chosen for an urbanized community as well. If an urbanized community assumes the base supplies are coming from within the community then the multiplier and negative impact prediction of the potential base closure is again inflated.

Based on the author's experience, most economic activity for military members and their spouses is internalized to the base. Military bases typically provide housing for lower ranking junior enlisted members and occasionally for higher ranking members, have commissaries to buy groceries at discounted rates in comparison to the local economy, have exchanges to buy retail items, and provide medical and dental care at no cost. Though, many military members typically live outside of the base on the economy, most choose to depend on the base for their daily needs due to lower or no costs which can alter any non-military multiplier chosen by a community to predict the socioeconomic effects of a closure.

Military retirees within the community typically rely on the base for daily needs as well. When a base closes, some retirees will leave the community in order to be near another military base to use its services or for other reasons (Fagan, 2001, p. 18). Retirees that choose not to leave the community revert their spending from the base to the local economy which is a positive impact on the community (Bradshaw, 1999, p. 5). Though the impact can be minor, communities must account for military retirees when predicting the impact of a base closure.

Military spouses that are employed in the community will likely leave with their spouse when the base closes (Renski, 2007, p. 50). The job that the spouse held within the community then becomes vacant and provides an opportunity to any person with the same skill set that lost employment due to the base closure (Renski, 2007, p. 50). If the job vacancy is not filled from within the community, the business looking to fill the vacancy will reach outside of the community to fill the position which promotes in-migration to the community.

Base Closure and Its Affect on the Housing Market

Military members and their families that live outside of the military base will most likely cause a void in the local housing market demand upon their departure (Dardia et al., 1996, p. 8). Existing case studies show that housing is the most impacted indicator among all of the economic indicators (Dardia et al., 1996, p. 8). Rental and sales prices fall as there is suddenly less demand (Bradshaw, 1999, pp. 6-7). This effect can be relieved quickly or linger dependent on the community's redevelopment efforts or industry diversity. The effect is null if most of the military members and their families live within the military installation.

As previously mentioned, earlier studies recognize that the housing market surrounding the closed base is affected; however, almost no literature exists that explains just how much the closure of the base has to do with housing market. For example, Dardia et al. (1996, pp. 28-29) show informative graphs that follow trends in affected areas surrounding the closing bases from the announcement of the closure through the actual closure. These graphs clearly show an increase in vacancies and a decrease in sales prices during the closure time period. While this trend is important to note, there is no statistical analysis that attributes the vacancies and house prices to the base closure. Though the vacancy and housing price variables most likely were affected by the closures, other variables were very much at play.

Housing Prices

Research demonstrates that there are national, regional and local attributes to house prices. Each house in a neighborhood has its own distinct attributes. O'Sullivan (2009) argues that "housing stock is heterogeneous, with each dwelling offering a

different bundle of housing services" (p. 339). O'Sullivan continues with his argument that:

> Dwellings differ in size, layout, style, utilities (heating and electrical), and the quality of the interior and exterior. As we saw in the chapter on neighborhood choice, when you choose an apartment or house, you also choose a neighborhood, with its own bundle of housing services. Neighborhoods differ in accessibility to jobs and social opportunities, local public goods and taxes, and environmental quality.

There are currently two techniques for analyzing home prices: hedonic models and repeat sales models (Quigley, 1995, p. 2). Repeat sales models measure the price of the same house sold multiple times (Quigley, 1995, p. 2). Quigley (1995, p. 2) argues that the repeat sales model drastically reduces an empirical study's sample size because it relies on the characteristics of the home to have remained the same between sales and also the sales may not be representative of the local housing market. Hedonic models relate the selling price to structural and locational characteristics of the home and "are routinely estimated from repeated cross-sectional samples of dwellings" (Quigley, 1995, p. 2). Quigley argues that in a hedonic model "neither the functional form of the relationship nor the set of variables is known with certainty" which "limits the generality of the procedure when applied across markets or time periods" (Quigley, 1995, p. 2). Small sample sizes and the argument that several researchers have found that repeat sales tend to involve "lower priced and homogenous "starter" homes" which are more frequently sold than more expensive homes (Quigley, 1995, p. 5) tends to guide researchers toward the use of hedonic models for most empirical analysis of home prices. For this reason, the following subsections on housing prices will look at previous hedonic pricing research and examine the national, regional and local components of the house price in an attempt to dissect the key variables at each level.

Housing Prices at the National Level

Peek and Wilcox (1991) conduct a regression analysis utilizing three national data sources (Federal Housing Administration (FHA), US Census Bureau and Mortgage Interest Rate Survey (MIRS)) from 1963-1989 and six national data sources (FHA, National Association of Realtors (NAR), US Census Bureau, MIRS, Bureau of Economic Analysis (BEA) and Freddie Mac) from 1970-1989 in order to understand the components and their strength of effect on house prices. The reason for splitting the analysis is due to the additional latter organizations not recording data during the 1963-1970 time period. Housing prices, as with any product or commodity, are a function of supply and demand. Peek and Wilcox (1991) identify the explanatory variables of both housing supply and housing demand. They hypothesize that housing supply (HS) responds positively to price (+P) and negatively to the real price of construction materials (-RPCON) and that housing demand (HD) responds negatively to price (-P), positively to the real income per household (+INC), positively to size and age distribution of the population (+HH), negatively to the cyclical component of the unemployment rate (UGAP), negatively to homeowner's real after-tax borrowing costs (-RATMR) and negatively to household heads age 20-29 (-POP20s). They then equate supply and demand producing a "reduced-form equation for real house prices" (p. 366):

P=H(-UGAP, -RATMR, +INC, +HH, -POP20s, +RPCON)

After running their regression analysis for the 1970-1989 period, Peek and Wilcox (1991) find a "lack of compelling evidence" that "transitory unemployment affects the prices of long-term assets" (p. 373). A majority of their data series show that housing prices respond negatively to increasing RATMR. For the remaining explanatory variables the coefficients were uniformly positive or negative and were statistically

significant: an increase in INC and HH increases housing prices, an increase in POP20s decreases housing prices and an increase in RPCON increases housing prices and accounts for 42% (.422 coefficient) of the overall house price which reflects real world conditions where materials generally reflect about 50% of a home's construction cost. After performing a regression analysis for both the 1963-1989 and the 1970-1989 periods Peek and Wilcox (1991) conclude:

> Real house prices are estimated to decline with increases in real after-tax interest rates, and rise with both cyclical and more permanent income increases and increases in the relative cost of materials. Demographic factors such as the size and age distribution of the population are also significant determinants of house prices. (p. 378)

Peek and Wilcox's study is significant because of their use of data series from multiple national data sources versus relying on one source. While not all of the data series agreed on the explanatory variables' effect (positive or negative) on housing prices; the explanatory variables with all of the data series in agreement (the same variable is either all positive or all negative through all of the data series), a high t-statistic (rejects the null-hypothesis that the coefficient value is zero) and similar coefficient values provides significant backup to Peek and Wilcox's conclusion above. While the explanatory variables they chose to include do not explain the entire makeup of housing prices, they do provide a good insight as to the effects of income, lending costs, age and distribution of the population, unemployment and construction material costs on housing prices. Some of the explanatory variables they chose, namely construction material costs and lending costs, tend to follow national trends and the cost is similar throughout the nation. However; variables such as income, age and distribution of the population, and unemployment react differently at a regional or local level. For example, unemployment could be well above the national average in a certain

city and its contribution (coefficient) and statistical significance to housing prices could be much greater than in Peek and Wilcox's (1991) study where there was little statistical evidence of its effect.

Housing Prices at the Regional Level

Hwang and Quigley (2006) conduct an analysis at the regional level utilizing U.S. metropolitan regions. In the study they analyze the inter-relationship of housing prices, vacancies and residential construction activity "in response to the exogenous factors, which affect the fortunes of the regional economy", and also take into account local land use and building regulations (p. 426). There analysis is of 74 Metropolitan Statistical Areas (MSA) from 1987-1999. They first illustrate the key relationships being explored in their analysis. They find a strong positive relationship between current annual real price changes as a function of their lagged values and suggest that "lags and slow adjustment to market conditions are crucial to understanding the course of prices" (p. 427). They find little relationship between housing prices decreasing with a vacancy rate increase and a slightly greater relationship between an increase in building permits and an increase in housing prices (p. 428). In defining their model, Hwang and Quigley (2006, p.430) argue that housing demand is a function of prices, incomes, and demographic variables and housing supply is a function of profitability. They define profitability as depending on "housing prices and input prices, including the costs of labor, materials, financing, and regulations inhibiting new construction". They define vacancy rate as a "difference between aggregate supply and demand in any market period" (p. 430).

The data series and variables at the MSA level that Hwang and Quigley (2006) use to conduct their analysis are as follows: metropolitan housing price indices

published by the U.S. Office of Federal Housing Enterprise Oversight which is defined by the weighted repeat sales method of all single-family houses financed through Freddie Mac and Fannie Mae, homeowner vacancy published by the U.S. Bureau of the Census, building permits published by the U.S. Bureau of the Census, mortgage interest rate published by Freddie Mac, median tax rate for each metropolitan area as a percentage of house values, annual rents at the 40th percentile of distribution from the U.S. Department of Housing and Urban Development, labor costs as average earnings per worker in the construction industry from the Regional Economic Information System (REIS) maintained by the Bureau of Economic Analysis, proprietary metropolitan data on material costs for residential construction, financing costs for housing suppliers from the DRI database, index of stringency regulation from the author Malpezzi; and three exogenous variables to include per capita income, employment and per capita transfer payments for unemployment which are all from REIS (pp.437-439).

Hwang and Quigley's (2006) empirical results for housing prices found that an increase in new housing stock negatively impacts housing prices and that the housing stock coefficients were unaffected when the housing vacancy variable (which an increase negatively impacted housing prices as well) was removed. They argue that this suggests an independent role between new housing stock and vacancies in housing prices. They found that an increase in rental prices increases housing prices but that the rental variable coefficient was insignificantly different from zero (unable to reject the null hypothesis that the rental price coefficient was any different from zero). An increase in user costs negatively impacts housing prices and they found this coefficient to be very significant in all five of their models. Their lagged price variable had a coefficient of

approximately .5 which Hwang and Quigley (2006) argue signifies that half of the "discrepancy between the market-clearing price and the observed price is eliminated within a year" (p. 440), therefore demonstrating the lag in the housing market.

Utilizing the results from their regression analysis, Hwang and Quigley (2006) simulated an unexpected exogenous income shock on three MSA housing markets. Within the first year they found approximately a .1 to .4 percent increase in housing prices within the three MSAs. Houston's prices peaked at a .4 percent increase in the first year after the initial shock and dissipated to below the zero increase level within ten years. San Jose and Tucson saw a lagged peak in response to the shock of approximately .8 percent and 1.3 percent increases respectively five years from the initial shock. The prices then dissipated but were still well above the zero increase level at ten years (.6 percent and 1.2 percent respectively). Hwang and Quigley (2006) make an interesting argument to explain the differences in the three MSAs' housing prices in response to the income shock. They tie it to the "strong relationship between building activities and regulation (p. 446). Houston's building permits increased by 3500 in the first year after the simulated income shock. Tucson's increased by 1200 and San Jose's increased by 650. The building permit increases quickly fell to status quo for all three MSAs at year three. They conclude that the simulation, based on their regression models discussed earlier, shows that a "housing market with more stringent regulation has a more persistent price appreciation arising from an endogenous shock.

The authors do not show the level of regulation (based on Malpezzi's index of stringency regulation which was one of their variables) for the three MSAs. They also do not indicate what the local building regulations are composed of. However; to further

argue the impact of building regulations on housing prices, Hwang and Quigley (2006) conduct another simulation, this time on Denver, based on their regression analysis results (p. 447). They shock Denver with an exogenous increase of income and demonstrate the change in housing prices based on Denver's building regulations. They then impose San Francisco's building regulations on Denver. The impact is dramatic as the San Francisco building regulations bring Denver a slow and steady increase in housing prices, still increasing at year 10 by slightly more than .5 percent. Denver's current regulations show an initial decrease in housing prices with only a .01 increase by year 10. Denver's current building regulations also brought higher building permits numbers as well which increased the amount of vacancies in comparison to San Francisco's regulations.

Hwang and Quigley (2006) have successfully demonstrated through regression analysis of empirical MSA data that: (1) housing prices are more localized and react differently based on regulation, income, new housing stock, vacancies and user costs; (2) the change in housing prices is not immediate when exposed to an exogenous shock and the lag in the market is dependent upon the local context; (3) Dardia et al.'s. (1996, pp. 28-29) argument that base closure increases vacancies and decreases home prices has statistical validity based on Hwang and Quigley's (2006) analysis of MSA data. However; Hwang and Quigley's (2006) study is conducted more at a regional level. Of course, this depends on the area that the MSA is comprised of and smaller MSAs could have a more localized effect. But, "micro-neighborhood externalities" (Li & Brown, 1980) such as proximity to landfills, construction of new stadiums, construction of major arterial roads, noise levels, or even proximity to military bases, are diluted

when engulfed in the economic activity of a large MSA when attempting to determine the components of house prices. This is not to point out a flaw in Hwang and Quigley's study, as they chose to focus at the MSA level due to the consistency of data availability across many MSAs, but to point out that there are more localized variables that Hwang and Quigley did not account for that will be discussed in the following subsection.

Housing Prices at the Local Level

When attempting to explain the puzzle that is the house price at the local level, researchers tend to focus more on local accessibility criteria such as proximity to the construction of a major road, a stadium, a bridge, a grocery store, a school, a river and conservation land (Li & Brown, 1980, p. 126). Researchers also focus on the proximity to congestion, noise pollution and air pollution (Li & Brown, 1980, p. 126). Li and Brown (1980) conducted a study of "781 sales of single-family houses in 15 suburban towns located in the southeast sector of the Boston metropolitan area" that combines both the positive and negative impacts of "micro proximity" which they claim, at the time of the publishing of their research, had never been done before (p. 126). The authors "classify micro-neighborhood variables into three types: aesthetic attributes, pollution levels and proximity" (Li & Brown, 1980, p. 125). They group the variables into five categories and sum the values:

> (1) structural and site characteristics; (2) neighborhood (census tract) characteristics; (3) local public services and costs; (4) macro-accessibility to CBD; (5) micro-neighborhood characteristics such as aesthetics, pollution levels, and proximity to non-residential activities. (Li & Brown, 1980, p. 126)

The structural and site characteristics include: "number of rooms, number of bathrooms, number of fireplaces, number of garage spaces, presence of basement, presence of a patio, and age of the structure" (Li & Brown, 1980, p. 126). They provide

both a linear and non-linear version of number of bathrooms and age. In the non-linear versions they square the number of bathrooms and age, hypothesizing that the “number of bathrooms has a non-linear effect on sales price” and that the square of age with a positive coefficient “would measure the valuation of older houses relative to newer houses” (Li & Brown, 1980, pp. 127-128).

The neighborhood (census tract) characteristics measure median income, residential density (number of units per square mile), percentage of persons between 16 and 21 years old who are high school dropouts (provides measure of vandalism and crime), and air pollution levels “indexed by mean values of total suspended particles” (Li & Brown, 1980, p. 128). The authors hypothesize that median income will become less significant when they add the remaining neighborhood characteristics just mentioned (Li & Brown, 1980, p. 128).

Local public services and costs are measured by school quality and property taxes. The authors find it difficult to measure the quality of the school so they devise their own measure of quality: “an input variable, expenditure per pupil; and an output variable, the standard test scores for fourth-grade pupils” (Li & Brown, 1980, pp. 128-129). For property taxes they measure the actual taxes paid for each unit.

Macro-accessibility is measured as the distance to the Boston central business district (CBD) and “is intended to provide a gross measure of relative locational advantage” (Li & Brown, 1980, p. 129).

Micro-neighborhood characteristics are a measure of aesthetic characteristics of a site and its view and of noise levels (Li & Brown, 1980). Li and Brown (1980, p. 129) devise an index from one to five-lowest to highest visual quality respectively. For noise

levels they utilize decibels on the A scale (dbA) and assume that an increase in 10 dbA is perceived as a doubling of the noise level (Li & Brown, 1980, p. 129).

The authors' empirical results show that the number of rooms, age of structure, number of garage spaces, number of fireplaces, a basement, presence of a patio, and land area are the "most significant determinants of the sales price" (Li & Brown, 1980, p. 133). The number of rooms squared coefficient demonstrates that adding rooms to a house has "a significant but declining effect on housing price" (Li & Brown, 1980, p. 133). The authors argue that this is most likely due to the "declining marginal value of rooms and the economy of scale in housing construction" (Li & Brown, 1980, p. 133). Median income was significant at the 95% confidence level but when the authors introduced "aesthetic quality and other desirable attributes that are highly correlated with income" the median income coefficient lowered significantly and became statistically insignificant (Li & Brown, 1980, p. 134). Li & Brown (1980) also discovered that the introduction of the micro-neighborhood variables did very little to the structural attribute coefficients which they argue is because construction costs are independent of location (p. 134). Also, initially, variables such as percentage of 16-21 years old who are high school dropouts, residential density and test scores were not significant at the 95% confidence level. However, when the authors introduce the micro-neighborhood variables the coefficients and significance for the aforementioned variables increase, residential density changes from a positive to a negative sign, and the test scores variable almost became significant at the 95% level (Li & Brown, 1980, p. 134). The micro-neighborhood variables have an effect on the distance to CBD coefficient as well. When the model is run without the micro-neighborhood variables each mile from the

CBD had an increasing effect on housing prices and the t-statistic was insignificant. However; when the micro-neighborhood variables are introduced, the CBD coefficient sign changes to negative and the t-statistic becomes significant, indicating that each mile from the CBD decreases home prices. The air pollution coefficient has a negative effect on house prices as would be expected; however, the significance is very low (Li & Brown, 1980, p. 135). Li and Brown (1980) argue that this is because the variation in air pollution across the suburbs is small and the air pollution level is low (p. 135). They also make an interesting argument that there is “a high correlation between air pollution levels and micro-neighborhood characteristics” where it may “measure closely associated factors such as congestion, noise pollution, and visual disorder” (Li & Brown, 1980, p. 135). The micro-neighborhood characteristics of visual quality and noise level are statistically significant with the properties with the highest visual index commanding a premium over the lowest visual index (Li & Brown, 1980, p. 135). However; noise level only measured significant at the 90% confidence level but did demonstrate a price drop for each doubling of the noise level (Li & Brown, 1980, p. 135). The coefficients for proximity, specifically “closeness to the ocean, rivers, and expressway interchanges”, are “highly valued as revealed by their large negative values” (Li & Brown, 1980, p. 135). Proximity to conservation land and schools is insignificant. Li and Brown argue that this is because most houses are “within a reasonable distance of schools, and buses are provided at no charge” (Li & Brown, 1980, p. 135). The second proximity group, specifically proximity to industry, commercial and major thruways, shows an interesting phenomenon. The authors found that for industry and commercial, accessibility dominates over the externality (noise and pollution) (Li & Brown, 1980, p.

135). For thruways they found “the opposite pattern of that for proximity to industries-the externality dissipates slower than the positive accessibility effect” (Li & Brown, 1980, p. 135). When examining the age and squared age coefficients, Li and Brown (1980) find that age does subtract from the house value; however, the older a house gets in the Boston suburbs, the more historical significance it takes on. In this case, at 264 years of age, the house begins to increase in value due to the squared age coefficient (Li & Brown, 1980, p. 133).

Li and Brown (1980) make a significant argument through hedonic analysis of empirical data that there is certainly a local element, even a “micro-neighborhood” element to house prices. The introduction of “micro-neighborhood” attributes to their latter models had a significant effect on several of their variables and changed the coefficient sign (positive or negative) to the sign that was expected. To truly explain the attributes of housing prices, researchers must take into account “micro-neighborhood” variables that also take into account accessibility and externalities immediate to the area, or even parcel, being studied. Li and Brown make a compelling argument that accessibility trumps negative externalities when examining proximity to industrial and commercial entities. This compelling argument deserves a more in-depth analysis as the theoretical framework of this thesis delves deeper into the effect of the closure of a military base on housing prices. Three pieces of literature dealing with the construction of major sports stadiums and the closure of military bases and their effects on housing prices will be examined in the next subsection in an attempt to get closer to the effect of the closure of a military base on single-family house prices.

Proximity to a specific externality and its effect on housing prices

Tu (2005); Dehring, Depken, & Ward (2006); and Hiebert (2009) studied the effects of the announcement of the construction of the Washington Redskins stadium (Fed Ex Field) on housing prices; the construction of the Dallas Cowboys stadium on housing prices; and the closure of Reese Air Force Base (AFB) and Red River Army Depot on housing prices; respectively. The summation of variables and methodology in this subsection will not be as in depth as the national, regional and local sections as key variables have already been discussed in the previous sections.

There are two variables in particular in these three studies that are not included in the national, regional and local examples and they are dummy variables that represent a point in time and proximity to a specific entity such as a stadium or military base (not general proximity such as proximity to commercial or industrial). Dehring et al. (2006); and Hiebert (2009) use the point in time dummy variable that represents if the public announcement of the construction of the stadiums or the closure of the military bases has any influence on housing prices. They set the date of the variable back 30 days prior to closing to represent when the contract to purchase was agreed upon by both buyer and seller. The Dehring et al. (2006) study saw movements in price but all announcement variables were statistically insignificant. Only when they totaled the accumulated effects of the several stadium announcements did they see a small effect on price at a 95% confidence level. The Hiebert (2009) dissertation analyzed the announcement of the closure of an AFB and an Army base in two different counties of Texas and saw much greater price movement in the negative direction that was statistically significant at the 95% confidence level and 90% confidence level, with some statistically insignificant results. What is interesting is that the Hiebert (2009) study

utilized 60 observations at the most for one town, 36 for a town with fewer significant results, and achieved much higher statistical significance; while the Dehring et al. (2006) study utilized thousands of observations with almost all of the announcement variables achieving no significance. It is this author's opinion that the difference in the two studies is that the closure of a military base represents the possibility of the movement of thousands of people out of the areas affected which potentially creates a large void in the demand for housing. Also, as earlier mentioned in the introduction of this thesis, Bradshaw (1999) argues that the closure of a military base is politically charged with sometimes imprecise assertions of dire economic consequences from the base closure. A stadium, while creating a positive or negative externality to its neighbors and also politically a charged issue, has far less of an effect on the demand for housing. Also, there could have been a lag in the market's response (as Hwang and Quigley (2006) demonstrated in their model) to the stadium announcements that Dehring et al.'s (2006) research does not capture.

Tu (2005) and Hiebert (2009) both use a dummy distance variable that indicates the property's distance from the stadium or military base respectively. In Tu's (2005) initial study of the impact of the stadium, he also draws rings around the stadium at one mile radius intervals. Tu (2005) finds that the impact of the stadium becomes statistically insignificant outside of three miles so he labels the ring three miles out as IMPACT, the ring two miles out as IMPACT2, and the ring one mile out as IMPACT1 (Tu, 2005, p. 387). Tu (2005) then adds two interactive variables; IMPACT times DISTANCE (I_DISTANCE) and IMPACT times DISTANCE squared (I_DISTANCE2) (p. 387). Within IMPACT, Tu (2005) shows that the properties sold at a reduction in price compared to

properties outside of IMPACT (p. 387). The interactive variable I_DISTANCE shows that each additional mile reduces the properties' price a certain percentage (Tu, 2005, p.387). The interactive variable I_DISTANCE2 shows that the reduction in price for each mile is non-linear because of its negative sign and its high significance (Tu, 2005, p. 387). Hiebert's (2009) differs from Tu (2005) in that he does not alter the distance variable and measures more than just the distance from the parcel to the military base. Hiebert (2009) also includes dummy variables that measure the distance to major roads, hospitals, transportation nodes, schools, and colleges (p. 72). When considering the effect of the closure of a military base, it is this author's opinion that Tu's (2005) method of demonstrating the diminishing effect of the base on house prices as the distance from the base increases is a more effective method because it gives a perspective of how localized the effects are. The linear method that Hiebert (2009) employs demonstrates that the two base closures have an effect on house prices but does not define a boundary to the effect.

Regression Methods

National, regional and local variables were discussed in the previous section in an attempt to identify pertinent variables to include in a hedonic pricing model. While there are hundreds of variable types that can be included in a hedonic pricing model, there are also many methods employed by researchers to conduct the regression analysis in order to estimate the variables' coefficients. While this section will not cover all of the methods available to the researcher, it will evaluate the more commonly used methods in an attempt to understand and identify a method more suitable for the hedonic pricing model that will be used in this thesis.

Hwang and Quigley (2006) estimate the coefficients for each variable through the use of two-stage least squares (TSLS) regression in an error components framework versus ordinary least squares (OLS). Garson (n.d.), a professor of Public Administration at North Carolina State University, states that two-stage least squares regression is used “to cover models which violate ordinary least squares (OLS) regression's assumption of recursivity, specifically models where the researcher must assume that the disturbance term of the dependent variable is correlated with the cause(s) of the independent variable(s)”. Garson (n.d.) describes the two stages as:

> (1) a stage in which new dependent or endogenous variables are created to substitute for the original ones, and (2) a stage in which the regression is computed in OLS fashion, but using the newly created variables. The purpose of the first stage is to create new dependent variables which do not violate OLS regression's recursivity assumption.

Similar to the Hwang and Quigley (2006) analysis, Li and Brown (1980) utilize a two-stage regression equation because of the “simultaneity between sales price and its property tax” (p. 131); however, in the second stage they utilize non-linear least squares (NLS) and term this method the “search method”. NLS allows the authors to choose “the parameters so as to minimize the sum of the squared residuals” (Li & Brown, 1980, pp. 129-130).

Tobler (1970) argues that “Everything is related to everything else, but near things are more related than distant things”. While Hwang and Quigley (2006) and Li and Brown (1980) account for data correlation and simultaneity respectively, they do not account for “spatial structure in the residuals from the model” (Charlton & Fotheringham, 2009, p. 3). Charlton and Fotheringham (2009) argue that “this will lead to inefficient estimates of the parameters, which in turn means that the standard errors of the parameters will be too large” and that there are “implications for interference where

potentially significant parameter estimates may appear not to be so" (p. 3). They continue their argument that spatial structure in the data means:

> that the value of the dependent variable in one spatial unit is affected by the independent variables in nearby units. This leads to parameter estimates which are both biased and inefficient. A biased estimates [sic] is one that is either too high or too low as an estimate of the unknown true value. (p. 3)

Spatial heterogeneity is another characteristic of data with spatial aspects that is not accounted for in a basic regression model (Charlton & Fotheringham, 2009, p. 3). Spatial heterogeneity occurs when the relationships being modeled are not homogeneous spatially and vary across space (Charlton & Fotheringham, 2009, p. 3).

In an effort to account for these spatial regression anomalies, Geographically Weighted Regression (GWR) was developed as "a fairly recent contribution to modeling spatially heterogeneous processes" (Charlton & Fotheringham, 2009, p. 4). The basic concept of GWR when testing a unit at location x,y is that "observations which are nearer that location should have a greater weight in the estimation than observations which are further away" (Charlton & Fotheringham, 2009, p. 4). "As the bandwidth gets larger the weights approach unity and the local GWR model approaches the global OLS model" (Charlton & Fotheringham, 2009, p. 6) In other words, as the distance increases from the unit being tested, the weighting decreases eventually to zero and the GWR model becomes a standard OLS regression model at those distances.

Gao, Asami, and Chung (2002) conduct "An Empirical Evaluation of Hedonic Regression Models" and evaluate a simple linear regression model that does not account for spatial regression anomalies, as well as, a spatial dependency model and a GWR. A housing and land price dataset from Tokyo is used for the "illustrating the prediction power of the models" (Gao et al., 2002). The results of their study indicate

that regression models generally predicted a higher percentage of samples correctly; however, at up to the 70% mark of well predicted samples, ordinary simple linear regression was able to predict at the same error rate as the spatial regression models. It was only past the 70% mark of well predicted samples that the error rate slightly increased over spatial regression models. Gao et al., (2002) stress that a different data set could provide different results.

The spatial aspect of data certainly introduces an additional aspect to consider when constructing a regression model. While Gao et al. (2002) may demonstrate that simple linear regression models are as accurate as spatial regression models up to a certain point, it is important to consider their comment that a different data set may produce a different result. It is this author's opinion that the Tokyo dataset may have met the OLS assumption of recursivity. Therefore, the error rate would be low and the prediction ability of the simple linear regression model would be as accurate as the spatial regression model (GWR). Other data sets may show the prediction ability of simple linear regression to be more fraught with error and GWR would become the researcher's choice when dealing with spatial data.

CHAPTER 3
METHODOLOGY

This thesis examines the effect of the NAS Cecil Field base closure announcement, the actual base closure and the subsequent redevelopment of the base on single-family home prices in the Jacksonville community surrounding the base. The closure of Cecil Field was recommended by the BRAC Commission to the President in July 1993 and approved by the President and Congress in the same month. It was officially decommissioned as an operational naval air station in September 1999 and closed its gates in 2000 with redevelopment efforts beginning soon after.

The author chose Cecil Field for this case study for four key reasons: 1) Jacksonville is unique when compared to other base closures because it was home (prior to Cecil Field's closure) to three sizable naval bases and a USMC MPF logistics hub which fall within a 40 mile diameter circle centering approximately on Naval Air Station Jacksonville; 2) Cecil Field employed over 7,000 military and almost 1,500 civilians and was home port to 17 fixed-wing squadrons of carrier aircraft with approximately 20,000 acres of real estate; 3) Housing sales data to include all recorded sales back to 1992, not just Multiple Listing Service sales, was available through a private vendor; 4) Jacksonville's proximity to the University of Florida greatly enhanced the author's ability to gather data and the City of Jacksonville Economic Development Commission was very cooperative in giving their time and allowing the author access to closure and redevelopment documents.

