

2015

# Connectivity, Sprawl, and the Cul-de-sac: An Analysis of Cul-de-sacs and Dead-end Streets in Burlington and the Surrounding Suburbs

Marshall B. Distel  
*University of Vermont*

Follow this and additional works at: <http://scholarworks.uvm.edu/castheses>

---

## Recommended Citation

Distel, Marshall B., "Connectivity, Sprawl, and the Cul-de-sac: An Analysis of Cul-de-sacs and Dead-end Streets in Burlington and the Surrounding Suburbs" (2015). *UVM College of Arts and Sciences College Honors Theses*. Paper 22.

This Undergraduate Thesis is brought to you for free and open access by the Undergraduate Theses at ScholarWorks @ UVM. It has been accepted for inclusion in UVM College of Arts and Sciences College Honors Theses by an authorized administrator of ScholarWorks @ UVM. For more information, please contact [donna.omalley@uvm.edu](mailto:donna.omalley@uvm.edu).

**Connectivity, Sprawl, and the Cul-de-sac: An Analysis of Cul-de-sacs and Dead-end Streets in Burlington and the Surrounding Suburbs**

**College Honors Thesis**

**Marshall B. Distel**

**Advisor: Dr. Meghan Cope**

**Department of Geography**

## **Acknowledgements**

This project has been partially funded by the University of Vermont's Academic Programs for Learning and Engagement grant. I would like to thank my thesis committee members, Pablo Bose, Brian Lee, and Meghan Cope for assisting in the development of this research. I would further like to give a special thank you to Meghan Cope for providing a great deal of support as my advisor. Without her guidance and constant encouragement this thesis would not have been possible. I would also like to thank all those who participated in this study, along with the Geography Department and the Chittenden County Regional Planning Commission.

## Abstract

For over six decades, professionals within the real estate industry, homebuyers, and planners have favored the cul-de-sac, an iconic symbol of suburban America. The cul-de-sac is a dead-end street characterized by a circular end to facilitate the turnaround of an automobile in one seamless motion. However, recent debates have challenged this street design. Cul-de-sac development and its connection with concerns related to urban sprawl have sparked a great deal of controversy between planners, developers, and policy makers. Relationships between physical neighborhood factors such as security, street connectivity, green spaces, and communal integration are often highlighted as the key elements that cause conflict between the proponents of the cul-de-sac and those who favor a grid street layout. Supporters of *Smart Growth*, a movement to highlight the need to develop more sustainable communities, claim that neighborhoods with cul-de-sacs tend to be more car-dependent, less safe for pedestrians, and can encourage crime by reducing levels of social cohesion and connectivity, while grid layouts foster non-car transport, can improve walkability, and lessen crime because of their enhanced permeability. This study uses a mixed-methods approach to understand: what is the experience of, and specifically, what is *attractive* about cul-de-sacs to residents in Chittenden County, Vermont, and what opinions do planning professionals have of cul-de-sacs?

## Glossary of Terms

**Dead-end:** a street that only has one way in or out

**Disconnected street:** a street that has only one way in or out, but refers to both the cul-de-sac and dead-end street

**Cul-de-sac:** a dead-end street with a round bulb at one end to facilitate the turnaround of an automobile in one seamless motion

**Grid street:** a system of streets that connect at right angles to form a grid

**Smart Growth:** a certain pattern of development that uses land efficiently, promotes community livability and protects natural resources to alleviate the undesirable effects of population growth

**Street connectivity:** a network of streets with multiple routes and connections that serve the same destination and origin

## **Table of Contents**

<b><u>Chapter 1: Introduction</u></b>	6
Framing the Debate	9
<b><u>Chapter: 2 Street Networks, Sprawl, and Patterns of Development</u></b>	15
The History of Street Design	18
Urban Street Design Guide	22
Sprawl and American Motorization	23
Street Connectivity	27
Smart Growth	30
<b><u>Chapter 3: Regional Context</u></b>	33
Chittenden County ECOS Plan	35
The Suburbanization of Chittenden County	36
<b><u>Chapter 4: Methodology and Survey Data</u></b>	41
<b><u>Chapter 5: Findings</u></b>	44
Survey Results	44
Vermont's Solution to Sprawl	46
Real Estate Professionals and Disconnected Streets	48
<b><u>Chapter 6: Spatial Analysis</u></b>	53
<b><u>Chapter 7: Evaluating the Cul-de-sac</u></b>	59
Limitations	59
Mobility	61
Crime	63
Social Cohesiveness	66
Youth Experience	68
Policy Initiatives	70
<b><u>Chapter 9: Conclusion</u></b>	71
Appendix A	74
Appendix B	79
References	87

## **Chapter 1: Introduction**

Post-World War II residential subdivisions in the US have been dominated by curvilinear roads and disconnected streets (Lucy & Phillips, 2006). These developments and street designs represented, in part, the post-war desire to escape the congestion, crime, and noise of cities (Marx, 2000), but were also part of a broad-scale shift in capital investment toward suburban residential infrastructure (Hanlon et al, 2010). During this period, the cul-de-sac started to become more prevalent in the suburban built environment as a variation to the dead-end street. The circular bulb used to enable the uninterrupted turn of an automobile at the end of a cul-de-sac is the defining characteristic that makes it distinguishable from a traditional dead-end street. Cul-de-sacs were first created as short and straight streets, and were designed to form a common public space for residents, while they also provided a safe environment that inhibited through traffic and limited the speed of vehicles (Othman & Said, 2010). Essentially, the goal of the cul-de-sac is decreases the presence of moving vehicles within residential neighborhoods. While cul-de-sacs existed in some American and European cities before the 20th century, they became widespread after the development of the automobile (Charmes, 2010). Although cul-de-sac developments appeared to meet middle-class residential desires and developers' profit motives, they have increasingly been subject to critique in the past twenty years, due to social and ecological concerns about exclusivity and inefficient uses of resources.

Recent literature has shown that the popularity of the cul-de-sac has come as a result of the suburbanite's desire to live in a quiet neighborhood with minimal through traffic, abundant open space, and where streets can serve as a place of play for children (Southworth & Ben-Joseph, 2004; Handy et al, 2008; Charmes, 2010; Othman & Said, 2010; Hochschild, 2014). The development of cul-de-sacs and dead-end streets bears a resemblance to the creation of gated communities because of strong links to local exclusiveness and

territorialization (Charmes, 2010). It has been argued that the lack of through traffic on disconnected streets has contributed to a greater feeling of street ownership for residents (Cozens & Hillier 2008). As a result, surveys of homebuyers have consistently shown that there is a residential preference for cul-de-sac streets compared to alternative street layouts (Morrow-Jones et al., 2004). Research also demonstrates that residents who live on disconnected streets believe that their neighborhoods are safer, quieter, and more resistant to incidents of crime compared to neighborhoods with through streets (Southworth & Ben-Joseph, 2003; 2004; Morrow-Jones et al., 2004).

While cul-de-sac developments have evoked occasional praise from planners, there are equally as many critics who say that cul-de-sacs cause traffic congestion, waste infrastructure resources, raise the cost of housing, and increase commuting distances (Lucy & Phillips, 2006). The cul-de-sac debate has generated a feeling of ambiguity about the ideal street type. Concerns about *sprawl* (a regional land use pattern characterized by scattered, low-density, and single-use development that generates high dependency on automobile use) have led to increased discussions about how to construct residential and commercial environments that enhance local livability and community vitality (The Champlain Initiative, 1999; Duany, Plater-Zybek, & Speck. 2000). Recent literature reveals that the cul-de-sac pattern of development has come under attack because of its correlation to sprawl-related patterns such as high levels of dependence on driving, increased carbon emissions, lack of diversity in the built environment, and a consequent sedentary lifestyle among suburban dwellers that has been shown to increase obesity and other health risks (Zhang, 2013). However, as mentioned above, developers and homebuyers have expressed a strong preference for cul-de-sac developments because it is believed that they provide a quiet and safe environment to raise a family, deter burglary rates, increase home values, reduce the cost



of development, and may promote neighborliness (Sanoff & Dickerson, 1971; Smith, 1973; Mayo, 1979; Appleyard, 1981; Southworth & Ben-Joseph, 2003; Hochschild, 2014).

In this study, I take these debates as the inspiration for an empirical examination of the *prevalence* and configurations of cul-de-sacs and dead-end streets in Burlington, VT and surrounding towns/cities through spatial analysis, and the *experience* of living on cul-de-sacs through analysis of an on-line survey of residents that resulted in (225) responses from (7) towns/cities. Chittenden County is the fastest growing region in Vermont, with a 2013 population of 159,515 people (Vermont, 2013) and an average population density of 291.7 persons per square mile. As the region continues to grow in the coming years, and as dependence on fossil fuels (and the land-use patterns that foster this dependence) becomes more precarious, it is imperative to evaluate and direct how the built environment will change in the context of balancing the needs for environmental sustainability and economic vitality (CCRPC, 2013).

Regional planners and supporters of *Smart Growth* would envision future growth in Chittenden County to support pedestrian- and transit-oriented development that reduces the need for car travel and increases the sense of community (Handy, 1991). Smart Growth advocates argue that their ideal developments reduce automobile dependence, enhance walkability, decrease energy consumption, foster a greater sense of community, and support a high quality of life (Morrow-Jones et al., 2004). However, findings have shown that consumer housing preferences often do not correspond to these neotraditional notions of the ideal living setting. Some studies have indicated that consumers are willing to pay up to a 29% price premium for homes located on cul-de-sacs (Asabere, 1990). The willingness of homebuyers to pay a premium to live on a cul-de-sac indicates that this street style functions differently than a traditional grid street. Thus, my **research question** is: What is the

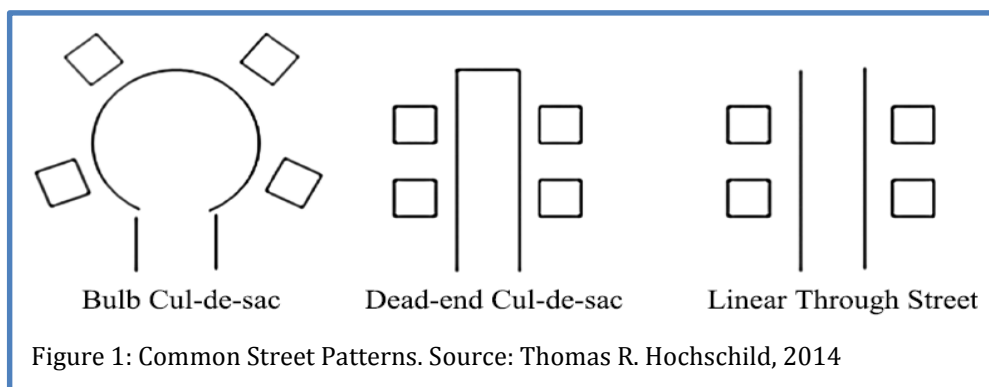
experience of, and specifically, what is *attractive* about cul-de-sacs to residents in Chittenden County, and what opinions do planning professionals have of cul-de-sacs?

My research involves exploring existing planning and sociological literature to identify the key points of conflict concerning the ideal street type that have divided many professionals within the real estate industry and planning fields. My aim is to engage in a dual assessment of the grid street network and the cul-de-sac/curvilinear street network with regard to neighborhood themes related to crime, connectivity, social interaction, sustainability, and street safety. I also investigate the driving factors that have historically led to the development of policies that affect the way in which street networks are constructed. Additionally, through a critical analysis of sprawling and fragmented developments in Chittenden County, I seek to uncover the local implications of suburbanization, and how Vermont communities have responded to rapid growth. Lastly, through a variety of qualitative and quantitative research methods, I connect the national debate between the supporters of the cul-de-sac and the advocates of the traditional grid street to the local study region of Burlington and the surrounding suburbs.

### **Framing the Debate**

For decades, the cul-de-sac has been an understudied element of the suburban built environment. However, recent concerns about neighborhood sustainability have sparked a surge in academic literature related to the function of the cul-de-sac in today's built environment. Numerous studies have attacked this iconic symbol of suburbia while others have shown renewed support for it. The debate over the future of the cul-de-sac has inspired researchers to develop reports about the advantages and disadvantages of this street pattern. Yet many of the studies that have been published display considerably contrasting views. The question of neighborhood design has significant implications on society as a whole, particularly around issues of sustainability.

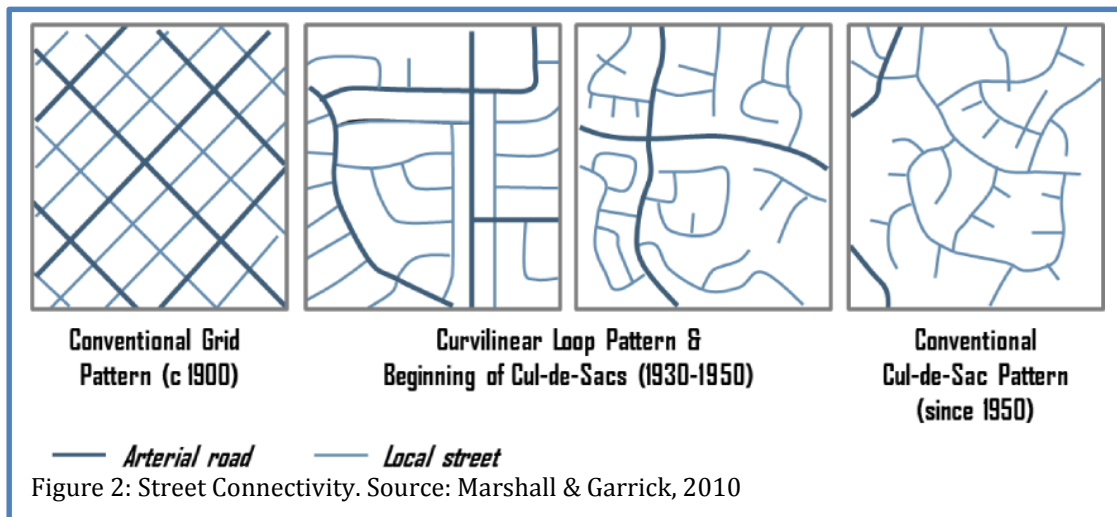
Within the context of street and neighborhood design, sustainability involves enhancing the economic, environmental, and social integrity of communities (Randall & Baetz., 2001). Following World War II, economic restructuring (deindustrialization and the shift to a service-based economy), powerful oil and automobile industry lobbies, and cheap and abundant energy led to the vast development of spatially dispersed, low-density suburban enclaves dominated by curvilinear and cul-de-sac street patterns (see Fig. 1; also Duany, Plater-Zybek, & Speck., 2000). Subsequently, multiple waves of economic growth and the expansion of car-dependent built environments have collectively made the United States the world's most motorized nation (Jones, 2008).



The grid street networks that were used in traditional neighborhood design during 1920s were abandoned in favor of the “loops and lollipops” street pattern, making suburbia more physically sprawling than compact urban neighborhoods and historic downtowns (Randall & Baetz., 2001). Despite this, many planners and policy makers are now advocating that streets and communities should be built with sustainability in mind. Along with single-use zoning, the low-density, single-family residential subdivisions that often coincide with the development of cul-de-sacs, have resulted in high-intensity resource usage: car-dependency, more housing construction materials, increased length of utilities and water/sewer services, and the conversion of open space to residential and commercial land uses. Consequently, this type of development has adversely impacted natural systems such as

water quality and wildlife habitats, while it has also exacerbated climate change because of increased carbon emissions (Benfield et al, 1999; Squires, 2002; Hanlon et al, 2010).

Many planners have denounced sprawl and the cul-de-sac due to an increasingly common desire to build sustainable communities. Cul-de-sac developments lack the connectivity that the grid street pattern has historically offered (see figure 2).



While grid streets provide numerous options to get from A to B (thereby reducing traffic on each street), in suburban subdivisions (where most cul-de-sacs are found) route choices are restricted and often require a resident to travel through congested connector roads onto larger arterial systems, contributing to suburban gridlock during peak periods of travel (Southworth & Ben-Joseph., 1995). However, not all planners and policy makers are critical of the cul-de-sac.

The cul-de-sac presents many advantages that are worth considering. From the perspective of residents, they typically offer quiet and safe streets where children can play without the fear of fast-moving through traffic (Southworth & Ben-Joseph., 2004). The cul-de-sac is popular with developers because it allows for flexibility in the organization and positioning of homes. Additionally, it can be employed in nearly all portions of a subdivision around problematic topography and environmentally sensitive areas where the grid street

pattern may be difficult to construct (Asabere, 1990). Studies have also shown that cul-de-sac residents experience higher levels of sociability and are less likely to encounter incidents of crime due to a decreased permeability (Hochschild, 2014; Southworth & Ben-Joseph., 1995; Johnson, & Bowers 2010).

The discussion over the future of the cul-de-sac has motivated researchers to conduct analyses regarding the advantages and disadvantages of this type of disconnected street. However, many of the reports that have been published convey considerably contrasting views. For example, Hochschild (2014) displays evidence that strong social networks on cul-de-sacs may create a greater sense of neighborhood interconnectedness than is typically found on grid streets. Conversely, Hillier and Shu (2000) show evidence that a grid street layout can foster higher levels of social interaction and a greater sense of community. The researchers indicate that enhanced street permeability provides more access for pedestrians, leading to more face-to-face interaction within the street environment. Besides the contrasting social aspects, there are also differing views about what type of street is the safest with respect to crime and traffic safety. Cul-de-sacs have often been labeled as the safest places to raise young children because of low traffic levels (Hochschild, 2013; Handy et al., 2008). On the other hand, accepted transportation engineering theory says that dense urban communities are safer on average than the lower-volume traffic environments because fewer miles are driven on a per capita basis, and the driving in these dense neighborhoods is done at lower a speed which is less likely to produce fatal crashes (Ewing & Dumbaugh 2009). That is, while the micro-geography of the cul-de-sac may see fewer crashes, the connector roads and larger, high-volume, high-speed arterials that service them have significantly higher rates of fatal crashes. In 2013, the Insurance Institute for Highway Safety found that out of a total of 32,719 traffic fatalities in the United States, 79% of occurred on arterial and collector roads (IIHS, 2013).

Southworth and Ben-Joseph (1995) describe the history, controversy, drawbacks, and the benefits of cul-de-sacs. The researchers begin by summarizing studies that suggest that the cul-de-sac should be eliminated from the American built environment. However, the authors later argue that planners need to reconsider the cul-de-sac because they have evidence that shows how these streets perform better than grid patterns when it comes to traffic safety, privacy, and safety for play. Zhang (2013) too describes the overall history and controversy of this form, but then moves on to suggest that the cul-de-sac street pattern can encourage permeability and street connectivity if it is built with pedestrian paths to promote walkability while also maintaining the safe and quiet residential environment.

In this study, I will examine the debate about disconnected streets within the context of Burlington and the surrounding suburbs. A mixed-methods approach was used to identify: Why do residents value cul-de-sacs and dead-end streets, and additionally, how do local planning professionals view these streets with regard to sustainability, mobility, and residential home preferences? To address ambiguity of the debate and answer the research questions, I distributed an online survey to residents on cul-de-sacs and dead-end streets, conducted interviews with residents, planners, developers, and real estate agents, and performed a spatial analysis of disconnected streets using ArcGIS and Google Earth in Burlington and the surrounding suburbs.