History of Cecil Field

NAS Cecil Field (now Cecil Commerce Center) opened in June 1941 on 2600 acres of land in Duval County (GlobalSecurity.org, n.d.) in the southwest of Duval

County. Following the attack on Pearl Harbor, Cecil Field quickly began operations and began training replacement combat pilots for the war, eventually being commissioned a Naval Auxiliary Air Station (GlobalSecurity.org, n.d.). In 1943 the base transitioned from training fighters to becoming the “principle war-at-sea and dive-bombing training center for the Navy” and “was the pilot’s last stop before assignment to combat in either the Atlantic or Pacific fleet” (GlobalSecurity.org, n.d.). After World War II Cecil Field was disestablished and reestablished several times until it was finally commissioned as a Naval Air Station on June 30, 1952 (GlobalSecurity.org, n.d.). In the 1950s, Cecil Field was chosen to be one of four bases to be used for the operation of jet aircraft and grew to 4,600 acres (GlobalSecurity.org, n.d.). Through the years Cecil Field continued to grow to approximately 20,000 acres and was the home to 17 fixed-wing carrier aircraft squadrons (GlobalSecurity.org, n.d.), 7,000 military and almost 1,500 civilians before its closure was announced.

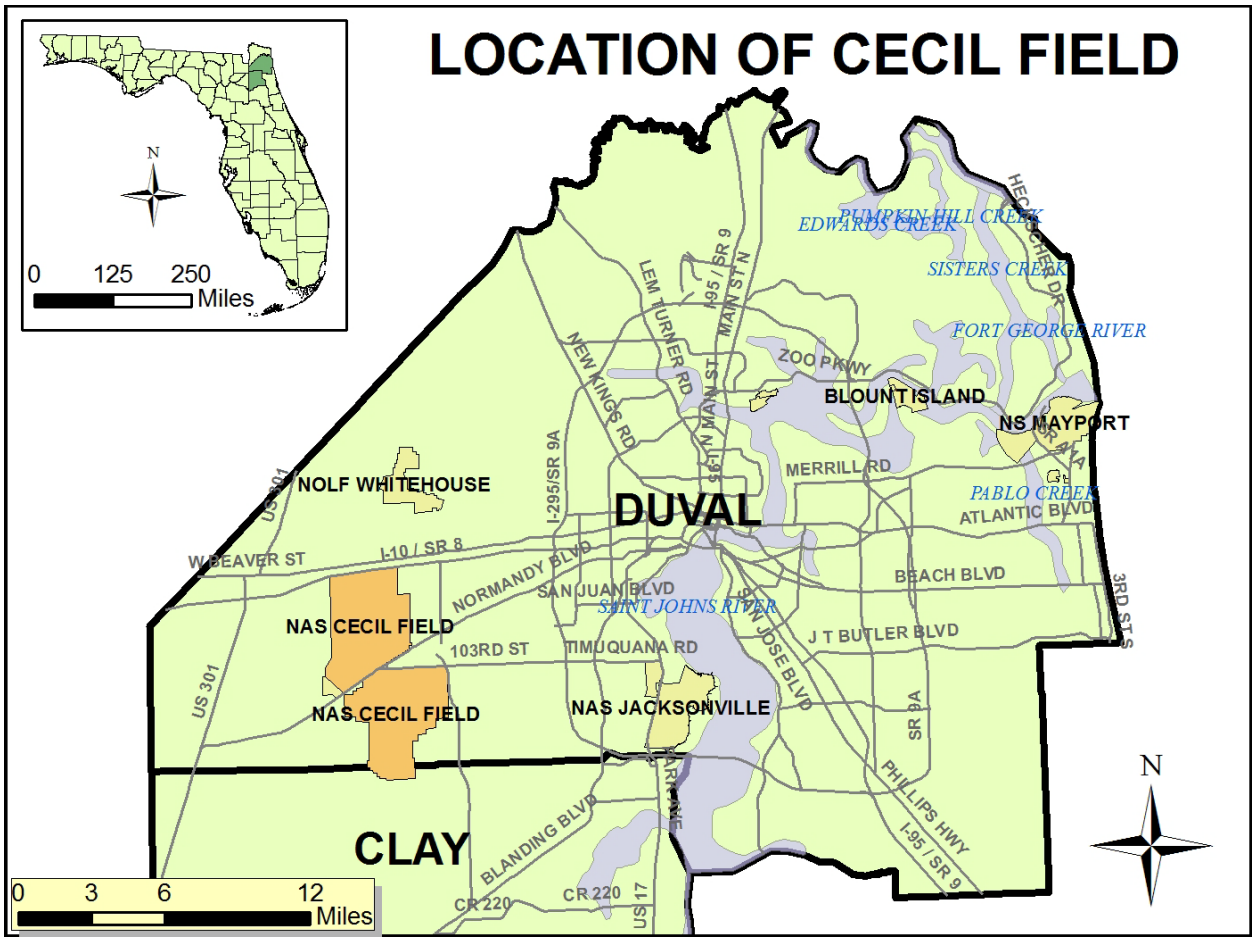

Figure 3-1. Map showing the location of Cecil Field and proximity to other military bases

After the closure of Cecil Field in late 1999 and early 2000, the federal government eventually turned over 16,583 acres and 642 acres to Duval and Clay Counties respectively and the development of Cecil Commerce Center in Duval County began. Currently, the location of Cecil Commerce Center in southwest Duval County is mostly rural in close proximity to Interstate 295 and major north-south and east-west corridors, Interstate 95 and Interstate 10 respectively. Cecil Commerce Center was directly connected to Interstate 10 in October 2009 when the Cecil Commerce Center Parkway was completed by the Florida Department of Transportation. The Cecil Commerce Center Parkway is the first section of the First Coast Outer Beltway which will connect Interstate 10 in Duval County to Interstate 95 in St. Johns County.

Cecil Commerce Center consists of Cecil north and Cecil south which occupy over 6,000 acres and are under the control of the Jacksonville Economic Development Commission (JEDC). The aviation portion of the Cecil Commerce Center occupies an additional 6,081 acres and is run by the Jacksonville Aviation Authority (JAA). The remaining 5,000 acres is under a conservation easement and will never be developed.

Due to a series of encroachment issues at NAS Oceana in Virginia Beach, Virginia (the only remaining master jet base on the east coast after the closure of NAS Cecil Field) and the City of Virginia Beach's unwillingness to purchase thousands of homes and businesses in order to condemn them and relieve the encroachment, the 2005 BRAC Commission voted to close Oceana and transfer the Oceana jets to Cecil Field, reopening NAS Cecil Field. The Governor of Florida and Mayor of Jacksonville were initially supportive of this idea and testified before the 2005 BRAC Commission that they would welcome back the Navy to Cecil Field even though they had already started demolition and construction at Cecil and had spent city and state taxpayer money. The public outcry to this decision was large as the majority of the public supported the further development of Cecil Commerce Center. The offer to the Department of Defense was reversed by the city and state and Jacksonville remains the owner of Cecil Commerce Center today.

Since Duval County has taken over Cecil Field "over $200 million in public funds have been invested on capital improvements at Cecil Field, including an equestrian center, recreational facilities, and improvements made by JAA, JEA, the City of Jacksonville and FCCJ" (Fishkind and Associates, 2006). In 2006 the Jacksonville Chamber of Commerce commissioned Fishkind and Associates, Inc. to conduct an

economic analysis of Cecil Commerce Center in order to determine if the Navy moving back to Cecil Field would benefit Duval County more economically than continuing to cultivate Cecil Commerce Center. This was in response to an initiative by a pro-Navy advocacy group called VoteJacksonville.com who made an unsuccessful effort to get the return of the Navy to Cecil Field added as a referendum for the citizenry to vote on after the state and city reversed their offer to the DoD. Fishkind and Associates (2006) argue:

> While a large portion of this facility is currently vacant land, the Cecil Commerce Center represents a critically important and primary future economic engine for the City of Jacksonville and northeast Florida. The extensive investments and initial successes of the location, occurring in under a decade indicate the economic viability and demand for this location.

Through the use of the Regional Input-Output Multiplier System II (RIMS) multipliers for northeast Florida, 2003, Fishkind and Associates, Inc. conduct an economic analysis estimating the 2006 (current at the time of Fishkind publication) direct and indirect economic impact to Cecil Commerce Center and also project the analysis to 2015 and 2030. Assuming the Fishkind and Associates, Inc. analysis is accurate; the 2006 and 2015 tables are provided in this thesis to support the hypothesis that single-family home values within a certain proximity to Cecil Field could be affected by both the closure of NAS Cecil Field and redevelopment of Cecil Field as Cecil Commerce Center.

Table 3-1. 2006 Direct Economic Impact of the Cecil Commerce Center

Direct Impacts (2006)	Economic	Earnings	Employment
Manufacturing (mfg)	$94,412,788	$26,813,456	592
Logistics & Dist (log)	$2,036,001	$872,278	22
Office (off)	$24,727,987	$10,630,024	248
Pub & edu use (pu)	$12,991,611	$6,327,956	269
General Aviation (GA)	$89,290,671	$19,318,818	474
Mixed use (mix)	$0	$0	0
Commercial (com)	$1,188,578	$254,947	7
Park (prk)	$0	$0	0
Military (mil)	$41,179,093	$27,627,054	668
Recreation (rec)	$0	$0	0
TOTAL	$265,826,729	$81,979,599	2,280

Source: Fishkind and Associates, Inc.

Table 3-2. 2006 Direct & Indirect Economic Impact of the Cecil Commerce Center

Direct & Indirect Impacts (2006)	Economic	Earnings	Employment
Manufacturing (mfg)	$186,153,695	$57,808,950	1,439
Logistics & Dist (log)	$4,538,450	$1,432,327	47
Office (off)	$55,252,215	$20,524,230	554
Pub & edu use (pu)	$29,883,303	$11,067,553	431
General Aviation (GA)	$169,152,246	$49,520,606	1,327
Mixed use (mix)	$0	$0	0
Commercial (com)	$2,339,477	$686,522	17
Park (prk)	$0	$0	0
Military (mil)	$86,336,087	$27,627,054	1,099
Recreation (rec)	$0	$0	0
TOTAL	$533,655,474	$168,667,242	4,914

Source: Fishkind and Associates, Inc.

Table 3-3. 2015 Direct Economic Impact of the Cecil Commerce Center

Direct Impacts (2015)	Economic	Earnings	Employment
Manufacturing (mfg)	$645,579,337	$183,346,064	4,048
Logistics & Dist (log)	$82,920,768	$35,525,504	896
Office (off)	$394,650,704	$169,651,754	3,958
Pub & edu use (pu)	$27,045,733	$13,173,440	560
General Aviation (GA)	$160,685,532	$34,765,721	853
Mixed use (mix)	$143,627,688	$36,113,525	1,037
Commercial (com)	$85,407,784	$18,319,763	503
Park (prk)	$387,573	$160,722	6
Military (mil)	$15,164,756	$6,541,140	246
Recreation (rec)	$581,360	$241,083	9
TOTAL	$1,556,051,234	$497,838,716	12,116

Source: Fishkind and Associates, Inc.

Table 3-4. 2015 Direct & Indirect Economic Impact of the Cecil Commerce Center

Direct & Indirect Impacts (2015)	Economic	Earnings	Employment
Manufacturing (mfg)	$1,272,888,779	$395,288,228	9,838
Logistics & Dist (log)	$184,838,685	$58,334,760	1,911
Office (off)	$881,807,532	$327,560,084	8,834
Pub & edu use (pu)	$62,210,595	$23,040,260	897
General Aviation (GA)	$304,402,671	$89,116,196	2,389
Mixed use (mix)	$274,716,679	$89,910,933	2,319
Commercial (com)	$168,108,140	$49,331,536	1,253
Park (prk)	$797,199	$247,620	10
Military (mil)	$31,794,427	$10,174,035	405
Recreation (rec)	$1,195,799	$371,431	15
TOTAL	$3,182,760,506	$1,043,375,083	27,870

Source: Fishkind and Associates, Inc.

Data

Dependent Variable

Table 3-5. Description of Dependent Variable Used in the Hedonic Price Model

Variable	Description
PRICE	Sale price recorded for the property
LOGPRICE	Natural logarithm of Price

The data utilized for the dependent variable, single-family home sales price, is transactional real estate data for all single-family home sales transactions at the county level. The data is proprietary data and was obtained from Metro Market Trends, Inc. (MMT). MMT records all of the real estate transactions recorded in all of the counties of the state of Florida. The author was able to obtain every deed type issued for both counties' single-family sales transactions; however, only single-family homes issued a warranty deed at the time of sale will be included in this study. The reason being that homes issued a warranty deed versus a quit claim deed, agreement deed or special warranty deed truly demonstrate the market value of the property. Other types of deeds issued such as a quit claim deed could have been issued due to a tax foreclosure sale

where the grantor gives no warranty to the grantee that the title is free and clear of liens or when a property is gifted from one family member to another for little to no cost. Using deed types other than warranty deeds has the potential to increase outliers and skew the market sales data in the sample. To further decrease the potential for outliers the top and bottom 2% of the total count of the sample for each calendar year of sales data were removed.

The dependent variable will be tested by the calendar year during specific years. January 1992 is the farthest back that MMT kept pricing data records in the State of Florida. This will allow one calendar year of data to be tested prior to the DoD announcement of bases to be considered for closure and realignment on March 15, 1993. The following major events involving Cecil Field are noted in order from March 1993 through November 2009:

Table 3-6. Major Events Involving Cecil Field

Event	Month/Year
Initial DoD 1993 BRAC Announcement	March 1993
BRAC Commission recommendation to President	July 1993
Approval of BRAC Commission closure recommendation by President	July 1993
Approval of President closure recommendation by Congress	July 1993
Jacksonville develops goals and objectives for Cecil	November 1993
Jacksonville initiates Cecil reuse planning process	September 1994
Navy issues Final EIS with preferred alternative which is the City of Jacksonville's reuse plan	October 1998
NAS Cecil Field ceases operations	September 1999
BRAC Commission recommends to President to close NAS Oceana, Virginia and transfer assets to and reopen NAS Cecil Field	September 2005
Mayor of Jacksonville turns down DoD attempt to reopen NAS Cecil Field; Cecil Commerce Center's fate secure	October 2005
Bridgestone/Firestone announces 1-million square feet distribution center at north Cecil Commerce Center	June 2006
Interstate 10 off ramp and Cecil Commerce Center Parkway open	October 2009
SAFT announces construction of lithium-ion battery factory at Cecil Commerce Center	November 2009

The dependent variable will be tested in the following calendar years: (1) 1992; (2) 1993 and 1994; (3) 1999 and 2000; (4) 2009. The reason for this is: (1) 1992 establishes the bases' impact on single-family house prices prior to any knowledge that the base may close; (2) 1993 is when the closure of the base is announced and is included to catch any impact on single-family house prices and 1994 is included to account for a lag in the market (as was discussed earlier in Chapter 2 when examining Hwang and Quigley (2006)) after the closure announcement; (3) 1999 is when the base officially ceased air operations, closing in early 2000, and is included to catch any impact on single-family house prices and calendar year 2000 is included to account for a lag in the market after the base officially ceased air operations; (4) 2009 attempts to capture any impact the redevelopment of Cecil Field NAS as Cecil Field Commerce Center has had on single-family house prices.

Explanatory Variables

Table 3-7. Description of Explanatory Variables Used in the Hedonic Price models

Variable	Description
LOTSIZE	Acreage of Lot
SF	Square footage of house
BATH	Number of bathrooms (available only in data starting in 1999)
ROOM	Number of bedrooms (available only in data starting in 1999)
AGE	Property age in years
AGE2	AGE squared
INCOME	Median household income in the census tract
MEDAGE	Median age in the census tract
PCTDROP	Percent of high school dropouts in the census tract
RATE	Prime interest rate at time of transaction
DISTROAD	Euclidean distance to major or minor arterial road in kilometers
DISTSCHL	Euclidean distance to school in kilometers
DISTWATR	Euclidean distance to body of water in kilometers
DISTHPTL	Euclidean distance to hospital in kilometers
DISTCOMM	Euclidean distance to commercial landuse
DISTINDU	Euclidean distance to industrial landuse
ZIPMIL	Dummy variable 1, if the property is located in a zip code where it is known that a higher percentage of Cecil personnel lived, 0 otherwise
IMPCEC	Dummy variable 1, if the property is located in the 5 kilometer radius impact area of Cecil Field, 0 otherwise

IMPCEC3	Dummy variable 1, if the property is located within a 3 kilometer radius of Cecil Field, 0 otherwise
IMPCEC1	Dummy variable 1, if the property is located within a 1 kilometer radius of Cecil Field, 0 otherwise
DISCEC	Euclidean distance from the property to Cecil Field
I_DISCEC	Interactive variable, IMPCEC times DISCEC
I_DISCEC2	Interactive variable, IMPCEC times DISCEC squared

Table 3-7. Continued

Table 3-8. Vector Category and Source of Explanatory Variables Used in the Hedonic Price models

Variable	Vector	Source of Data
LOTSIZE	Structural	Florida Department of Revenue (parcel geometry)
SF	Structural	MMT, Inc.
BATH	Structural	MMT, Inc. (available only in datasets starting in 1999)
ROOM	Structural	MMT, Inc. (available only in datasets starting in 1999)
AGE	Structural	Florida Geographic Data Library, University of Florida
AGE2	Structural	ARCGIS
INCOME	Demographic	U.S. Census Bureau 2000 decennial data
MEDAGE	Demographic	U.S. Census Bureau 2000 decennial data
PCTDROP	Demographic	U.S. Census Bureau 2000 decennial data
RATE	Financial	Wall Street Journal
DISTROAD	Proximity	Buffer distance in 1 kilometer increments, ARCGIS
DISTSCHL	Proximity	Buffer distance in 1 kilometer increments, ARCGIS
DISTWATR	Proximity	Buffer distance in 1 kilometer increments, ARCGIS
DISTHPTL	Proximity	Buffer distance in 1 kilometer increments, ARCGIS
DISTCOMM	Proximity	Buffer distance in 1 kilometer increments, ARCGIS
DISTINDU	Proximity	Buffer distance in 1 kilometer increments, ARCGIS
ZIPMIL	Zone	Geometry from U.S. Census Bureau, Data of military member location from NAS Cecil Field Final Base Reuse Plan created by the City of Jacksonville
IMPCEC	Zone	5 kilometer buffer distance, ARCGIS
IMPCEC3	Zone	3 kilometer buffer distance, ARCGIS
IMPCEC1	Zone	1 kilometer buffer distance, ARCGIS
DISCEC	Proximity	Buffer distance in 1 kilometer increments, ARCGIS
I_DISCEC	Interactive	ARCGIS
I_DISCEC2	Interactive	ARCGIS

The explanatory variables are a conglomeration of national, regional, and local attributes based on the studies by Peek and Wilcox (1991), Hwang and Quigley (2006), and Li and Brown (1980), respectively. They were selected based on the aforementioned authors' research, what is applicable to a military base closure, and what data is readily available to the author. The structural vector is the structural

characteristics of the property. The BATH and ROOM variables were not available in the datasets until calendar 1999 and therefore will not be utilized in any models previous to that year. An increase in LOTSIZE, SF, BATH, and ROOM coefficients is expected to have a positive effect on the house price. An increase in AGE is expected to have a negative effect on the house price to some point in time when the effect will be positive. AGE2 is a non-linear variable that represents the curve and point in time that AGE would become positive due to the house's historical impact to the community as argued by Li and Brown (1980).

The demographic vector is the demographic characteristics of the property. An increase in INCOME and MEDAGE is expected to have a positive impact on the house price. An increase in PCTDROP is expected to have a negative impact on the house price. This is due to the perception that in an increase in high school dropouts is causal to an increase in crime as argued by Li and Brown (1980).

The financial vector is the prime interest rate that the national lending rates are tied to. An increase in RATE will have a negative impact on the house price.

The proximity vector is the Euclidean distance from the property to the attribute. An increase in distance for DISTROAD, DISTSCHL, DISTWATR, DISTHPTL, DISTCOMM, and DISTINDU is expected to have a negative impact on the house price. The Li and Brown (1980) study argued that the overall net effect (proximity vs. negative externalities) of proximity to commercial and industrial uses was positive. This author is hypothesizing that the house price will react similarly to commercial and industrial uses as it did in the Li and Brown (1980) study. Essentially, the farther you get from the attribute, the more negative the impact on the house price. DISCCEC will most likely be

positive and negative to the house price as the status of Cecil Field changes through the calendar years tested.

The zone vector indicates if the property is in a specified zone spatially. The ZIPMIL zone represents known zip codes where Cecil Field personnel (military and civilian) were known to live in higher percentages. IMPCEC, IMPCEC3, and IMPCEC1 are buffers drawn around Cecil Field at five, three, and one kilometers respectively. This methodology mirrors the methodology utilized by Tu (2005) and will demonstrate that properties inside IMPEC will sell at a reduction in price compared to properties outside of IMPCEC. The interactive variable I_DISCEC will demonstrate that each additional kilometer will reduce the properties' price a certain percentage. The interactive variable I_DISCEC2 will demonstrate that the reduction in price for each mile will be non-linear.

Model

Hedonic Pricing Model

In order to examine the impact of the announcement of the closure of NAS Cecil Field, the actual closure, and the subsequent redevelopment of the base as Cecil Commerce Center, a hedonic pricing model is employed. As discussed earlier in Chapter 2, the hedonic pricing model relates the price to the structural and locational attributes of the home (Quigley, 1995, p. 2). "The number and type of attributes embodied in a particular property distinguish it from others and determine its price" (Tu, 2005). This hedonic model is a hybrid of sorts, including national, regional, and local attributes. The hedonic equation is written as **P** = f(**S,D,F,R,Z,I**) where **P** is the sale price of the property, **S** is a vector of structural characteristics, **D** is a vector of demographic characteristics, **F** is a vector of the financial characteristic, **R** is a vector of

proximity characteristics, **Z** is a vector of zonal characteristics, and **I** is a vector of interactive characteristics.

Regression Analysis of the Hedonic Pricing Model

The coefficients for the hedonic model will initially be estimated by utilizing the Ordinary Least Squares function in the Spatial Statistics tools available in ArcGIS. If ArcGIS warns the author to check to ensure that the residuals are not spatially autocorrelated, the Spatial Autocorrelation (Morans I) function in the Analyzing Patterns tools available in ArcGIS will be utilized. If significant clustering is discovered by the Spatial Autocorrelation function, the GWR function in the Modeling Spatial Relationships will be utilized to conduct the regression analysis and estimate the coefficients.

CHAPTER 4
RESULTS

This chapter presents the results of the regression analysis utilizing the hedonic pricing methodology as applied to the single-family housing surrounding Cecil Field and in Duval County. It begins with the difficulties of using geographically weighted regression (GWR) with the variables as defined in Chapter 3 and gives an overview of fine tuning the hedonic pricing model in order to better work with GWR and other discoveries. It concludes with the results of the revised methodology.

Geographically Weighted Regression: Trials and Tribulations

GWR is an extremely powerful tool to the researcher when attempting to determine the localized effects of an explanatory variable on the dependent variable being tested. The author utilized ESRI's ArcGIS to conduct both the ordinary least squares (OLS) and GWR regression analysis for this thesis. The author cannot attest to other software packages, but in ArcGIS, GWR's ability to give the researcher a visual picture, versus a table like OLS, of the explanatory variable's effect on the dependent variable allows the researcher to see that the explanatory variable does not act the same globally and can act differently on the dependent variable within a radius of just blocks.

Variables and Variance in Their Values (Local Multicollinearity)

The localized result of GWR requires the values for the explanatory variable being applied to vary almost to the parcel level in order to avoid local multicollinearity. Local multicollinearity is the spatial clustering of identical values. For example, the initial methodology for this study contains a dummy variable (ZIPMIL) for the parcels falling within a zip code identified as having Cecil personnel living there. If the parcel falls

within such a zip code the parcel receives a value of one (1). If the parcel falls outside of such a zip code the parcel receives a value of zero (0). It was discovered very soon into the analysis process that, while OLS will accept a variable with only two values, if OLS suggests testing for spatial autocorrelation and the author discovers spatial autocorrelation and attempts to run GWR, GWR will not run with a variable with only two values. This is because GWR estimates the variable's coefficient based on it examining the values of the same variable for different parcels surrounding the parcel (its neighbors) being tested. A variable with only two values does not provide enough variance and the software keeps seeking more neighbors in order to find more variance. The maximum number of neighbors the software will seek is 1,000. Anymore than 1,000 neighbors essentially means the variable is being applied globally to the entire geographical space (such as how OLS functions) versus locally to the parcel being tested and nullifies the reason for utilizing GWR.

The same principle applies to data at the census tract level such as for the proposed variables INCOME, MEDAGE and PCTDROP. The parcels that fall within the same tract will all have the same values for the aforementioned variables respectively. The researcher has to direct the software to search beyond the tract to adjacent tracts to find differing values for each of the variables. This minimizes the local intent of GWR.

When setting up buffers to determine proximity the author hypothesized that the same issue could surface depending on the width of the buffer. The author did not necessarily experience such an issue in this study, but in order to insure enough variance in the proximity variables DISTROAD, DISTSCHL, DISTWATR, DISTHPTL, DISTINDU, DISTCOMM and DISCEC, the buffers were replaced with 5 meter grid

matrices for each variable. An additional grid matrix was added to replace the dummy variable value in ZIPMIL. The new grid matrix measures the parcel's distance from each zip code's centroid. It was discovered that the matrices were much quicker to generate than the previously created buffers and have the potential to work better with GWR.

After replacing the buffers with the grid matrices, the author discovered an almost insurmountable issue with the proximity variables and local multicollinearity. When GWR is used to calculate the regression model, it is already accounting for the spatial aspect of the variable. That plus the proximity measurement for the variable causes a local multicollinearity that quite frequently does not allow the GWR function in ArcGIS to proceed. It is a painstaking process to attempt to isolate which proximity explanatory variables or combination of variables is causing the program not to run. The author started to do so with the 1992 dataset but realized there was just not enough time in the span of this study to do so. For this reason, no proximity or zone variables are included in the GWR regression analysis.

Variables and Global Multicollinearity

A product of the Ordinary Least Squares function of ArcGIS is the variance inflation factor (VIF) for each variable. The VIF measures the "redundancy among explanatory variables" (ARCGIS.COM, n.d.). For example, the AGE and AGE2 variables. AGE represents the AGE of the structure. AGE2 represents the squared age of the structure. An initial OLS regression that includes both variables indicates a high VIF for both variables. Any variable with a VIF over 7.5 must be discarded due to global multicollinearity and the possibility of inflating the value of the variable's coefficient.

Summary of OLS Results

Variable	Coefficient	StdError	t-Statistic	Probability	Robust_SE	Robust_t	Robust_Pr	VIF [1]
Intercept	9.851932	0.085177	115.664882	0.000000*	0.102236	96.364738	0.000000*	--------
LOTSIZE	0.004637	0.000605	7.670212	0.000000*	0.001136	4.080376	0.000052*	1.180335
AGE	-0.008471	0.000962	-8.802246	0.000000*	0.001137	-7.452116	0.000000*	12.052776
AGE2	-0.000000	0.000014	-0.003854	0.996923	0.000019	-0.002881	0.997700	10.530822
SF	0.001082	0.000043	24.962139	0.000000*	0.000056	19.224126	0.000000*	21.320331
SF2	-0.000000	0.000000	-12.883804	0.000000*	0.000000	-10.038431	0.000000*	19.961181
INCOME	0.000006	0.000001	10.573781	0.000000*	0.000001	8.875056	0.000000*	3.246818
MEDAGE	0.004664	0.001732	2.692708	0.007104*	0.001882	2.478418	0.013210*	1.878712
DISTROAD	-0.017420	0.008820	-1.975118	0.048291*	0.007985	-2.181510	0.029167*	1.627531
DISTSCHL	-0.017104	0.007364	-2.322592	0.020216*	0.007903	-2.164276	0.030465*	1.934676
DISTWATR	-0.025563	0.003106	-8.229054	0.000000*	0.004324	-5.912567	0.000000*	2.511653
DISTHPTL	-0.012589	0.001826	-6.894900	0.000000*	0.002276	-5.530741	0.000000*	1.513178
DISTCOMM	0.029289	0.014366	2.038734	0.041507*	0.014619	2.003519	0.045155*	1.620946
DISTINDU	0.018322	0.004660	3.931936	0.000094*	0.004629	3.958514	0.000085*	1.966421
ZIPMIL	0.045677	0.011982	3.812049	0.000150*	0.011889	3.841909	0.000134*	1.490617
IMPCEC	0.029571	0.057609	0.513315	0.607761	0.078704	0.375730	0.707145	1.644514
IMPCEC3	0.177012	0.106160	1.667405	0.095495	0.098414	1.798640	0.072127	1.577113
IMPCEC1	0.008355	0.242573	0.034443	0.972513	0.111195	0.075137	0.940091	1.179672
DISCEC	-0.023444	0.002760	-8.495234	0.000000*	0.002832	-8.277911	0.000000*	32.383503
DISCEC2	0.000478	0.000049	9.705133	0.000000*	0.000049	9.692949	0.000000*	27.202597

Figure 4-1. Initial 1992 OLS Results

As can be seen in the initial OLS results for the 1992 Duval dataset, all of the variables with squared values significantly raise the VIF value due to redundancy. The squared variables were initially included to indicate a curve of the non-squared variable. The removal of the squared variables significantly reduces the VIF for their counterpart variables to within normal limits. Variables with a VIF under 7.5 can be used in GWR. For this reason the squared variables were removed for both OLS and GWR.

Issues Not Related to GWR

Impact Zones

The author set up impact zones to replicate the methodology used by Tu (2005) when he identified the farthest impact that was statistically significant that the Washington Redskins stadium had on surrounding house prices. This study was initially set up with arbitrary impact zones at one, three, and five kilometers from Cecil Field. The author then decided to forgo the arbitrary impact zones and test Tu's (2005) methodology, setting up impact zones up to 13 kilometers from Cecil Field in two kilometer increments using the 1992 dataset. The reason the farthest zone is 13

kilometers is because NAS Jacksonville is located due east of Cecil Field about 13 kilometers away. It was discovered that the three kilometer impact zone was statistically significant as were the seven, nine, and eleven kilometer impact zones. The three latter mentioned impact zones are all closer to NAS Jacksonville rather than Cecil Field. The author decided that it was not clear whether NAS Jacksonville or Cecil Field was having greater influence on the farther impact zones so the impact zones were removed from the methodology of this study.

Structural Variables

As mentioned earlier in Chapter 3, the proprietary sales data does not include the number of bathrooms (BATH) and bedrooms (ROOM) until 1998. When formatting the 1999 dataset the author discovered that only two-thirds of the warranty deed samples in the dataset contained the number of bathrooms and bedrooms which means that just over 3,000 samples would have had to be deleted. It was decided by the author to forgo including BATH and ROOM as structural variables starting with the 1999 dataset.

Percent of High School Dropouts in Census Tract (PCTDROP) Variable

When formatting the 2000 decennial U.S. Census Bureau data for number of 18-25 year olds that have not obtained their high school diploma the researcher noticed an anomaly in the data for two tracts when calculating the dropout percentage rate. Two of the tracts had a higher number of 18-25 year olds who had not obtained their high school diploma than the population for 18-25 year olds in the tract. For this reason the PCTDROP variable was removed from the model.

Prime Interest Rate at Time of Transaction (RATE) Variable

The prime interest rate (RATE) variable had to be removed because the OLS regression would not run with a variable that had no variance. Being a national level

variable, the interest rate was the same for every parcel in the specific dataset being tested. This was identified as an issue early on. All of the parcels in the 1992 dataset test run had a RATE of six (6). When the author altered just one parcel from a RATE of 6 to a RATE of 6.1 the OLS regression then ran. It is impossible for the software to estimate a coefficient for a variable that that does not vary.

Central Business District

It was discovered during this study that the central business district (CBD) was having an effect on single-family house sales prices. For this reason a proximity explanatory variable called DISTCBD was added to the hedonic pricing model.

The Revised Hedonic Pricing Model

Because of all of the earlier mentioned reasons, the hedonic pricing model was revised. Due to a statistically significant Jarque-Bera statistic (indicates spatial autocorrelation) in OLS for every dataset and statistically significant Moran's I for clustering of the residuals in the 1992 dataset, the author decided that OLS and GWR would be run for every dataset. The OLS regression includes all of the revised hedonic pricing model explanatory variables and the GWR includes only the variables that do not account for proximity.

Table 4-1. Revised Explanatory Variables

Variable	OLS	GWR
LOTSIZE	Yes	Yes
SF	Yes	Yes
AGE	Yes	Yes
INCOME	Yes	Yes
MEDAGE	Yes	Yes
DISTROAD	Yes	No
DISTSCHL	Yes	No
DISTWATR	Yes	No
DISTHPTL	Yes	No
DISTCOMM	Yes	No
DISTINDU	Yes	No

DISTCEC	Yes	No
DISTZIP	Yes	No
DISTCBD	Yes	No

Table 4-1. Continued

Results Using Revised Methodology

The following results use the revised hedonic pricing model just discussed is broken down by the year of the dataset tested. For all datasets the dependent variable PRICE is in dollars, therefore the coefficients are in dollars. The results discussed in this chapter are brief, touching on the results of the OLS and GWR regression analysis. The author's interpretation of the results will follow in Chapter 5.

Zip Codes with Cecil Personnel

Figure B-1 is a graphic depicting which zip codes Cecil Field personnel primarily lived at and was derived from the NAS Cecil Field Final Base Reuse Plan (1996) published by the Cecil Field Development Commission. The two main zip codes where Cecil Personnel lived at the time of the publication of the Final Base Reuse Plan were 32210 and 32244 with Cecil Field personnel populations of approximately 1,509 (20.3% of the Cecil personnel) and 1,420 (19.1% of the Cecil personnel) respectively plus their dependents. The 2005 U.S. Census Bureau population for 32210 was 60,807 and 32244 was 54,451. Both Cecil Field zip code populations represent approximately 2.5% of the total population for each zip code. These two zip codes will hereinafter be referred to as the "main" zip codes. The main zip codes are extremely close to NAS Jacksonville and provide easy access to Cecil Field, NAS Jacksonville, the CBD, and Interstates 95 and 10. When Cecil Field was still operational as a NAS, NAS Jacksonville provided dependents with more robust services than NAS Cecil Field. The

main Naval Hospital for the southeast is at NAS Jacksonville and the larger Exchange (department store) and Commissary are at NAS Jacksonville.

1992 Dataset

The 1992 dataset is representative of the Jacksonville housing market while NAS Cecil Field was an operational jet base. The OLS results are shown in Figure 4-2.

Summary of OLS Results

Variable	Coefficient	StdError	t-Statistic	Probability	Robust_SE	Robust_t	Robust_Pr	VIF [1]
Intercept	-26568.621677	3322.648853	-7.996217	0.000000*	4275.929069	-6.213532	0.000000*	--------
LOTSIZE	301.705484	33.960107	8.884115	0.000000*	88.426329	3.411942	0.000665*	1.166503
AGE	-333.438499	22.354211	-14.916138	0.000000*	30.174589	-11.050308	0.000000*	2.036945
SF	44.267015	0.631203	70.131224	0.000000*	0.992543	44.599616	0.000000*	1.416002
INCOME	0.285731	0.032902	8.684292	0.000000*	0.046936	6.087681	0.000000*	3.586443
MEDAGE	608.748980	97.348639	6.253287	0.000000*	108.687070	5.600933	0.000000*	1.858813
DISTCEC	0.015433	0.045438	0.339640	0.734153	0.049088	0.314384	0.753251	2.759139
DISTCBD	0.445687	0.083277	5.351887	0.000000*	0.095518	4.666008	0.000005*	3.656480
DISTIND	1.016141	0.262212	3.875272	0.000118*	0.297622	3.414201	0.000660*	1.918388
DISTCOM	1.333773	0.744699	1.791023	0.073342	0.835155	1.597037	0.110321	1.800154
DISTHPT	-0.658657	0.108945	-6.045781	0.000000*	0.120220	-5.478751	0.000000*	1.686005
DISTSCH	-0.850933	0.421355	-2.019517	0.043466*	0.515419	-1.650954	0.098810	1.990260
DISTWAT	-0.870970	0.163519	-5.326422	0.000000*	0.200611	-4.341595	0.000018*	2.197774
DISTROA	3.787657	1.100401	3.442070	0.000597*	1.401457	2.702656	0.006895*	1.385074
DISTZIP	-0.079260	0.096585	-0.820621	0.411879	0.097671	-0.811492	0.417100	1.569825

OLS Diagnostics

Number of Observations:	6349	Number of Variables:	15
Degrees of Freedom:	6334	Akaike's Information Criterion (AIC) [2]:	144912.064751
Multiple R-Squared [2]:	0.672305	Adjusted R-Squared [2]:	0.671581
Joint F-Statistic [3]:	928.211624	Prob(>F), (14,6334) degrees of freedom:	0.000000*
Joint Wald Statistic [4]:	7731.580389	Prob(>chi-squared), (14) degrees of freedom:	0.000000*
Koenker (BP) Statistic [5]:	562.921151	Prob(>chi-squared), (14) degrees of freedom:	0.000000*
Jarque-Bera Statistic [6]:	14295.824397	Prob(>chi-squared), (2) degrees of freedom:	0.000000*

Notes on Interpretation

* Statistically significant at the 0.05 level.
[1] Large VIF (> 7.5, for example) indicates explanatory variable redundancy.
[2] Measure of model fit/performance.
[3] Significant p-value indicates overall model significance.
[4] Significant p-value indicates robust overall model significance.
[5] Significant p-value indicates biased standard errors; use robust estimates.
[6] Significant p-value indicates residuals deviate from a normal distribution.

Figure 4-2. 1992 OLS Results

Due to a statistically significant Koenker (BP) value the robust estimates must be used. The adjusted R-Squared is .671 which means that approximately 67% of the housing price “story” is told with the current model. The LOTSIZE variable is statistically significant to the .00 level (100% confidence) that an increase in the size of the lot will result in a price increase of $301.71 for each acre increased. The AGE variable is statistically significant to the .00 level that an increase in the age of the structure by one year will result in a price decrease of $333.44 for each year of increase in structure age.

The SF variable is statistically significant to the .00 level that an increase in the square footage of the structure by one square foot will result in a price increase of $44.28 for each square foot increase. The INCOME variable is statistically significant to the .00 level that an increase by one dollar of the median income in the census tract will result in a price increase of $0.29 for each dollar increase in median income. The MEDAGE variable is statistically significant to the .00 level that an increase in the median age of the census tract by one year will result in a price increase of $608.75 for each year increase. The DISTCEC variable is statistically significant to the .75 level (only 25% confidence), therefore, the author could not reject the null hypothesis that the coefficient was different from zero (0) and that the distance from Cecil field had any effect on the 1992 single-family house prices. The DISTCBD variable is statistically significant to the .00 level that an increase in the distance from the central business district by one meter will result in a price increase of $0.45 for each one meter increase in distance from the CBD. The DISTINDU variable is statistically significant to the .00 level that an increase in the distance from an industrial land use by one meter will result in a price increase of $1.02 for each one meter increase from the industrial land use. The DISTCOMM variable is statistically significant to the .11 level (89% confidence), therefore, the author could not reject the null hypothesis that the coefficient was different from zero (0) and that the distance from a commercial land use had any effect on the 1992 single-family house prices. The DISTHPTL variable is statistically significant to the .00 level that an increase in the distance from the hospital by one meter will result in a price decrease of $0.66 for each one meter increase in distance from the hospital. The DISTSCHL variable is statistically significant to the .10 level (90% confidence), therefore, the author

could not reject the null hypothesis that the coefficient was different from zero (0) based on a statistical significance to the .05 level as the software is set for. However, the t-statistic is -2.02, just barely over the threshold of 2.0 which leads the author to believe that an increase in the distance from a school by one meter will result in a price decrease of $0.85 for each one meter increase in distance from the school at a 90% confidence level. The DISTWATR variable is statistically significant to the .00 level that an increase in the distance from a major water body by one meter will result in a price decrease of $0.87 for each one meter increase in distance from the major water body. The DISTROAD variable is statistically significant to the .00 level that an increase in the distance from a major or minor arterial road by one meter will result in a price increase of $3.79 for each one meter increase in distance from the major or minor arterial road. The DISTZIP variable is statistically significant to the .42 level (only 58% confidence), therefore, the author could not reject the null hypothesis that the coefficient was different from zero (0) and that the distance from the centroid of any zip code identified as having Cecil Field personnel living there had any effect on the 1992 single-family house prices.

The GWR result maps for the 1992 dataset are located in Appendix C. Figure 4-3 demonstrates that each parcel was compared to 700 of its neighbors and that the R-Squared Adjusted is .447, or in other words, the five variables tell 45% of the housing price “story”.

```
Neighbours          : 700
ResidualSquares     : 51783619837.26286
EffectiveNumber     : 3.8714107851925483
Sigma               : 24378.99856807047
AICc                : 2101.036371719718
R2                  : 0.4654511237460579
R2Adjusted          : 0.44783452485101616
Executed (GeographicallyWeightedRegression) successfully.
```

Figure 4-3. 1992 GWR Results

Recall that the AGE coefficient was statistically significant in the OLS results and was negative for each year the age of the structure increased. The AGE coefficient in GWR varies by area and is negative in most areas but is positive just west of the CBD where predominantly older structures are clustered. This is because the older structures could be considered historic and actually gain value with age. The SF coefficient in OLS was positive and statistically significant. The GWR results in the main zip codes where Cecil personnel lived and all of Duval County depict a positive increase in house prices with an increase in square footage. The LOTSIZE coefficient in OLS was positive and statistically significant. The GWR results in the main zip codes depict a neutral to increase in house prices if the size of the lot were to increase in those areas. The INCOME coefficient in OLS was positive and statistically significant. The 2000 decennial U.S. Census Bureau median income for the main zip codes ranges from $29,000 to $50,000. The GWR results in the main zip codes depict a neutral to increase in house prices if the median income were to increase in those areas. The MEDAGE coefficient in OLS was positive and statistically significant. The 2000 decennial U.S. Census Bureau median age for the main zip codes is very diverse and represents the full range of median ages. The GWR results in the main zip codes depict a neutral to positive increase in house prices if the median age were to increase in those areas.

1993 Dataset

The 1993 dataset is representative of the Jacksonville housing market when the announcement was made that NAS Cecil Field was selected by the Base Closure and Realignment Committee and approved for closure by the President and Congress. The OLS results are shown in Figure 4-4.

Summary of OLS Results

Variable	Coefficient	StdError	t-Statistic	Probability	Robust SE	Robust t	Robust Pr	VIF [1]
Intercept	-37682.048386	3026.319714	-12.451443	0.000000*	3692.240945	-10.205739	0.000000*	--------
LOTSIZE	2988.084041	528.198014	5.657129	0.000000*	920.225554	3.247121	0.001187*	1.231946
AGE	-355.821345	21.012169	-16.934061	0.000000*	24.302255	-14.641495	0.000000*	2.251452
SF	45.565475	0.591197	77.073213	0.000000*	1.415991	32.179218	0.000000*	1.394868
INCOME	0.404900	0.030624	13.221449	0.000000*	0.038730	10.454447	0.000000*	3.549673
MEDAGE	743.811203	89.662858	8.295645	0.000000*	103.096096	7.214737	0.000000*	1.842150
DISTCEC	0.071334	0.040719	1.751842	0.079850	0.047219	1.510698	0.130925	2.759696
DISTCBD	0.388560	0.075566	5.142017	0.000001*	0.078559	4.946066	0.000001*	3.568093
DISTIND	0.860345	0.249305	3.450973	0.000578*	0.258201	3.332077	0.000883*	1.987943
DISTCOM	3.706791	0.742684	4.991072	0.000001*	0.891166	4.159485	0.000038*	1.989705
DISTHPT	-0.705355	0.099143	-7.114517	0.000000*	0.104473	-6.751582	0.000000*	1.820384
DISTSCH	-0.614045	0.371122	-1.654566	0.098068	0.504528	-1.217069	0.223620	1.962354
DISTWAT	-0.399332	0.141547	-2.821200	0.004802*	0.161004	-2.480258	0.013139*	2.356458
DISTROA	-1.103461	0.455165	-2.424309	0.015348*	0.477206	-2.312335	0.020771*	1.904331
DISTZIP	0.018132	0.089362	0.202902	0.839213	0.095397	0.190066	0.849256	1.621548

OLS Diagnostics

Number of Observations:	7232	Number of Variables:	15
Degrees of Freedom:	7217	Akaike's Information Criterion (AIC) [2]:	164696.981852
Multiple R-Squared [2]:	0.697465	Adjusted R-Squared [2]:	0.696878
Joint F-Statistic [3]:	1188.433496	Prob(>F), (14,7217) degrees of freedom:	0.000000*
Joint Wald Statistic [4]:	10272.410454	Prob(>chi-squared), (14) degrees of freedom:	0.000000*
Koenker (BP) Statistic [5]:	1064.350143	Prob(>chi-squared), (14) degrees of freedom:	0.000000*
Jarque-Bera Statistic [6]:	17141.580247	Prob(>chi-squared), (2) degrees of freedom:	0.000000*

Notes on Interpretation

* Statistically significant at the 0.05 level.
[1] Large VIF (> 7.5, for example) indicates explanatory variable redundancy.
[2] Measure of model fit/performance.
[3] Significant p-value indicates overall model significance.
[4] Significant p-value indicates robust overall model significance.
[5] Significant p-value indicates biased standard errors; use robust estimates.
[6] Significant p-value indicates residuals deviate from a normal distribution.

Figure 4-4. 1993 OLS Results

Due to a statistically significant Koenker (BP) value the robust estimates must be used. The adjusted R-Squared increased slightly from .671 in 1992 to .697 in 1993. Similar to the 1992 dataset, the coefficients for DISTCEC, DISTSCHL, and DISTZIP are all statistically insignificant due to their robust t-Statistics being under two (2). Though it is still statistically insignificant, the robust t-Statistic for DISTCEC did increase from .75 to 1.5 and the coefficient increased slightly as well. The DISTCOMM coefficient went from being statistically insignificant in 1992 to statistically significant at the .00 level (100% confidence) in 1993. An increase in distance from a commercial land use will increase the house price by $3.71 for each meter in increased distance. The DISTINDU coefficient decreased from $1.02 in 1992 to $0.86 in 1993. The LOTSIZE coefficient increased drastically from $301.70 in 1992 to a $2,988.08 per acre increase in 1993.

Another drastic change is that the DISTROAD coefficient went from positive to negative and indicates that an increase in distance from a major or minor arterial road will decrease the house sale price by $1.10 for each one meter increase in distance from the arterial road. The remaining coefficients saw a slight increase or decrease in their coefficient value; however, all of their signs and statistical significance remain unchanged.

The GWR result maps for the 1993 dataset are located in Appendix D. Figure 4-5 shows that each parcel was compared to 700 of its neighbors and that the R-Squared Adjusted decreased from .447 in 1992 to .295 in 1993.

```
Neighbours          : 700
ResidualSquares     : 8818348541.846954
EffectiveNumber     : 0.5329917804359378
Sigma               : 21852.209667564406
AICc                : 436.2355511792588
R2                  : 0.27678636279925095
R2Adjusted          : 0.2950755577277375
Executed (GeographicallyWeightedRegression) successfully.
```

Figure 4-5. 1993 GWR Results

The AGE coefficient remained statistically significant in the OLS results and was negative for each year the age of the structure increased. The AGE coefficient in GWR varies by area and remained negative in most areas but remained positive just west of the CBD where predominantly older structures are clustered. The high and low coefficient values decreased slightly in comparison to the 1992 values. The SF coefficient in the OLS results remained positive and statistically significant. The GWR results in the main zip codes and all of Duval County still depict a positive increase in house prices with an increase in square footage. The high and low coefficient values increased slightly in comparison to the 1992 values. The LOTSIZE coefficient in the OLS results remained positive and statistically significant; however, it was mentioned

earlier that the coefficient increased drastically. The GWR results in the main zip codes changed from a neutral to positive increase in house prices in 1992 to a neutral to negative decrease in house prices in 1993 if the size of the lot were to increase in those areas. Similar to the OLS results, the high and low coefficient values significantly increased and significantly decreased respectively which could be due to the significantly lower R-Squared Adjusted which indicates missing variables in the model. The LOTSIZE coefficients could have significantly changed to compensate for variables that were not defined in the model. The INCOME coefficient in the OLS results remained positive and statistically significant. The GWR results in the main zip codes still depict a neutral to positive increase in house prices if the median income were to increase in those areas. The influence area for the positive increase in house prices has grown farther south than the main zip codes; more toward NAS Jacksonville. Also, the area west of Cecil Field has shifted from neutral to a positive increase in house prices if the median income increased in that area. The MEDAGE coefficient in the OLS results remained positive and statistically significant. The GWR results in the area of the main zip codes depicted a neutral to positive increase in house prices in 1992 but changed to a neutral to negative decrease in house prices in 1993 if the median age were to increase in those areas.

1994 Dataset

The 1994 dataset is representative of the Jacksonville housing market a year after the NAS Cecil Field closure announcement was made in order to attempt to capture any lag in the housing market reaction to the announcement. The OLS results are shown in Figure 4-6.

Summary of OLS Results

Variable	Coefficient	StdError	t-Statistic	Probability	Robust_SE	Robust_t	Robust_Pr	VIF [1]
Intercept	-45814.446355	3170.977852	-14.448050	0.000000*	4204.045544	-10.897705	0.000000*	--------
LOTSIZE	1340.020050	653.746574	2.049755	0.040411*	1222.412699	1.096209	0.273015	1.205077
AGE	-262.404564	20.823647	-12.601278	0.000000*	28.475587	-9.215071	0.000000*	2.164489
SF	48.076138	0.603668	79.640031	0.000000*	1.254402	38.325944	0.000000*	1.402927
INCOME	0.455655	0.029742	15.320061	0.000000*	0.041010	11.110784	0.000000*	3.262897
MEDAGE	755.514974	91.973953	8.214445	0.000000*	106.597971	7.087517	0.000000*	1.809302
DISTCEC	0.055944	0.043517	1.285562	0.198642	0.049762	1.124220	0.260950	2.859200
DISTCBD	0.553315	0.077187	7.168494	0.000000*	0.087411	6.330032	0.000000*	3.380383
DISTIND	1.503972	0.260981	5.762759	0.000000*	0.271514	5.539204	0.000000*	1.954392
DISTCOM	7.103118	0.789613	8.995691	0.000000*	0.904696	7.851389	0.000000*	1.824681
DISTHPT	-0.921499	0.105314	-8.750013	0.000000*	0.117715	-7.828197	0.000000*	1.780294
DISTSCH	-1.413432	0.405292	-3.487446	0.000506*	0.486686	-2.904201	0.003700*	1.801663
DISTWAT	-0.284798	0.151830	-1.875771	0.060723	0.178341	-1.596933	0.110336	2.239539
DISTROA	-1.519665	0.491943	-3.089106	0.002029*	0.508471	-2.988696	0.002821*	1.832789
DISTZIP	-0.035446	0.092296	-0.384047	0.700969	0.096950	-0.365614	0.714678	1.578850

OLS Diagnostics

Number of Observations:	7721	Number of Variables:	15
Degrees of Freedom:	7706	Akaike's Information Criterion (AIC) [2]:	177105.266610
Multiple R-Squared [2]:	0.698436	Adjusted R-Squared [2]:	0.697888
Joint F-Statistic [3]:	1274.815734	Prob(>F), (14,7706) degrees of freedom:	0.000000*
Joint Wald Statistic [4]:	10747.561993	Prob(>chi-squared), (14) degrees of freedom:	0.000000*
Koenker (BP) Statistic [5]:	1210.480793	Prob(>chi-squared), (14) degrees of freedom:	0.000000*
Jarque-Bera Statistic [6]:	17604.263733	Prob(>chi-squared), (2) degrees of freedom:	0.000000*

Notes on Interpretation

* Statistically significant at the 0.05 level.
[1] Large VIF (> 7.5, for example) indicates explanatory variable redundancy.
[2] Measure of model fit/performance.
[3] Significant p-value indicates overall model significance.
[4] Significant p-value indicates robust overall model significance.
[5] Significant p-value indicates biased standard errors; use robust estimates.
[6] Significant p-value indicates residuals deviate from a normal distribution.

Figure 4-6. 1994 OLS Results

Due to a statistically significant Koenker (BP) value the robust estimates must be used. The adjusted R-Squared increased almost unnoticeably from .697 in 1993 to .698 in 1994. In comparison to the 1993 dataset DISTCEC and DISTZIP remain statistically insignificant due to their robust T-Statistic being under two (2). DISTSCHL became statistically significant with a robust T-Statistic at -3.49 and a probability at the .00 level (100% confidence). DISTWATR was statistically significant in 1993 but became statistically insignificant in the 1994 dataset. The coefficients for DISTSCHL, DISTCOMM, and DISTINDU nearly doubled in value when compared to 1993. While LOTSIZE experienced a drastic increase in 1993, it experienced a drastic decrease in 1994 from $2,988.08 to $1,340.02 per acre increase in lot size. LOTSIZE also became statistically insignificant in 1994 using the robust T-Statistic. It remained statistically significant using the non-robust T-Statistic, however, as mentioned earlier, the

statistically significant Koenker (BP) value requires the researcher to use the robust values. All of the signs for the statistically significant coefficients remained the same as 1993. It is interesting to note that the SF robust t-Statistic has remained very high through all three datasets so far suggesting that square footage contributes the most to a house's price; not in dollars but in consistency of the estimated coefficient, statistical significance, and surety that an increase in a house's square footage will increase its value.

The GWR result maps for the 1994 dataset are located in Appendix E. Figure 4-7 shows that each parcel was compared to 700 of its neighbors and that the R-Squared Adjusted increased drastically from .295 in 1993 to .738 in 1994 with no additional variables added and the neighbors remaining at 700.

```
Neighbours          : 700
ResidualSquares     : 117762432027.26573
EffectiveNumber     : 7.007687500512251
Sigma               : 24449.99326624837
AICc                : 4707.7375180967365
R2                  : 0.746040796322261
R2Adjusted          : 0.738295785797656
Executed (GeographicallyWeightedRegression) successfully.
```

Figure 4-7. 1994 GWR Results

The AGE coefficient remained statistically significant in the OLS results and was negative for each year the age of the structure increased. It is interesting to note that while the age coefficient decreased from 1993 to 1994 in the OLS results, the high and low coefficient values increased in comparison to 1993 by as much as $128.00 for the high coefficient value. The GWR patterns for AGE remain the same between 1993 and 1994 but the 1994 patterns contain more intense reds indicating higher coefficient values for each year increase in the structure's age. The SF coefficient in the OLS results remained positive and statistically significant. The GWR results in the main zip codes and all of Duval County still depict a positive increase in house prices with an

increase in square footage; however, the northern area of the main zip codes and directly on the east side of Cecil Field experienced a decrease in the value of the SF coefficient while the area directly west of NAS Jacksonville experienced an increase in the value of the SF coefficient. The high and low coefficient values increased slightly in comparison to the 1993 values. The LOTSIZE coefficient in the OLS results decreased dramatically and lost its statistical significance when using the robust values. The GWR results in the main zip codes changed from a neutral to negative decrease in house prices in 1993 to a neutral to very positive increase in house prices in 1994 if the size of the lot were to increase in those areas. The area outside of Cecil Field saw no change and remains negative. The fact that the LOTSIZE variable is statistically insignificant in the OLS results brings into question the accuracy of the LOTSIZE GWR results. The INCOME coefficient in the OLS results remained positive and statistically significant. The GWR results in the main zip codes still depict a neutral to positive increase in house prices if the median income were to increase in those areas; however, the positive influence is much less intense. The patterns remain relatively similar to the 1993 patterns, but the area west of Cecil Field has shifted back to a neutral effect on house prices if the median income increased in that area. The MEDAGE coefficient in the OLS results remained positive and statistically significant. The GWR results in the area of the main zip codes depicted a neutral to negative decrease in house prices in 1993 but changed to a neutral to positive increase in house prices in 1994 if the median age were to increase in those areas. Also, the area west of Cecil Field saw a dramatic change from a negative to a positive influence on house prices with an increase in the median age.

1999 Dataset

The 1999 dataset is representative of the Jacksonville housing market in the year that NAS Cecil Field officially ceased air operations. The OLS results are shown in Figure 4-8.

Summary of OLS Results

Variable	Coefficient	StdError	t-Statistic	Probability	Robust_SE	Robust_t	Robust_Pr	VIF [1]
Intercept	-88605.631710	3815.283769	-23.223864	0.000000*	5175.442249	-17.120398	0.000000*	--------
LOTSIZE	-2033.636509	740.678782	-2.745639	0.006050*	1627.293157	-1.249705	0.211441	1.259023
AGE	-46.517362	23.166204	-2.007984	0.044662*	31.305508	-1.485916	0.137347	2.305305
SF	56.398715	0.602427	93.619158	0.000000*	1.460187	38.624308	0.000000*	1.497119
INCOME	0.393316	0.036317	10.830217	0.000000*	0.046209	8.511680	0.000000*	3.444315
MEDAGE	1287.068672	107.816562	11.937579	0.000000*	120.926159	10.643426	0.000000*	1.776780
DISTCEC	0.310374	0.051174	6.065088	0.000000*	0.058108	5.341336	0.000000*	3.116181
DISTCBD	1.112455	0.092190	12.067000	0.000000*	0.098727	11.267937	0.000000*	3.590511
DISTIND	1.579521	0.295230	5.350136	0.000000*	0.329734	4.790294	0.000003*	1.900140
DISTCOM	10.691421	0.874616	12.224131	0.000000*	1.097250	9.743836	0.000000*	1.776975
DISTHPT	-1.478428	0.124065	-11.916535	0.000000*	0.140176	-10.546959	0.000000*	1.853730
DISTSCH	-1.156854	0.431103	-2.683478	0.007295*	0.559800	-2.066548	0.038790*	1.682651
DISTWAT	0.826924	0.168358	4.911690	0.000002*	0.202431	4.084967	0.000051*	2.362115
DISTROA	-3.668507	0.548967	-6.682565	0.000000*	0.581017	-6.313946	0.000000*	1.771083
DISTZIP	0.501130	0.107066	4.680558	0.000004*	0.112169	4.467619	0.000011*	1.488977

OLS Diagnostics

Number of Observations:	10263	Number of Variables:	15
Degrees of Freedom:	10248	Akaike's Information Criterion (AIC) [2]:	241354.617476
Multiple R-Squared [2]:	0.684109	Adjusted R-Squared [2]:	0.683677
Joint F-Statistic [3]:	1585.252692	Prob(>F), (14,10248) degrees of freedom:	0.000000*
Joint Wald Statistic [4]:	13310.255815	Prob(>chi-squared), (14) degrees of freedom:	0.000000*
Koenker (BP) Statistic [5]:	1757.998525	Prob(>chi-squared), (14) degrees of freedom:	0.000000*
Jarque-Bera Statistic [6]:	30245.805407	Prob(>chi-squared), (2) degrees of freedom:	0.000000*

Notes on Interpretation

* Statistically significant at the 0.05 level.
[1] Large VIF (> 7.5, for example) indicates explanatory variable redundancy.
[2] Measure of model fit/performance.
[3] Significant p-value indicates overall model significance.
[4] Significant p-value indicates robust overall model significance.
[5] Significant p-value indicates biased standard errors; use robust estimates.
[6] Significant p-value indicates residuals deviate from a normal distribution.

Figure 4-8. 1999 OLS Results

Due to a statistically significant Koenker (BP) value the robust estimates must be used. The adjusted R-Squared decreased from .698 in 1994 to .684 in 1999. Had the non-robust estimates been allowed, all of the variables would have been statistically significant. However, because robust estimates must be used, LOTSIZE changed to an unexpected negative sign and remained statistically insignificant and AGE changed from being statistically significant in 1994 to statistically insignificant in 1999. DISTZIP, DISTWATR, and DISTCEC all changed from being statistically insignificant in 1994 to being statistically significant in 1999. DISTWATR's sign made an unexpected change

from negative to positive meaning that an increase in distance from a major water body will increase the house price. DISTCEC and DISTZIP both became significant on the year that NAS Cecil Field ceased operations. Both coefficient values were positive indicating that an increase in distance from Cecil Field and from the centroid of a zip code with known Cecil Personnel living in it will increase a single-family house's sales price. MEDAGE, DISTROAD, and DISTCBD nearly doubled their values when compared to 1994.