In order to better understand the nationwide debate, it is important to use multiple data sources and to incorporate a mixed methods approach to develop a comprehensive study. With this research, I intended to uncover why residents value living on cul-de-sacs and dead-end streets, while I also cross-referenced the perspectives of planners and real estate professionals in order to develop a localized study of debate about cul-de-sac development. The rest of this paper is divided into seven additional chapters. Chapter two discusses the history of street design, sprawl and American motorization, street connectivity, and provides

an overview of the principles of Smart Growth. Chapter three describes the regional context of Burlington and the surrounding suburbs, while it also illustrates how the region became suburbanized. Furthermore, this chapter provides a variety of statistics that show how suburbanization has impacted the region. Chapter four conveys the methodological approaches that were used in this study. It also displays an overview of the online survey results. Chapter five is used to highlight the findings of this paper. I start by examining the outcome of the survey and then I discuss how Vermont has attempted to address sprawl. I provide an analysis of the Vermont Planning and Development Act, Act 250, and Act 200 in order to show how the state has used land use planning guidelines to manage uncontrolled growth. Additionally, this chapter includes excerpts from local land use professionals that describe how Vermont land use policies have affected economic growth, sprawl, and housing. This section is also used to convey the opinions that real estate professionals have of cul-de-sacs and disconnected streets. With the exception of one developer who had a background in planning, this chapter shows how many real estate agents and developers are unaware of the concerns that have been associated with the development disconnected streets. Chapter 6 is the spatial analysis section. This chapter discusses how the present demographics on local cul-de-sacs and dead-end streets compare to the overall population characteristics of the region. I also created maps that convey transportation choices made by residents within the study region. Additionally, I located every cul-de-sac and dead-end street in each municipality that was studied (see Appendix B). Chapter 7 uses that data that were collected from the online surveys and the phone interviews to discuss the themes of mobility, crime, social cohesiveness, and youth experience on cul-de-sacs and dead ends. An overview of the policy initiatives from around the county that address the development of disconnected streets is also examined in this chapter. Lastly the overall findings are discussed in chapter 8, which serves as the conclusion of this paper.

## **Chapter 2: Street Networks, Sprawl, and Patterns of Development**

Street networks are an integral part of human society. In addition to being one of the most noticeable elements of the built environment and the foundation for numerous modes of transportation, street networks connect destinations that are spatially separated to facilitate the movement of people, goods, ideas, and wealth (CNU, 2012). They also play a pivotal role in the development of neighborhoods and communities. Cities and towns are often characterized by the quality and connectedness of their street networks. In the United States, a monumental amount of land is dedicated to roads, parking, and infrastructure related to the automobile. On average, street networks constitute almost half of all the land in American metropolitan areas (Southworth & Ben-Joseph., 2003). Over the past decade, there has been a new wave of interest related to street standards and the design of residential living arrangements as a result of concerns related to sprawl and sustainable development. Planners are seeking alternatives to the contemporary network practice where a branching hierarchy is used so that local streets only link into connectors, while connectors only link to arterials (CNU, 2012). Although road networks have already been thoroughly studied by engineers, geographers, and urban planners, a consensus has yet to be determined about how to best arrange our streets to address real-world issues such as traffic congestion, safety, air pollution, and transportation efficiency. There is, of course, the added complication that making changes to street networks is slow and expensive, as well as highly disruptive to existing residential and commercial areas; thus, new standards for road networks are only very slowly manifested in the built environment.

Many of today's suburban landscapes are characterized by a battle between sprawl and community identity. The formation and layout of our street network influences the way that communities are developed. Conventional network planning has continued to emphasize the importance of mobility for vehicles by encouraging high speeds and reducing travel delay



by way of established level-of-service standards (CNU, 2012). The conventional method of designing streets involves focusing on data from peak intervals of motor vehicle traffic (TRB, 2000). This assessment often creates less than ideal streets for livability and non-automotive uses because the focus is put on accommodating the maximum volume of traffic. Critics of traffic-accommodation approaches argue that streets should be designed for all hours of the day instead of just the few hours of heavy traffic, and that planning only for excess traffic can fail to provide a safe and appealing environment during the other hours of the day.

Traditionally, the focus of street design has remained on providing efficient vehicle movement during the morning and afternoon peaks hours, while not much emphasis has been placed on the off-peak hours. The endorsement of local governments, with incentives provided in the form of federal funds, has further required local planning organizations to adhere to minimum street capacity requirements so that they can continue to be eligible to receive governmental funding. For example, if local municipalities fail to follow the methodologies and guidelines in the *Highway Capacity Manual* published by the American Association of State Highway and Transportation Officials and the Federal Highway Administration, then the municipalities may be considered ineligible for future project funding. Subsequently, critics argue, with the world's highest level of vehicle miles traveled per capita, U.S. street design guidelines and standards have supported the development of a car-centric society (see figure 3 & CNU, 2012).

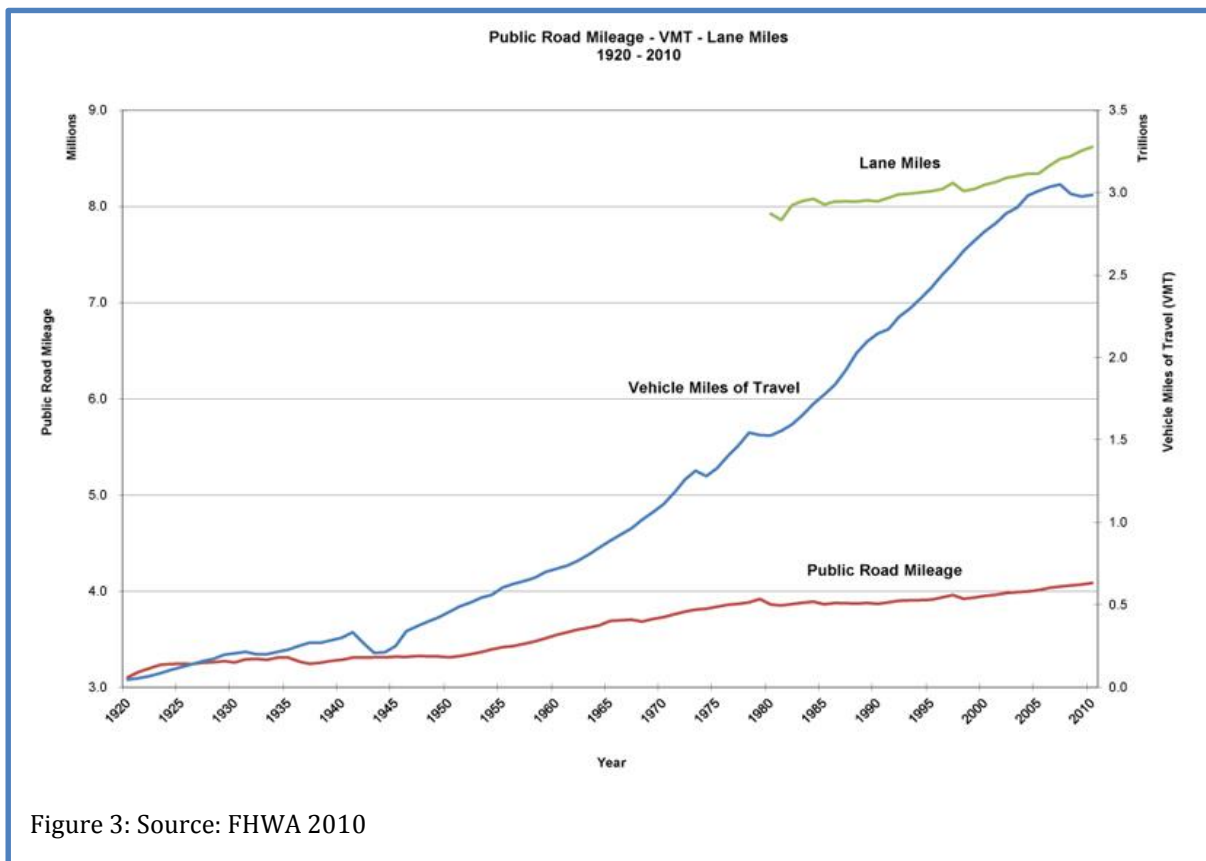


Figure 3: Source: FHWA 2010

Federal bureaucracy and political influence from auto, oil, and tire industries have affected American development principles (Hanlon et al, 2010). Beginning in the 1920s, a coalition of special interest groups lobbied the government for a road-building revolution (Jackson, 1985). City planners, real estate agents, and business owners argued that traffic congestion contributed to a decline in real estate values and therefore, negatively impacted downtown businesses (Rose, 1979). As a result of the pressure from special interest groups, elected officials declared that building highways would encourage economic development, which in turn, justified public financing for road building projects. While highways were improving, the nation’s electric streetcar systems began to decline. Ridership plummeted because of the popularity of the automobile and through a concerted effort by the auto industry to eliminate all trolley systems (Slater, 1997). Moreover, the creation of the Federal Highway Act of 1916 and the Interstate Highway Act of 1956 shows how the government supported policies that benefited private vehicle ownership (Jackson, 1985).

## **The History of Street Design**

The historical roots of today's American street design guidelines come from the ancient Greeks and Romans. These civilizations created standards for straight and parallel streets in their villages and cities in order to primarily move military units, and to facilitate trade from one region to another (LVPC, 2011). In 450 B.C.E., Hippodamus was the first to develop the concept of straight and parallel streets, which provided the foundation for the gridiron system (Handy et al, 2003). While the Greeks are credited for the first known grid system, the Romans are known for their street standards and design guidelines. During the peak of the Roman Empire around 300 C.E., nearly 53,000 miles of roads had been constructed to connect Rome with distant frontiers (Southworth, & Ben-Joseph., 1995). Today's modern elevated sidewalks are a prime example of a design that originated in Rome. The Romans developed sidewalks with the intention of giving the pedestrian a safe place to move through the street space. In addition to creating sophisticated pedestrian infrastructure, the Romans also developed methods to address street congestion and regulate traffic patterns. For example, the first documented instance of traffic calming came as a result of Romans placing large stone blocks at the entrances of streets in order to discourage chariot traffic (Handy et al, 2003). After the collapse of the Roman Empire, subsequent civilizations began to place less of an emphasis on the importance of a grid network. However, straight and parallel streets were still praised for their ability to create dramatic perspectives on civic and religious landmarks, while they also provided increased mobility through cities (Southworth, & Ben-Joseph., 1997).

In the late 1600s, the first grid street networks emerged in American cities (Handy et al, 2003). More than a century later, as the railroad began to span across the country, it helped to create the standardization of the gridiron pattern because it was easy to layout streets, and it streamlined the processes of surveying land (Jackson, 1985). The U.S. Department of

Agriculture has shown that nearly four-fifths of land subdivision in this country has been conducted using the rectangular land survey so that land could be divided in an efficient manner (Ben-Joseph, 2005). American street networks have historically followed this same pattern. The grid was a cost-effective and economical approach to create towns and cities for pedestrians and horse-drawn vehicles (LVPC, 2011). When the automobile became a popular mode of transportation in the United States, changes in the construction and design of streets began to reshape the landscape.

As industrialization spread throughout the United States during the nineteenth and twentieth centuries, a movement against urbanization soon followed. Frederick Law Olmsted, Calvin Vaux, and other advocates of suburban living designed secluded communities with curvilinear streets to create private residential neighborhoods that separated citizens from industrialized cities. In 1928, Clarence Stein and Henry Wright planned the first American development with cul-de-sacs in Radburn, New Jersey. Stein indicated that the inspiration for the Radburn plan came from the desire to create living spaces that were isolated from the automobile (Charmes, 2010). In fact, the two square mile development also incorporated pedestrian paths that were completely separated from vehicle traffic. It offered residents the mobility benefits of the automobile but minimized its negative impacts, particularly from the perspective of a pedestrian (Handy, 1993). The success of the Radburn plan led to the creation of new policies to encourage curvilinear streets and dead ends in order to create safe environments for pedestrians and quiet neighborhoods for residents.

In 1936, the Federal Housing Administration (FHA) published a booklet of standards that rejected the grid street pattern and endorsed the creation of residential developments with cul-de-sacs to discourage through traffic and support a hierarchy of streets (Handy et al, 2003). The FHA emphasized that,

*Cul-de-sacs are the most attractive street layout for family dwellings; street construction costs are thereby reduced since an 18-foot pavement with a minimum 30-foot radius turnaround are sufficient.* (FHA, 1936).

In total, the FHA proposed three different types of residential street layouts: curvilinear, cul-de-sacs, and courts (Ben-Joseph, 2005). Furthermore, FHA design standards also specified minimum housing lot sizes, encouraged front yards to be used for lawn space, and discouraged the presence of trees and shrubbery (Ross, 2014). As rail travel diminished through the postwar years, government policies continued to favor the development of vehicle-oriented suburbs, which has had a significant impact on the way that Americans travel. For example, in 1969, 49% of elementary-aged children walked or biked to school; by 2009, the number had dropped to just 13% (Ross, 2014). Moreover, when the population of the United States doubled between 1950 and 1980, the number of automobiles on American roads increased by nearly 200% (Jackson, 1985). In 2008, the U.S. Department of Transportation estimated that there were about 256 million registered passenger vehicles in the country, which gives the United States the largest passenger vehicle market in the world (U.S. DOT, 2008). Additionally, in 2009, the National Household Travel Survey found that on average, an American household has 1.9 vehicles (NHTS, 2009).

A 1961 study of motor vehicle crash rates by Harold Marks helped to influence the standardization of suburban street guidelines. The study looked at both grid street neighborhoods and subdivisions that were designed with FHA guidelines that supported networks of disconnected streets. The results showed that the gridiron developments had an average of 77.7 accidents per neighborhood each year, while the FHA subdivisions had an average of 10.2 accidents during the same study period (Handy et al, 2003). However, a limitation to this study would be the lack of data that review crashes with regard to vehicles miles travelled. Nevertheless, based on these results, the Institute of Transportation Engineers published *Recommended Practice for Subdivision Streets* in 1965 to further promote the

concept of street hierarchy, which in turn contributed to the creation of more residential neighborhoods with cul-de-sacs and dead-end streets. Prior to this publication, the Urban Land Institute published a 1960 handbook that labeled cul-de-sacs as the best type of streets for single family housing developments (Ben-Joseph, 2005). Additionally, the American Society of Civil Engineers argued that the reduction of through traffic on residential streets has been an effective way to improve the neighborhood living environment (Handy et al, 2003). With numerous professional engineering and planning organizations to support the cul-de-sac pattern of development, the federal government was motivated to continue to develop policies that would encourage disconnected streets. Thus, a paradigm shift occurred in regard to dead-end streets. During the beginning of the twentieth century, developers who created dead-end streets were criticized for ignoring accepted circulation planning, and thereby creating problematic street patterns; however, by the 1940s, dead-end streets were viewed as desirable locations for residential housing (Southworth, & Ben-Joseph., 1995).

While federal policies have succeeded in producing residential streets with minimized through traffic, the effort to create a hierarchy of streets has led to the development of relatively low-traffic residential areas surrounded, and even *confined*, by high-speed thoroughways (VTPI, 2012). Cul-de-sacs and dead-end streets may ease traffic *within* residential neighborhoods, but they often make it nearly impossible for residents to walk to adjacent neighborhoods because of the high-volume arterial roads that surround the residential streets. Jason Charest, a senior transportation planning engineer at the Chittenden County Regional Planning Commission states that,

*Cul-de-sacs and dead-end streets can definitely limit one's options in terms of what roadways they can choose to take. They would also lead to an increase in vehicle miles travelled on main thoroughfares. In general I think people enjoy cul-de-sacs because there's not a lot of traffic on them. There's nowhere to go except to service the houses that live on them. In general, roads that are cul-de-sacs would seem very walkable because of the amount and speed of the traffic, but most of the trips made by residents on these streets would have to be made with an automobile (because of the arterial roads that they connect to). I grew up*

*on a cul-de-sac. It was nice as a kid because you could play right in the street. It felt like you owned the street, but I couldn't really go anywhere else until I had my license. People who live on cul-de-sacs tend to take ownership of the street because there are so few other vehicles. Coming from a planners' perspective I don't see them as very democratic because they benefit very few people and the amount of traffic that it adds on other main roads is contributing to unnecessary congestion (Personal interview, Feb, 3, 2015).*

Concerns about the negative side effects that Jason Charest highlighted have contributed to a surge in interest regarding street connectivity. Planning organizations and practitioners are now reexamining the concept of street hierarchy and developing plans that incorporate a variety of accepted planning principles to benefit homeowners and entire communities.

### **Urban Street Design Guide**

Taking the traffic-based critique of cul-de-sacs a step further, and responding to an increasingly common desire to design streets to function as public spaces and destinations, cities around the country and organizations like the National Association of City Transportation Officials (NACTO), have been developing plans that challenge the national standards of street design. The NACTO *Urban Street Design Guide* is a prime example of a nationwide coalition of transportation professionals that have come together in an effort to try to change the paradigm about street design. The President of NACTO, Janette Sadik-Khan, says,

*The NACTO Urban Street Design Guide charts the design principles and strategies that cities are adopting to confront 21st Century demands on their streets. It is based on the fundamental idea that streets are spaces for people as well as arteries for traffic. The guide is rooted in on-the-ground, built projects and great streets, and reflects international best practices and research in urban design, planning and engineering (NACTO Urban Street Design Guide, p.4, 2012).*

NACTO wanted to formulate a guide that would encourage the movement away from the notion that urban and suburban streets do not fit in with the actual needs and desires of the individuals who pass through them every day. Instead, the idea was to create an environment with streets that were designed to promote livability and sustainability. Overall, the guide is

meant to directly address urban issues such as walkability and street safety. Its contributors claim that translating successful real-world projects into standards that could be replicated and implemented throughout the nation would mitigate car dependency and stimulate economic prosperity. Furthermore, another purpose of the guide was to convey how street design can be used as a tool to accommodate growth, foster sustainability, and promote livability. Numerous interim design strategies are highlighted to alleviate the complications caused by conventional street standards, while also minimizing the complexity and long-term planning that comes with permanent construction projects. NACTO emphasizes that these approaches save money, deliver quick improvements, require fewer approvals, and builds public and political support for future projects (NACTO, 2012). Furthermore, the guide states that,

*Conventional street design has historically favored the function of movement over that of place. The NACTO Urban Street Design Guide considers street design as a balance of these two needs and safety as the driving parameter in design. The Guide uses street width and dimension as a primary point of departure. Width is a limiting factor in design when considering the re-organization of a given corridor. The guide has been organized accordingly, ranging from very large streets to very small streets (NACTO Urban Street Design Guide, p.8, 2012).*

Overall, in contrast to prior eras' engineering manuals, the *Urban Street Design Guide* argues that streets are public places that play a larger role for communities rather than solely being channels for vehicle traffic.

### **Sprawl and American Motorization**

Terms such as “sprawl” and “suburbanization” have been used to describe a pattern of growth that reflects low-density and car-dependent development on the periphery of larger metropolitan areas (Squires, 2002). Characteristically, cul-de-sacs and other streets lacking connectivity have been located in sprawling developments. For decades, American cities have been rapidly expanding across the landscape. In the 1920s, the average density of all



urbanized areas in the country was 6,160 persons per square mile; while by 1990, that number had dropped to 1,469 persons per square mile (Benfield et al., 1999). Suburban sprawl and particularly the car-dependent lifestyle that it is associated with, causes numerous environmental problems. The inefficient land use practices that are linked to sprawl contribute to a loss of natural environments, a rise in air and water pollution, greater energy consumption, and increased carbon emissions, which exacerbates climate change (Squires, 2002). The geographically extensive land-use patterns of suburban sprawl also take over vast amounts of arable land. For example, even just in the decade from 1982 to 1992, the American Farmland Trust reported that on average, nearly 400,000 acres of “prime” land used for agriculture was lost as a result of suburban development (Benfield et al., 1999).