The GWR result maps for the 1999 dataset are located in Appendix F. Figure 4-9 shows that each parcel was compared to 700 of its neighbors and that the R-Squared Adjusted decreased from .738 in 1994 to .729 in 1999.

```
Neighbours          : 700
ResidualSquares     : 60338007030.064285
EffectiveNumber     : 5.204080415569877
Sigma               : 24466.621583900727
AICc                : 2448.498087990697
R2                  : 0.7403110801631834
R2Adjusted          : 0.7294797577591849
```

Figure 4-9. 1999 GWR Results

The AGE coefficient became statistically insignificant in the OLS results. In the GWR results the high coefficient value increased from $132.00 in 1994 to $943.00 in 1999. The GWR patterns for AGE remain the same between 1994 and 1999 but the 1999 patterns contain less intense reds indicating neutral coefficient values for each year increase in the structure's age. The SF coefficient in the OLS results remained positive and statistically significant. The GWR results in the main zip codes and all of Duval County still depict a positive increase in house prices with an increase in square footage; however, the area of the main zip codes and the area surrounding the circumference of Cecil Field up to NAS Jacksonville experienced a decrease in the value of the SF coefficient. The high and values increased by $25.00 per square foot in

comparison to the 1993 value. The LOTSIZE coefficient in the OLS results remained statistically insignificant when using the robust values. The high value in the GWR results doubled to $166,000. The results in the main zip codes remain neutral to a positive increase in house prices in 1999 if the size of the lot were to increase in those areas. The area outside of Cecil Field saw no change and remains negative. The fact that the LOTSIZE variable is statistically insignificant in the OLS results and its sign in the OLS results is opposite of what it should be brings into question the accuracy of the LOTSIZE GWR results. The INCOME coefficient in the OLS results remained positive and statistically significant. The GWR results in the main zip codes still depict a neutral to positive increase in house prices if the median income were to increase in those areas; however, the positive influence is less intense. The area northwest of Cecil Field increased from a neutral to a positive increase in house prices if the median income were to increase in that area. This area has consistently “flip-flopped” from neutral to positive and back with each dataset tested since the initial 1992 dataset. The MEDAGE coefficient in the OLS results remained positive and statistically significant. The high coefficient in the GWR MEDAGE results increased drastically from $5,300 in 1994 to $49,000 in 1999. The GWR results in the area of the main zip codes depicted a neutral to positive increase in house prices in 1994 and remained that way in 1999. Also, the area west of Cecil Field that saw a dramatic change from a negative to a positive influence on house prices in 1994 shifted to the northwest edge of Cecil Field in 1999.

2000 Dataset

The 2000 dataset is representative of the Jacksonville housing market in the year that NAS Cecil Field ceased to exist as a NAS and is one year after air operations officially ended. The purpose of this dataset is to capture any lag in the market in

reaction to the end of air operations at Cecil Field. The OLS results are shown in Figure 4-10.

Summary of OLS Results

Variable	Coefficient	StdError	t-Statistic	Probability	Robust_SE	Robust_t	Robust_Pr	VIF [1]
Intercept	-95704.374750	4397.983035	-21.760970	0.000000*	5883.466530	-16.266664	0.000000*	--------
LOTSIZE	-2452.845935	748.242084	-3.278145	0.001065*	1517.772516	-1.616083	0.106122	1.258578
AGE	-70.402474	26.441626	-2.662562	0.007764*	34.309844	-2.051961	0.040189*	2.174788
SF	60.883647	0.680250	89.501896	0.000000*	1.598815	38.080487	0.000000*	1.519605
INCOME	0.530818	0.041241	12.871001	0.000000*	0.054811	9.684476	0.000000*	3.384883
MEDAGE	1324.883085	122.881479	10.781796	0.000000*	145.382898	9.113060	0.000000*	1.784231
DISTCEC	0.408118	0.060541	6.741159	0.000000*	0.065892	6.193777	0.000000*	3.130049
DISTCBD	1.027274	0.108750	9.446241	0.000000*	0.114267	8.990108	0.000000*	3.574620
DISTIND	0.745870	0.344970	2.162133	0.030617*	0.392381	1.900883	0.057344	1.891701
DISTCOM	9.161512	1.065622	8.597334	0.000000*	1.241297	7.380594	0.000000*	1.779098
DISTHPT	-1.801975	0.143605	-12.548178	0.000000*	0.154958	-11.628820	0.000000*	1.776387
DISTSCH	-0.857253	0.504904	-1.697852	0.089578	0.634092	-1.351936	0.176438	1.546616
DISTWAT	0.856510	0.196821	4.351713	0.000017*	0.217576	3.936597	0.000092*	2.268330
DISTROA	-4.109729	0.678683	-6.055444	0.000000*	0.702948	-5.846417	0.000000*	1.800607
DISTZIP	0.831546	0.127034	6.545832	0.000000*	0.135105	6.154817	0.000000*	1.476288

OLS Diagnostics

Number of Observations:	9818	Number of Variables:	15
Degrees of Freedom:	9803	Akaike's Information Criterion (AIC) [2]:	233728.341134
Multiple R-Squared [2]:	0.675132	Adjusted R-Squared [2]:	0.674668
Joint F-Statistic [3]:	1455.167256	Prob(>F), (14,9803) degrees of freedom:	0.000000*
Joint Wald Statistic [4]:	12669.105068	Prob(>chi-squared), (14) degrees of freedom:	0.000000*
Koenker (BP) Statistic [5]:	2086.794892	Prob(>chi-squared), (14) degrees of freedom:	0.000000*
Jarque-Bera Statistic [6]:	23703.888544	Prob(>chi-squared), (2) degrees of freedom:	0.000000*

Notes on Interpretation

* Statistically significant at the 0.05 level.
[1] Large VIF (> 7.5, for example) indicates explanatory variable redundancy.
[2] Measure of model fit/performance.
[3] Significant p-value indicates overall model significance.
[4] Significant p-value indicates robust overall model significance.
[5] Significant p-value indicates biased standard errors; use robust estimates.
[6] Significant p-value indicates residuals deviate from a normal distribution.

Figure 4-10. 2000 OLS Results

Due to a statistically significant Koenker (BP) value the robust estimates must be used. The adjusted R-Squared decreased from .684 in 1999 to .674 in 2000. LOTSIZE continues to be statistically insignificant and have the opposite sign than expected. DISTINDU and DISTSCHL changed from being statistically significant in 1999 to statistically insignificant in 2000. DISTWATR continues to have the opposite sign expected. No statistically significant variables experienced major changes in their coefficients' values with exception of DISTCOMM which increased by $8.00 and seems to fluctuate in each dataset.

The GWR result maps for the 2000 dataset are located in Appendix G. Figure 4-11 shows that each parcel was compared to 750 of its neighbors, an increase of 50 neighbors from 1999, and that the R-Squared Adjusted increased from .740 in 1999 to .795 in 2000.

```
Neighbours          : 750
ResidualSquares     : 214678428636.6207
EffectiveNumber     : 10.422927392235623
Sigma               : 27369.917155008494
AICc                : 6919.826444694802
R2                  : 0.8015355139139523
R2Adjusted          : 0.7950098123799506
Executed (GeographicallyWeightedRegression) successfully.
```

Figure 4-11. 2000 GWR Results

The AGE coefficient became statistically significant in the 2000 OLS results. In the GWR results the high coefficient value decreased from $943.00 in 1999 to $769.00 in 2000. The GWR patterns for AGE remained the same between 1999 and 2000 and the overall results are relatively unchanged between the two datasets. The SF coefficient in the OLS results remained positive and statistically significant. The GWR results in the main zip codes and all of Duval County remain relatively unchanged from 1999 to 2000. There was only a slight increase in the SF high coefficient from $100.00 in 1999 to $112.00 in 2000. The LOTSIZE coefficient in the OLS results remained statistically insignificant when using the robust values. The high value in the GWR results increased from $166,000 in 1999 to $219,000 in 2000. The results in the main zip codes and all of Duval County remain relatively unchanged from 1999 to 2000. The fact that the LOTSIZE variable is statistically insignificant in the OLS results and its sign in the OLS results is opposite of what it should be continues to bring into question the accuracy of the LOTSIZE GWR results. The INCOME coefficient in the OLS results remained positive and statistically significant. The GWR results in the main zip codes still depict a

neutral to positive increase in house prices if the median income were to increase in those areas. The area of positive coefficients northwest of Cecil Field decreased in actual area, not quite going back to a neutral state. The MEDAGE coefficient in the OLS results remained positive and statistically significant. The high coefficient in the GWR MEDAGE results decreased from $49,000 in 1999 to $30,000 in 2000. The GWR results throughout Duval County remained relatively unchanged.

2009 Dataset

The 2009 dataset is representative of the Jacksonville housing market nine years after the closing of NAS Cecil Field and nine years into the redevelopment of Cecil Field. The purpose of this dataset is to capture any effects of the redevelopment of Cecil Field as Cecil Commerce Center. The OLS results are shown in Figure 4-12.

Summary of OLS Results

Variable	Coefficient	StdError	t-Statistic	Probability	Robust_SE	Robust_t	Robust_Pr	VIF [1]
Intercept	-141149.505841	19244.409211	-7.334572	0.000000*	22090.107197	-6.389716	0.000000*	--------
LOTSIZE	842.233214	2686.221378	0.313538	0.753924	3793.528031	0.222018	0.824327	1.155677
AGE	-234.944174	109.126624	-2.152950	0.031459*	150.325765	-1.562900	0.118291	1.842972
SF	80.038831	2.608004	30.689685	0.000000*	6.387392	12.530753	0.000000*	1.463489
INCOME	0.207599	0.157966	1.314200	0.188979	0.223846	0.927418	0.353837	2.917122
MEDAGE	3360.097070	560.031948	5.999831	0.000000*	542.153284	6.197688	0.000000*	1.922362
DISTCEC	0.491465	0.256840	1.913506	0.055860	0.275237	1.785604	0.074360	3.312986
DISTCBD	3.238335	0.444268	7.289146	0.000000*	0.485687	6.667532	0.000000*	3.067680
DISTIND	1.497695	1.414832	1.058568	0.289949	1.777138	0.842757	0.399478	1.669620
DISTCOM	3.711462	4.078049	0.910107	0.362890	4.256641	0.871923	0.383368	1.816714
DISTHPT	-4.176981	0.531926	-7.852561	0.000000*	0.513472	-8.134775	0.000000*	2.026827
DISTSCH	-3.043058	1.545405	-1.969101	0.049109*	1.447702	-2.101992	0.035699*	1.586926
DISTWAT	-0.037209	0.735956	-0.050559	0.959669	0.842237	-0.044179	0.964754	2.526507
DISTROA	-2.482580	2.595019	-0.956671	0.338866	2.476365	-1.002510	0.316239	1.600215
DISTZIP	0.182637	0.532451	0.343012	0.731649	0.554001	0.329668	0.741706	1.774037

OLS Diagnostics

Number of Observations:	1597	Number of Variables:	15
Degrees of Freedom:	1582	Akaike's Information Criterion (AIC) [2]:	39844.662999
Multiple R-Squared [2]:	0.590213	Adjusted R-Squared [2]:	0.586586
Joint F-Statistic [3]:	162.752706	Prob(>F), (14,1582) degrees of freedom:	0.000000*
Joint Wald Statistic [4]:	1441.409504	Prob(>chi-squared), (14) degrees of freedom:	0.000000*
Koenker (BP) Statistic [5]:	287.219902	Prob(>chi-squared), (14) degrees of freedom:	0.000000*
Jarque-Bera Statistic [6]:	3107.794299	Prob(>chi-squared), (2) degrees of freedom:	0.000000*

Notes on Interpretation

* Statistically significant at the 0.05 level.
[1] Large VIF (> 7.5, for example) indicates explanatory variable redundancy.
[2] Measure of model fit/performance.
[3] Significant p-value indicates overall model significance.
[4] Significant p-value indicates robust overall model significance.
[5] Significant p-value indicates biased standard errors; use robust estimates.
[6] Significant p-value indicates residuals deviate from a normal distribution.

Figure 4-12. 2009 OLS Results

Due to a statistically significant Koenker (BP) value the robust estimates must be used. The adjusted R-Squared decreased from .674 in 2000 to .587 in 2009. LOTSIZE, DISTINDU, and DISTSCHL continued to be statistically insignificant. INCOME, DISTCOMM, DISTWATR, DISTROAD, and DISTZIP changed from being statistically significant in 2000 to statistically insignificant in 2009. The AGE variable unexpectedly changed signs from negative to positive which is contrary to the hypothesized negative sign. An explanation for the drastic decrease in statistically significant variables could be the drop in the number of observations from 9818 in 2000 to 1748 in 2009 which reflects the national recession in the real estate market. The low adjusted R-Squared illustrates a lack of variables.

The GWR result maps for the 2009 dataset are located in Appendix H. Figure 4-13 shows that each parcel was compared to 1000 of its neighbors, an increase of 250 neighbors from 2000, and that the R-Squared Adjusted decreased from .795 in 2000 to .661 in 2009.

```
Neighbours          : 1000
ResidualSquares     : 3318919760251.223
EffectiveNumber     : 17.533050513938015
Sigma               : 58540.43891123214
AICc                : 24458.185789768744
R2                  : 0.6609423606647105
R2Adjusted          : 0.6551541847427115
Executed (GeographicallyWeightedRegression) successfully.
```

Figure 4-13. 2009 GWR Results

The AGE remained statistically significant in the 2009 OLS results. In the GWR results the high coefficient value remained unchanged and the low coefficient value increased by $2,300 to -$160.00. The GWR coefficient pattern for AGE changed drastically west of the St. John's River as the entire area west of the river contains neutral to negative coefficients. The SF coefficient in the OLS results remained positive and statistically significant. The GWR results in the area of the main zip codes show an increase in

positive coefficients for an increase in SF. The high and low coefficients remained relatively unchanged. The LOTSIZE coefficient in the OLS results remained statistically insignificant. The low value in the GWR results decreased drastically from -$50,000 in 2000 to -$289,000 in 2009. The coefficients in the main zip codes remained relatively unchanged from 2000 to 2009. The fact that the LOTSIZE variable is statistically insignificant in the OLS results and its sign in the OLS results is opposite of what it should be continues to bring into question the accuracy of the LOTSIZE GWR results. The INCOME coefficient in the OLS results changed from statistically significant to statistically insignificant. The GWR results in the main zip codes still depict a neutral to positive increase in house prices if the median income were to increase in those areas. The area of positive coefficients northwest of Cecil Field decreased in actual area, not quite going back to a neutral state. The MEDAGE coefficient in the OLS results remained positive and statistically significant. The area immediately northeast of Cecil Field, the area of the main zip codes, and the area immediately west of NAS Jacksonville all saw an increase in positive coefficients for MEDAGE. The rest of Duval County remained relatively unchanged.

CHAPTER 5
DISCUSSION

This chapter analyzes the regression results in more detail as they pertain to Cecil Field and its effects on Duval County house prices. Each variable will be discussed in relation to the OLS results. If the variable was included in the GWR analysis the GWR results will be discussed as well.

Acreage of Lot (LOTSIZE) Variable

In previous regression studies conducted by other authors the size of the lot was generally a key variable representing a large portion of the house price. In the 1992 and 1993 datasets the LOTSIZE variable was trustworthy as an indicator of house price due to it having a global positive effect on house prices and its statistical significance. However, in 1994 the variable lost its statistical significance when using the required robust values. In 1999, 2000 and 2009 the sign changed from positive to negative which does not make sense globally.

A general rule is to discard any variables found to be statistically insignificant in the OLS results prior to running GWR. The author made the decision keep the variables consistent that were run in the GWR equation to see if there were any patterns that could be attributed to Cecil Field. The highly variable high and low coefficient values for LOTSIZE cannot be trusted as the values seemed to have become inflated when the variable became statistically insignificant in the OLS results. The pattern around the CBD remained fairly consistent in that an increase in the size of the lot in the central business district would increase the price of the house. This makes sense as the lots are generally constrained within the CBD. The pattern at the main zip codes identified earlier seemed inconsistent and it is difficult to attribute the patterns to any action at

Cecil Field. The pattern surrounding Cecil Field remained consistent through all of the datasets in that an increase in the size of the lot would have a neutral to negative effect on the house price. This makes sense as Cecil Field is in a rural location. The negative coefficient also makes sense as an increase in the size of a lot in a rural area does not necessarily mean that the price will increase proportionately to the increase in the size of the lot.

While the size of the lot may play a large factor in the price of a house, after review of the OLS and GWR results it is not possible to utilize the LOTSIZE variable as an indicator that the actions at Cecil Field had any effect on surrounding house prices. Previous research by other authors reviewed in Chapter 2 indicates that the addition of more structural and “local” variables often settles the tendency for a variable to switch signs and bounce between statistical significance and insignificance. While the author would have liked to add additional structural variables, the data was not available to do so.

Property Age in Years (AGE) Variable

With the exception of the 1999 dataset, the AGE variable was consistent in terms of being statistically significant; however, the sign of the variable unexpectedly switched to positive in 2009. Previous research reviewed in Chapter 2 indicates that an increase in the age of the structure generally decreases the price of the house up to a certain point where the house is deemed “historic” and the coefficient slowly curves upward in the positive direction. Researchers often square the age of the structure to determine at what point the age of the structure actually increases the house’s value, if there is any increase at all. The squared values were removed from this study’s pricing model for earlier discussed reasons. The global coefficients in the OLS results make sense with

the exception of the sign change in 2009 which could be explained by the lack of structural variables as was discussed with the variable LOTSIZE. The increase from the -300s to under -100 in 1999 and 2000 could be a result of the housing boom that the nation experienced when investors were buying old houses, renovating them and "flipping" them for a quick profit.

When reviewing the GWR results for AGE the focus is really around the CBD and directly across the St. Johns River from the CBD in the San Marco area. It is evident by reviewing the structure ages in the AGE result maps that these two areas contain the older structures in Jacksonville and the age of these structures increases their value. The spike in the high coefficient value in 1999 can be attributed to the variable's statistical insignificance in the OLS results or to the housing boom; however, the 2000 dataset's high coefficient value only decreased by 200 so the latter is assumed to have influenced the value. There seems to be a "cloud" of light red that gravitates west toward Cecil Field from NAS Jacksonville as the dataset years progress. This cloud represents neutral to negative influences on the house price. The yellow and green surrounding Cecil Field is all negative influence on the house prices in regard to the AGE variable. This advancing cloud could be attributed to actions at Cecil Field or could be attributed to the housing boom in 1999 and 2000. The red almost disappears in every area west of the St. Johns River in 2009. This is most likely attributed to the cooling of the housing market.

Square Footage of House (SF) Variable

The SF variable is the most stable variable in the model and its OLS result is consistently statistically significant with a consistent positive sign. The value of the coefficient in the OLS results consistently increases through each dataset and generally

follows the regional real estate market trend; however, the 2009 value may be overtly high due to the statistical insignificance of the other variables in the model. It is important to note that research reviewed in Chapter 2 indicates that generally the square footage influence on the house price is on a curve and the influence of square footage is less on the price as the square footage of the house increases. This may or may not have been evident had the square footage squared variable (SF2) been kept in the pricing model.

Both the high and low values are consistently positive in the GWR results and the high value generally trends upward through the dataset years following the regional market trend. The GWR result maps for each dataset year are showing a general trend opposite to what previous researchers have found using OLS regression. The Duval County results are showing that the SF variable has a greater potential to increase the house price in higher square footage homes east of the St. Johns River and in the immediate vicinity of NAS Jacksonville than in lower square footage homes.

For the 1993 and 1994 datasets (announcement of the closure), Cecil Field shows a slightly higher increase in price in comparison to 1992 if the square footage was increased in a house around Cecil Field. The 1993 dataset indicates that on the northeast corner of Cecil Field there is even more of a positive price impact should the square footage of the home increase. The main zip codes experience a more positive impact toward the southwest of 32210 which is right next to NAS Jacksonville. The 2009 dataset demonstrates a more positive impact in main zip code 32205 which borders Interstate 10 and has Normandy Boulevard running through the center, providing a direct route to the Cecil Commerce Center. With 2009 being a “cool” housing market,

there is a real possibility that the potential for redevelopment at Cecil Field may have contributed to the SF variable's positive influence on price in this area. The other possibility is that NAS Jacksonville is influencing the prices within this area.

Median Household Income in the Census Tract (INCOME) Variable

The INCOME variable was consistently statistically significant in OLS results with the exception of the 2009 dataset. It consistently had a positive influence on price in the OLS results and the coefficient values stayed fairly consistent as well. The consistent coefficient values may have been influenced by the fact that only the 2000 decennial U.S. Census Bureau data was used to define the median income. Had the median income varied according to the year of the dataset being tested, the coefficient results may have varied more depending on if there was a great variance in the median income for the census tract being tested. The only reason the author can think of that would have changed the median income greatly is the recent national recession which would have influenced the 2009 dataset or possibly the closure of Cecil Field.

In the GWR results the median income consistently influences the CBD in all of the dataset years where an increase in the median income would provide a significant boost to house prices. This makes sense as the CBD of Jacksonville generally houses lower income individuals and families. An increase in median income in a lower income neighborhood will most likely increase house prices. Also, the main zip codes and basically the entire area surrounding NAS Jacksonville would experience increase in house prices with an increase in median income. Though the Cecil Field population and the NAS Jacksonville population comprise a small percentage of the overall population of this area, the median income of the military members and non-military members

living in these areas is most likely lower than other areas of Jacksonville and therefore an increase in median income will increase house prices in these areas.

The house prices in the area directly to the west of Cecil Field would seem to benefit from an increase in median income as well. However, it is difficult to tell whether the closure of Cecil Field had an influence on the INCOME variable as the author is unsure if there was a loss of income in that area attributed to the closure of Cecil Field due to the use of 2000 census data. Also, data at the census block level, versus the tract level, may have created more concise patterns in the GWR results and would have allowed the author to use fewer neighbors in the GWR settings due to the greater variance in median incomes at the parcel level.

Median Age in the Census Tract (MEDAGE) Variable

The MEDAGE is consistently statistically significant through all of the dataset years with a consistent positive sign. The value of the coefficient in the OLS results consistently increases through each dataset and generally follows the regional real estate market trend; however, the 2009 value may be overtly high due to the statistical insignificance of the other variables in the model.

In the GWR results an increase in median age has a consistent positive influence on house prices in the main zip codes and the area surrounding NAS Jacksonville. Starting in 1994 and carrying throughout the remaining dataset years, there is a positive MEDAGE influence at the border of Cecil Field that shifts around the border slightly at each dataset year but predominantly settles around the northern portion of Cecil Field. The military population is generally a younger population. It is evident from the GWR maps that, according to the 2000 census tract data, younger populations tend to live around Cecil Field and NAS Jacksonville, to include the main zip codes. The GWR

results are indicating that an increase in the median age in these areas would increase house prices in the respective areas.

As with the INCOME variable, it is difficult to tell whether the closure of Cecil Field had an influence on the MEDAGE variable as the author is unsure if there was an increase, decrease, or no change to the median age as a result of the closure and redevelopment of the base due to the use of 2000 census data. The same holds true with MEDAGE as it did with INCOME with regard to the use of census block data versus tract data and the variance of the variables at the parcel level.

Euclidean Distance to Cecil Field (DISTCEC) Variable

The DISTCEC variable was far from being statistically significant in the OLS results until 1999 when the base closure occurred and the variable then become very significant at a .00 (100% confidence) level and never went below the .02 (98% confidence) level for the remaining dataset years. The first statistically significant coefficient is .31 in 1999 which increases to .41 in 2000 and increases again to .59 in 2009. This indicates, for example in 1999, that each meter increase from Cecil Field will increase a house's price by $0.31. So a property 1000 meters from Cecil will theoretically be worth $310.00 more than a property right on the border of the base. The fact that the coefficient for 2009 is the highest could be due to the high amount of statistically insignificant variables in the 2009 dataset or may indicate that the redevelopment of Cecil Field has been slower than expected. Cecil Field was clearly having a negative impact on house prices according to this global variable. It would be interesting to see the reaction of this variable at the local GWR level if the model could have been run in the GWR function of ArcGIS. This variable possibly indicates why a majority of the Cecil Field personnel lived in the main zip codes where the property

values could theoretically be approximately $4650.00 greater in 1999 as compared to living right next to Cecil Field.

Euclidean Distance to the Central Business District (DISTCBD) Variable

The DISTCBD variable OLS results remained statistically significant and positive through all of the datasets. The variable indicates that an increase in distance away from the CBD will increase the house price which is mainly due to more poverty in the downtown area than in the suburbs. The coefficient in the 2009 dataset is most likely elevated due to the large amount of statistically insignificant variables in the dataset.

Euclidean Distance to an Industrial Land Use (DISTINDU) Variable

The OLS results for the DISTINDU variable remained statistically significant until 2000 and 2009. The coefficient remained positive through all of the datasets. The types of land uses classified as industrial for this model are 1510 Food processing, 1520 Timber processing, 1523 Pulp and paper mills, 1530 Mineral processing, 1540 Oil and gas processing, 1550 Other light industry, 1560 Other heavy industrial, 1561 Ship building and repair, 1562 Pre-stressed concrete plants, 1563 Metal fabrication plants, and 1590 Industrial under construction. The OLS results for this variable indicate that an increase in distance away from an industrial land use will increase the house price. This finding contradicts Li and Brown's (1980) argument that accessibility outweighs the negative externalities of such a land use.

Euclidean Distance to a Commercial Land Use (DISTCOMM) Variable

The OLS results for the DISTCOMM variable were statistically significant with the exception of the 1992 and 2009 datasets. The coefficient remained positive through all of the datasets and increased substantially as the dataset years increased. The types of land uses classified as commercial for this model are 1460 Oil and gas storage: except

those areas associated with industrial use or manufacturing, 1480 Cemeteries, 1490 Commercial and services under construction. It would have been interesting to see whether commercial land uses such as grocery stores or department stores would have had the opposite effect.

Euclidean Distance to a Hospital (DISTHPTL) Variable

The OLS results for the DISTHPTL variable were statistically significant and negative for all of the datasets. The negative sign indicates that an increase in distance away from a hospital will reduce the house price.

Euclidean Distance to a School (DISTSCHL) Variable

The OLS results for the DISTSCHL variable were statistically significant only for the 1994 and 1999 datasets. The sign was negative for all of the datasets. The negative sign indicates that an increase in distance away from a school will reduce the house price. This variable may have had improved results had the schools been ranked in terms of the education quality or standardized testing results. The variable in this model treated all schools equally.

Euclidean Distance to a Major Water Body (DISTWATR) Variable

The OLS results for the DISTWATR variable varied in statistical significance. The sign for the coefficient varied from negative to positive. Based on common knowledge of the real estate market, an increase in distance from a water body should decrease the house price unless the water body is being used for an industrial use such as shipbuilding. The results of this variable are inconclusive. This variable may have had improved results had the water bodies been classified by their use such as recreational use or industrial use. The variable in this model treated all water bodies equally.

Euclidean Distance to a Major Road (DISTROAD) Variable

The OLS results for the DISTROAD variable were statistically significant with the exception of the 2009 dataset. The coefficients' signs were negative with the exception of the 1992 dataset which was positive. Overall the results of this variable indicate that house owners prefer accessibility to major/minor arterial roads and that the house price decreases the farther a property is from a major/minor arterial road.

Euclidean Distance to a Known Zip Code with Cecil Personnel (DISTZIP) Variable

The OLS results for DISTZIP were statistically insignificant with the exception of the 1999 and 2000 datasets. The signs varied from positive to negative but the 1999 and 2000 datasets both had positive coefficient signs. The zip codes identified in this variable are all of the zip codes identified in the Final Base Reuse Plan where Cecil Personnel lived. Several of the zip codes were right next to Cecil Field or included Cecil Field as illustrated in Figure B-1. The DISTZIP variable was only statistically significant during the years that Cecil Field closed and indicates that an increase in distance from a Cecil Personnel zip code will increase the house price. The addition of a second zip code variable that included only the two main zip codes were Cecil Personnel lived may have had more telling results.

CHAPTER 6
CONCLUSION

This chapter contains an analysis of this study and recommendations for future studies involving base closure and hedonic pricing models. First, this chapter begins with a summary of findings with an emphasis on how the results attempt to answer the research question. The chapter then provides recommendations for future studies and how this methodology can be improved. Third, it discusses the limitations of this research. Finally, this chapter closes with a brief discussion of areas of future research. The overall emphasis of this chapter lies in allowing future researchers to refine the process of determining the effects of a base closure on surrounding single-family house prices.

Summary of Findings

The results of this study attempt to answer the research questions which are:

1) When the closure of Cecil Field was announced in 1993, was there an anticipatory effect on single-family house sales prices from the announcement to the actual closure in 1999?
2) After Cecil Field closed and was turned over to the City of Jacksonville in 1999, what effect did the closure and redevelopment have on single-family house sales prices after the closure and in 2009?

In regard to question one (1), the OLS results are unclear as the two variables specifically tied to Cecil Field, DISTCEC and DISTZIP, were not statistically significant during the 1992 period when no closure was announced and during the 1993 to 1994 period when the closure was announced and the year following, respectively. The most telling variable in the GWR analysis is SF. The 1992 dataset indicates that an increase

in square feet will provide the lowest increase in the house price (a green color band). The 1993 dataset indicates that an increase in square footage for houses located on the northeast of Cecil Field will provide a higher price increase while the rest of the area remains slightly above the 1992 values (yellow color band). The 1994 dataset shows a slightly elevated increase in price should the square footage of the house increase (yellow color band). This provides clear evidence that home values immediately around Cecil Field could potentially be the slightest amount higher after the announcement of the base closure in comparison to before the base closure. This could possibly be explained by the fact that the market knew that the base would eventually be redeveloped; however, the final reuse plan was not published until 1996 and the final use of the land in 1994 was undetermined.

In regard to question two (2), the OLS results are clear as the two variables specifically tied to Cecil Field, DISTCEC and DISTZIP, are both statistically significant in 1999 and 2000 and indicate that an increase in distance away from Cecil Field will increase the house price. The GWR results are clear as the SF variable remains at the lowest level (green band) for the 1999, 2000 and 2009 datasets immediately around Cecil Field but increases slightly to the yellow band as the distance increases east toward NAS Jacksonville from Cecil Field.

Both the OLS and GWR analysis provide inconclusive evidence that there was any anticipatory effect on house prices after the announcement of NAS Cecil Field's closure. However, both analyses provide conclusive evidence that the actual closure of NAS Cecil Field had a negative effect on house prices immediately surrounding the base but that the effect diminishes rather quickly as distance increases from the base. This could

be due to an obvious influence from NAS Jacksonville that seems to correct any minimal effect that Cecil Field had. The evidence is inconclusive that the redevelopment of Cecil Field has had any effect on house prices.

Recommendations for Future Studies

In future studies there is certainly room for improvement of the methodology used for this study. First the inclusion of more structural variables may settle the “flip-flopping” of signs and statistical significance. This was argued by authors reviewed in Chapter 2 and this author believes the argument is valid. Unfortunately, the structural variables needed were not available in the data accessible by the author. Variables such as number of bedrooms, number of bathrooms, garage, pool, and exterior façade construction (brick, vinyl, stucco, etc.). Second, attempt to get demographic data at the block level and according to the year of the dataset. It takes much more time to harvest the data but the results of the labor may be more conclusive. Third, as seen in this study, GWR is a powerful tool that provides the researcher with pertinent local level data. If the researcher plans to use GWR, build a model with as few proximity variables as possible and still be able to tell the “story” of what composes the house price. Be familiar with your “tools” before building your model.

Limitations of this Study

The lack of block level data and structural data hampered the results of the study. Use of such data might have provided more conclusive results.

Areas of Future Research

There is certainly an opportunity to carry this research farther. Though much has happened since the closure of NAS Cecil Field, Jacksonville has only just started to tap the economic potential of Cecil Commerce Center. The recent hiring of a new developer

that has successfully redeveloped bases in the past may pay dividends to the pace of redevelopment at Cecil Commerce Center. Also, the recent completion of the Cecil Commerce Center Parkway and its connection to Interstate 10 has great potential to spur commercial development in the Center. It would be very interesting to continue this study in another ten years, with a carefully developed pricing model, to see if the development of Cecil Commerce Center has any kind of effect on surrounding house prices.

APPENDIX A
THE MODERN BASE CLOSURE PROCESS

The modern base closure process began when the first Base Closure and Realignment Act was enacted in October 1988 and allowed for only one wave of closures (Collins, 2008, p. 4). Prior to the 1988 Act, decisions made by the Secretary of Defense in regard to base closures during and after the Vietnam War were often made without consulting the military service or Congress (Collins, 2008, p. 4). Concerns that decisions to close bases were politically motivated surfaced in the 1970s by Congressmen representing northeastern and Midwestern states, adding to opposition of future base closures (Wilson & Weingarter, 1993, p. 33).

The 1988 Base Closure and Realignment Act allowed the Secretary of Defense to appoint an eight member Base Closure and Realignment Commission, who was not independent and worked for the Secretary of Defense, and all discussions were held behind closed doors (Collins, 2008, p. 4). Upon completion of the commission's deliberations, a recommendation was made to the President of the United States and the President's decision could only be reversed through a joint resolution in Congress which could be vetoed by the President (Collins, 2008, p. 4).

The end of the Cold War created additional need for the Department of Defense to close additional bases and in 1990 the Base Closure and Realignment Act was reenacted to support closures in 1991, 1993, and 1995 (Collins, 2008, p. 5). Complaints on the 1988 Act's lack of transparency saw major changes in the 1990 version. The eight member Commission, appointed by the President, must be submitted to Congress for advice and consent. The President should consult with the Speaker of the House of Representatives for two members, the majority leader of the Senate for two members,

the minority leader of the House of Representatives for one member, and the minority leader of the Senate for one member. All proceedings are open to designated committees within the Senate and House of Representatives and with the exception of meetings with classified information the public with opportunities for the public to be heard. The Secretary of Defense is required to publish in the Federal Register the criteria to be used by the Commission and the recommended list of base closures and realignments (with a summary of the selection process) to be considered by the Commission. After visiting the sites, holding public hearings, and deliberating, the Commission is required to submit their recommendations to the President and copy both Armed Services Committees in Congress. They must explain any deviations from the Secretary of Defense's recommendations. The President can approve or disapprove the recommendations as a whole. If disapproved, the President must provide reason for disapproval to the Commission and Congress and the Commission must resubmit a revised recommendation to the President. Upon approval the President must submit the approved list to Congress and Congress can either approve or disapprove the list via joint resolution. The President can veto the joint resolution which will require Congress to override the veto with a two-thirds majority.

The 1990 Base Closure and Realignment Act provides greater transparency to the public and removes some of the power from the Secretary of Defense when making closure decisions. The Act was amended in 2004 to support additional required closures and realignments in 2005.

APPENDIX B
KNOWN ZIP CODES WITH CECIL FIELD PERSONNEL

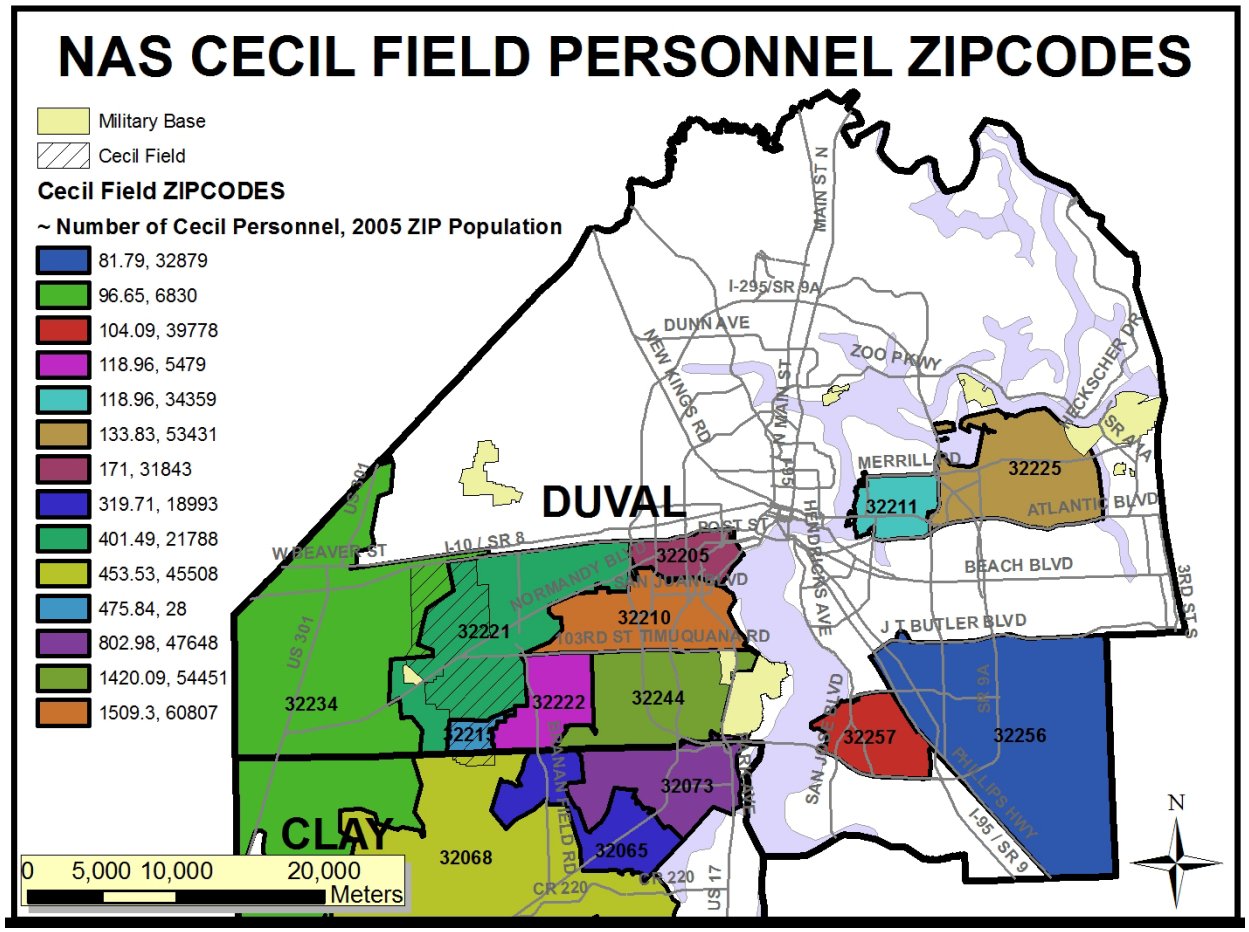

Figure B-1. NAS Cecil Field Personnel Zip Codes

APPENDIX C
1992 DUVAL GWR RESULTS

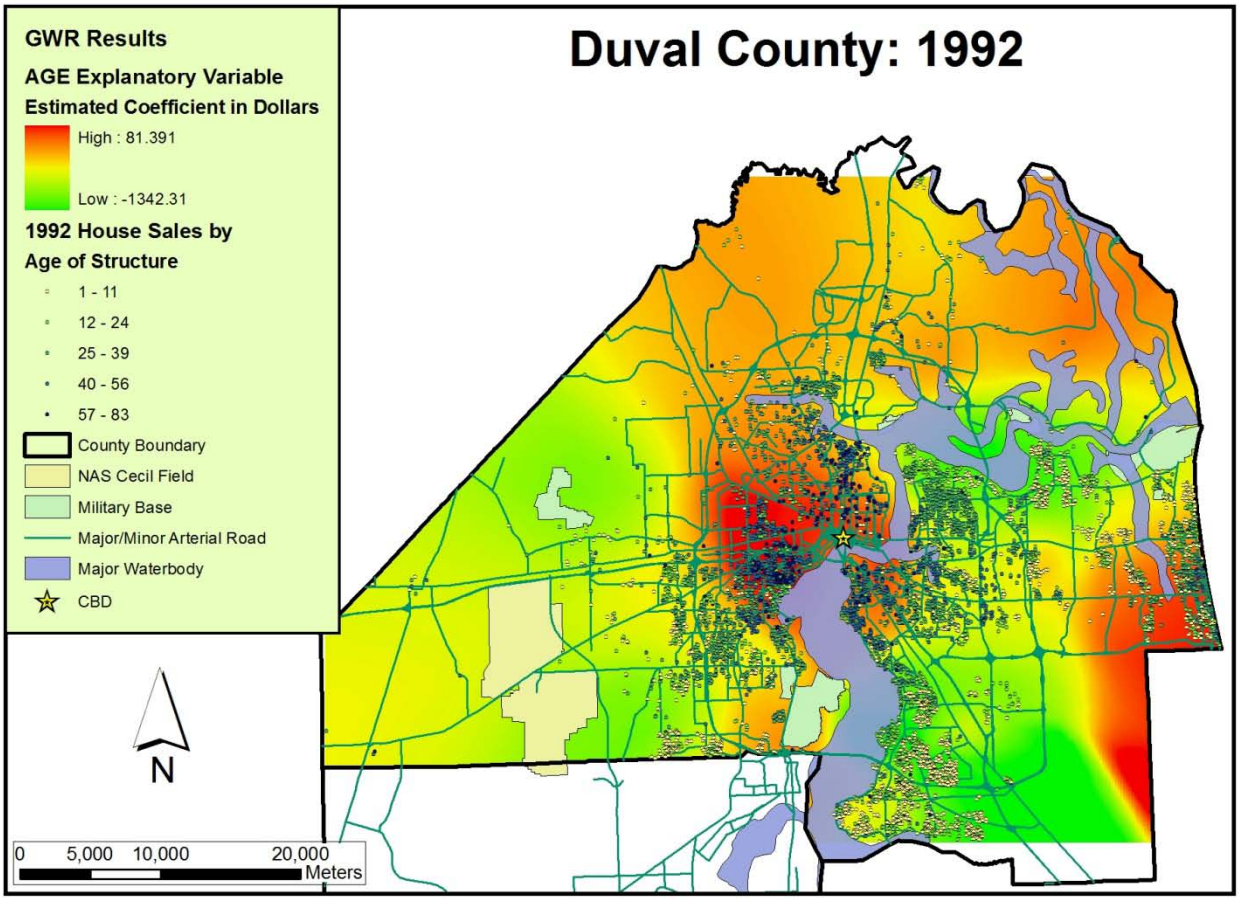

Figure C-1. Duval 1992 Property Age in Years (AGE) GWR Output

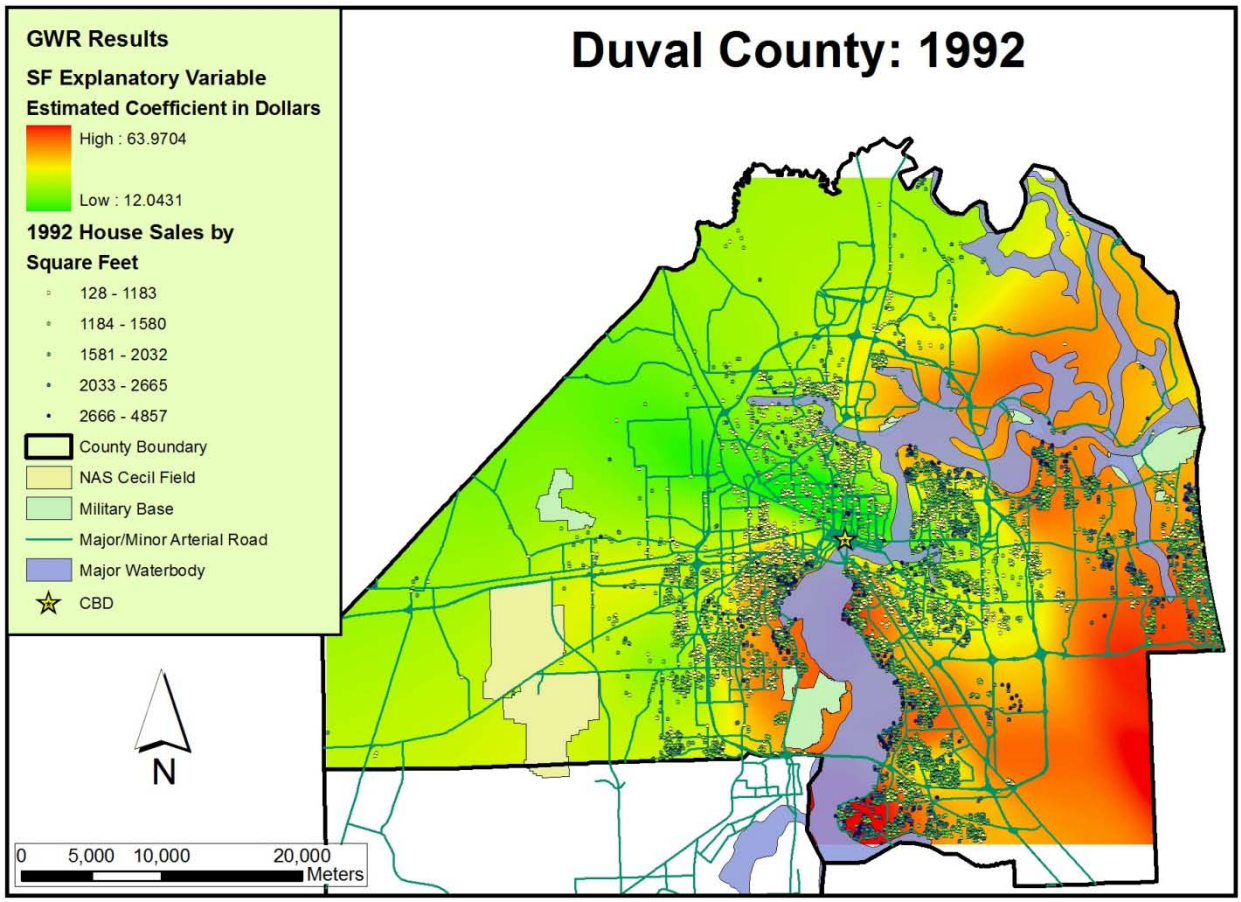

Figure C-2. Duval 1992 Square Footage of House (SF) GWR Output

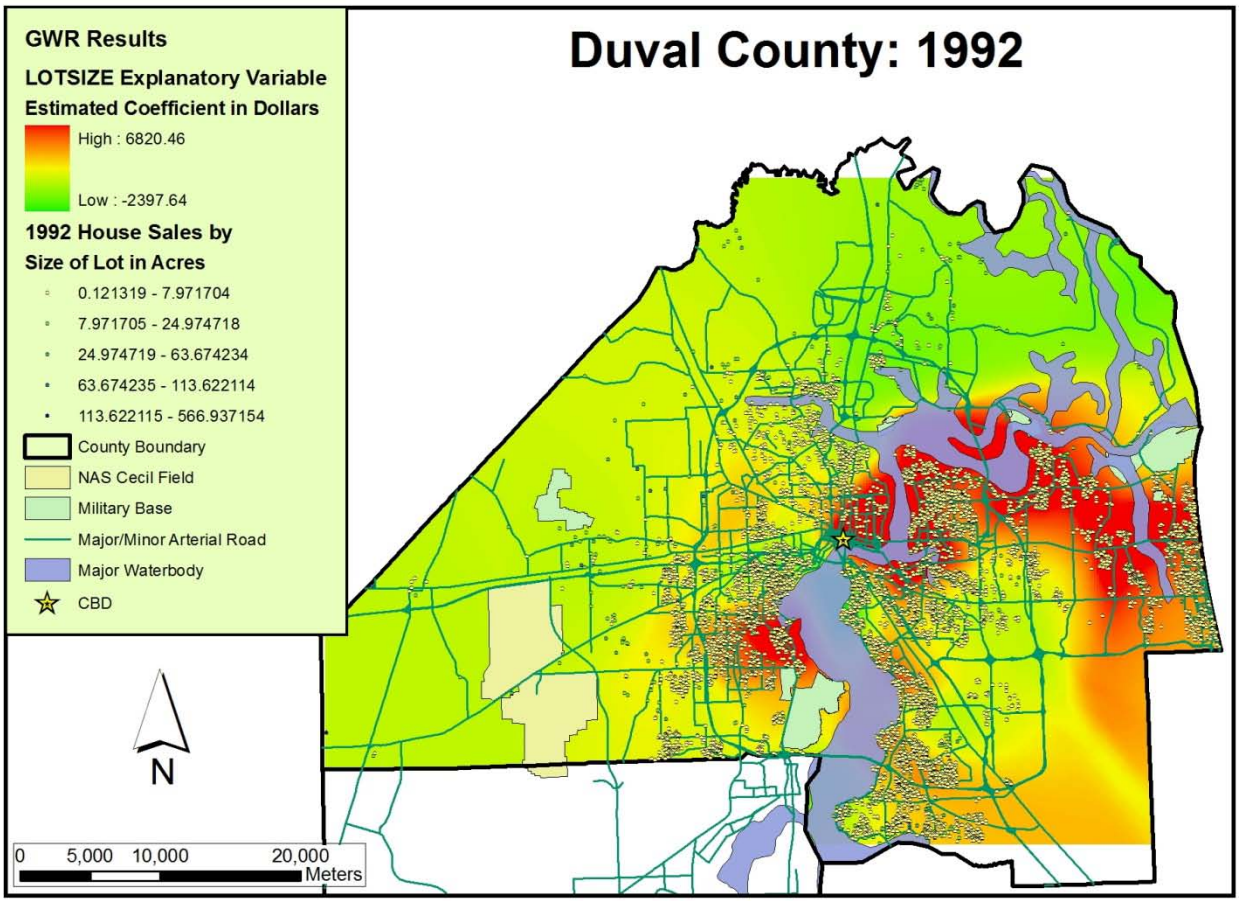

Figure C-3. Duval 1992 Acreage of Lot (LOTSIZE) GWR Output

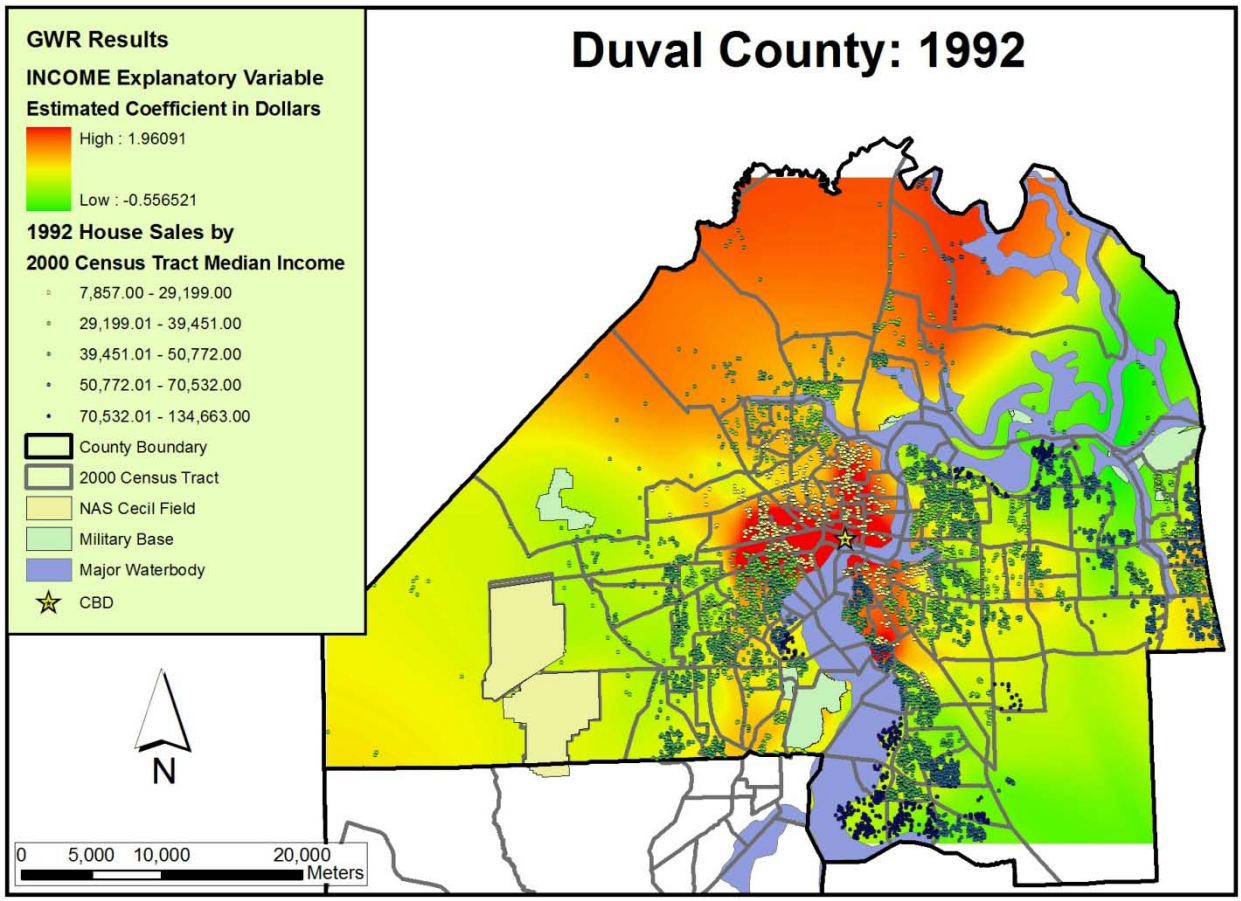

Figure C-4. Duval 1992 Median Household Income in the Census Tract (INCOME) GWR Output