Aside from the evident environmental consequences of sprawl, much of the population has become immobilized by sprawl. Estimates state that there are approximately 80 million Americans who are too young, too old, or too poor to drive; they are the most obvious victims of sprawling developments (Duany, Plater-Zybek, & Speck. 2000). In suburbia, these immobile populations are dependent on others for transportation. When others are not available to offer assistance with transportation, suburban residents may feel like they are stuck in their homes. The elderly, children, and teenagers without driver’s licenses are essentially stranded if their homes are located in large car-dependent developments. As the ability to safely drive diminishes with age, the elderly become especially dependent upon others for mobility. Some have even argued that when seniors retire to suburban communities and live in homes that distance them from their physical and social needs, they become nonviable members of society because their independent participation in public life is rendered difficult or impossible by spatial constraints (Duany, Plater-Zybek, & Speck. 2000).

The suburbanization of the American landscape during the late-industrial era was initiated by a variety of factors. Following the Second World War, numerous policies were

designed to motivate people to leave urban areas. The Federal Housing Administration and the Veterans Administration created loan programs that provided mortgages for over eleven million new homes to be built in suburbia, which were almost entirely targeted for whites (Hanlon et al, 2010). During this period, federal policies also supported massive investments for highway infrastructure, which contributed to an automobile-dependent environment that promoted the expansion of low-density developments. These federal initiatives functioned to better support infrastructure that favored suburban developments rather than compact cities.

Economic restructuring was also a factor that contributed to the fragmentation of the urban core, which in turn, motivated residents to move out of deteriorating urban areas and into newly built suburbs (Berry, 1975). This restructuring shifted the balance of jobs from manufacturing to the service sector. A loss in manufacturing jobs was triggered by automation, unionization, cheap transportation costs, and by a decline in European immigration. Initially, a change in immigration laws cut off the influx of immigrants, the majority of whom worked to boost industrial manufacturing in the urban core (Sternlieb & Hughes, 1975). However, automation then came to replace the need for abundant human labor. A critical reduction in employment opportunities occurred within urbanized areas as a result of developing this technology to replace the lack of cheap European labor.

Furthermore, the unionized workforce also put a strain on manufacturing industries that did not rely solely on automation. Unionization led to increases in wages and worker's rights, which consequently pushed manufacturing out of the north and into the mostly nonunionized southern states (Sternlieb & Hughes, 1975). Additionally, a fall in transportation prices allowed companies to move spaces of production out of the city centers and into the suburbs where there was more room and cheap land available for expansion (Glaeser, 2011).

Inexpensive transportation and shifting international trade agreements also enabled companies in other countries to sell products in U.S. markets, and it spurred industry to move

out of the United States altogether in order to take advantage of cheap labor overseas (Hanlon et al. 2010). As some industries matured, the products became more routinized rather than distinctive, which made it more economically viable to leave the urban core and relocate overseas to where less skilled labor sources could work at much lower wages (Sternlieb & Hughes, 1975). These processes – outward geographic expansion, growth of low-density car-oriented suburbs, and the shift away from a manufacturing-based economy after the 1970s – have been identified as the fragmentation of the American urban system.

The fragmentation of American cities has immensely impacted both individual lives and whole city landscapes (Hanlon et al. 2010). Deindustrialization has led to the decentralization of cities. The suburbs were viewed as a way to escape the congestion, crime, and deteriorated landscapes of American cities (Glaeser, 2011), which were simultaneously becoming perceived as dominated by African-Americans, the poor, and the dependent elderly, who were unable to afford to move or who experienced rampant racism in the suburban real estate process (Squires, 2002). Suburban life offered middle-class whites with newly defined suburban aspirations the opportunity to move freely in a living environment that was close to nature. The new age of automobility was the driving force that enabled people to live, work, and move throughout the suburban environment (Jones, 2008).

In addition to government policies and other factors such as economic restructuring, the system of mass motorization has assisted in the expansion of the suburbs, while it has also -ironically - increased the desirability of disconnected streets for residents who want to live in neighborhoods with low vehicle traffic. The automobile is by far the most common form of daily transportation in the United States (Ross, 2014). Without cars, the majority of Americans wouldn't be able to travel to work, school, or to access common amenities. The U.S. has adjusted to mass motorization by constructing more metropolitan expressways and highways than any other nation in the world (Jones, 2008). During the postwar period, a road-

building revolution was necessary to support a suburbanized nation. As more roads and expressways were created, it allowed the suburbs to expand to more regions, which consequently required even more roads to be developed (Jackson, 1985). Thus, a positive feedback loop was created between road building and the expansion of the suburbs, lubricated by the strong political lobbies of Big Oil, the construction industry, and financial lenders. Residential developments could now be located even farther from city centers because of linkages provided by highways (Benfield et al, 1999). However, since as early as the 1920s, home buyer surveys have shown that major highways and streets built to support high-volume traffic have consistently been a source of anxiety for homeowners (Lucy & Phillips, 2006). In order to design neighborhoods to alleviate this anxiety and provide safe residential living environments, planners and developers created cul-de-sacs, dead ends, and other types of disconnected streets.

### **Street Connectivity**

Connectivity (or street permeability) refers to the number of available linkages and the density of connections in a network of streets (VTPI, 2012). Connectivity has significant implications for transportation choices and quality of life. After decades of encouraging the development of disconnected residential streets such as cul-de-sacs, an increasing number of planners and municipalities are beginning to reconsider the potential benefits of connected street networks (Handy et al, 2003). Improving roadway connectivity has been shown to reduce vehicle travel distances while also enabling the use of other modes of transportation such as walking and biking. Additionally, it increases route choices and provides more direct paths of travel. Peter Keating, a senior transportation planner at the Chittenden County Regional Planning Commission is a prominent supporter of street connectivity:

*Connected streets make the transportation system work more efficiently. More links make it possible to effectively distribute the users of the street to reduce traffic on arterials. Grid systems work pretty well. Cul-de-sacs and dead-end streets funnel cars onto one or two major roads and they lead to congested conditions. They also don't work for public*

transportation because transit will never go into individual cul-de-sacs. From a land use perspective, it is an inefficient use of land to build sprawling subdivisions with lollipop streets (Personal Interview, Feb. 26, 2015).

Peter Keating mainly focuses on transportation planning for bicyclists and pedestrians. He emphasized how a road network with many different linkages can benefit active modes of transportation not only by virtue of more route options, but because traffic is spread over a greater number of streets, which reduces the need for high-volume arterial streets. In a hierarchical road system, disconnected streets force traffic onto high-volume routes that make travel by walking and biking dangerous.

This figure highlights the difference between a hierarchical road system (left) and a grid street network:

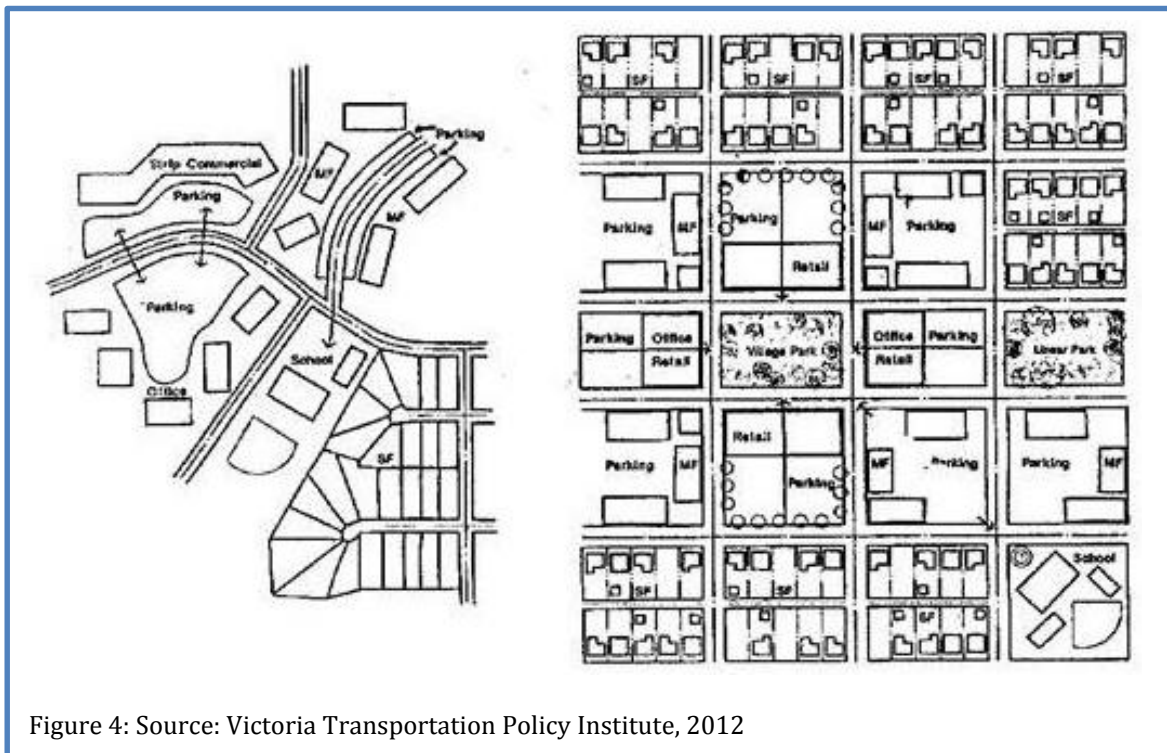
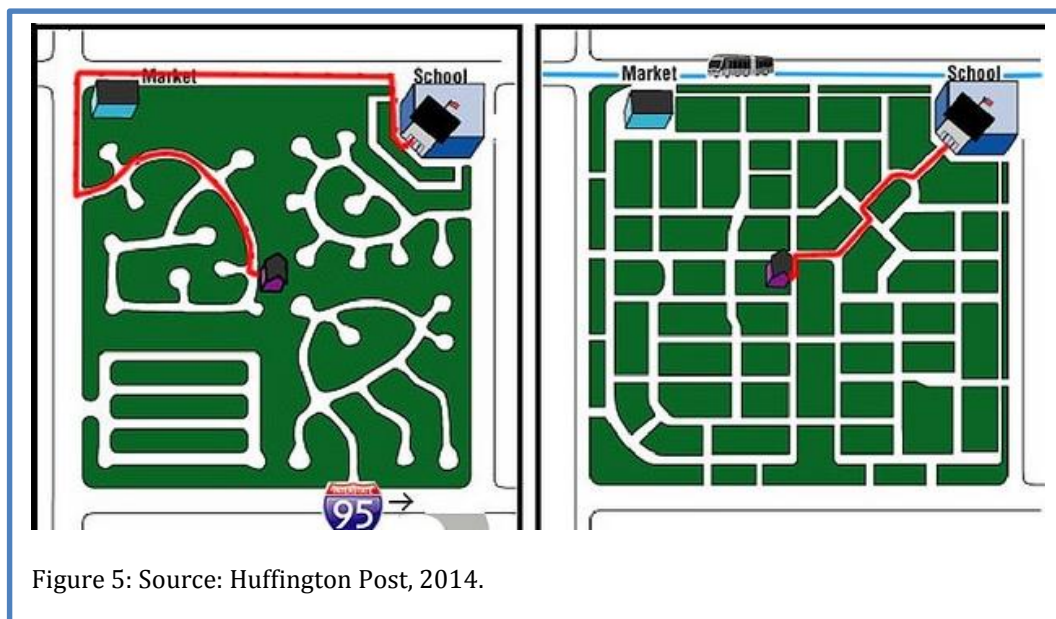


Figure 4: Source: Victoria Transportation Policy Institute, 2012

The following figure illustrates how travel distances to desired destinations can be reduced by enhancing street connectivity:



The red line shows the travel path that a vehicle or pedestrian would need to take in order to get from home to school under the two different street layouts. The travel distance in the first configuration is twice the distance as the second, and requires the user to move through a high-volume arterial street, thereby also making it difficult to travel by foot or bike. Locally connected streets allow for efficient travel within a neighborhood, while they also provide greater accessibility when it is necessary to reach larger arterials for long-distance travel. Local connections help to join developments together instead of forming barriers between them.

While reduced traffic congestion, more direct transportation routes, a reduction in travel times, and improved accessibility for non-motorized modes of transportation seem like viable reasons to support connected streets, literature has shown that ordinances requiring new residential subdivisions to increase street connectivity have been vigorously opposed by developers and real estate agents (Handy et al, 2003). Financial institutions and commercial developers have favored traditional suburban street design that incorporates the use of a

hierarchy of streets and the segregation of land use patterns in order to decrease infrastructure costs and maximize the profitability of developments (Southworth & Ben-Joseph., 2003). As a result, street hierarchies have remained dominant in the suburbs. However, recent concerns related to sustainability and climate change have resulted in renewed support for street connectivity.

### **Smart Growth**

Smart Growth land use initiatives encourage improved street connectivity in order to increase land use accessibility (VTPI, 2012). Beginning in the 1970s, transportation and community planners started to encourage Smart Growth to promote compact and walkable neighborhoods with a range of housing and job options. This concept refers to a certain pattern of development that uses land efficiently, promotes community livability and protects natural resources to alleviate the adverse effects of population growth. These policies and improvement initiatives play an integral role in fostering transportation, economic, community, and environmental benefits for both cities and towns (Vermont Agency of Transportation, 2013).

Communities that follow Smart Growth development guidelines will often have vibrant and dense downtowns filled with places to shop, live, and work. Furthermore, these locations are walkable and make use of restored historical infrastructure surrounded by a few dense neighborhoods easily accessible on foot. The historic downtowns also serve as a place to gather for community events, farmers' markets, and other civic activities. The housing options that border the downtowns, whether they are old or newly built apartment buildings, upscale condos, or single-family homes, support a diverse array of dwelling units by size, configuration, and amenities to accommodate people of all financial backgrounds. Vacant land within the immediate downtown district is reused and redeveloped whenever possible, especially before developing valuable agricultural land or open-space for new construction in

order to preserve forests, wetlands, and working landscapes such as farms, and to provide more housing options within walking distance of the town center (EPA, 2010). Fostering a distinctive community that differs from others is a key difference between towns that encourage Smart Growth and towns that support sprawl. Developing a sense of place that is appealing and unique in comparison with other towns is a key benefit to this development pattern because it strengthens community pride and the overall togetherness of local citizens. From a social justice standpoint, walkable Smart Growth neighborhoods offer greater levels of mobility for the elderly, children, and other populations who counteract the traditional monoculture of car-oriented suburbs.

Smart Growth approaches to community development promote greater levels of livability and sustainability compared to traditional post–World War II American land use patterns. Throughout the country, communities have struggled to find solutions to promote sustainability rather than sprawl. The study region around Burlington, Vermont has also endured some of the same sprawl related problems that much of the country has experienced.

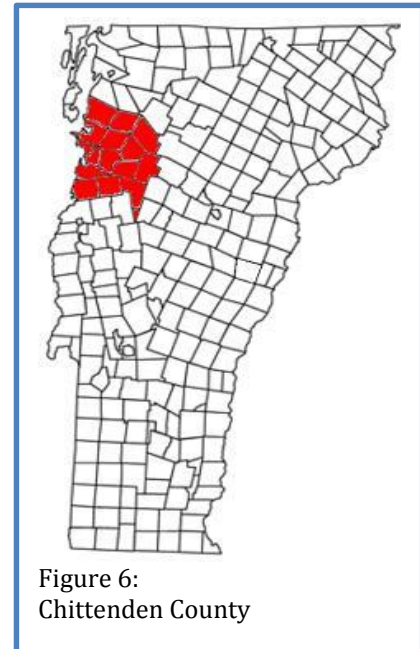
After reviewing literature related to Smart Growth, sprawl, and the development of cul-de-sacs, I have found that themes linked to a lack of street connectivity, mobility, and sustainability have been used in arguments against the cul-de-sac. On the other hand, advocates of the cul-de-sac have contended residential housing preferences, lower incidents of crime, increased levels of social cohesion, and environments that benefit young families to be the key reasons to support the development of cul-de-sacs. Based on this ambiguity, I have developed this study to examine: To what extent and why do residents in Burlington and the surrounding suburbs value cul-de-sacs and dead-end streets? Do local residents share the same views about crime, neighborliness, and street safety that were revealed in the literature review? What are the opinions of local planners and real estate professionals on disconnected streets? Within the methodology and survey data section, I provide a more detailed highlight



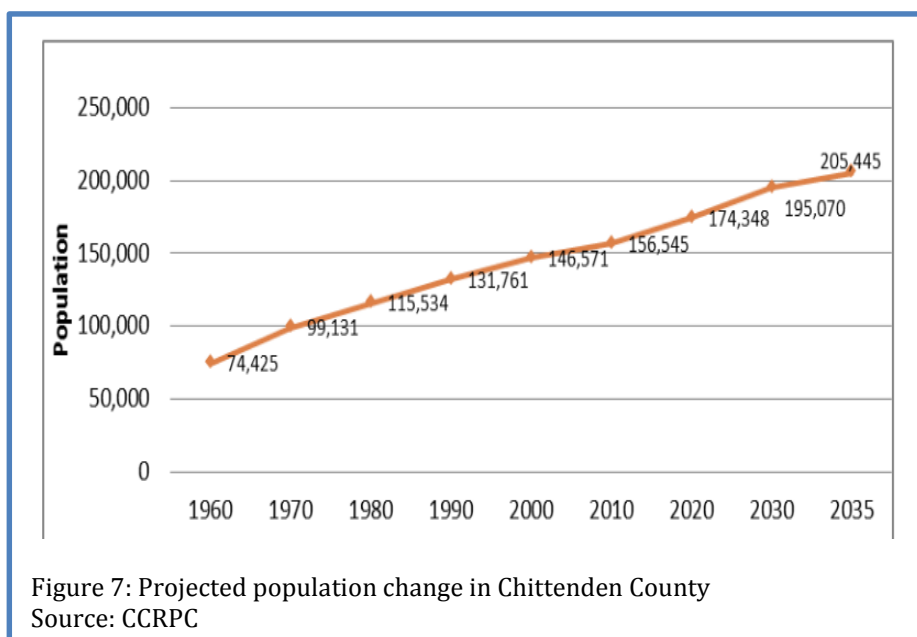
account about the methods that were employed in this study to answer the previous questions. Before I reveal the specific approaches that were used in this study and the overall findings, it is necessary to review the regional context in which this study was conducted.

### Chapter 3 Regional Context

Burlington, Vermont is a city of 40,000 located 45 miles south of the U.S.-Canadian border in northwestern Vermont. Situated between the Adirondack and Green Mountains on the shores of Lake Champlain, Burlington is a unique and vibrant city characterized by a thriving arts scene, innovative entrepreneurship, and its proximity to popular outdoor recreation destinations. Burlington is also home to numerous institutions of higher education including the University of Vermont. Like many other cities around the country, Burlington is seen as the center



of a rapidly growing area, Chittenden County, where about 156,000 people live, which is roughly a quarter of Vermont’s population (CCRPC, 2013; Murphy, 2005). Burlington was founded in 1763 as a port city and an industrial center for processing lumber. As a city that was largely constructed before the introduction of the automobile, Burlington has developed streets that were made for pedestrians (Murphy, 2005).



Burlington's downtown streetscape was established with a gridded network of streets that run parallel and perpendicular, and connect at right angles.

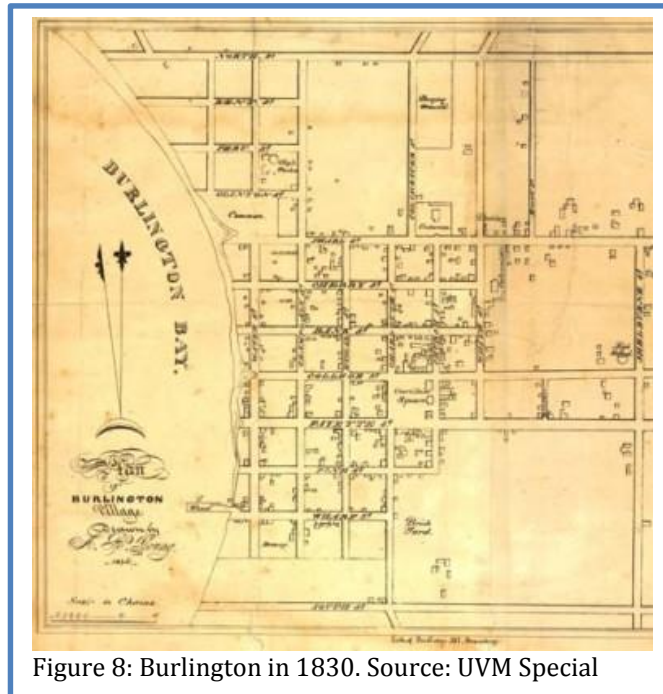


Figure 8: Burlington in 1830. Source: UVM Special

Unlike many other American cities, Burlington's center remains free from larger arterial routes, which has helped preserve accessibility and walkability. The majority of the downtown built environment exemplifies mixed-use development because housing, commerce, and civic and cultural institutions are permitted to exist next to each other (Murphy, 2005).

Today, the street network in downtown Burlington remains mainly gridded, while the surrounding suburbs (not including Winooski), are dominated by curvilinear streets, dead-ends, and cul-de-sacs. In contrast with many other parts of Vermont, which have experienced some form of population decline within the past 30 years, Chittenden County is growing at a rate that is higher than the rest of state, and even higher than the U.S. as a whole (CCRPC, 2013).

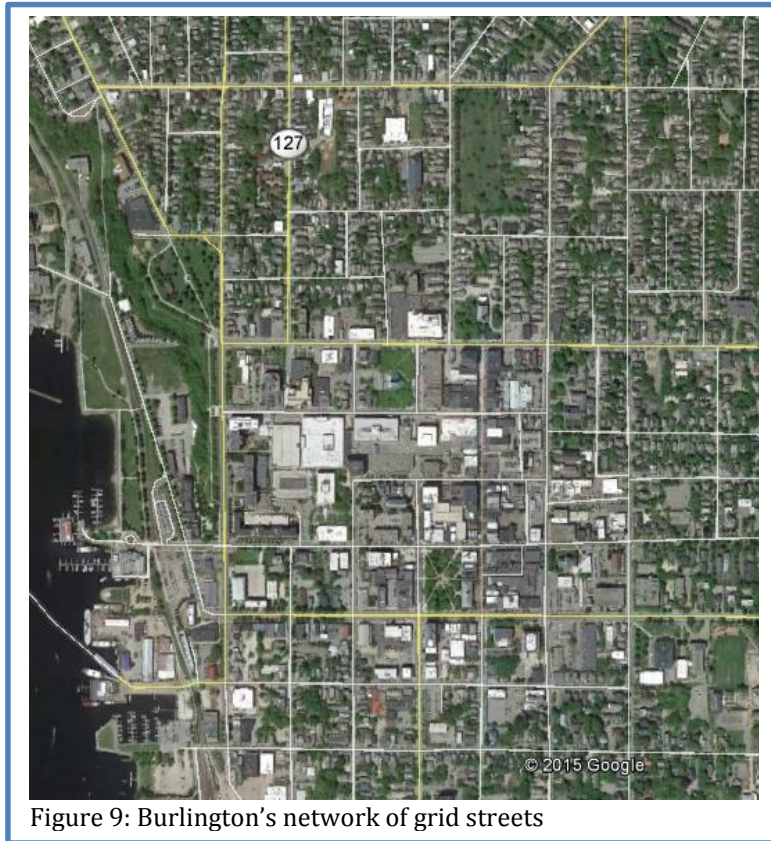


Figure 9: Burlington's network of grid streets

The municipalities that most closely surround Burlington include: South Burlington, Colchester, Winooski, Essex, Essex Junction, and Williston. The region is serviced by I-89, an interstate highway that runs diagonally across the region, beginning in New Hampshire and ending in Quebec, and three arterial routes: Route 7, Route 2, and Route 15.

### **Chittenden County ECOS Plan**

In October 2010, the Chittenden County Regional Planning Commission was awarded a Sustainable Communities Regional Planning Grant from the Partnership of Sustainable Communities to develop a report that focuses on the environment, community, opportunity, and sustainability in northwestern Vermont. The project used a variety of resources to bring together citizens, organizations and municipalities in order to discuss the future of local communities and the region as a whole. An emphasis is placed on the importance of investing in alternative modes of transportation, developing walkable communities, and expanding mixed-use

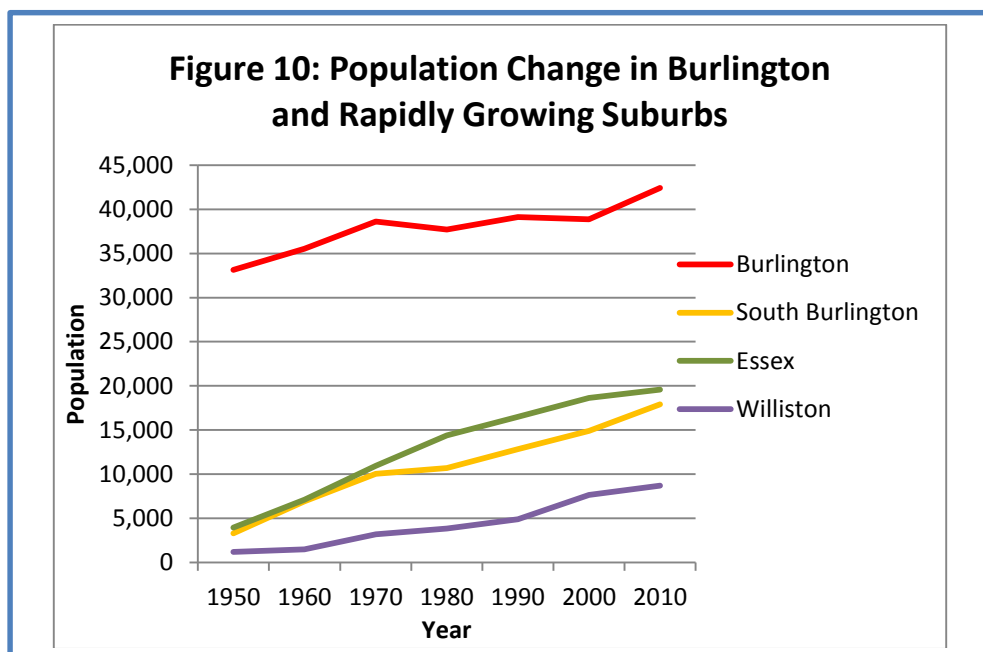
redevelopment. At least every eight years, the State of Vermont requires that the Chittenden County Regional Planning Commission develop a regional plan to protect local resources and guide development. Additionally, every five years the CCRPC creates a Metropolitan Transportation Plan to address long term transportation needs, while the Greater Burlington Industrial Corporation is also responsible for developing a Comprehensive Economic Development Strategy to generate economic development priorities within the region. The ECOS Plan is a combination of these three reports, blended into one planning document. The unified regional, transportation, and economic plan was crafted with the assistance of 65 partner organizations and many other citizens through meaningful community engagement practices. Overall, the ECOS Plan is of importance to this paper because it addresses issues related the study region's natural systems, social community, economic infrastructure, and built environment.

### **The Suburbanization of Chittenden County**

The challenges of a growing population have affected numerous municipalities within Chittenden County (CCRPC, 2013). Like many other regions around the country, Burlington and the surrounding communities have experienced significant suburban growth within the previous half century (The Champlain Initiative, 1999). While the City of Burlington is still known for its robust and vibrant urban core, it has been subject to increasing competition for jobs, housing, and population growth as a result of the suburbanization of its neighboring communities (Murphy, 2005). Moreover, the high cost of housing in Burlington has made the cost of living much more affordable in the surrounding municipalities. The bulk of the suburban expansion has increased along interstate exchanges and major state highways, which has led to the development of car-dependent communities within the region. As the interstate highways were constructed in the 1960s to connect Vermont to Boston and New York City, the state became increasingly accessible to tourists and second home buyers (Jay,

1997). Since then, Smart Growth advocates have claimed that Vermonters are facing an uphill battle to save their historic villages from commercial developers who have supported bringing more national big-box chain stores to the state (Albers, 2000).

Since the end of World War II, growth in Chittenden County has become increasingly dispersed throughout the landscape. In 1940, five densely developed growth centers - Burlington, Winooski, Essex Junction, Milton Village and Richmond Village - surrounded by acres of farmland, contained 71% of the county's population; while by 1996, half of the region's residents had moved out of the town centers and onto land that was previously used for agriculture (Murphy, 2005). Between 1982 and 1997, the population of Burlington, Vermont had increased by 20.6%; however, during that same period of time, housing density had dropped by nearly 20%, and the amount of developed land in the county nearly doubled from 7% to 12% (CCMPO, 2003; Fulton et al, 2001). Additionally, between 1940 and 1996, 66% of all the new homes built were located on the suburban fringe, while the older communities of Burlington and Winooski saw their share of the county-wide housing fall from 64% to 33% (The Champlain Initiative, 1999).



When the population started to shift to the suburbs, suburban job growth began to outpace job growth within the urban core. Between 1980 and 1996, 82% of all the new jobs in Chittenden County were created in the suburbs; for instance, during the 1990s, job growth in Williston grew by over 107% (CCMPO, 2003). As the jobs moved to the suburban communities, so did the majority of the region's retail sales. In the 1940s, nearly 90% of the county's retail sales took place in Burlington, Winooski and Essex Junction; however, by 1992, only 40% of all retail sales occurred within these three dense population centers (The Champlain Initiative, 1999). Retail growth has moved to places like Taft Corners, which is a sprawling development at the interchange of Route 2A and I-89 in Williston.



Figure 11: Taft Corners in Williston, VT

With over 760,000 square feet of retail space, Taft Corners now has more retail square footage than downtown Burlington (Murphy, 2005). The development is characterized by single story big-box stores like Wal-Mart, Home Depot, and Best Buy. By 2035, the population of Chittenden County is expected to grow by 48,900 people, reaching a total of 205,445 residents (CCRPC, 2013).

Williston is a prime example of a Vermont town that has experienced rapid suburban growth, which has been accompanied by a network of curvilinear streets and cul-de-sacs. In 1960, Williston was an agricultural community with a population of only 1,484. By 2010, it became a suburb with over five times the population. In recent years, Williston has grown faster than any other town in the county (Campoli et al., 2002). In an effort to control growth, the town approved zoning in 1963, and subdivision regulations in 1972 (Campoli et al., 2002). However, the growth restrictions were unable to restrict some of the disconnected developments from being built. In recent years, since Williston was designated as the state's first "growth center," the town has worked hard to support infill development and encourage street connectivity. Figure 11, a 2013 aerial photo of Williston, fails to show some of the latest densification efforts. Four large apartment buildings now occupy the green space that is shown in the upper right-hand corner of the photo. Additionally, several connector streets have been added to extend the grid network in the center of the photo.

Several miles past Taft Corners and the sprawling single story retail stores, one can find the historic village of Williston. With its small collection of nineteenth-century Greek Revival buildings, the village center has been listed on the National Register of Historic Places as an historic district. However, aside from the public buildings like the town offices, the library, and churches, the village lacks businesses and services that would attract permanent residents (Jay, 1997). After the development of Taft Corners, a variety of grocery stores, shopping centers, and a collection of other services have encouraged Williston residents to spend time and money at Taft Corners rather than in the local village. This is a prime example of the pressure and the competition that historic Vermont villages face from their suburban neighbors. Sprawling low-density shopping plazas and acres of fragmented subdivisions replaced neighboring farms and have become an economic threat to local downtowns.



While Williston is perhaps one of the most extreme examples of a Vermont municipality that has seen a dramatic change in its built environment, the town has made an effort to combat sprawl within the past decade by adopting a progressive mixed-use zoning strategy and strict density standards. Williston is also a prime example of a town that is attempting to retrofit its built environment to enhance sustainability and preserve its historic village center. However, it is too late to reverse much of the impact that sprawl has had on the region. Between 1950 and 1992, the amount of farmland in Chittenden County dropped from 72.6% to 24% as a result of the expansion of the suburbs (Albers, 2000). Historic village centers that were built with traditional compact street grids have become surrounded by networks of cul-de-sacs and curvilinear streets, connecting to larger arterial roads that make active modes of transportation such as walking and biking seemingly impossible. Subsequently, in 1993, the National Trust for Historic Preservation in Washington, D.C., placed Vermont at the top of its list of “America’s 11 Most Endangered Historic Places” (Albers, 2000).

The next chapter will provide an overview of the methods that were utilized to conduct this study of cul-de-sacs and dead-end streets in Burlington and the surrounding municipalities. Data collection methods will be discussed in detail to show how they were used to answer the individual research questions that were developed during the beginning of this study. After the methodology section, the survey findings will be examined to extract themes that will later be analyzed.

## **Chapter 4: Methodology**

The study methods were designed to give rise to other questions concerning Smart Growth, suburbanization, and residential housing preferences in Chittenden County. These questions included: How do local planners and professionals within the real estate industry view the cul-de-sac debate? Do residents living on cul-de-sacs and dead-ends value their streets? How and when did Chittenden County become suburbanized? What steps has Vermont taken to combat sprawl and promote Smart Growth initiatives? There are several methodological approaches employed in this project to answer the questions above: statistical and spatial analysis of the distribution of cul-de-sacs in Burlington in addition to the surrounding suburbs, an on-line survey of residents living on cul-de-sacs and dead-end streets, and interviews with professionals regarding the cul-de-sac debate. The methods used in this study were intended to address the questions relating to the debate between supporters of the grid street and supporters of the cul-de-sac. To answer the research questions, I have thoroughly analyzed the data that were collected from the qualitative and quantitative research methods.

The first set of data came from ArcGIS and Google Earth. I used this computer mapping software to locate and quantify the number and characteristics of cul-de-sacs and dead-end streets in Burlington and a selection of surrounding towns (Winooski, Colchester, South Burlington, Essex, Essex Junction, and Williston). These data and their analysis will be used to contextualize the qualitative findings, and to understand patterns of the spatial distribution and demographics of cul-de-sacs. By using U.S. Census data, I was able to compare regional patterns of race, household size, income, and transportation choices to household demographics in neighborhoods with numerous cul-de-sacs and dead-end streets.

The second set of data came from the online survey that I distributed to residents living on cul-de-sacs and dead-end streets in Burlington and the surrounding suburbs. There

were 225 total respondents. I posted my survey to Front Porch Forum (an online community-building service for local neighborhoods) and also distributed door-to-door copies of an informational pamphlet to encourage residents to take the online survey. I used the data created from the mapping of cul-de-sacs and dead-end streets to select specific neighborhoods to circulate my door-to-door pamphlet. I selected areas with a high number of these street types in order to ensure for efficient survey distribution.

I obtained the third set of data through an extensive review of local and regional reports. By looking at statewide development guidelines and regional reports, I was able to better understand the growth-related concerns within the study area. I used studies from the Chittenden County Regional Planning Commission, public records from the State of Vermont, and reports from other states and communities from around the country to frame the cul-de-sac debate, and reveal how other regions have implemented policies to either restrict or promote developments with cul-de-sacs.

Lastly, I conducted interviews with planners from the Chittenden County Regional Planning Commission, developers from Dousevicz Real Estate, Redstone Commercial Group, and Snyder Homes, real estate agents from three local agencies, and residents living on cul-de-sacs and dead-end streets. With the planners and real estate professionals, I conducted semi-structured interviews in-person or over the phone. Through these interviews, I attempted to evaluate how regional attitudes about street connectivity varied based on the given profession. Furthermore, I compared the local professional opinions with the more holistic views from planners, developers, and real estate agents that I discovered through the literature review. Professional contacts were recruited by phone or through email. Since much of this research was based on themes related to the built environment, policy initiatives, opinions, and other non-personal data, I applied for and received a determination of human subjects exemption form from the UVM IRB in November, 2014.

After residents living on cul-de-sacs and dead-end streets had completed my online survey, they were given my contact information and a brief description of an optional follow-up phone interview. Residents who were interested in the post-survey interview contacted me through email to indicate that they wanted to continue participating in the study. I responded to ten residents and then proceeded to ask them a set of open-ended questions regarding their experiences and perceptions of their neighborhoods. The follow-up phone interviews provided me insight into why residents value their neighborhoods, while they also helped me to connect recurring themes that I found in the survey responses.

## **Chapter 5: Findings**

### **Survey Results**

The online survey yielded 225 completed responses from households on cul-de-sacs and dead-end streets in Burlington, South Burlington, Colchester, Winooski, Essex, Essex Junction, and Williston (See full survey results in Appendix A). Nearly 62% of the respondents lived on a cul-de-sac, while about 38% indicated that they lived on some version of a dead-end street. Eighty-five percent of respondents said that they were “very satisfied” with their current neighborhood. When I examined the specific values, I found that the most desired neighborhood characteristic was a quiet neighborhood. Nearly 84% of respondents said that they “highly value” a quiet neighborhood. Seventy-four percent highly valued sidewalk and paths, while only about 17% placed the same value on “lots of parking.” In fact, over 29% of respondents said that parking has “no value” to them, which is surprising based on how vital the car is for the suburban lifestyle.

The results of the survey have enabled me to identify themes related to mobility, crime, social cohesiveness, and youth experience. These themes also appeared throughout the literature review, and will be discussed extensively in chapter 7. Numerous survey questions addressed each of these subjects. Mobility was the most frequently addressed theme that I found after studying literature related to the development of disconnected streets. Therefore, I created six survey questions to address mobility. I asked residents about their work commuting patterns, whether they could walk to access goods and services, and if they were concerned about traffic. Less than 3% of respondents were concerned about traffic in their neighborhoods, which is not unusual because each resident that answered the survey lived on a street that inhibited through traffic. I also asked residents if they lived within walking distance to bus stops, grocery/convenience stores, schools, shopping centers, parks, and nature trails. It was interesting to see that over 70% of cul-de-sac and dead-end street

residents said that they lived within walking distance of a bus stop, school, park, and a nature trail. Additionally, about 69% said they could walk to a grocery/convenience store, and 44% believed they could walk to a shopping center from their home. Only 4% answered that none of the destinations are within walking distance. The Congress for New Urbanism states that the average pedestrian is willing to walk up to a half mile to access a good or a service (WAPC, 1997). I selected ten survey responses (with listed addresses) to verify that the addresses were located within a half mile of the services that they stated they could walk to. After the analysis, I found that only two of the households were actually located within a half mile of all the destinations. Additionally, four out of ten of the selected streets were not located within a half mile radius of any of the destinations that were listed on the survey. Therefore, either the residents' perceptions of walking distance were far greater than a half mile, or exaggerated answers were given in defense of their neighborhoods.