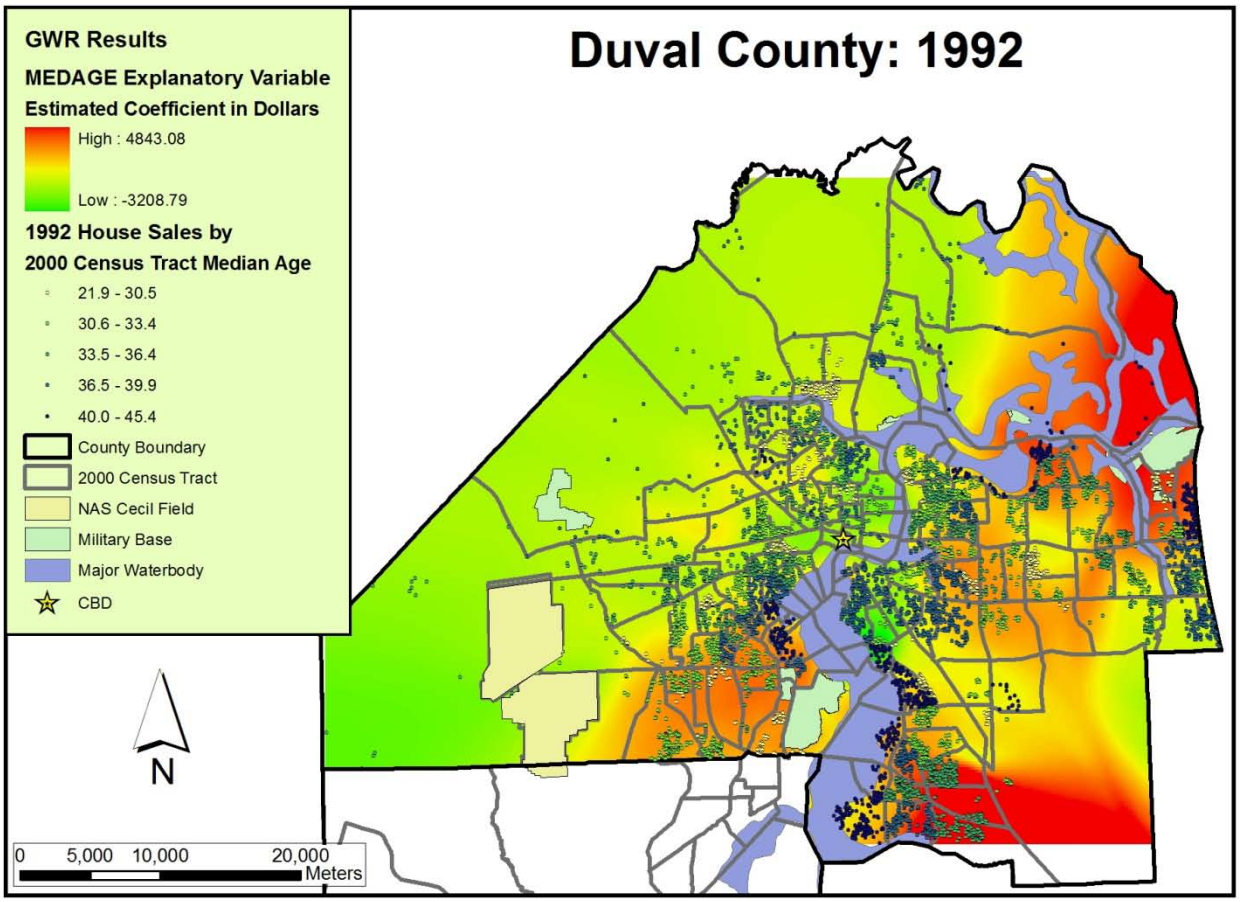

Figure C-5. Duval 1992 Median Age in the Census Tract (MEDAGE) GWR Output

APPENDIX D
1993 DUVAL GWR RESULTS

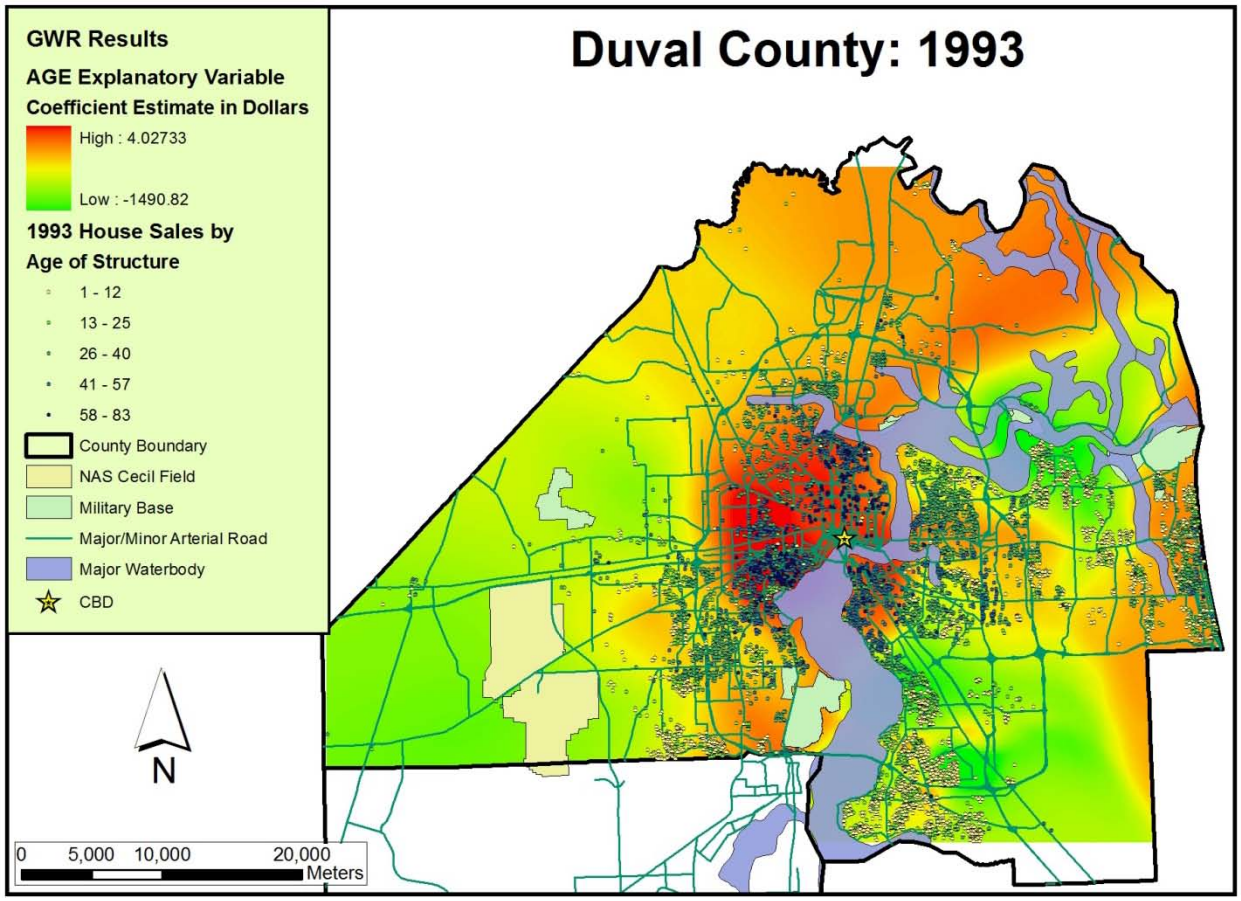

Figure D-1. Duval 1993 Property Age in Years (AGE) GWR Output

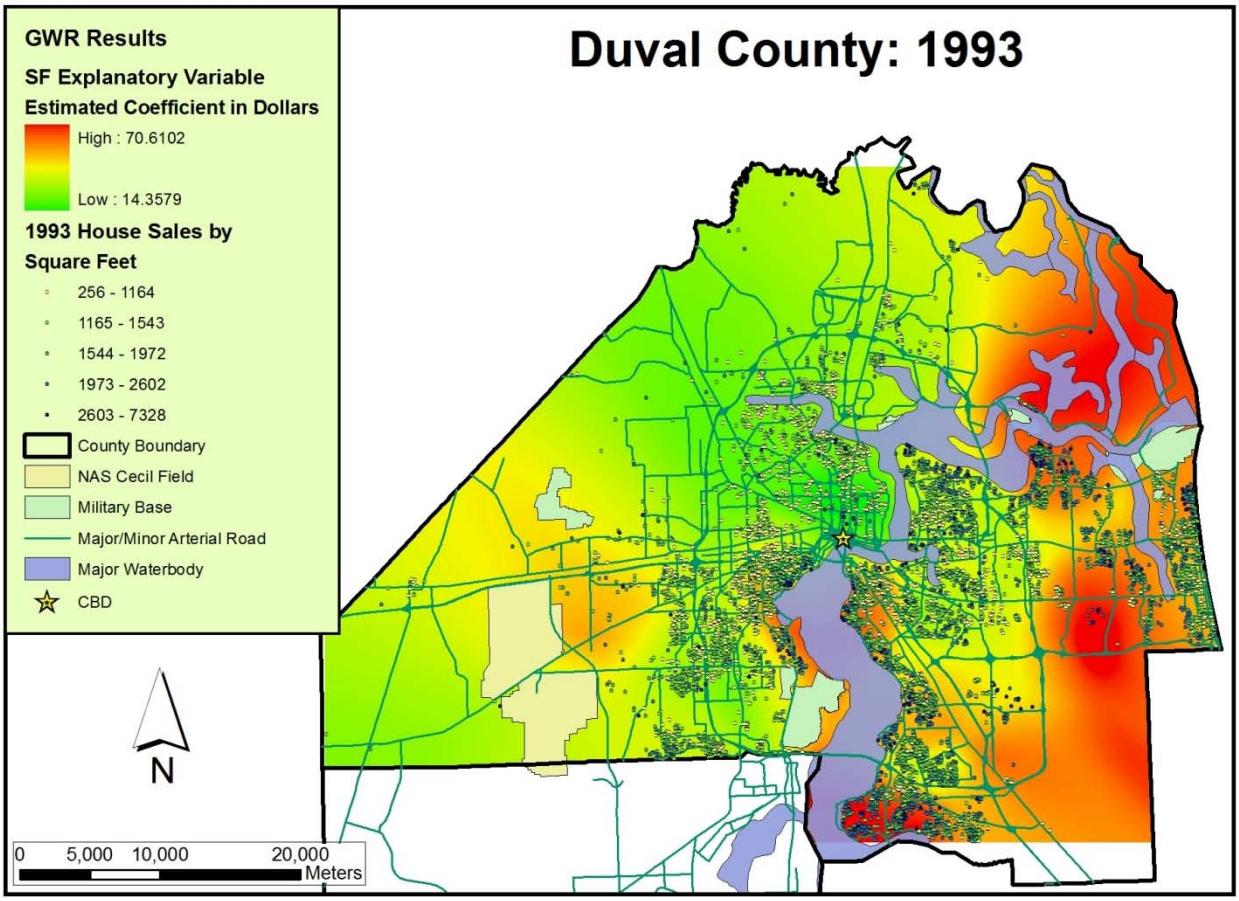

Figure D-2. Duval 1993 Square Footage of House (SF) GWR Output

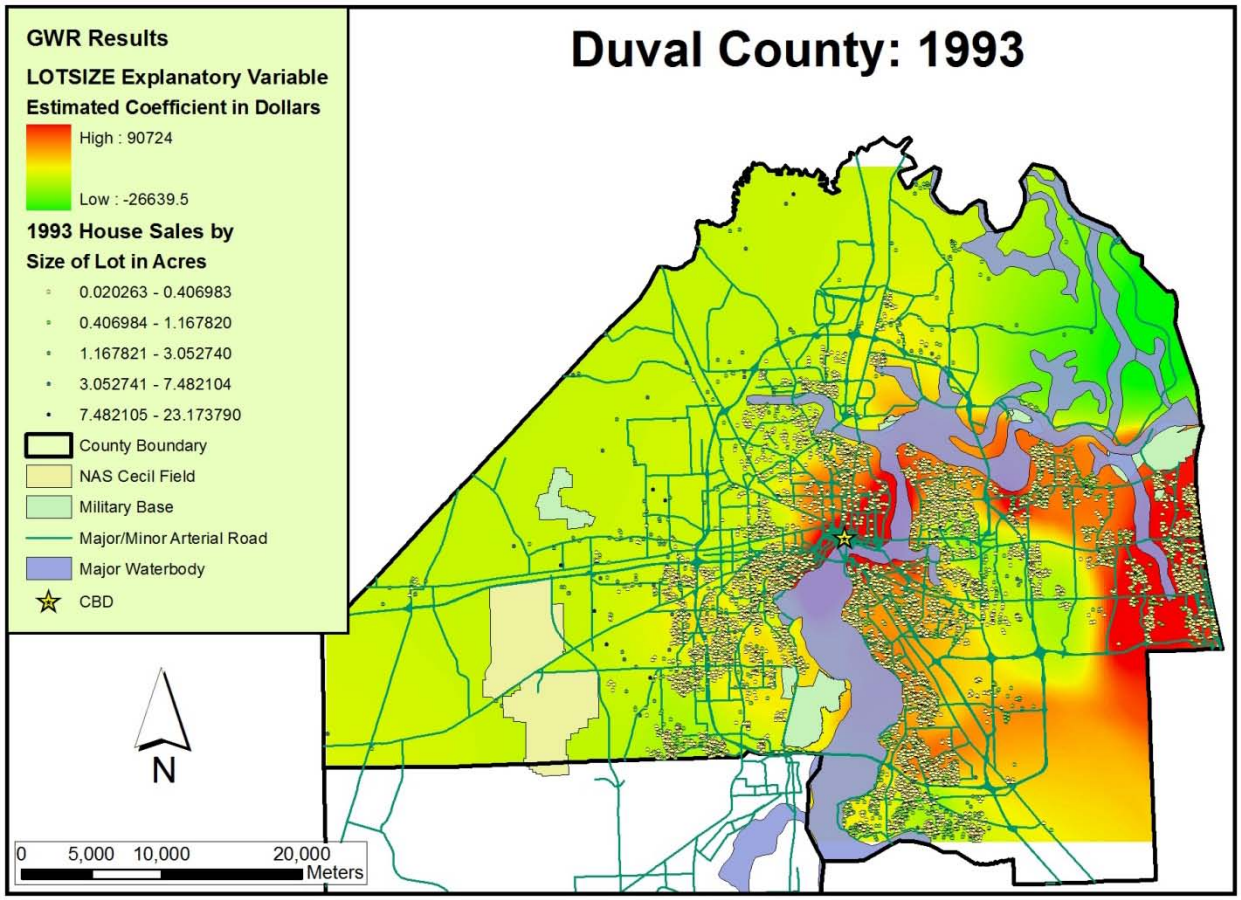

Figure D-3. Duval 1993 Acreage of Lot (LOTSIZE) GWR Output

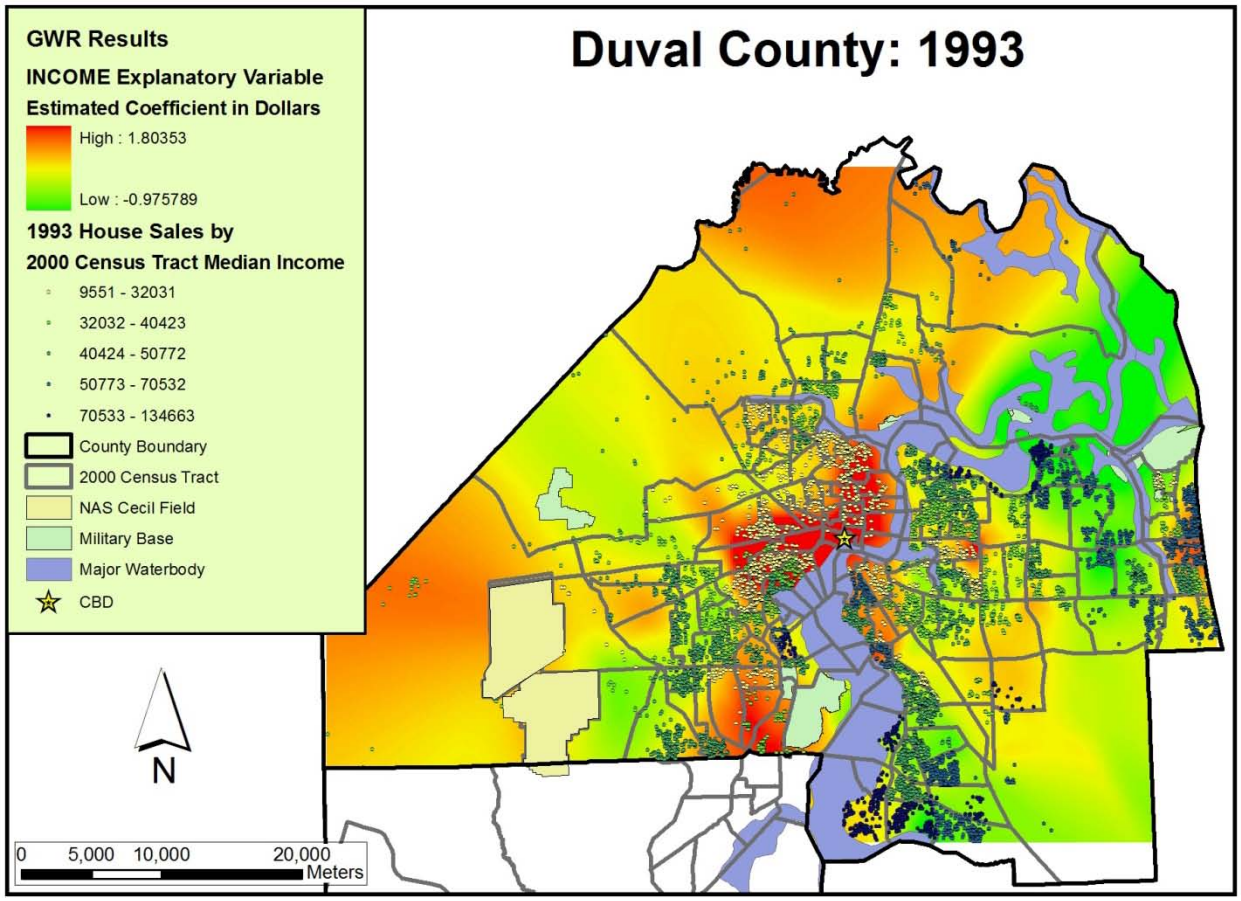

Figure D-4. Duval 1993 Median Household Income in the Census Tract (INCOME) GWR Output

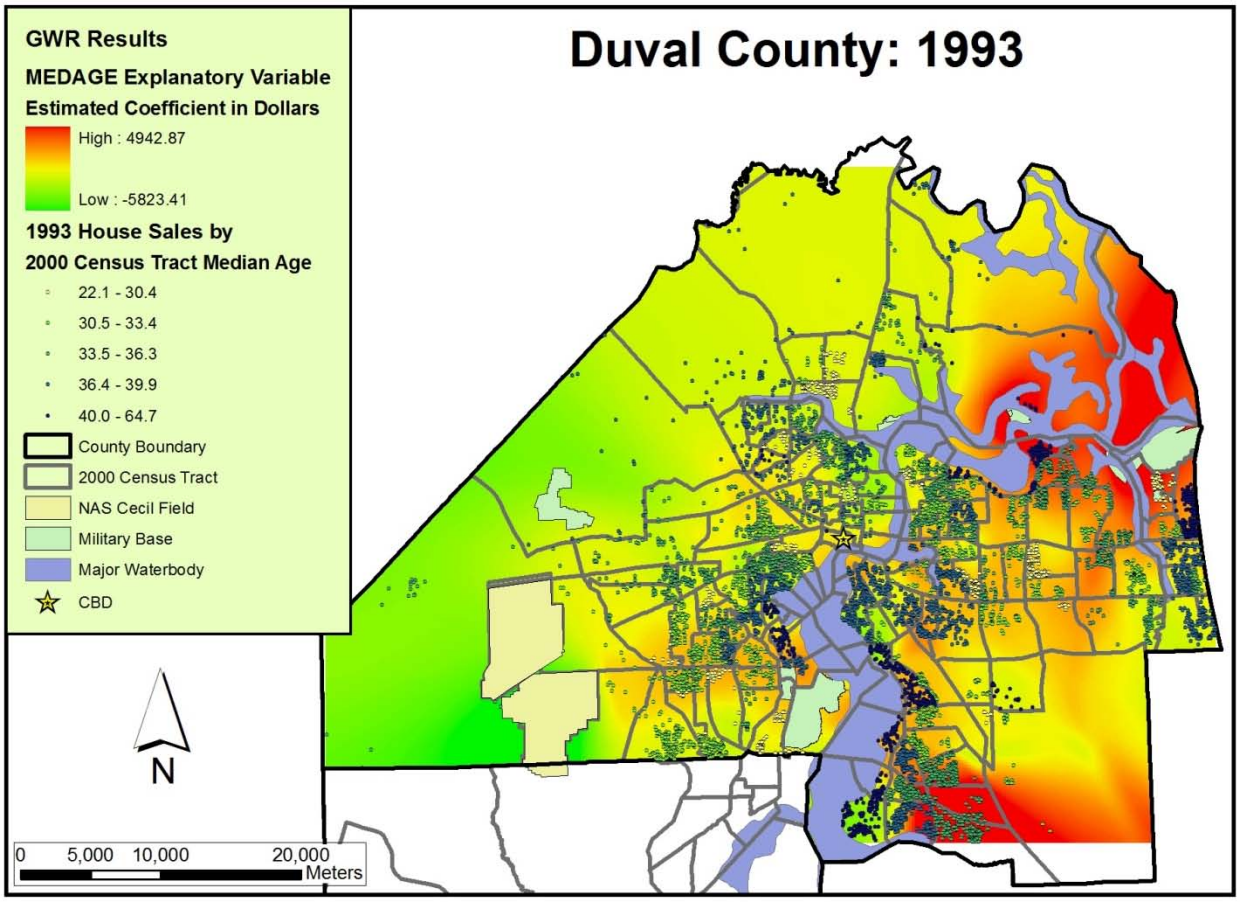

Figure D-5. Duval 1993 Median Age in the Census Tract (MEDAGE) GWR Output

APPENDIX E
1994 DUVAL GWR RESULTS

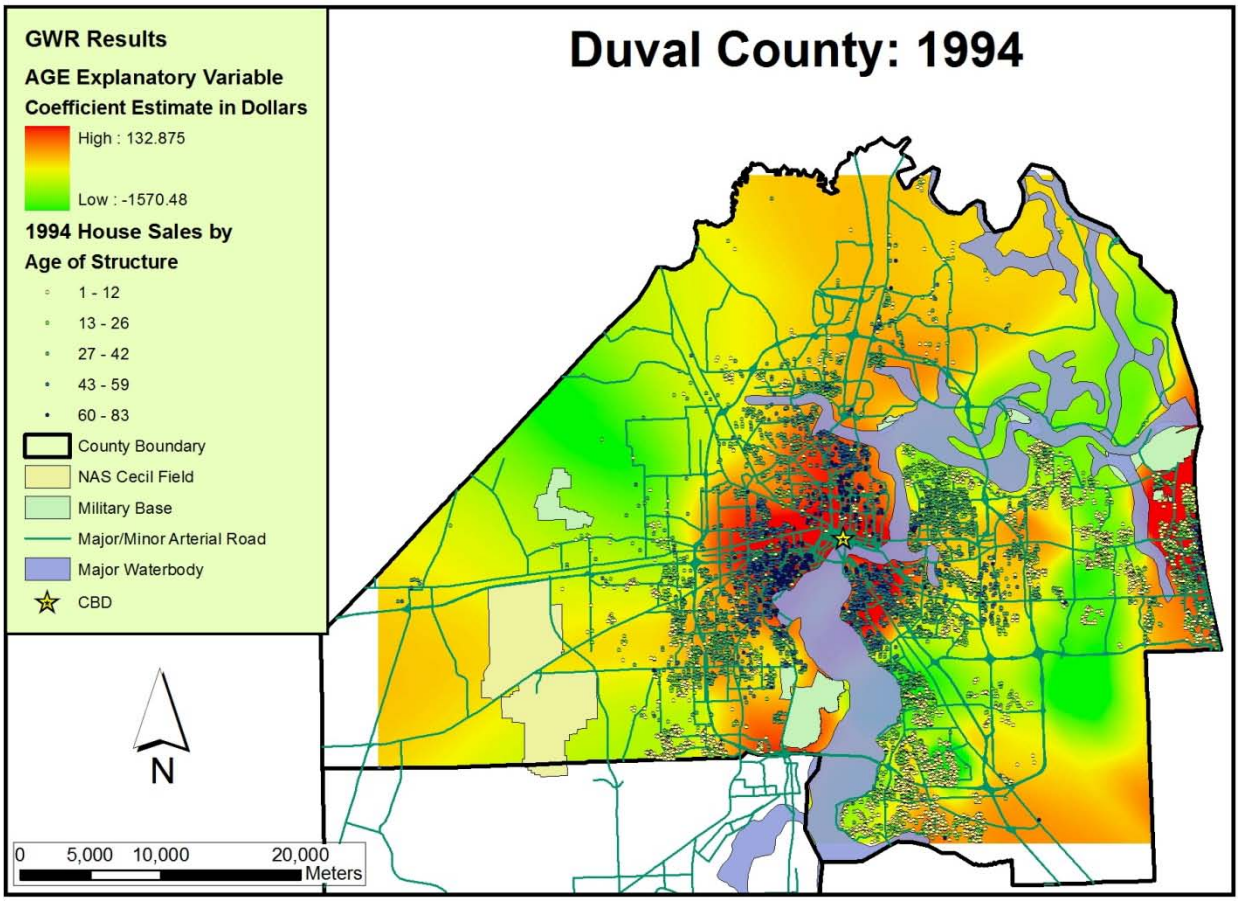

Figure E-1. Duval 1994 Property Age in Years (AGE) GWR Output

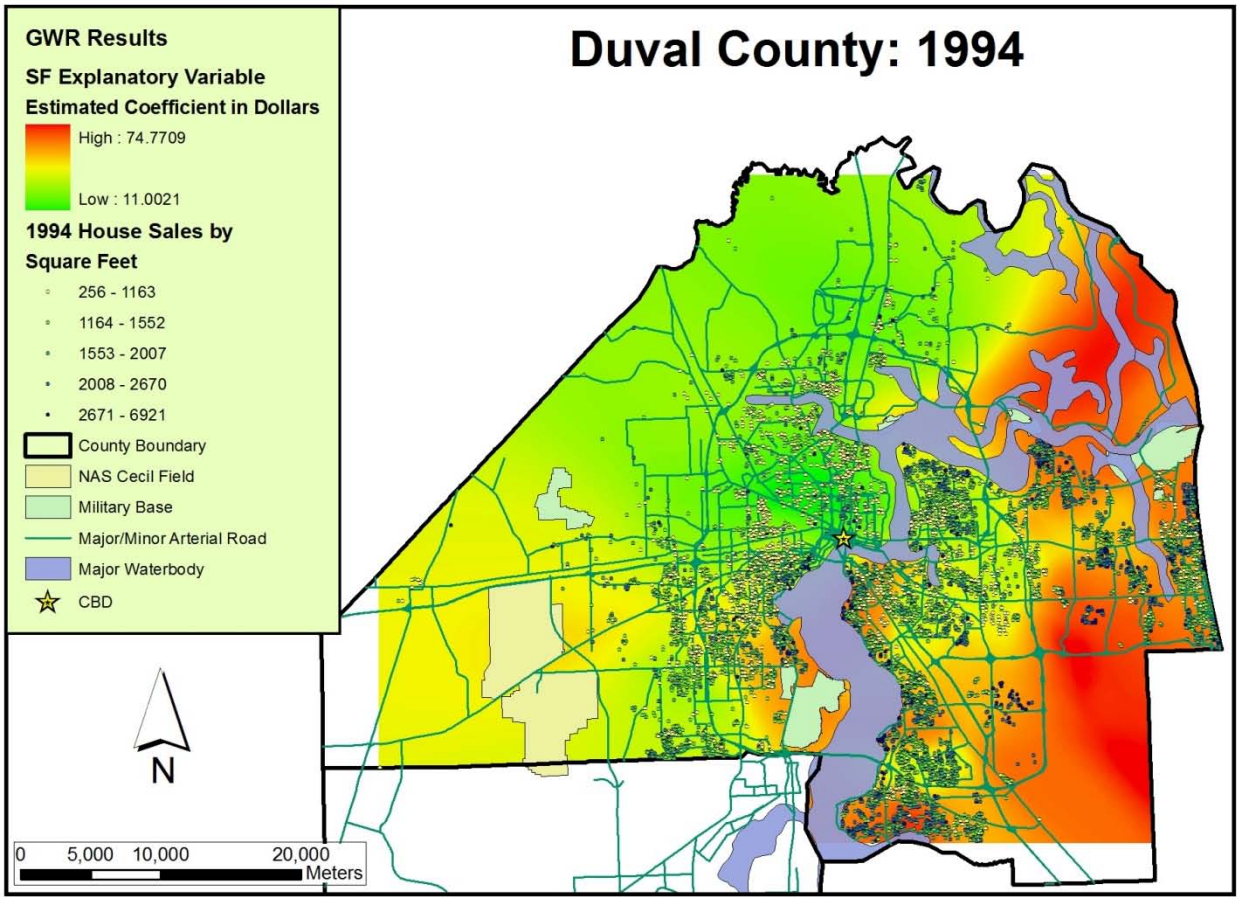

Figure E-2. Duval 1994 Square Footage of House (SF) GWR Output

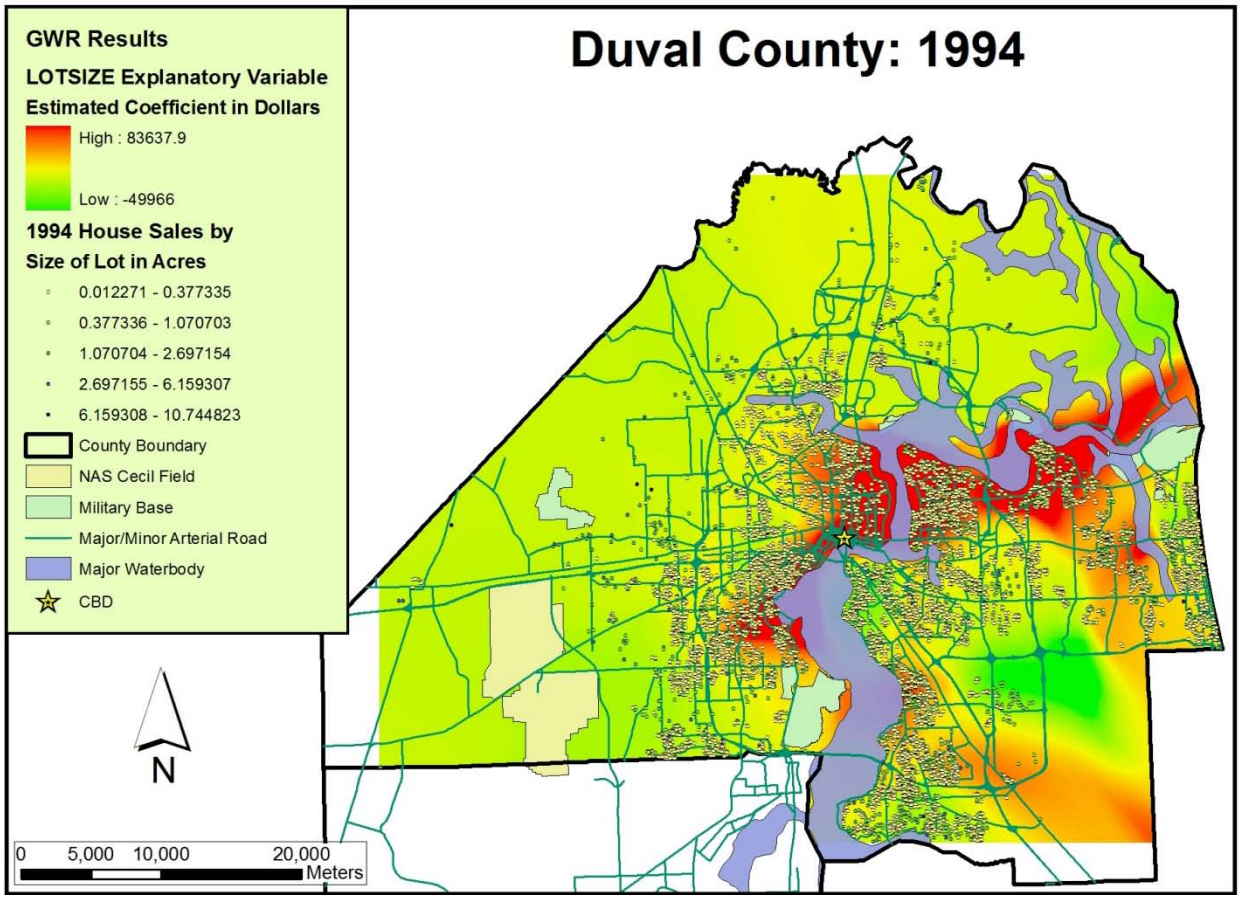

Figure E-3. Duval 1994 Acreage of Lot (LOTSIZE) GWR Output

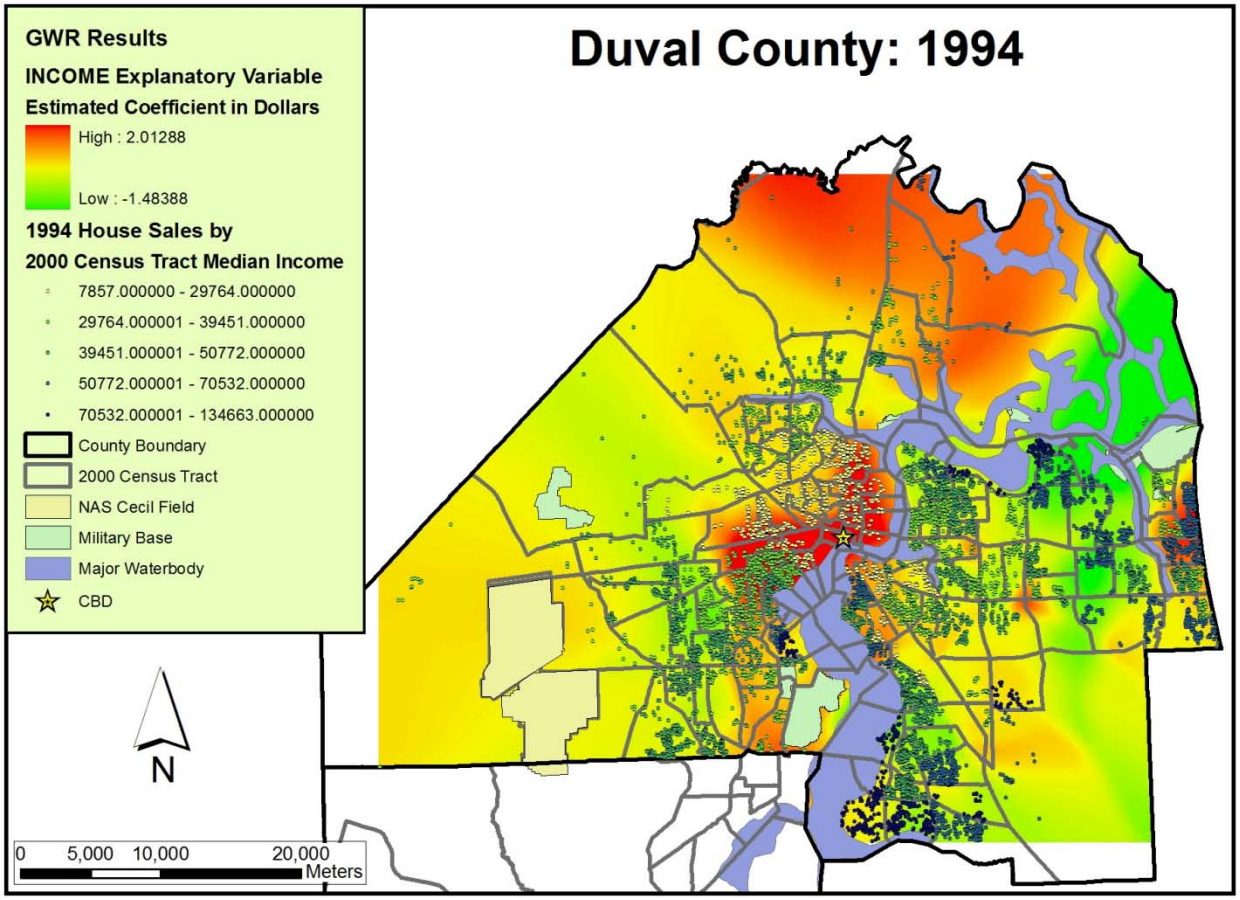

Figure E-4. Duval 1994 Median Household Income in the Census Tract (INCOME) GWR Output