Survey responses related to crime, social cohesiveness, and youth experience revealed that residents on cul-de-sacs and dead-end streets in Burlington and the surrounding suburbs were not worried about crime, were likely to know their neighbors, and felt that children used the street as a place of play. Less than 4% of respondents were "very concerned" about crime on their neighborhood, while over 48% indicated that they were "not concerned" about crime. Additionally, only about 1% of respondents listed that they did not know their neighbors, while nearly 30% said that they see neighbors socializing every day. With regard to children using the street space, 40% said that children play in the street every day, and only about 10% believed that children and teens do not use the street. Chapter 7 provides more discussion related to the themes of mobility, crime, social cohesiveness, and youth experience, while it also displays many of the open-ended survey responses that connect to these themes.

## **Vermont's Solution to Sprawl**

Over the past half century, Vermont and Chittenden County have developed numerous policies to promote Smart Growth initiatives and to address uncontrolled growth. In 1967, the State of Vermont enacted its first attempt to control land development with the creation of the Vermont Planning and Development Act, also known as Chapter 117. It was intended to expand the authority over land use planning by allowing the legislative bodies of municipalities to work alongside regional planning commissions (Jay, 1997). The overall objective was to initiate zoning ordinances and subdivision regulations, as well as to give regional planning commissions the ability to coordinate land use planning in Vermont. While Chapter 117 aimed to support compact and efficient land use planning within the state, it failed to solve many planning and zoning challenges.

In 1968, after the International Paper Company announced its plans to construct a massive new development on 20,000 acres in southern Vermont, citizens and Governor Deane Davis convinced the Vermont Legislature to develop the state's landmark environmental law, Act 250 (Albers, 2000). Two years later, with bipartisan support, Act 250 passed through the legislature. This growth management statute created a land use permit system that was meant to control development in order to protect and preserve Vermont's natural environments (Jay, 1997). However, some environmentalists have argued that the law does not do enough to restrict development. A 1992 study conducted by the Vermont Natural Resources Council found that between 1970 and 1991, the index of residential construction in Vermont surpassed the New England average 59% of the time (Albers, 2000). Furthermore, Act 250 does not address connectivity issues that relate to the construction of disconnected streets such as cul-de-sacs and dead-ends. It also does not apply to small developments. While Act 250 has helped to prevent environmentally insensitive development, it is clear that it has been somewhat insufficient at managing sprawl in Vermont.

Since it was made a law in 1970, Act 250 has been the center of conflict between environmentalists and developers. It has been called a barrier to the state's economic growth by developers and property rights activists, but environmentalists argue that Vermont's economic strength lies in its pristine landscapes and the "green" image (Albers, 2000). Moreover, some citizens and policy makers claim that Act 250 is flawed because it only restricts growth rather than providing guidelines for future growth. Lee Krohn, a senior planner with the Chittenden County Regional Planning Commission commented on the Act 250 process by saying,

*Act 250 has been an interesting process, but I think there has been varying results depending on the region. In many ways I think it has been helpful. There hasn't always been a very collaborative relationship between some towns in the state and Act 250. I think that that concept has great merit, but sometimes it becomes a fairly duplicative exercise in communities that already have a strong development review processes. For projects that are highly controversial it has sometimes been a second way to challenge and tie things up. In other situations it can be fairly straightforward under zoning and town plans. In balance I think it has been really good for the state, but no system is perfect. The unintended consequence has been driving towns to write detailed plans that have almost become a second zoning ordinance. (Personal interview, Feb. 26, 2015).*

I also talked with Mr. Krohn about the impact that Act 250 has had on sprawl within the state. He said that it probably has had an impact, but different communities have seen varying results. He also indicated that Act 250 has specifically affected development located near interstate interchanges and responded to questions about economic growth by saying,

*Act 250 has helped to prevent the nonsense that happens at a lot of interstate interchanges. Where you can be dropped off blindfolded from a helicopter and would have no idea where you are because it looks the same as everywhere else, but some would look at this and point it out as a barrier to economic development. I think like any system, it has been a twin-edged sword. There may be times when a developer can point to a time where a project was prevented. In that case it could be seen as a barrier. Not every project is the right project, at the right place, at the right time. In many cases people point to these regulatory processes and say it just drives up the cost of the project. (Personal interview, Feb. 26, 2015).*



Brad Dousevicz, the director of residential development for Dousevicz Real Estate, describes the added time and additional costs that come with the Act 250 process from the perspective of a housing developer:

*Well-designed projects in the right areas should get through Act 250 fairly easily. That being said, there is always a cost implication that comes with Act 250 because there is more time in the permit process. Time is money. So if I'm adding another six to nine months on my permit process to go through Act 250, my project is essentially being delayed. There are also added costs that come from engineering or architectural work that is required in some cases by Act 250. Economically, I think it certainly affects the average cost of building in Vermont. However, the cost of Act 250 is passed on to the buying public instead of the builder, which increases our cost of housing. (Personal interview, Mar. 4, 2015).*

Overall, while there is a great deal of support for the idea of controlling growth within the state, Act 250's complexity and inefficient system of permitting has compelled many lawmakers to call for amendments to the Act.

In 1988, Governor Madeleine Kunin's administration passed Act 200 in an effort to deal with some of the shortcomings of Act 250. Act 200 was developed to support agriculture and forestry, to encourage development to resemble historic settlement patterns where compact villages were surrounded by acres of countryside, to discourage sprawl, and to provide requirements for affordable housing (Albers, 2000). Incentives are given to towns who draft development plans that are consistent with the values stated in Act 200. A key provision of Act 200 is its ability to recommend and designate future growth areas within Vermont's existing communities. The objectives of Act 200's future growth area designations are to facilitate mixed-use development within compact village centers in order to support sustainable communities and preserve the state's pristine landscapes (Jay, 1997). Even with financial incentives to promote sustainable high-density development, many Vermonters are unwilling to change the way that they live. For example, a study by the Vermont Forum on Sprawl showed that 78% of Vermonters see sprawl as a concern; however, the way in which

many Vermonters live, contradicts this value (Albers, 2000). Building homes in the countryside on large lots, commuting to work and other destinations by car, and shopping at big-box stores supports sprawl rather than compact sustainable development.

### **Real Estate Professionals and Disconnected Streets**

Literature related to community planning has labeled developers and other professionals within the real estate industry as obstacles to the Smart Growth movement and supporters of sprawling developments (Ross, 2014; Lucy & Phillips., 2006; Southworth & Ben-Joseph., 2003; Albers, 2000; Duany, Plater-Zybek, & Speck., 2000; Jackson, 1985). Land developers are said to avoid uncertain projects where time and profitability may be at risk, rather than making decisions to support neighborhood sustainability. Furthermore, developers and other real estate related interests are among the largest contributors to pro-growth political candidates (Lucy & Phillips., 2006). The modern real estate developer has been demonized and turned into a reviled public figure whose only interest lies in sprawl and the profitability of uncontested development decisions (Duany, Plater-Zybek, & Speck., 2000).

With the intention of determining the opinions that housing professionals in Chittenden County have in regard to sprawl, disconnected streets, and more specifically, the cul-de-sac, I conducted interviews with real estate agents from Century 21, Catamount Realty, and Kelly Williams Realty. Additionally, I interviewed housing developers from Dousevicz Real Estate, Redstone Commercial Group, and Snyder Homes. Each real estate agent that I interviewed expressed how they viewed disconnected streets as ideal locations for residential developments. When asked about any disadvantages to living on a cul-de-sac street, each realtor was unable to think of any reasonable drawback. Mark Montross, the owner of Catamount Realty located in Williston says that,

*Cul-de-sacs include the added benefit of not having to worry about through traffic. For certain individuals who have young children, I would say that the cul-de-sac would definitely*

*be valuable. I wouldn't say that someone is willing to pay a premium just to live on a cul-de-sac. If the house needs a lot of work, or there are other factors involved, then I wouldn't see the need to add a premium to the property. However, I have used the fact that a home is located on a private cul-de-sac as advertising (Personal interview, Jan. 8, 2015).*

Mr. Montross was surprised when I asked about the disadvantages of living on a cul-de-sac. When I mentioned that some studies indicated that cul-de-sac developments increase car dependency and traffic congestion on arterial roads, he disagreed with this statement and argued that the added social benefits of being connected to neighbors outweighs any of the disadvantages.

In my interview with Robbi Handy Holmes, a realtor with Century 21 in South Burlington, she expressed a similar outlook toward the cul-de-sac. She even mentioned that homes located on cul-de-sacs have traditionally been the first homes to sell in new developments because they are valuable to families, especially those with young children. However, when asked about a negative side to owning a home on a cul-de-sac, she only cited problems with snow removal during the winter. When I referenced the notion of car dependency and decreased walkability, she was unaware of the meaning of both of these concepts. After I explained the basic principles of walkability and car dependency, the realtor did not see either of these concepts as being relevant to cul-de-sacs. She said,

*For newly constructed homes in cul-de-sac neighborhoods, I can definitely see a premium being placed on those homes because they tend to sell before homes on other streets. I think there is some value to people who like to know that their kids can just ride their bikes around the circle of the cul-de-sac. It definitely has its advantages because of the lack of through traffic, but I don't have buyers that come in and say that they need to be on a cul-de-sac. I live in a neighborhood with a cul-de-sac and it seems like it creates more of a community. We always have neighborhood barbeques right in the cul-de-sac. The only disadvantage about living on a cul-de-sac in Vermont would be the buildup of snow at the end of the street from the plow truck. (Personal interview, Jan. 8, 2015)*

The final interview with the real estate agent from Keller Williams Realty in Colchester (who asked for anonymity), also expressed how the cul-de-sac is ideal for young families, provides a greater sense of community, more privacy and safety. The realtor could

not attest to whether homes on cul-de-sacs are listed at higher prices, but did say that the cul-de-sac in general is a good selling feature. Once again, this realtor could not give any disadvantages to living on a cul-de-sac. When I asked about mobility and car dependency, the realtor laughed and said that these should not be of concern.

When I spoke with Brad Dousevicz, the director of residential development for Dousevicz Real Estate, he talked with me about sprawl, Smart Growth, and cul-de-sacs:

*There are certainly examples of developers in Chittenden County that are exacerbating sprawl. If people want Smart Growth, they have to first go to their local communities. Builders can only build where they are allowed to build. If a builder is allowed to put 20 homes on thirty acres in the country somewhere, then they will do it and it will add to sprawl. If communities have zoning regulations that permit this to happen, then they essentially want those building to go there. Builders are going to find land where they can put homes that are marketable and can make a profit of them. A lot of our building that we do is anti-sprawl. For example, we have over 200 units on ten acres in Essex, which is high-density housing. But this is not the type of housing that is for everybody. There are buyers with children who don't want to live in the center of town in a four-story building. There is a fine balance between sprawl and giving homebuyers what they want at affordable prices. I would agree that developers would be more inclined to building cul-de-sac developments rather than grid street developments, but in our region, cul-de-sacs are frowned upon by regulatory committees, public works, and the planning commission; although, home buyers love cul-de-sacs because they give you privacy and a street where the only traffic would be from your neighbors. It's an interesting situation because we have home buyers who want them, but zoning committees that approve our projects do not want them (Personal interview, Mar. 4, 2015).*

Mr. Dousevicz acknowledged that developers value building cul-de-sac developments because that is where many homebuyers want to live. He emphasized how Smart Growth sounds like a great concept, but was reluctant to say that people want to live in communities that incorporate the principles of Smart Growth. Additionally, Mr. Dousevicz stressed that as long as zoning regulations allow developers to build sprawling housing developments, they will continue to create them in order to offer homebuyers what they are looking for. When I asked him about the relationship between sprawl and developers, he admitted that they do play a large role in shaping the way that communities develop. Until stricter guidelines are enforced to regulate growth, developers will continue to contribute to sprawl.

Chris Snyder, the president of Snyder Homes, believes that residents value cul-de-sacs and dead ends because they limit through traffic. When I asked Mr. Snyder about sprawl, he said that developers are not a catalyst for sprawl because they do not create the market. He explained that the buyers create the market while developers are only satisfying the needs of the market. In response to a question about whether cul-de-sacs developments are more car dependent than a network of grid streets, Mr. Snyder said that he did not believe that cul-de-sacs would increase car dependency.

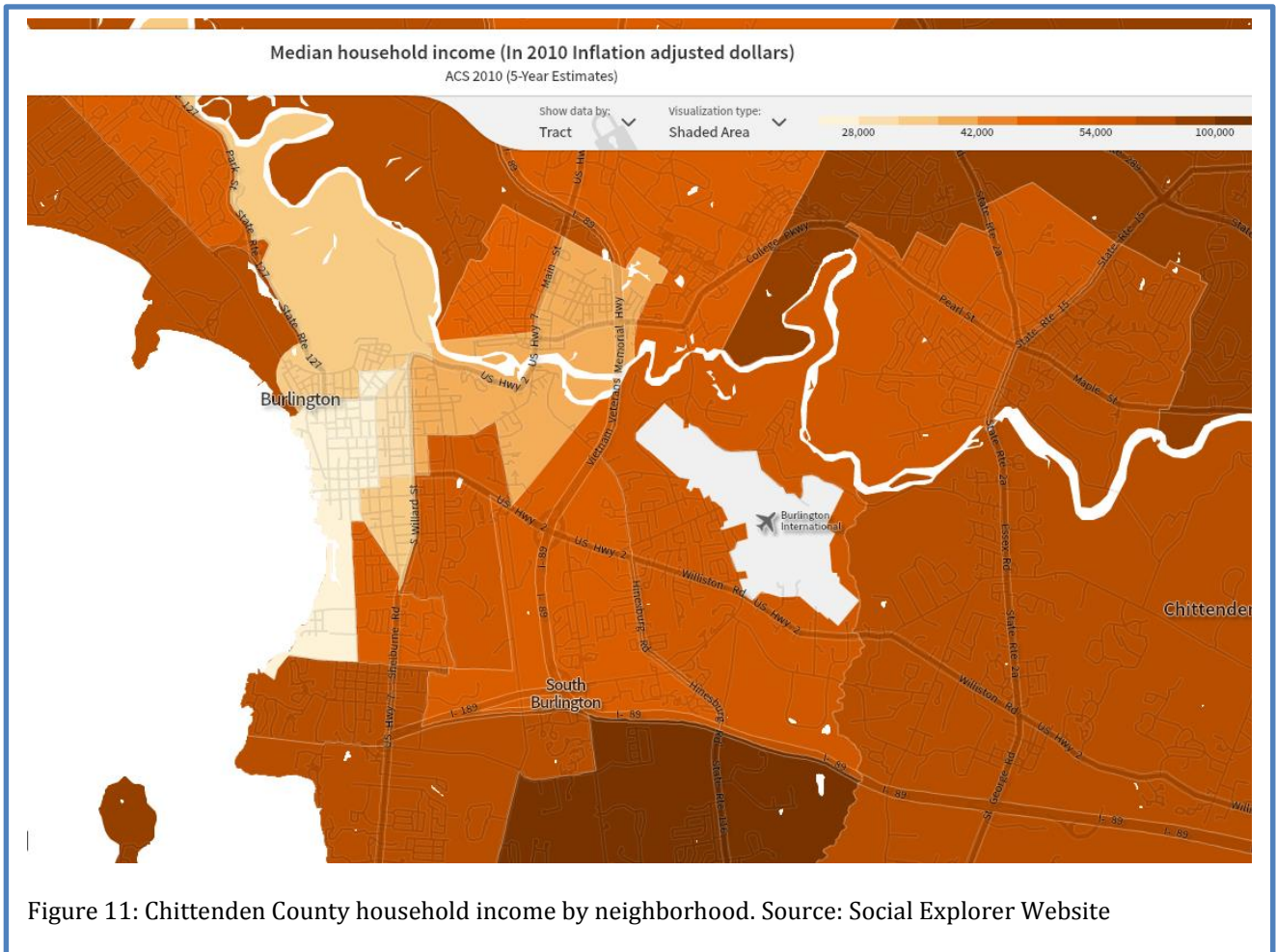
Justin Dextrateur, a developer with Redstone Commercial Group, and the chair of the CCRPC Permit Integration Committee, is critical of the cul-de-sac. Mr. Dextrateur is a project manager for Redstone that assembles new residential and mixed-use real estate developments or acquisitions. He is also an advocate for Smart Growth. He says,

*Mainly suburban residential developers deal with cul-de-sac development. The companies that I have worked for, including Redstone, have been focused on Smart Growth and urban infill projects for large multi-family residential developments. In order to access deeper back lots, suburban developers will build cul-de-sacs. I have a degree in planning and started in environmental science as an undergrad, so I feel that the cul-de-sac is an anachronistic development that wastes land. Philosophically I would not support owning a suburban property on a cul-de-sac. I grew up on one in Connecticut and it is not the type of environment that I would like to live in. I like to live closer to services, which inherently means living on a downtown grid street. Cul-de-sacs tend to be in more remote locations so they lack connectivity and promote car dependency. So it would be a horrible place to grow old. I'm hopeful that more Smart Growth outreach will contribute to better public education about these issues (Personal interview, Feb. 19, 2015)*

## **Chapter 6: Spatial Analysis**

The following spatial analysis section of this paper analyzes how the demographics of local neighborhoods with a high number of cul-de-sacs and dead-end streets compare to the overall population characteristics of Chittenden County. After studying the results from the online survey, reviewing U.S. Census Bureau data, and examining neighborhood demographic information from Social Explorer's interactive online maps, I was able to evaluate how the population characteristics of households on disconnected streets differ from the region's overall household characteristics. I analyzed the spatial distribution of data that include: household income, household size, education level, race/ethnicity, and transportation choices.

Household income was the first piece of demographic information that I investigated. The online survey results showed that nearly 50% of respondents living on cul-de-sacs or dead-end streets said that their household income was greater than \$100,000 (see Appendix A). The U.S. Census Bureau indicates that the median household income for Chittenden County is \$63,989, which is significantly lower than the median household income specified by the survey respondents. Additionally, statistics from the Social Explorer website support my survey data findings that residents on cul-de-sacs and dead-end streets in Chittenden County have greater household incomes than residents that live on traditional grid streets. By comparing figure 11 with the location of every disconnected street in the region (see Appendix B), it is clear that the neighborhoods with numerous cul-de-sacs and dead-end streets have significantly higher household incomes.



I found a few other spatial trends related to household size, number of children under the age of 18, education level, and race/ethnicity that I will discuss in the following paragraphs. The average number of persons per household was found to be greater on cul-de-sacs and dead-end streets (2.93) compared to the rest of Chittenden County (2.37). Additionally, about 25% of survey respondents indicated that two or more children under the age of 18 live in their household. Data from the 2010 American Community survey show that households located in neighborhoods with a high number of disconnected streets have more children under the age of 18 (see figure 12). The darker shaded areas of the map represent census tracts where more children under the age of 18 live. Additionally, figure 13 shows that there are less family households in grid street neighborhoods. Based on the literature that described how disconnected streets are popular with young families, I am not surprised to see that more families live on these streets in Chittenden County than on traditional grid streets.

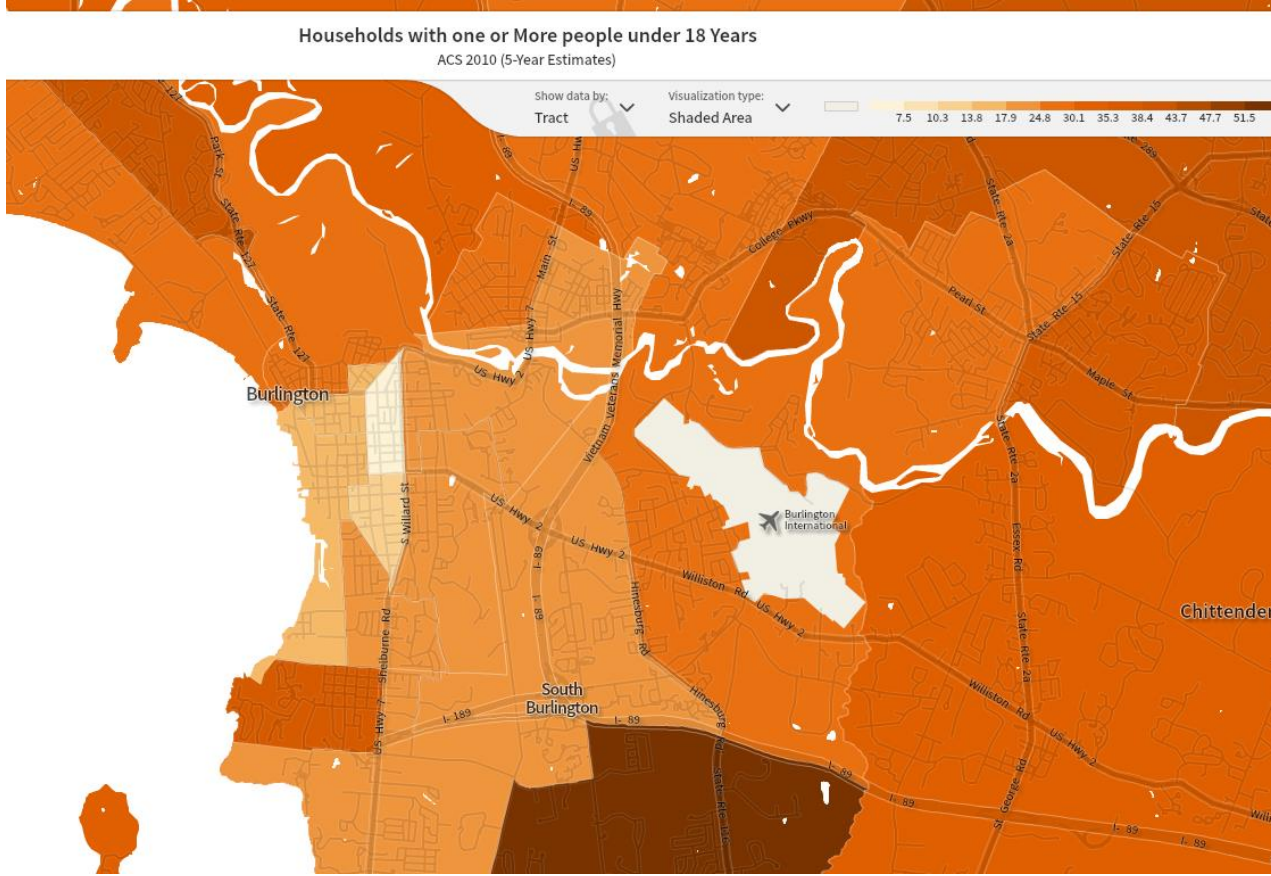


Figure 12: Chittenden County households with children under 18 years. Source: Social Explorer Website

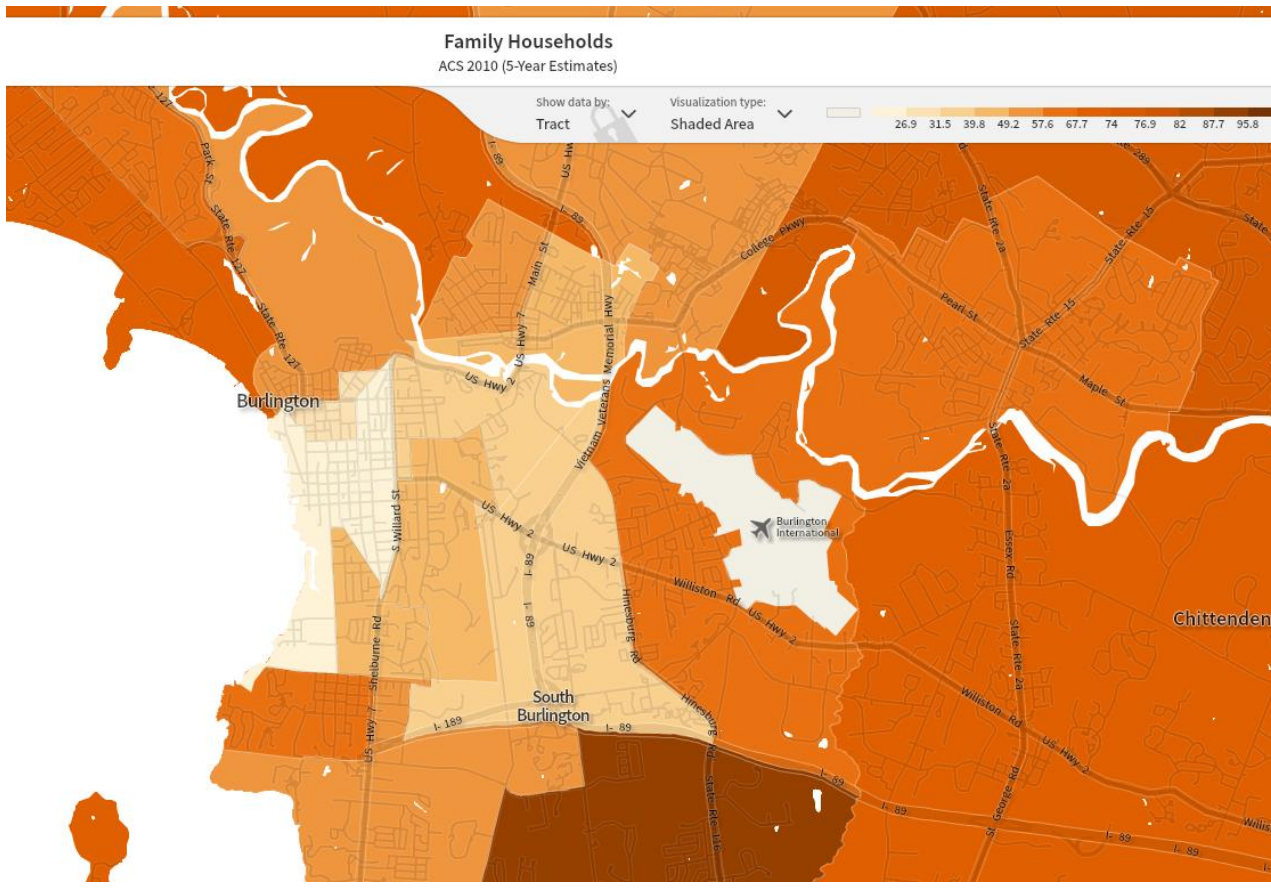


Figure 13: Chittenden County family households. Source: Social Explorer Website



After examining survey responses related to education level and race/ethnicity, I found some significant differences between households on disconnected streets and the region in general. The results from the online survey showed that 85.3% of residents living on cul-de-sacs and dead-end streets have a bachelor's degree or higher. On the other hand, the U.S. Census Bureau indicates that only 47.7% of persons in Chittenden County that are at least 25 years old have a bachelor's degree or higher. Furthermore, there is a slight difference in the racial makeup of households on cul-de-sacs and dead-ends in comparison to the overall region. Nearly 99% of survey respondents identified as either white or Caucasian, while the U.S. Census Bureau shows that just over 90% of Chittenden County residents identify as white alone.

In addition to analyzing the general population characteristics in the study region, I also examined how residents commute to work. Within the online survey, I developed questions that asked about how long it takes residents to commute to work by car, bus, bicycle, and walking (see survey discussion in chapter 7). I used the Social Explorer website to analyze walking, biking, and single-occupant vehicle trips to work within Chittenden County. Figure 14 shows that residents living in neighborhoods dominated by cul-de-sacs and dead-end streets are more likely to drive to work in a single-occupant vehicle. Figure 15 and 16 display how residents living in grid street neighborhoods are more likely to walk or bike to work. Overall, these maps support the literature that describes how cul-de-sacs and dead-end streets support mobility for vehicles rather than active modes of transportation.

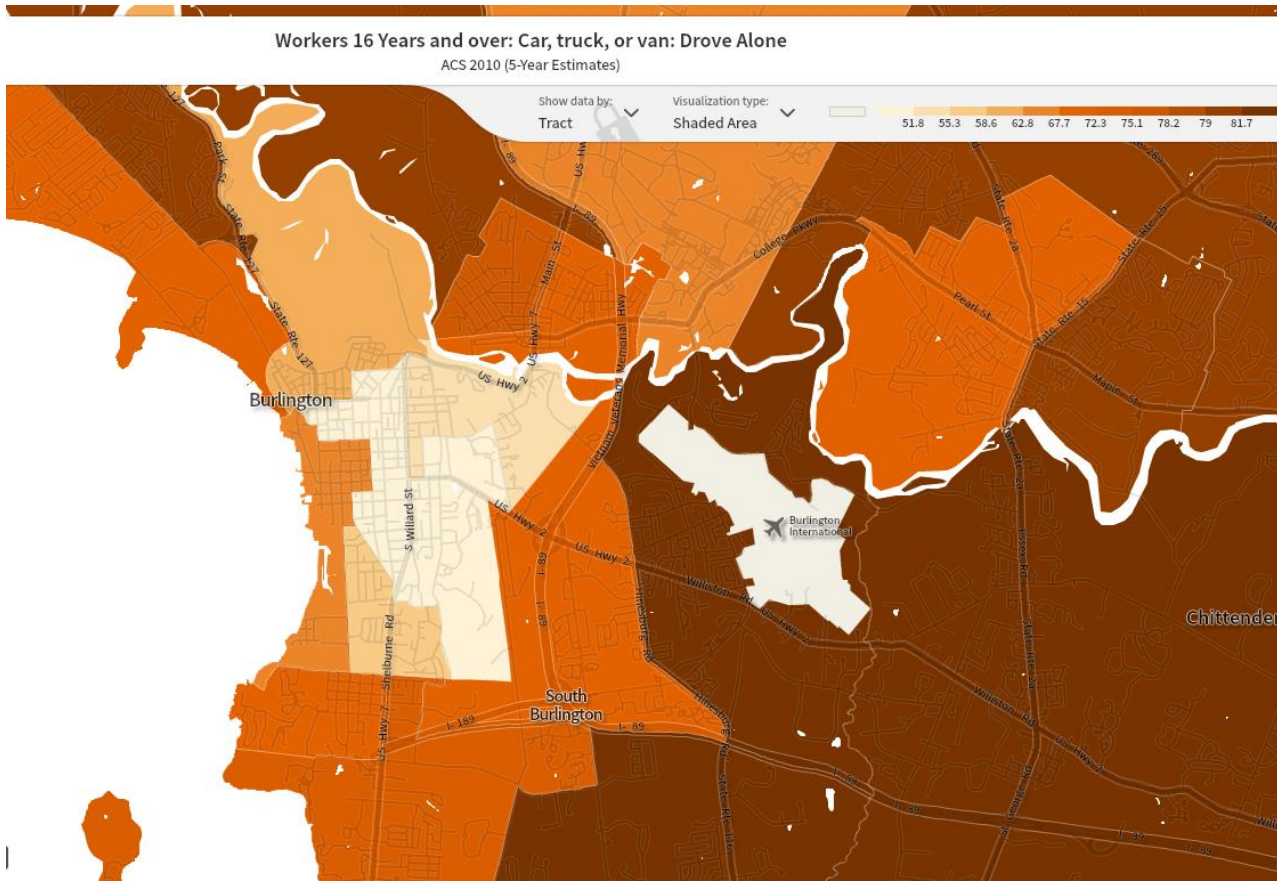


Figure 14: Chittenden County driving alone to work. Source: Social Explorer Website

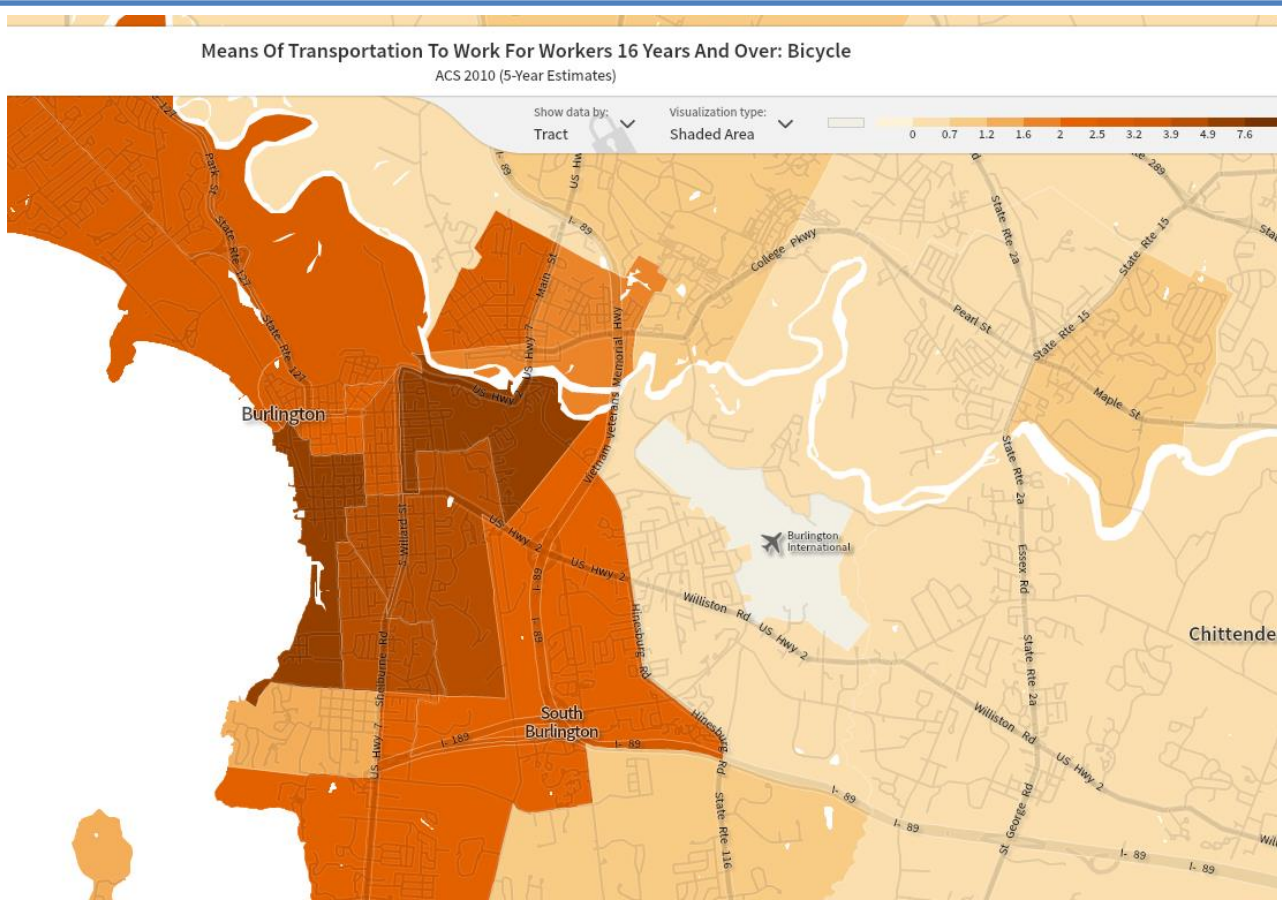


Figure 15: Chittenden County biking to work. Source: Social Explorer Website

Means Of Transportation To Work For Workers 16 Years And Over: Walked  
ACS 2010 (5-Year Estimates)

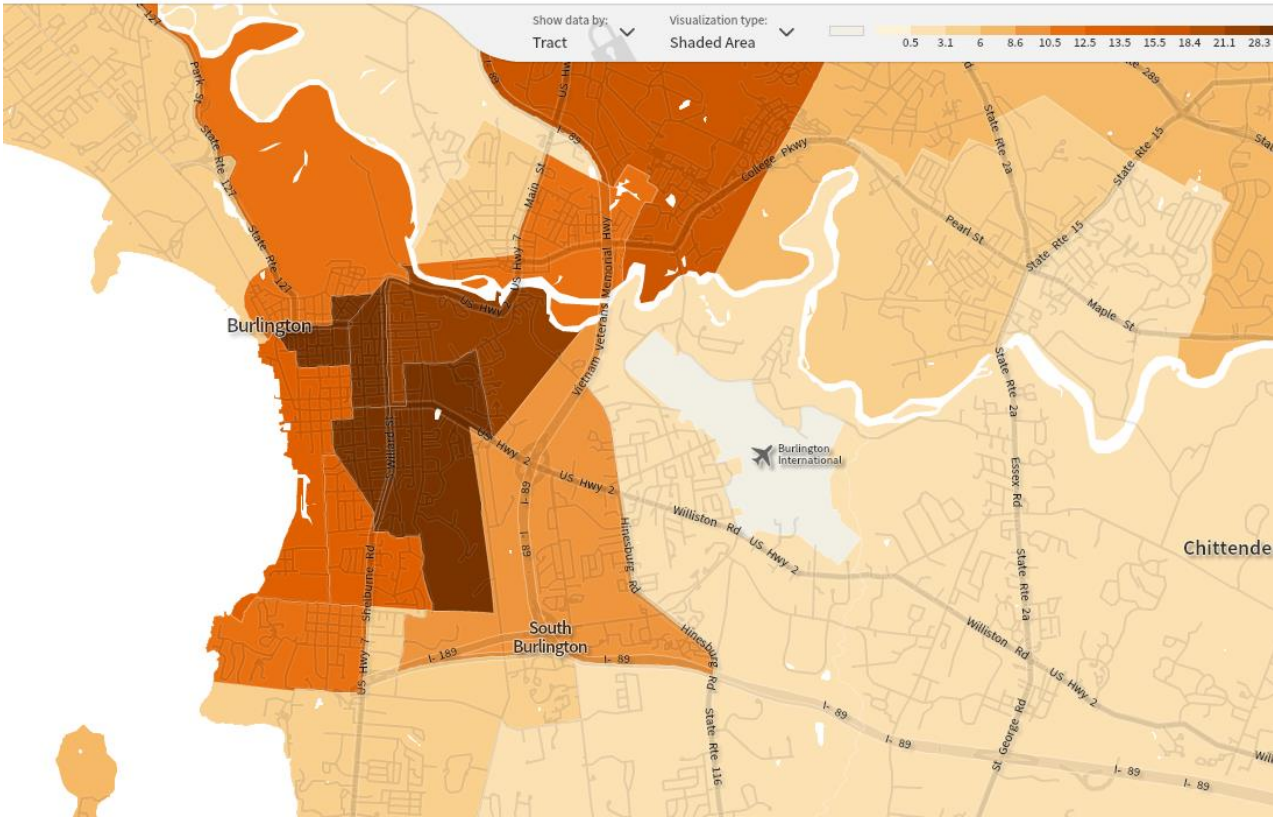


Figure 16: Chittenden County walking to work. Source: Social Explorer Website

## **Chapter 7: Evaluating the Cul-de-sac**

This chapter begins with a discussion of study limitations. Then, four other sections critically analyze the major themes that this research has uncovered, while one additional section has been dedicated to an overview of current policy initiatives that affect cul-de-sac development. After a thorough literature review, I determined that the major recurring themes surrounding the cul-de-sac debate were related to mobility, crime, social cohesiveness, and youth experience. Moreover, these subjects were also addressed within the online survey that was distributed to residents on cul-de-sacs and dead-end streets in Burlington and the surrounding municipalities.