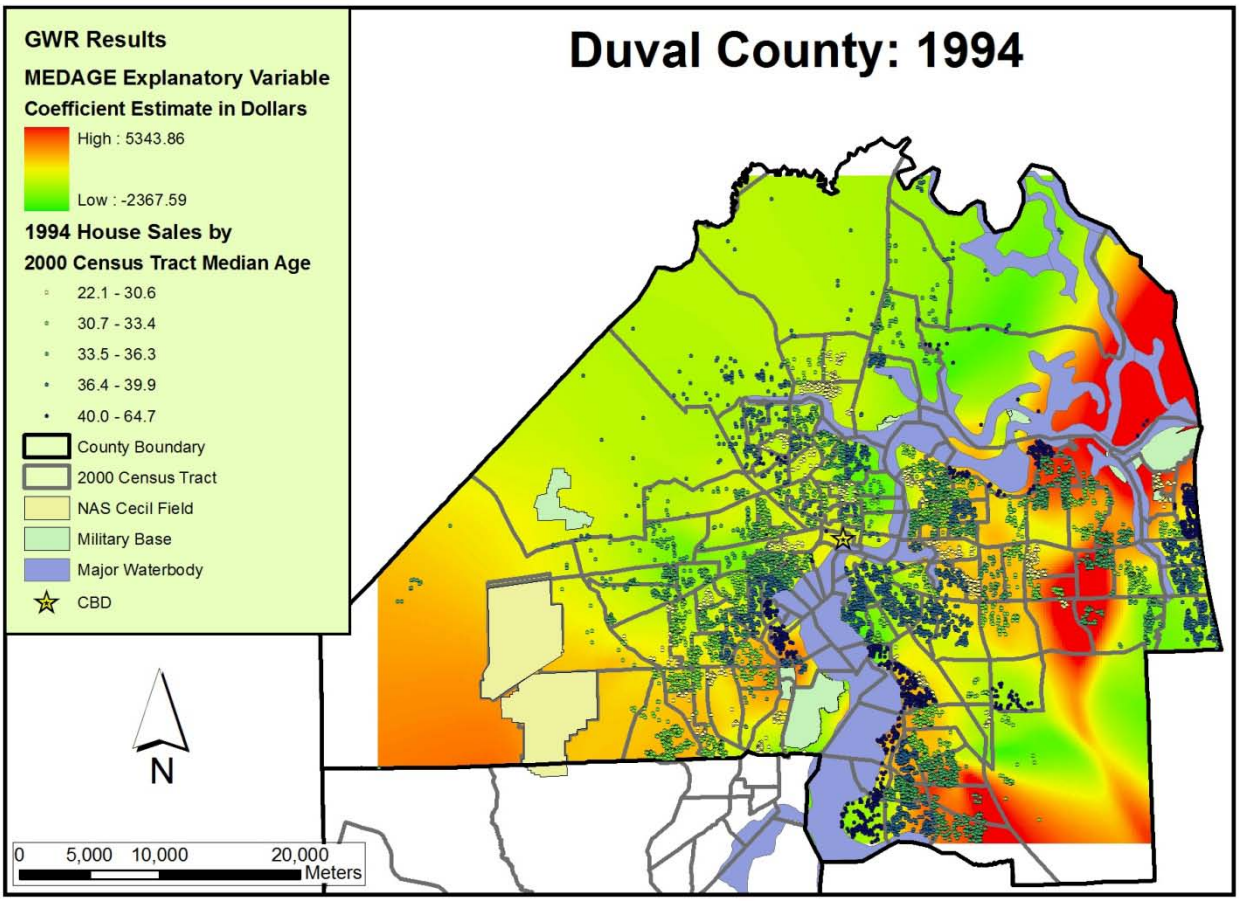

Figure E-5. Duval 1994 Median Age in the Census Tract (MEDAGE) GWR Output

APPENDIX F
1999 DUVAL GWR RESULTS

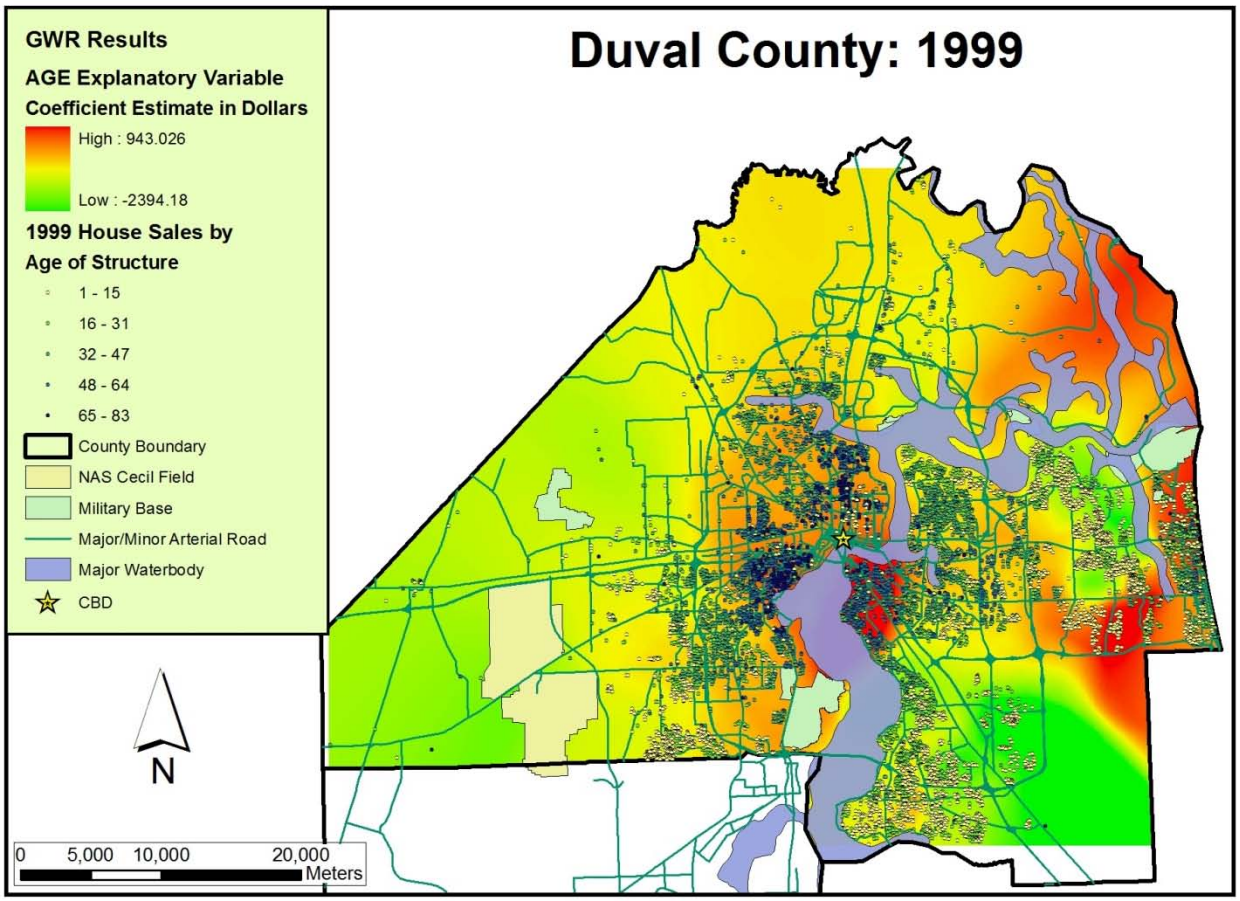

Figure F-1. Duval 1999 Property Age in Years (AGE) GWR Output

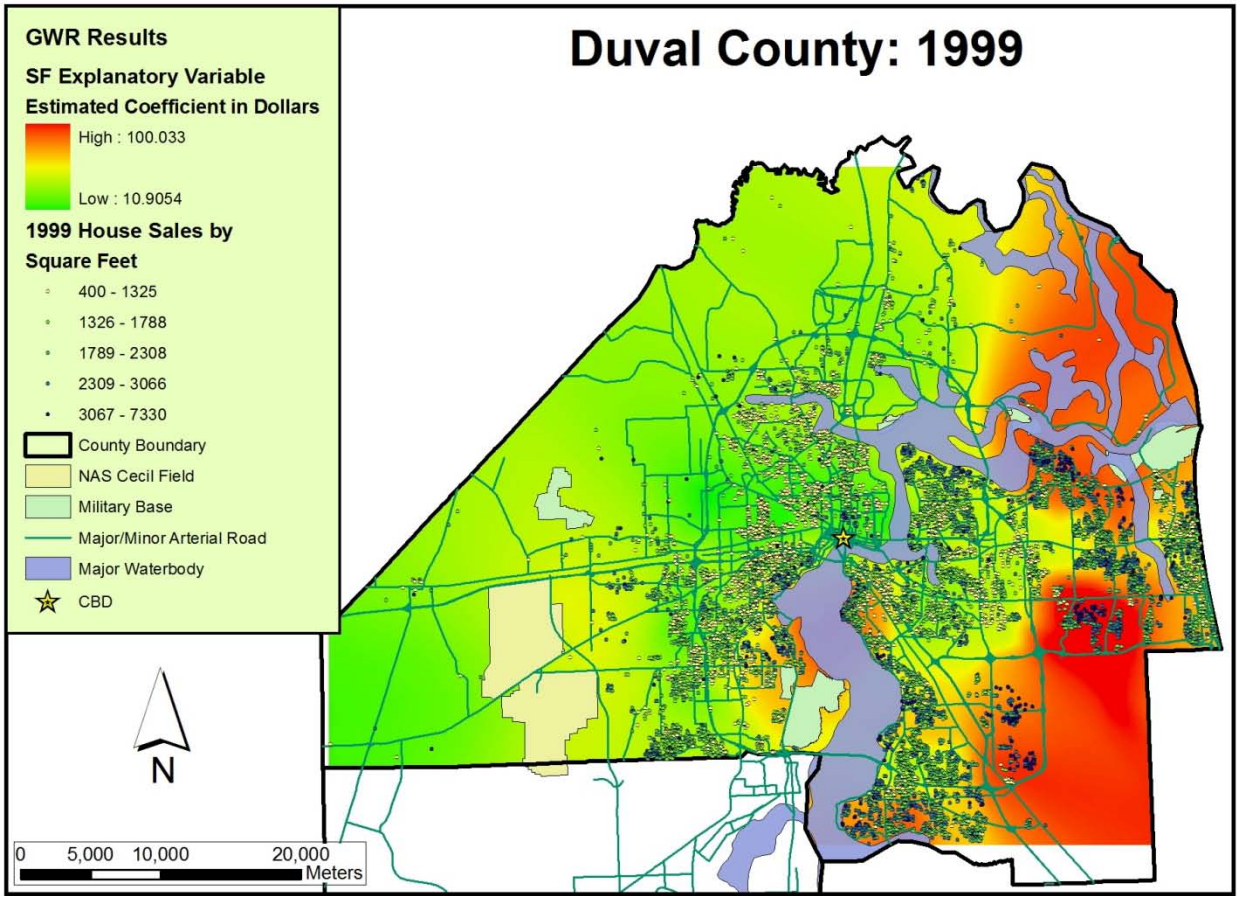

Figure F-2. Duval 1999 Square Footage of House (SF) GWR Output

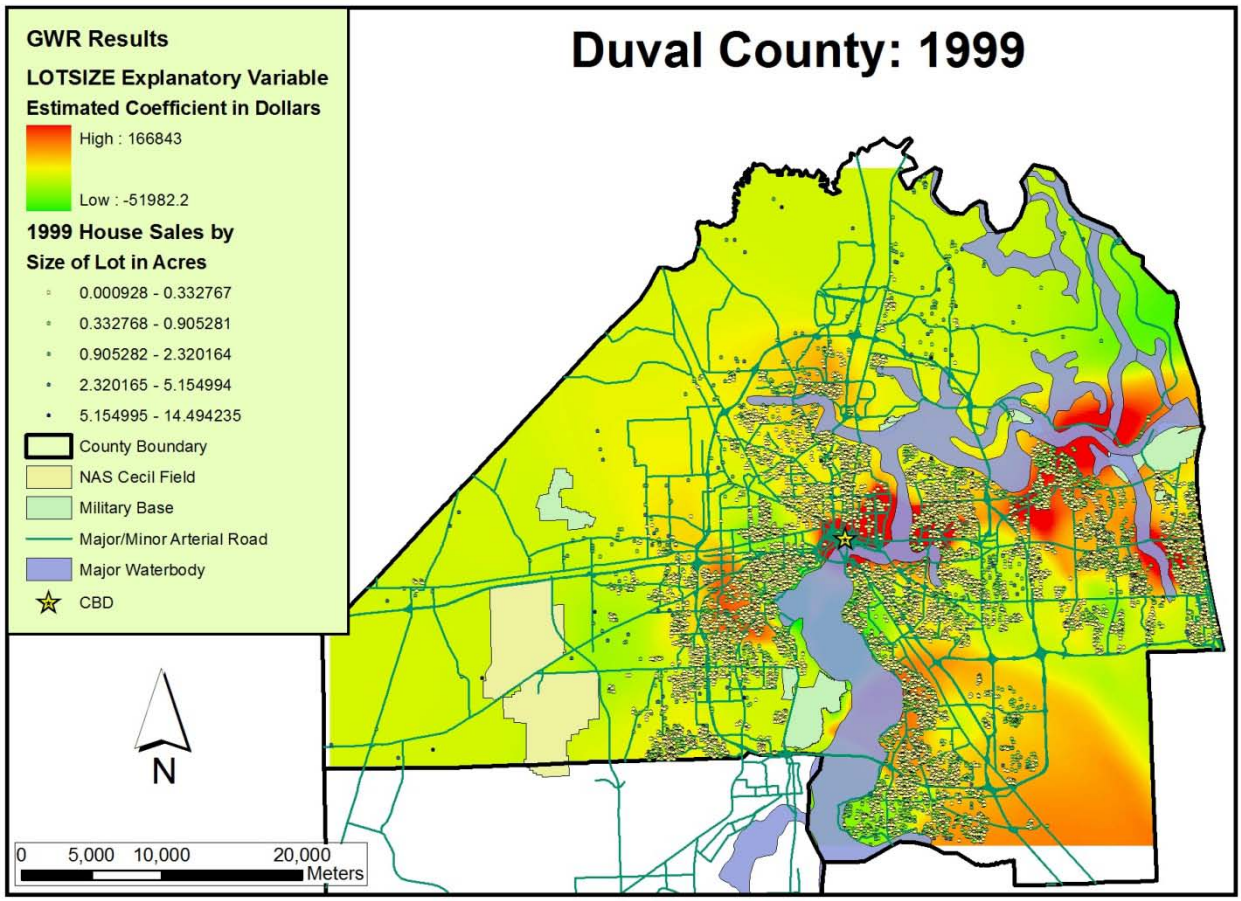

Figure F-3. Duval 1999 Acreage of Lot (LOTSIZE) GWR Output

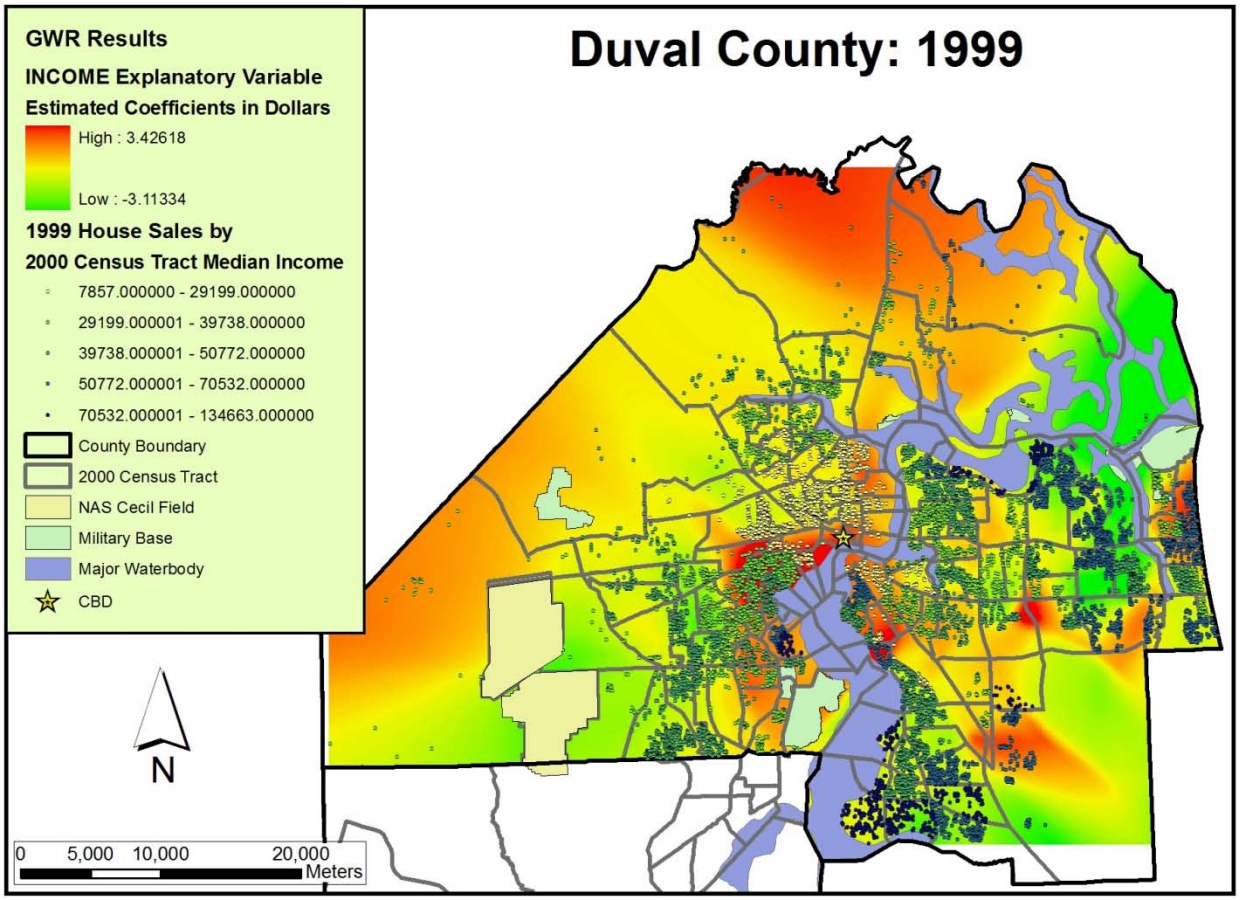

Figure F-4. Duval 1999 Median Household Income in the Census Tract (INCOME) GWR Output