### **Study Limitations**

There are a few limitations of this research that are imperative to discuss. To begin with, this project was not a comparative study that evaluated the differing experiences of residents living on cul-de-sacs and dead-end streets, with those that live on grid streets. This research solely examined the residential experience of living on a disconnected street, and then compared the results with findings from other academic studies. While a comparative study would have provided more comprehensive findings about the differences between living on a disconnected street and a grid street, this study critically evaluated the residential experience of living on cul-de-sacs and dead-end streets. After reviewing the overall study results, I have determined that the methodology, study scope, and survey questions should be adjusted when pursuing further research related to this project. One aspect of the methodology that became problematic relates to the follow-up phone interviews. Instead of interviewing a diverse set of survey respondents from the entire study region, seven out of ten of the follow-up interviews were conducted with residents living on cul-de-sacs and dead-end streets in Burlington. I relied on survey respondents to reach out to me for a follow-up phone interview after completing the online survey. However, this resulted in an unequal distribution of phone

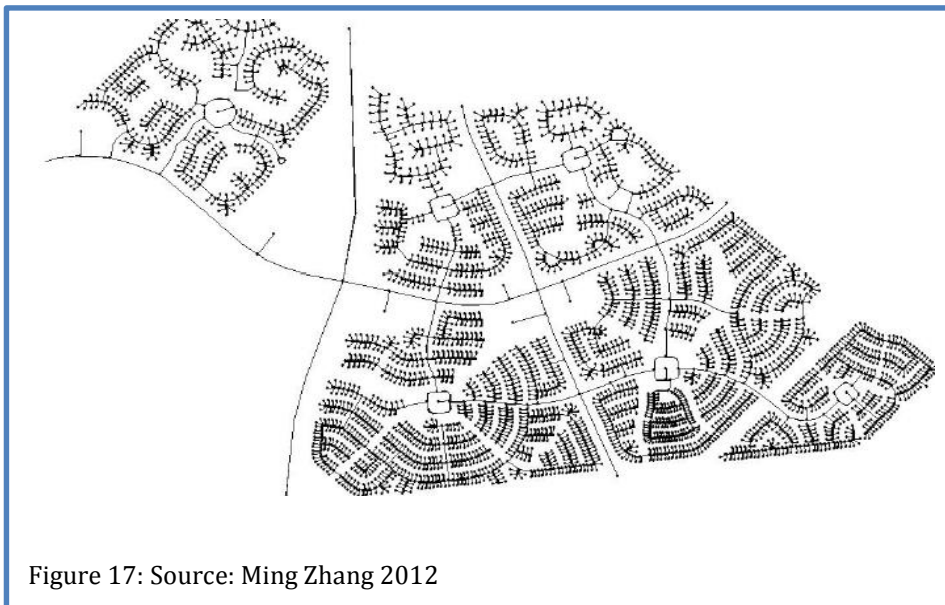
interviews with residents from Burlington. In order to ensure that the other municipalities in the study region would be accurately represented, I should have selected a specific number of residents in each town instead of allowing the vast majority of phone interviews to be conducted with Burlington residents.

Another limitation to this study would be related to scale issues. While the survey questions revealed residents' experiences related to the micro geography of individual cul-de-sacs and dead-end streets, questions should have also addressed the geography of entire neighborhoods. Literature shows that many planners are critical of disconnected streets because of consequences that can only be seen from a comprehensive view. Rather than simply including survey questions that ask residents about their experience on their specific streets, additional questions should requested that residents provide views about issues within the surrounding region to evaluate if planners and residents share similar views.

The last limitation would be that the online survey did not provide enough information to evaluate the characteristics of the respondents. Besides providing basic demographic information, additional questions should have addressed where the residents were originally from and how long they have resided on their street. It would have been useful to analyze whether the number of years spent living on a street and past state residency influenced neighborliness. Furthermore, additional free-response questions would have allowed residents to include more information to benefit certain questions. For example, one question asked about trips to work, but there was specified location where the respondent could state why he or she was unable to use a specific mode of transportation to commute to work. Therefore, it is unknown whether many of the respondents were unable to physically commute by bus or by walking, or if other factors (retirement, unemployment, working at home) affected the need to commute to a workplace.

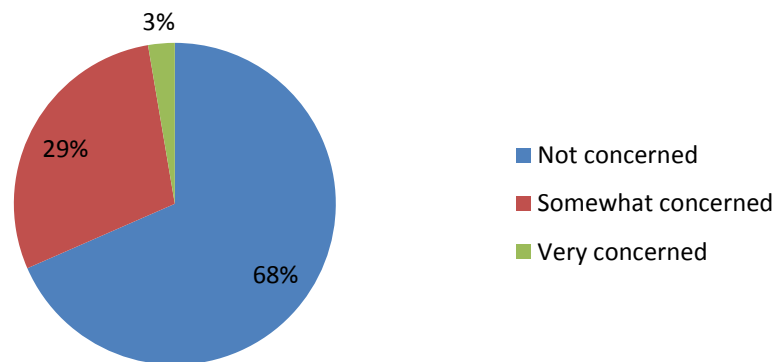
## Mobility

One key criticism of the cul-de-sac is that its lack of interconnectedness hinders mobility, especially for those who do not have a driver's license. However, mobility can still be challenging even for residents who do have drivers' licenses. Living on a street that is not connected to a traditional grid network can minimize route choices for drivers and can often force them onto larger arterial roads (see figure 17). Having a road network filled with cul-de-sacs, loops and dead-end streets that connect to major arterials and collector roads can produce suburban gridlock during peak intervals of travel (Southworth & Ben-Joseph., 2004). Additionally, the express highways that cut through the neighborhoods limit walkability and jeopardize safety for pedestrians. Even adjacent streets may be nearly impossible to access on



foot if a four-lane highway separates the pedestrian and the desired destination (see figure 11). However, in response to a question about traffic concerns in my online survey, only three percent of respondents indicated that they were very concerned about traffic within their neighborhoods (see graph 1).

**Graph 1: How concerned are you about traffic in your neighborhood?**



To mitigate the negative effects that sprawl and the cul-de-sac have had on pedestrians and walkability in general, some planners have suggested that shared-use paths for pedestrians and cyclists should be implemented to connect adjacent streets. Essentially, this would increase street accessibility for active modes of transportation while it would still block through-traffic from entering cul-de-sacs and dead-ends in order to maintain safe and quiet residential environments. Functionally, the cul-de-sac was designed to limit through traffic to provide safe neighborhoods for families with young children. Designing cul-de-sac neighborhoods that are connected and walkable will attain the benefits that Smart Growth supporter strive to achieve, while also preserving residential streets that families will value.

The results from my online survey show that 70% of residents living on cul-de-sacs and dead-end streets in the study region indicated that they live within walking distance of a bus stop, school, park, and nature trail. Forty-four percent of residents also indicated that they live within walking distance of a shopping center and 69% listed that they could walk to a grocery store. About 57% of respondents noted that they were unable to walk to work from their cul-de-sac or dead-end street, while about 69% said that taking the bus to work was not an option. In order to compensate for the lack of data related to additional factors that may

affect commutes to work, I asked ten residents about commuting to work in follow-up phone interviews. These are their responses:

*"I use a combination of walking and driving. I walk to work, bank, services, I drive when it's really cold. I use the car to commute 50% of the time during nice months."*

*"I have a 10 minute drive to work. 14 minutes for my husband. Everything we do is in Burlington. We would like to walk, but why get hooked on that when we are so dependent on the weather."*

*"I drive. I don't use public transit. Anywhere I need to go I use my car."*

*"I walk and use the car. I use my car about 70% of the time."*

*"I am only able to drive to work."*

*"I drive an EV from home to work. In the warmer months I ride my bike."*

*"I'm retired. My husband walks to work."*

*"I mainly use a car to commute."*

*"I work in Williston so I take a car."*

*"I drive to 2.5 miles to work. It isn't a walkable route."*

One Burlington resident indicated that she was retired. Therefore, on the survey she selected "N/A" for all of the questions about commuting to work. All ten of the residents that I spoke with over the phone said that they were able to access services and places of interest on foot from their cul-de-sacs and dead-end streets, which challenges the findings from most of the literature reviewed.

## **Crime**

Throughout North and South America, Australia and many European countries, crime prevention planning has become an integral part of city and regional planning. Numerous studies have indicated that the cul-de-sac street design can inhibit levels of crime. While some researchers have claimed that cul-de-sacs actually encourage crime by hindering social cohesion, many others have developed studies that show how discontinuous street systems have lower incidents of crime compared to more permeable street patterns (Southworth & Ben-Joseph., 2004). Criminals may be discouraged to go into cul-de-sacs and dead-end



streets because these neighborhoods only have one way to enter and exit, which could create a feeling of being trapped. Empirical evidence has shown that there is a positive correlation between higher levels of permeability and burglary risk (Johnson, & Bowers 2010). Some cities are even retrofitting streets in notoriously crime-ridden neighborhoods to create cul-de-sacs in order to reduce crime. For example, the Five Oaks district of Dayton, Ohio converted many small neighborhood streets to cul-de-sacs to create barriers for criminals. Shortly after the streets were reconstructed, the overall crime rate dropped by 26 percent and violent crimes were cut in half (Southworth & Ben-Joseph., 2004). Despite the fact that there is a great deal of evidence to show how discontinuous streets can prevent crime, there are still planners who would refute this claim.

Author and urban theorist Jane Jacobs suggested that permeability and mixed-use development should be associated with safer neighborhoods because they are more likely to be filled with pedestrians to enhance the “eyes on the street” and therefore, create a street protected by the people who pass through it (Jacobs, 1961). However, the concept of natural policing can also be applied to the cul-de-sac. Since the cul-de-sac does not permit through traffic to use the street, vehicles that enter the street would have nowhere to go other than to the homes situated along it. Residents living on the cul-de-sac should then easily be able to determine who is new to the street and who is a daily user of the street. While a through street could have a diverse flow of traffic from both residents of the street and those who live elsewhere, a cul-de-sac would typically have the same daily flow of traffic, which would make newcomers more noticeable.

Nearly half of the survey respondents revealed that they are not concerned about crime on their cul-de-sacs and dead-end streets (see graph 2). Numerous responses mentioned the creation of a neighborhood watch program has helped reduce crime. While some of the

open-ended comments referenced break-ins and drug-related problems, the majority show that newcomers are visible and crime is not of great concern:

*“Strangers are visible and we haven’t ever had a burglary. Neighboring through streets have had problems with crime, but ours has been unaffected. Our street seems like a crime deterrent.”*

*“In living on this street for 37 years, I can count on one hand (maybe two) the number of times the police have been called here.”*

*“It is easy to notice differences in cars driven by strangers because we know all our neighbors by face and their cars.”*

*“Crime is a problem everywhere, but I think much less so in our neighborhood.”*

*“I’m not concerned about crime in my community. We have a shared neighborhood awareness. Crime occasionally “visits” our neighborhood.”*

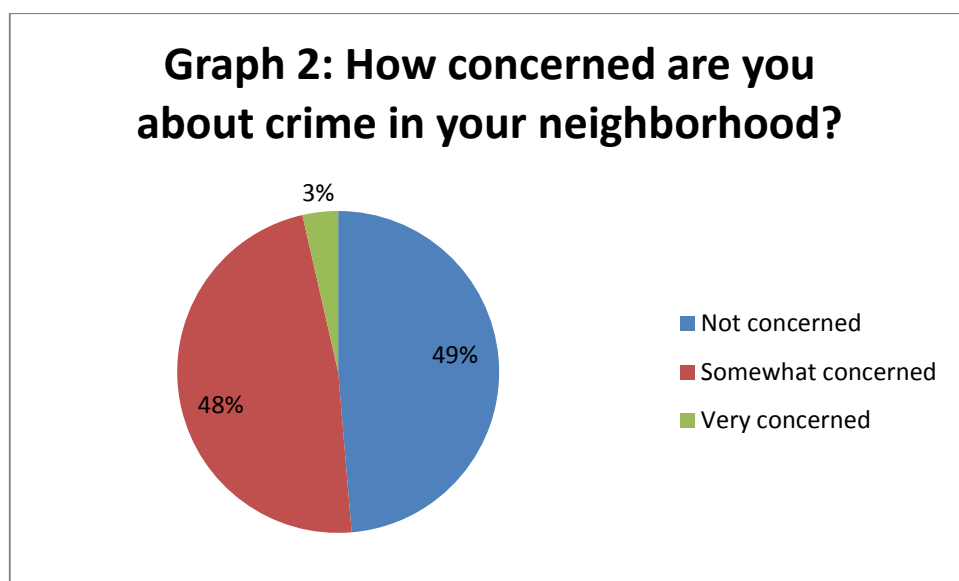
*“Lived here 20+ years and only one car stereo has been stolen.”*

*“We watch over each other and question any stranger walking or driving in the Court.”*

*“I am always aware if there is a strange car or strange people hanging around.”*

One respondent shared a concern about crime accessing the dead-end street from a bike path:

*“There is some drug dealing because the end of our dead end is quiet and dark and there is easy access to a bike path. Break-ins are due to the access of the bike path.”*

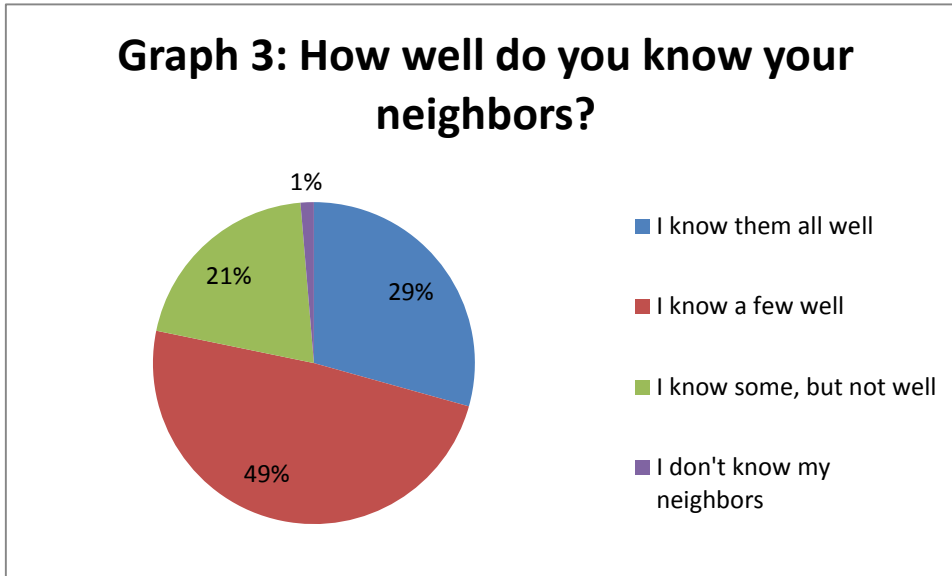


## **Social Cohesiveness**

In addition to providing a safe space for families with young children, studies have shown that living on a cul-de-sac can encourage neighborliness. While some researchers have disputed this claim, others like James M. Mayo and Thomas R. Hochschild strongly believe that the cul-de-sac promotes social cohesion. A study conducted by Mayo found that cul-de-sac residents were much more likely to identify that they knew their neighbors than residents living on curvilinear and grid streets (Mayo, 1979). Likewise, Hochschild found that street design does have an effect on neighborly bonds. In his study, he determined that cul-de-sac residents experience the greatest levels of attitudinal and behavioral connectedness, followed by dead-ends and then grid streets (Hochschild, 2014). In 1963, Peter Willmott was one of the first researchers to suggest that cul-de-sacs are conducive to higher levels of neighborhood cohesion. Through his qualitative research in Dagenham, England, Willmott revealed that people living on cul-de-sacs experience a different degree of sociability than people who live on through streets. Suburban critics have suggested that cul-de-sacs reduce neighborhood interaction due to increased time spent commuting in automobiles, the spatial and socioeconomic polarization of neighborhoods, and from an absence of pedestrian activity (Squires, 2002). However, the studies from Hochschild, Mayo and Willmott indicate just the opposite.

The results from the survey (see Appendix A and Graph 3) and the follow-up phone interviews show that residents on cul-de-sacs and dead-ends streets in Burlington and the surrounding suburbs are likely to know their neighbors. During five out of the ten follow-up phone interviews, residents mentioned that the physical street space in their neighborhoods is often used for block parties, potlucks, seasonal gatherings, and other social events.

**Graph 3: How well do you know your neighbors?**



The following responses are excerpts taken from the phone interviews regarding neighborliness on cul-de-sacs and dead-end streets:

*“We absolutely know everybody on the street. We’re outside in the summer and always seeing the neighbors. We used to have a couple of neighbors that would snow blow our driveway after every storm. That describes the culture of the neighborhood. People do things for each other. We still borrow things and ask for help, and now I’m the guy that snow blows the driveways.”*

*“I know everyone who lives on the street because it’s a destination. You can drive into it, but you can’t drive through it. Kids can play here. Neighbors have potlucks and set up tables in the street. You can’t do that on many other types of streets. Right across from our street (a through street) the city had to put in speed bumps to slow drivers down. The arrangement of the houses facilitates interaction between neighbors.”*

*“I know everybody that lives in my neighborhood. We aren’t all best friends, but at some time or another you end up meeting another neighbor out on the street or is out gardening. It feels like a closed neighborhood because there are only 11 homes. When I visit friends’ homes that are in a development, I don’t get the same feeling.”*

One Burlington resident mentioned how she had experience living on both a cul-de-sac and a grid street:

*“There is a community BBQ on my cul-de-sac at least once a year. It does facilitate some community interaction but I have lived on a through street in the past and there was just as much, if not more community interaction.”*

Overall, the survey evidence and the information that I received from the follow-up phone interviews suggest that cul-de-sacs and dead-end streets may facilitate community interaction, which coincides with the majority of the literature that I reviewed. It was remarkable to hear about the numerous social events that take place directly within the street on cul-de-sacs and dead ends. Future research that compares neighborliness and the prevalence of social events on through streets would complement this study.