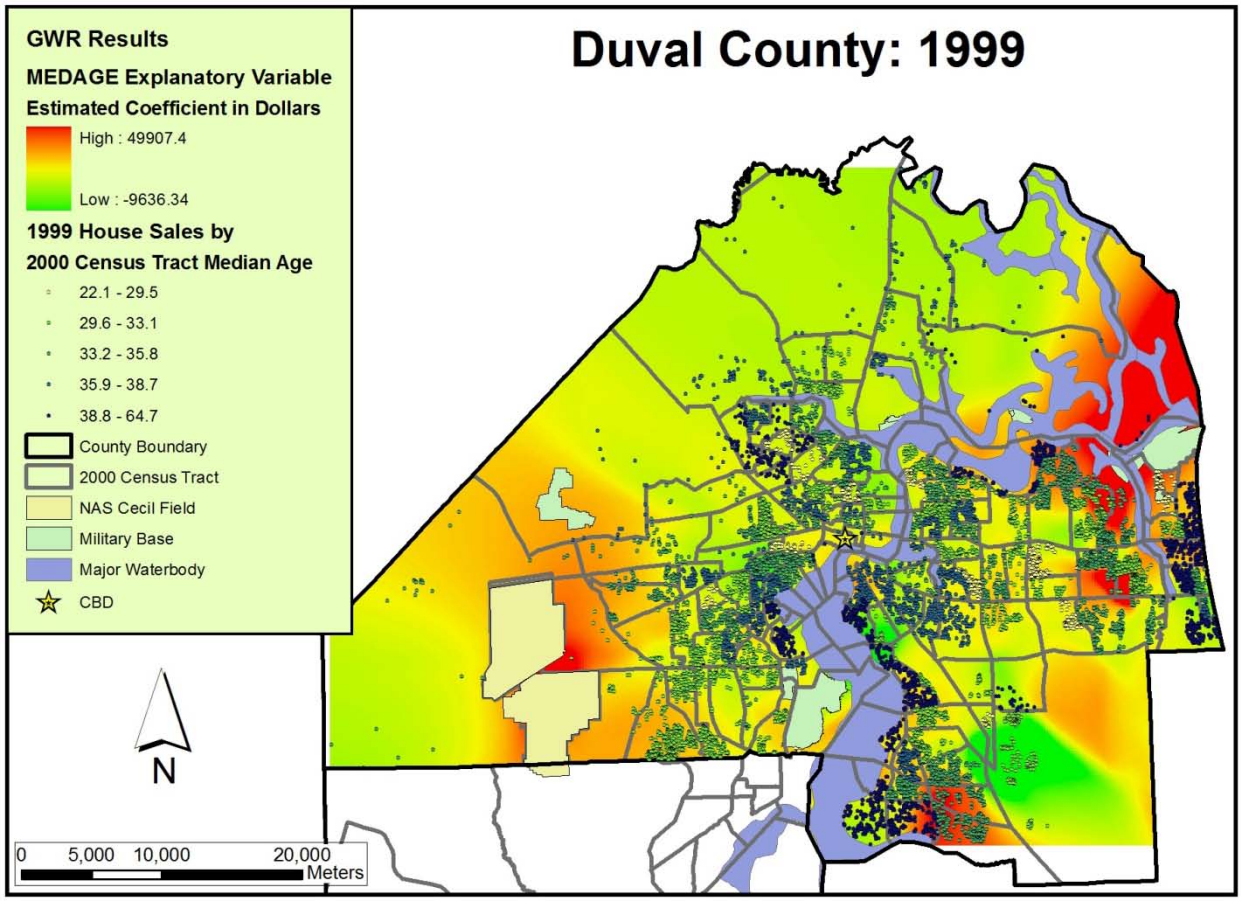

Figure F-5. Duval 1999 Median Age in the Census Tract (MEDAGE) GWR Output

APPENDIX G
2000 DUVAL GWR RESULTS

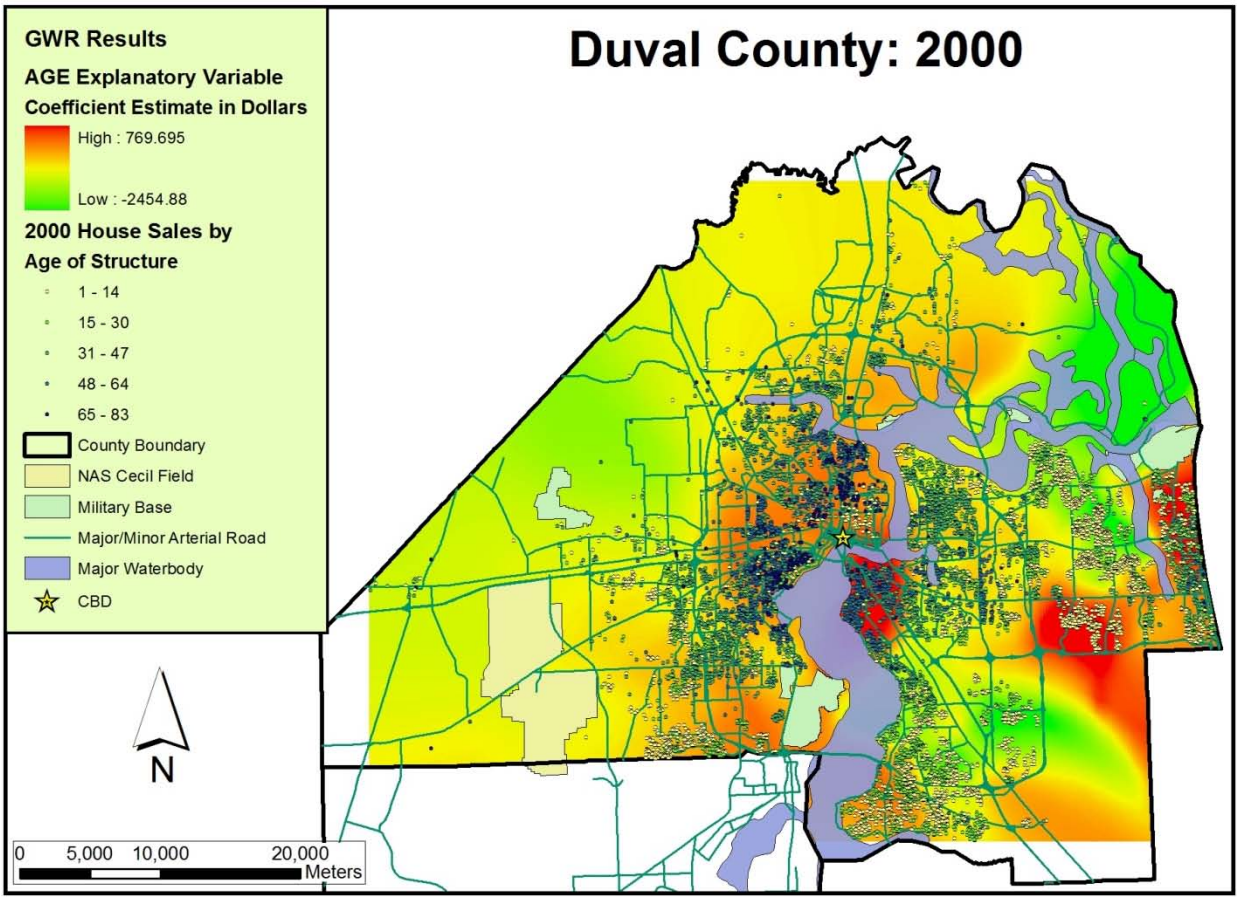

Figure G-1. Duval 2000 Property Age in Years (AGE) GWR Output

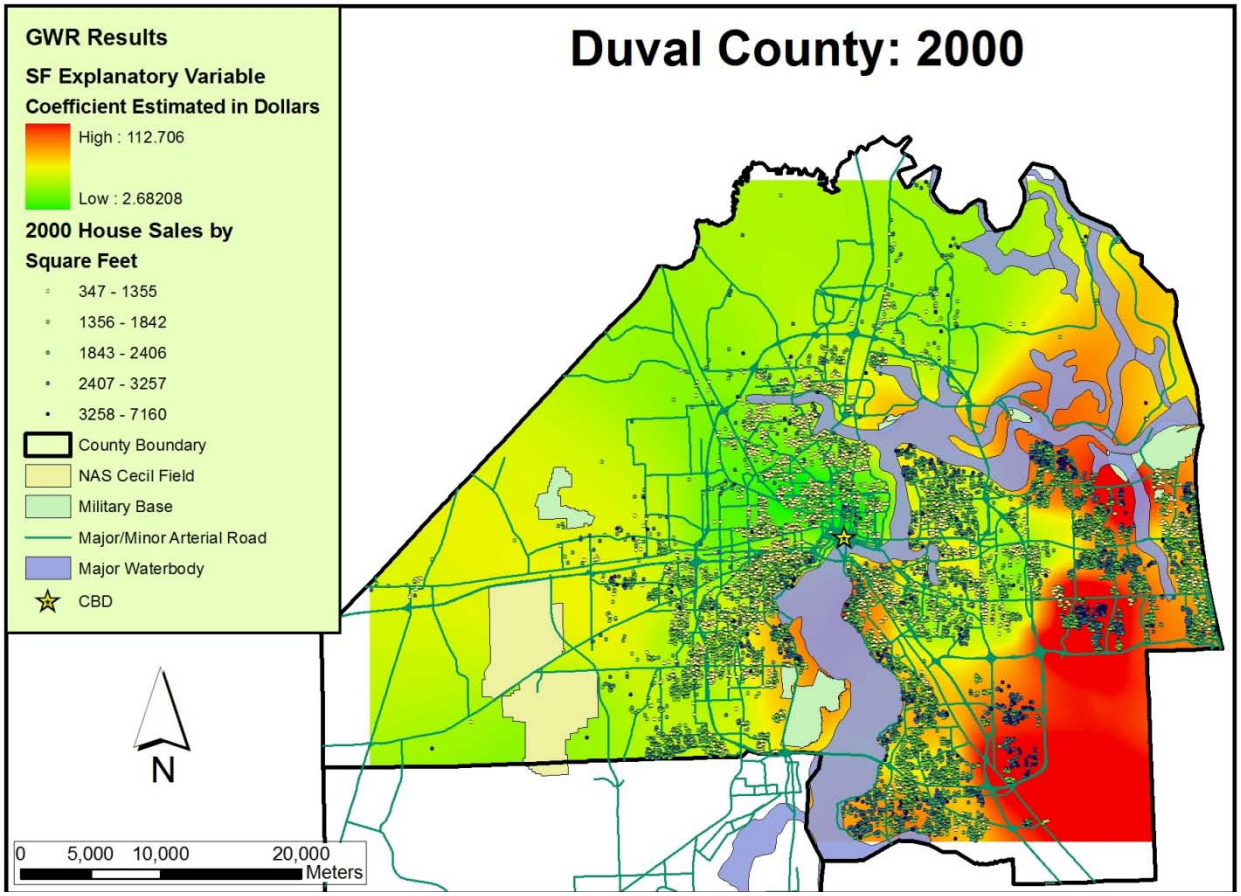

Figure G-2. Duval 2000 Square Footage of House (SF) GWR Output

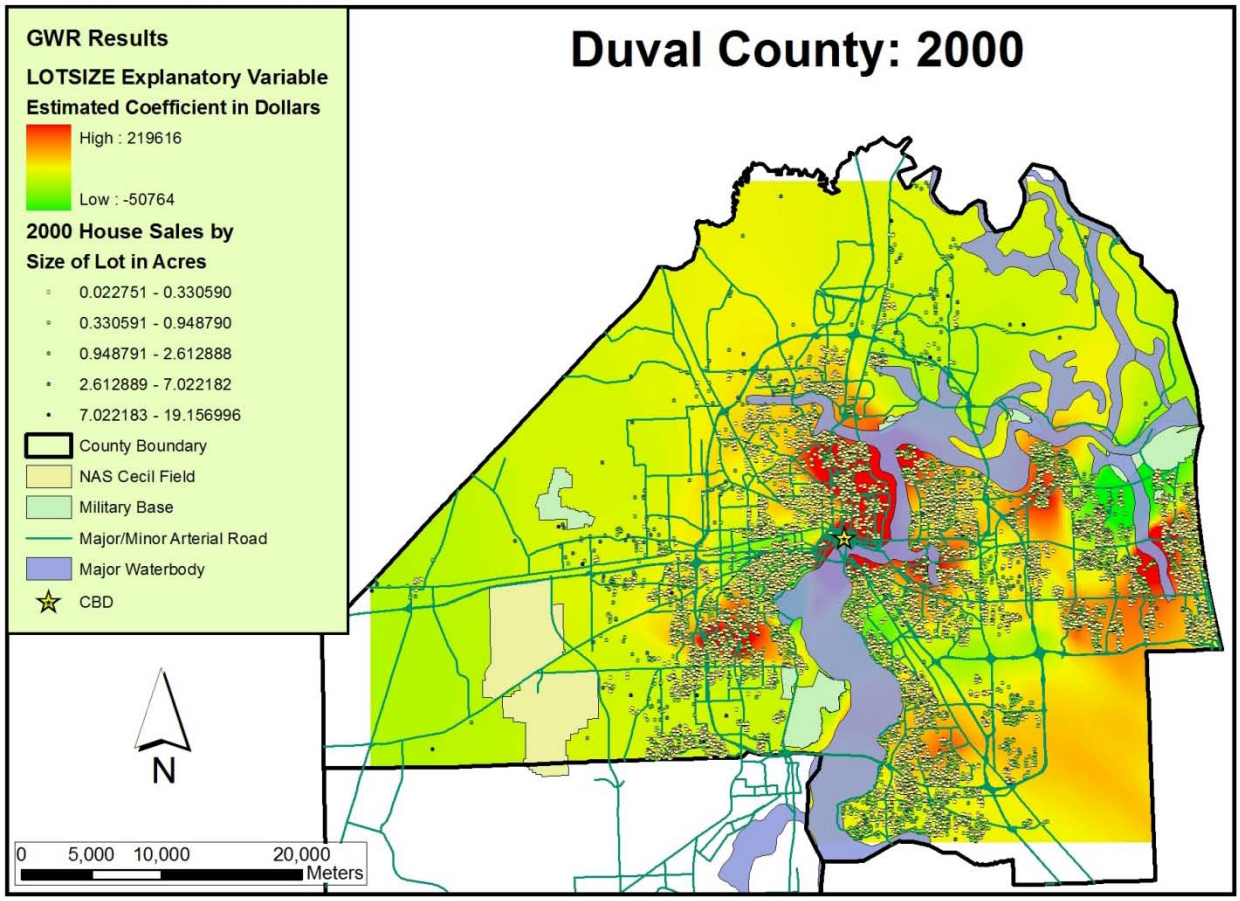

Figure G-3. Duval 2000 Acreage of Lot (LOTSIZE) GWR Output

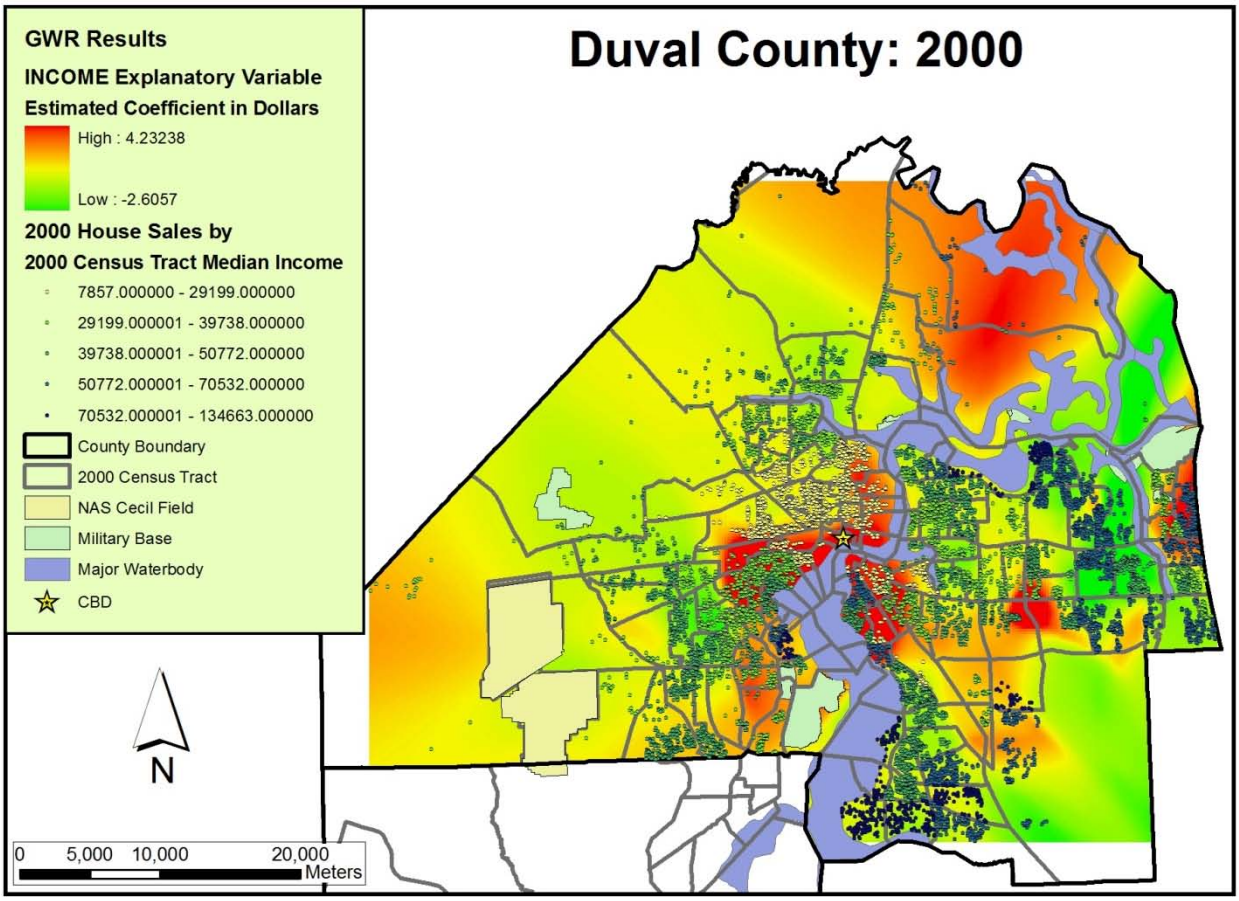

Figure G-4. Duval 2000 Median Household Income in the Census Tract (INCOME) GWR Output

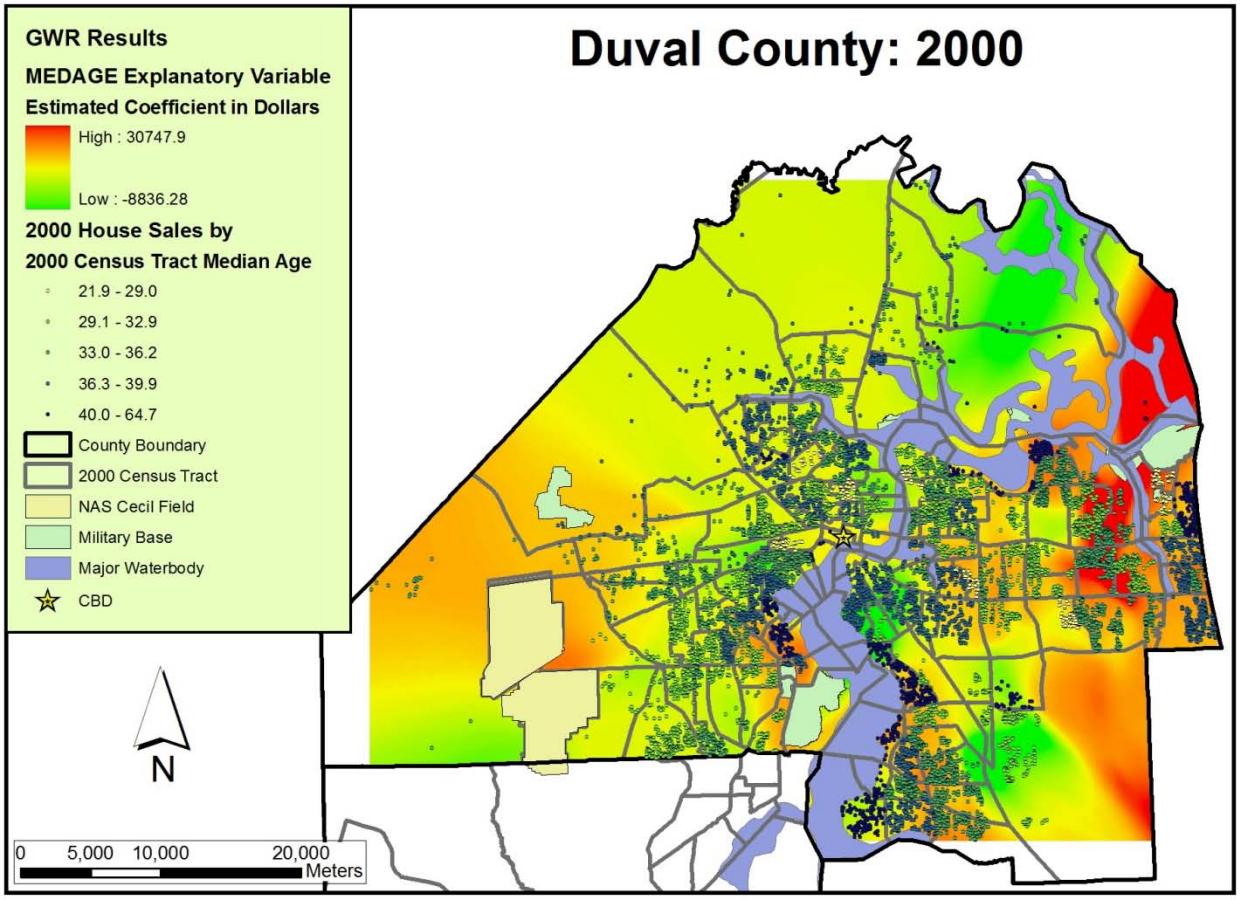

Figure G-5. Duval 2000 Median Age in the Census Tract (MEDAGE) GWR Output

APPENDIX H
2009 DUVAL GWR RESULTS

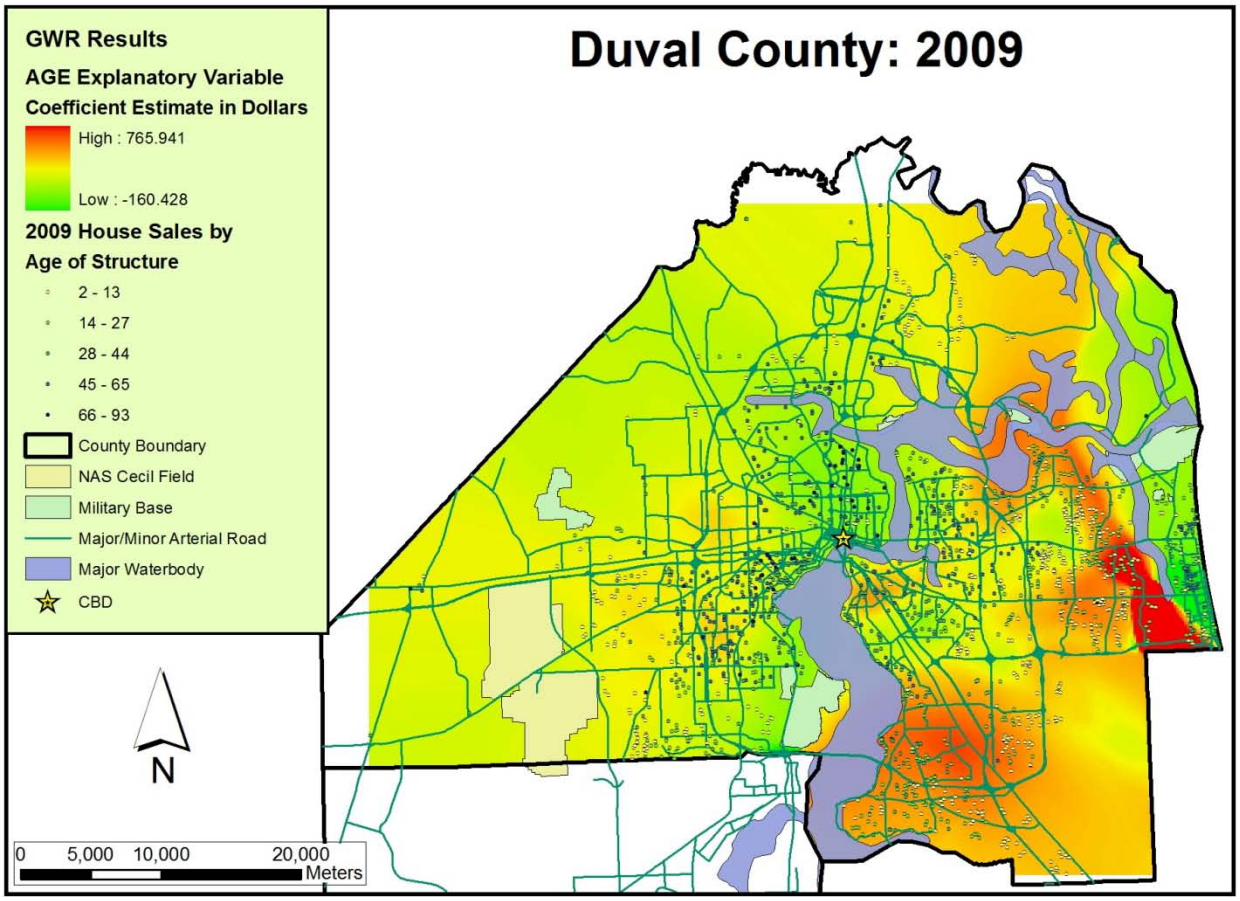

Figure H-1. Duval 2009 Property Age in Years (AGE) GWR Output

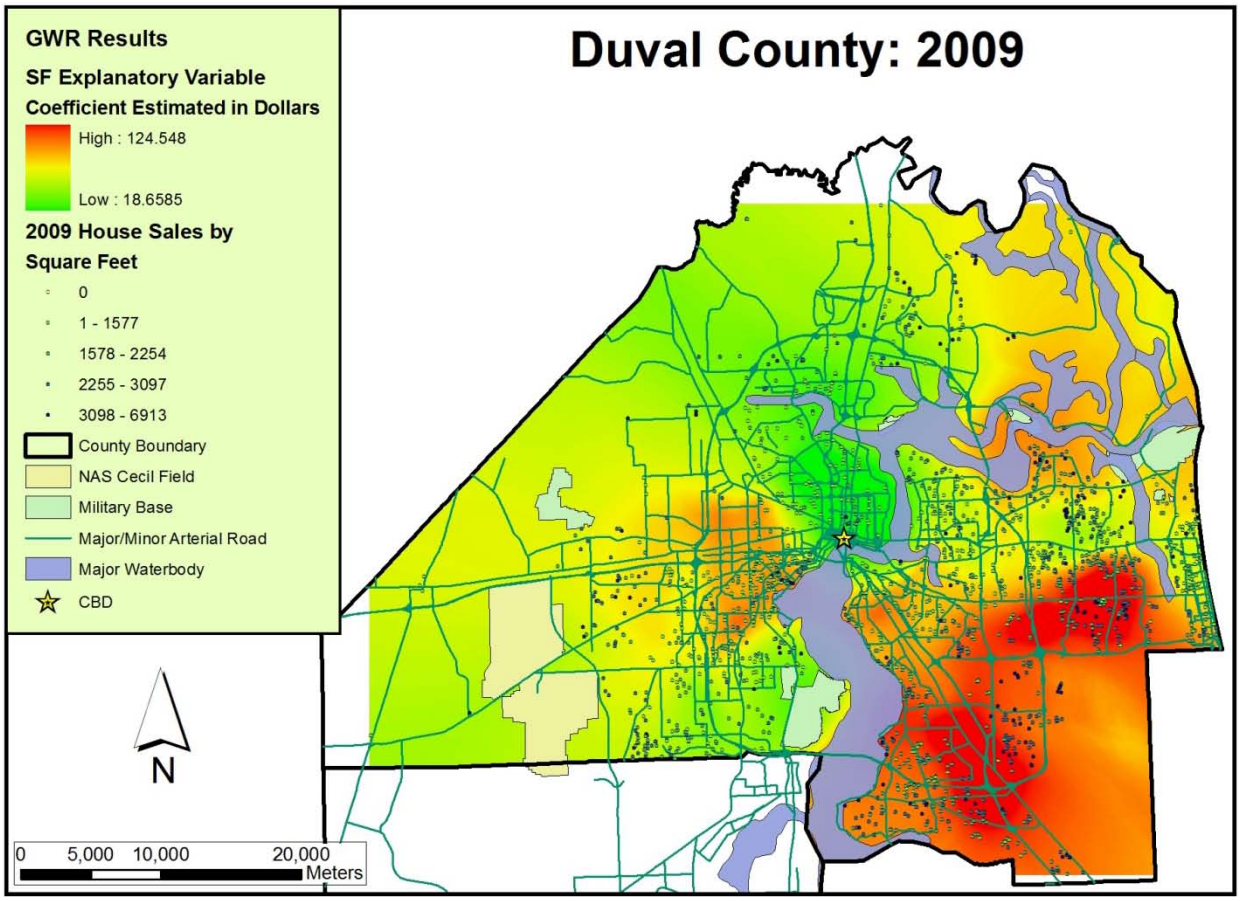

Figure H-2. Duval 2009 Square Footage of House (SF) GWR Output

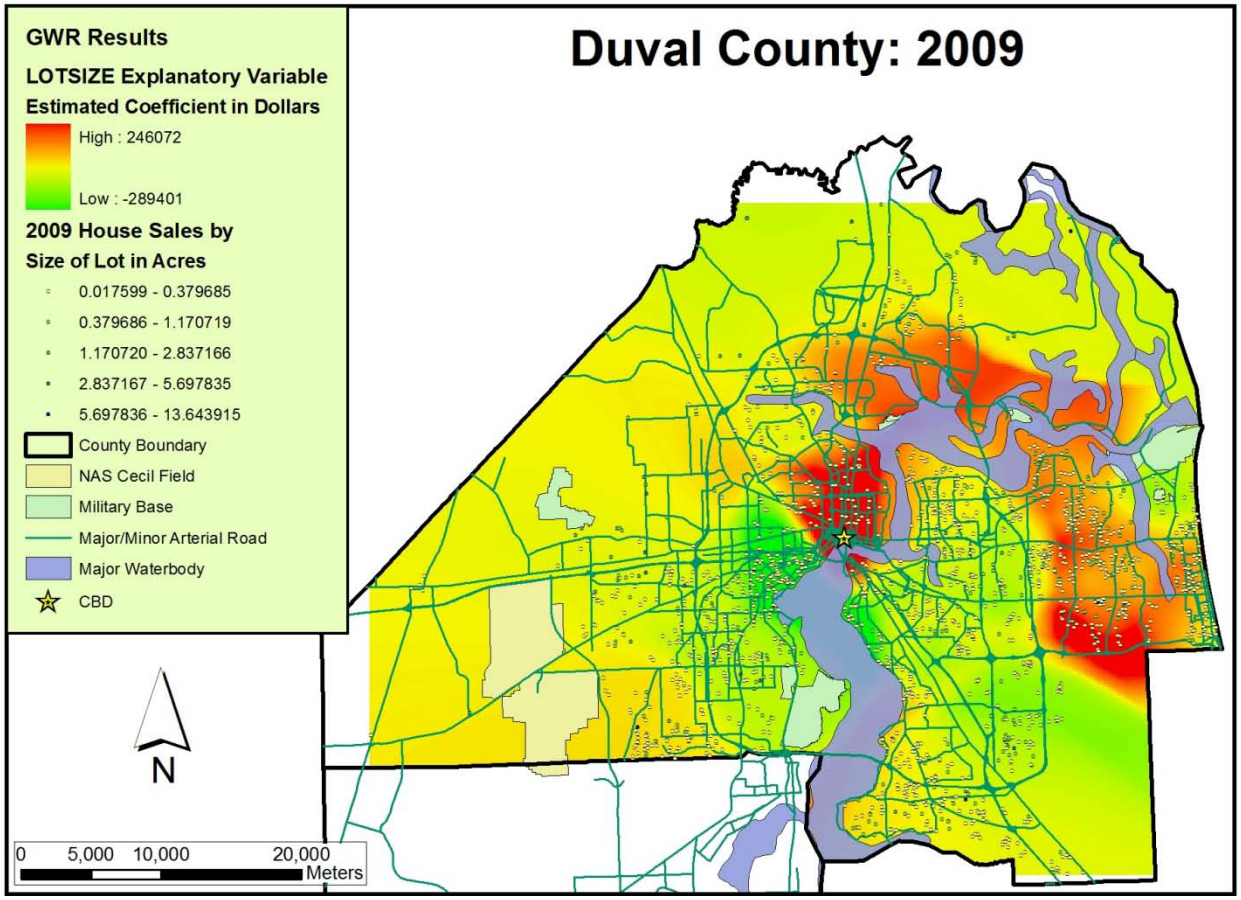

Figure H-3. Duval 2009 Acreage of Lot (LOTSIZE) GWR Output

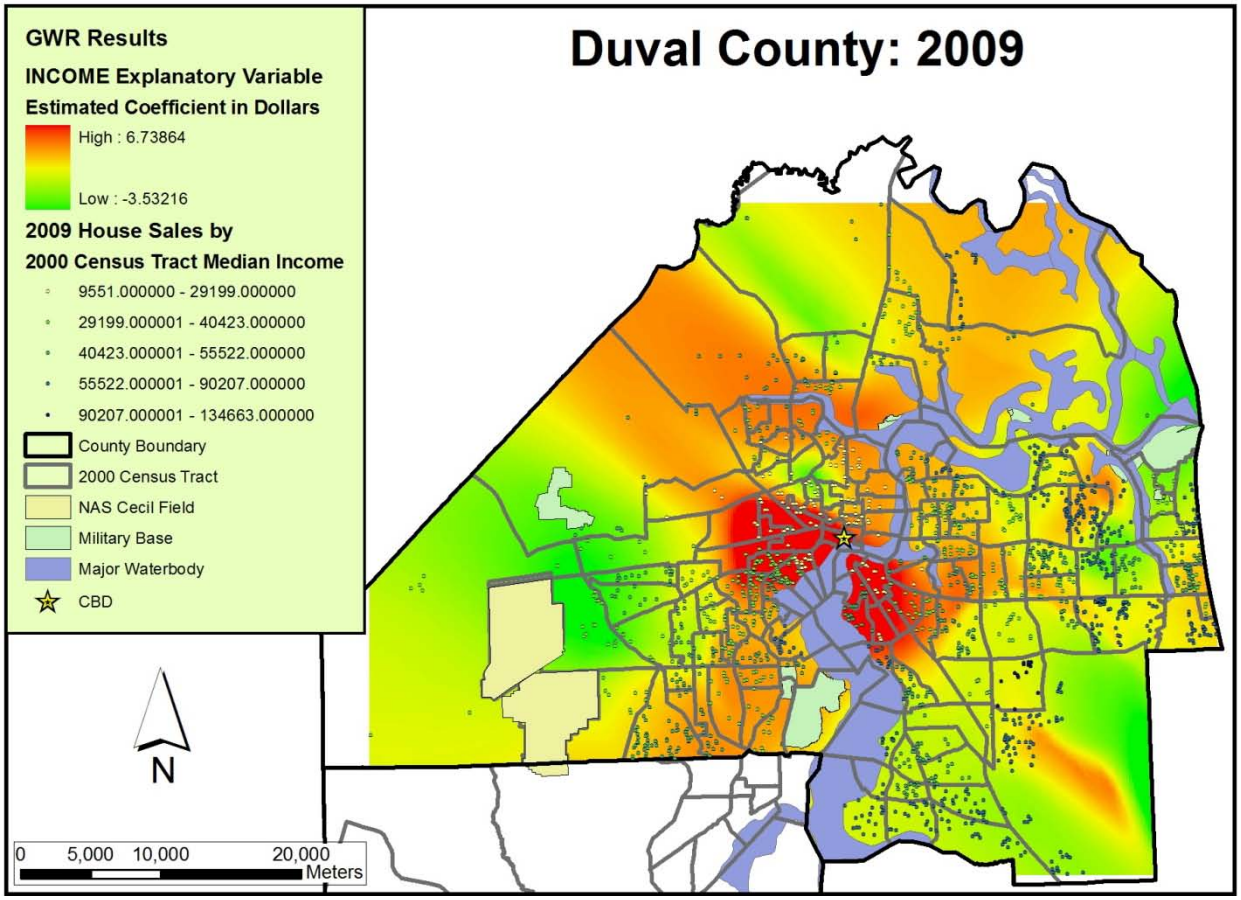

Figure H-4. Duval 2009 Median Household Income in the Census Tract (INCOME) GWR Output

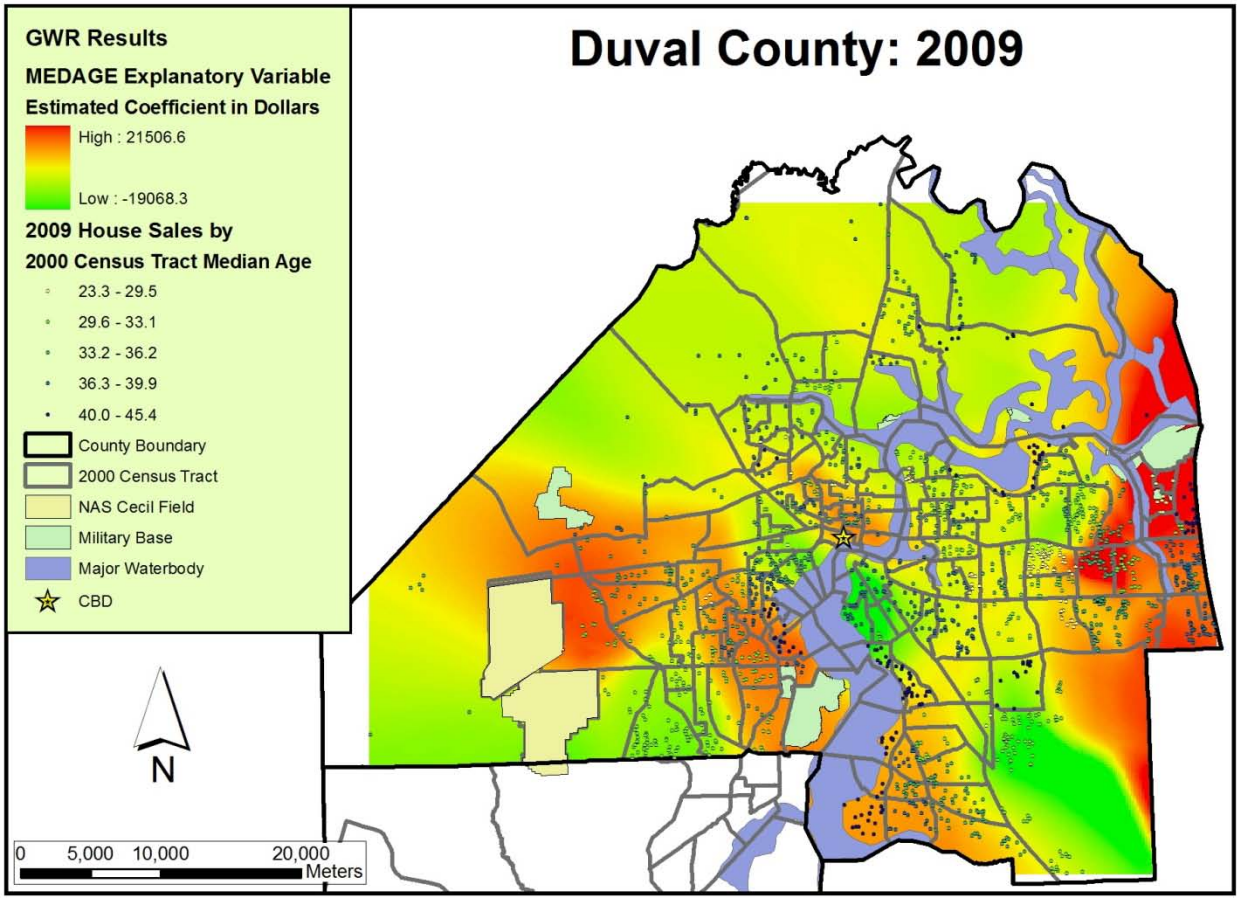

Figure H-5. Duval 2009 Median Age in the Census Tract (MEDAGE) GWR Output

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BIOGRAPHICAL SKETCH

Lieutenant Commander Greg Jennings reported aboard the Naval Reserve Officers Training Corps, University of Florida, as a postgraduate student in the Urban and Regional Planning program in December of 2008 after completing a tour with the 25th Naval Construction Regiment in Gulfport, Mississippi.

A native of Virginia Beach, Virginia, Lieutenant Commander Jennings graduated from Savannah College of Art and Design in 1996 with a Master of Architecture. Prior to joining the United States Navy he worked as an intern architect for four years in Florida. He was commissioned a United States Naval Officer and member of the Civil Engineer Corps on 07 July 2000.

Lieutenant Commander Jennings' first tour was as Assistant Resident Officer in Charge of Construction at Norfolk Naval Station, Virginia, from December 2000 to September 2002. While serving as Assistant Resident Officer in Charge of Construction, Lieutenant Commander Jennings managed major airfield military construction projects and job order contracts.

In October 2002, Lieutenant Commander Jennings reported to Public Works Center Pearl Harbor to serve as intern architect in the Civil Engineer Corps Intern Architect Development Program. He then was assigned as the Navy Region Hawaii Historic Preservation program manager. In that capacity he was responsible for consulting with parties around the nation on treatment of the Pearl Harbor National Historic Landmark and all historic structures within the Navy Region Hawaii AOR. During his tenure Navy Region Hawaii won the FY 2003 Chief of Naval Operations Cultural Resources Management Award for Installations.

In September 2005, Lieutenant Commander Jennings reported to Naval Mobile Construction Battalion Seven, Gulfport, Mississippi. At Naval Mobile Construction Battalion Seven he served as Charlie Company Commander; Detail Whiskey field exercise Officer in Charge; Detail Buehring, Kuwait Officer in Charge; homeport training officer; and the Detail Pacific Partnership Officer in Charge aboard the USS Peleliu.

In September 2007, Lieutenant Commander Jennings reported to the 25th Naval Construction Regiment, Gulfport, Mississippi. At the 25th Naval Construction Regiment he served as the Future Operations officer in charge of mission planning and exercise planning for Seabees deploying to the United States Southern Command and United States Northern Command areas of operations and was in charge of disaster preparedness planning for the command.

Lieutenant Commander Jennings is a licensed architect in the State of Florida.