### **Youth Experience**

Suburban sprawl can bring about numerous unintended social consequences, especially for teenagers. The lack of access to entertainment and services within walking distance of a residential neighborhood can lead teens to feel isolated if they don't have a personal vehicle. Teenagers crave a higher level of social interaction than can be found on the realm of cul-de-sac streets. This is evident by the results of my survey that I distributed to residents on cul-de-sacs and dead-end streets. The following responses were left in an open ended section of the survey, which asked how teens use the street space on cul-de-sacs and dead-ends:

*"Teens don't use the street because that isn't the nature of a teenager."*

*"I wouldn't say that teens use the street for anything productive."*

*"Teens don't hang out in the street. It's mainly only a place for young children to play."*

*"In the winter, teens will drive their cars and purposely do fast circles at the end of the cul-de-sac."*

*"Teens tend to drive their cars down our road and do donuts."*

These responses coincide with literature that describes how the suburban experience of a teenager greatly differs from that of a child. Researchers suggest that teens living in suburbia are much more likely to experience feelings of isolation and boredom than children (Gaines, 1998). Additionally, studies have suggested that the rise in number teen suicides can be linked to the growth of sprawl (Duany, Plater-Zybek, & Speck. 2000). Between 1950 and

1980, teenage suicide rates nearly tripled (Gaines, 1998). Sociologists highlight that sprawl may be a factor since teenage suicide rates are much higher in suburbs than the cities (Duany, Plater-Zybek, & Speck, 2000). *The New York Times* has even suggested that suburban high school shootings may be linked the relationship between teenage boredom and suburbia (Hamilton, 1999). However, it seems unjustified to assume that high school-related violence can be attributed the design of suburbia without comparing numerous other social factors.

In contrast to the teenage experience in suburbia, this study reveals that nearly all of the surveyed residents living on cul-de-sacs and dead-end streets believed that their disconnected streets provided a safe space for children to play. In all ten of the follow-up phone interviews, residents described how children use their street:

*"Since there is not a lot of traffic on this street, the kids can use the area as a play space."*

*"They use the street and sidewalks for skateboarding, biking, and using a scooter."*

*"My kids and others ride bikes and play street hockey. There is a basketball hoop in the circle of our cul-de-sac."*

*"Kids from the area walk down this street to get to the school because they can avoid Williston Rd, which is dangerous to walk on. They also ride bikes and play sports here."*

*"Little kids use my street for learning how to ride bikes. No through traffic so families bring their kids here. The kids were allowed to run freely through the backyards and street."*

*"It's a great place for children to play because of the lack of through traffic."*

*"They just use it as a playground (the street). They are out there all the time biking, playing, and having fun. But kids and teens don't tend to hang out there because it is more for just action."*

These findings support research that describes how suburbia can be beneficial for young families. Residents in Burlington and the surrounding suburbs view cul-de-sacs and dead-end streets and places where children can play without the fear of fast-moving traffic. On the other hand, more research is needed to evaluate the teenage experience on disconnected streets. This study supports the notion that teenagers crave a higher level of social interaction than what can be offered on the realm of a cul-de-sac or a dead-end street.

The open-ended survey results show that some residents thought that teens only use the street for mischievous reasons.

### **Policy Initiatives**

Across the nation policy advocates have struggled to come to an agreement regarding policies to either restrict or promote the development of cul-de-sacs. From small municipalities to entire states, planners and policy makers are implementing strategies that affect cul-de-sac development. However, contrasting views have divided policy makers about how to address the future of this iconic symbol of suburbia. States such as Virginia and Oregon have initiated policies to limit cul-de-sacs. The states have decided that all new subdivisions must have through streets that link them to other developments, schools, and shopping centers, which effectively bans cul-de-sacs from being built. Virginians and Oregonians were able to convince lawmakers that a policy banning cul-de-sacs would be beneficial because they provided evidence that it would improve safety and accessibility while also saving money since it would lower road maintenance costs (Weiss, 2009). Furthermore, local municipalities from Charlotte, North Carolina to San Luis Obispo, California have also implemented bans on the cul-de-sac. Conversely, numerous other cities and towns have been purposefully retrofitting existing grid streets so that they function like a cul-de-sac.

A surge in traffic calming measures has compelled many local governments around the country to save the cul-de-sac. Berkeley, California has been working to transform much of its grid system into cul-de-sacs and loops by placing traffic barriers across some intersections (Southworth & Ben-Joseph., 2004). These barriers block vehicle traffic, but allow pedestrians and bicyclists to cut through the intersections. In fact, numerous other cities throughout California have implemented similar strategies to calm traffic, create safer neighborhoods and promote walkability.

## **Chapter 8: Conclusion**

As the debate over the future of the cul-de-sac continues between planners, developers and policy makers, these officials need to recall why the cul-de-sac was first created and also, the advantages that this pattern of development can offer residents, developers, and local municipalities. The cul-de-sac was originally developed to provide a safe and quiet neighborhood for families and also to mitigate the negative impact of the automobile on the suburban built environment (Zhang, 2013). Today, Smart Growth advocates and critics of suburbia claim that the cul-de-sac leads to the physical and social separation from the larger world, which not only causes environmental ills from oversized carbon footprints, but also contributes to a phenomenon called suburban isolation for residents who do not possess drivers' licenses. Teens without access to an automobile crave a higher level of social interaction that can't be found within the realm of the cul-de-sac, while senior citizens often are unable to drive due to medical conditions. Furthermore, the advancement of a built environment based around "loops and lollipop" street patterns contributes to a country where everyplace resembles no place in particular (Kunstler, 1993).

Today, many planners argue that challenging traditional transportation planning standards is vital because many federal guidelines and street standards have failed to create comprehensive and logical approaches to street design. Mainstream planning has neglected the complex transportation needs that many urban areas require. Current standards often only address the movement of freight and transportation by car on an interregional scale. Policy framework should also be designed to address the social and environmental impacts that street standards have on society. The vitality and diversity of livable streets that support commerce, accessibility, and social inclusion depend on a system that can provide a variety of transportation modes. However, streets are not just made for transportation. Author and urban activist Jane Jacobs revealed that the streetscape is a public space where humans



congregate as social animals and can meet intentionally or unintentionally with neighbors, acquaintances, or even strangers (Jacobs, 1961). Within the coming years, street design will continue to challenge planners as urban populations grow, and as citizens demand safe and accommodating public spaces to address an ever-growing set of needs.

Within the recent debate about street standards, there has been a renewed appreciation for cul-de-sacs, particularly those that use shared-use paths to link to neighboring developments. The continued willingness of homebuyers to pay a premium to live on a cul-de-sac has prompted policy makers to reconsider the key issues. For developers and local governments, the cul-de-sac can be a cost-effective pattern of development because it often allows municipalities to reduce the length of their utilities. Additionally, the cul-de-sac can be a less invasive way to develop land, which would be important when trying to work around areas of ecological or historical significance.

Overall, discontinuous street patterns like the cul-de-sac have been shown to reduce incidents of crime and provide safe places for children to play, while also offering a street style that homeowners value. By looking at the localized experience of a resident on a cul-de-sac or a dead-end street, it would seem like an ideal living environment. They provide quiet and safe spaces to raise a family because they are isolated from through traffic. However, when you look at discontinuous street patterns from a more comprehensive angle, the true faults become increasingly noticeable. For example, vehicle accidents may occur at lower rates directly on cul-de-sac streets, but the streets that surround cul-de-sac developments often have higher rates of crashes because they are large arterial connectors.

Real estate agents and developers were found to be supportive of cul-de-sacs because homebuyers value living on these streets. However, the drive for profit may not be the most logical approach when looking at these developments from a broad scale. Planners are trained to view development at a comprehensive level. Therefore, these professionals are more

critical of discontinuous streets. During periods of cheap energy and abundant land resources, everyone is happy with cul-de-sac developments. However, as gas prices have risen, and concerns about sustainability and climate change have been highlighted in media outlets across the country, planners and suburban critics continue to advocate for more connected streets. However, rather than completely disregarding the cul-de-sac as an obsolete form of the built environment, planners need to assess how the advantages of the cul-de-sac can be applied to more sustainable forms of development.

## Appendix A

<b>Which street type best describes where you live?</b>		
Answer	Count	Percentage
On a dead end street	78	34.67%
On a cul-de-sac street but not directly on the circle	66	29.33%
On the circle of a cul-de-sac	73	32.44%
Other	8	3.56%

<b>How satisfied are you with your current neighborhood?</b>		
Answer	Count	Percentage
Not satisfied	3	1.33%
Somewhat satisfied	31	13.78%
Very satisfied	191	84.89%
Comments	53	23.56%

<b>How often do you observe people using the shared street space? [Children Playing]</b>		
Answer	Count	Percentage
Every day	91	40.44%
A few times a week	68	30.22%
Sometimes	39	17.33%
Hardly ever	27	12.00%

<b>How often do you observe people using the shared street space? [People walking]</b>		
Answer	Count	Percentage
Every day	170	75.56%
A few times a week	33	14.67%
Sometimes	15	6.67%
Hardly ever	7	3.11%

<b>How often do you observe people using the shared street space? [Neighbors socializing]</b>		
Answer	Count	Percentage
Every day	66	29.33%
A few times a week	85	37.78%
Sometimes	57	25.33%
Hardly ever	17	7.56%

<b>How often do you observe people using the shared street space? [Doing home maintenance]</b>		
Answer	Count	Percentage
Every day	48	21.33%
A few times a week	99	44.00%
Sometimes	52	23.11%
Hardly ever	26	11.56%

<b>How do children and teens use the cul-de-sac or dead-end street?</b>		
Answer	Count	Percentage
Play	166	73.78%
Socialize/hangout	81	36.00%
Ride bicycles	184	81.78%
Children and teens don't use the street	22	9.78%
Other	35	15.56%

<b>Are there ways that people use your street space that you consider to be bothersome?</b>		
Answer	Count	Percentage
Yes	68	30.22%
No	157	69.78%
Comments	65	28.89%

<b>How well do you know your neighbors?</b>		
Answer	Count	Percentage
I know them all well	66	29.33%
I know a few well	110	48.89%
I know some, but not well	46	20.44%
I don't know my neighbors	3	1.33%

<b>How concerned are you about crime in your neighborhood?</b>		
Answer	Count	Percentage
Not concerned	109	48.44%
Somewhat concerned	107	47.56%
Very concerned	8	3.56%
Comments	60	26.67%
No answer	1	0.44%

<b>How concerned are you about traffic in your neighborhood?</b>		
Answer	Count	Percentage
Not concerned	154	68.44%
Somewhat concerned	65	28.89%
Very concerned	6	2.67%
Comments	56	24.89%

<b>How long is your average commute to work? [By car]</b>		
Answer	Count	Percentage
Less than 5 minutes	25	11.11%
5-15 minutes	73	32.44%
15-30 minutes	51	22.67%
Greater than 30 minutes	22	9.78%
N/A	54	24.00%

<b>How long is your average commute to work? [By bus]</b>		
Answer	Count	Percentage
Less than 5 minutes	3	1.33%
5-15 minutes	7	3.11%
15-30 minutes	18	8.00%
Greater than 30 minutes	42	18.67%
N/A	155	68.89%

<b>How long is your average commute to work? [By bike]</b>		
Answer	Count	Percentage
Less than 5 minutes	5	2.22%
5-15 minutes	29	12.89%
15-30 minutes	26	11.56%
Greater than 30 minutes	39	17.33%
N/A	126	56.00%

<b>How long is your average commute to work? [By walking]</b>		
Answer	Count	Percentage
Less than 5 minutes	5	2.22%
5-15 minutes	11	4.89%
15-30 minutes	24	10.67%
Greater than 30 minutes	56	24.89%
N/A	129	57.33%

<b>Which of the following is within walking distance of your home?</b>		
Answer	Count	Percentage
Bus stop	168	74.67%
Grocery/convenience store	155	68.89%
School	161	71.56%
Shopping center	99	44.00%
Park	170	75.56%
Nature Trail	166	73.78%
None of the above are within walking distance	10	4.44%

<b>How much do you value: Neighbors nearby</b>		
Answer	Count	Percentage
No value	5	2.22%
Somewhat value	99	44.00%
Highly value	121	53.78%

<b>How much do you value: Bus stop nearby</b>		
Answer	Count	Percentage
No value	70	31.11%
Somewhat value	112	49.78%
Highly value	43	19.11%

<b>How much do you value: Shopping facilities nearby</b>		
Answer	Count	Percentage
No value	30	13.33%
Somewhat value	102	45.33%
Highly value	93	41.33%

<b>How much do you value: Sidewalks and paths</b>		
Answer	Count	Percentage
No value	10	4.44%
Somewhat value	50	22.22%
Highly value	165	73.33%

<b>How much do you value: Lots of parking</b>		
Answer	Count	Percentage
No value	66	29.33%
Somewhat value	121	53.78%
Highly value	38	16.89%

<b>How much do you value: Quiet neighborhood</b>		
Answer	Count	Percentage
No value	1	0.44%
Somewhat value	36	16.00%
Highly value	188	83.56%

<b>How much do you value: Compact neighborhood [Easy to reach services]</b>		
Answer	Count	Percentage
No value	25	11.11%
Somewhat value	99	44.00%
Highly value	101	44.89%

<b>What is your total annual household income?</b>		
Answer	Count	Percentage
Less than \$25,000	5	2.22%
\$25,000 to \$50,000	17	7.56%
\$50,000 to \$100,000	57	25.33%
\$100,000 to \$150,000	64	28.44%
\$150,000 to \$200,000	27	12.00%
\$200,000+	21	9.33%
No answer	34	15.11%

<b>What is the highest degree or level of education you have completed?</b>		
Answer	Count	Percentage
Less than high school	1	0.44%
High school graduate (includes equivalency)	1	0.44%
Some college, no degree	11	4.89%
Associate's degree	16	7.11%
Bachelor's degree	85	37.78%
Graduate or professional degree	107	47.56%
No answer	4	1.78%

<b>Number of household members</b>		
Answer	Count	Percentage
No answer	4	1.78%
Average number of household members	2.93	
One-member households	16	7.24%

<b>Number of members under 18</b>		
Answer	Count	Percentage
No answer	22	9.78%
Average number under 18	0.79	
Households with no children under 18	108	53.20%
Households with 2 or more children under 18	51	25.12%

<b>Respondent age</b>		
Answer	215	95.56%
No answer	10	4.44%
Average age	51.78	

<b>Respondent occupation</b>		
Answer	207	92.00%
No answer	18	8.00%

<b>Race/Ethnicity</b>		
Answer	195	86.67%
No answer	30	13.33%
White	193	98.97%
Other	2	1.02%

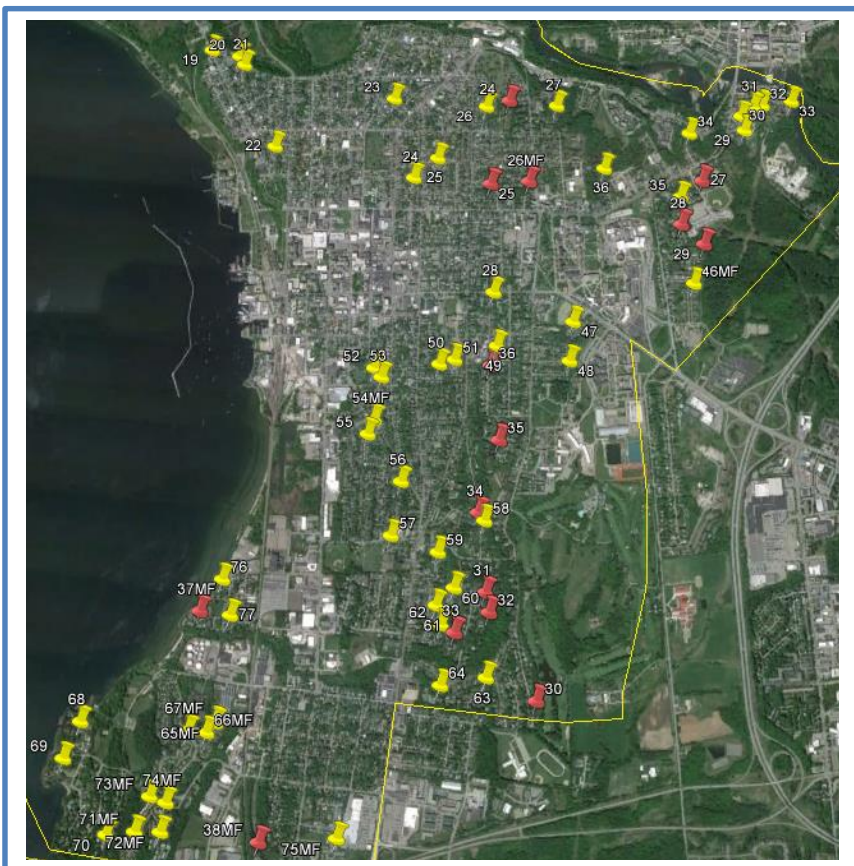
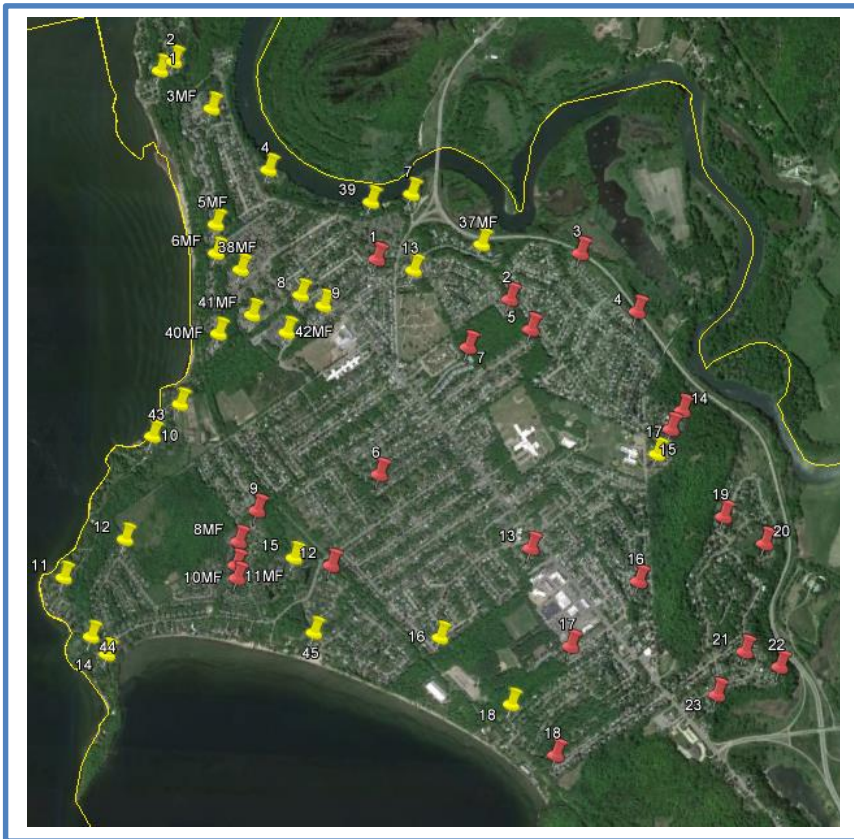
<b>Address</b>		
Answer	140	62.22%
No answer	85	37.78%
Burlington	47	33.57%
Colchester	18	12.86%
Winooski	7	5%
Essex	10	7.14%
Essex Junction	18	12.86%
South Burlington	19	13.57%
Williston	20	14.29%
Shelburne	1	0.71%

## **Appendix B**

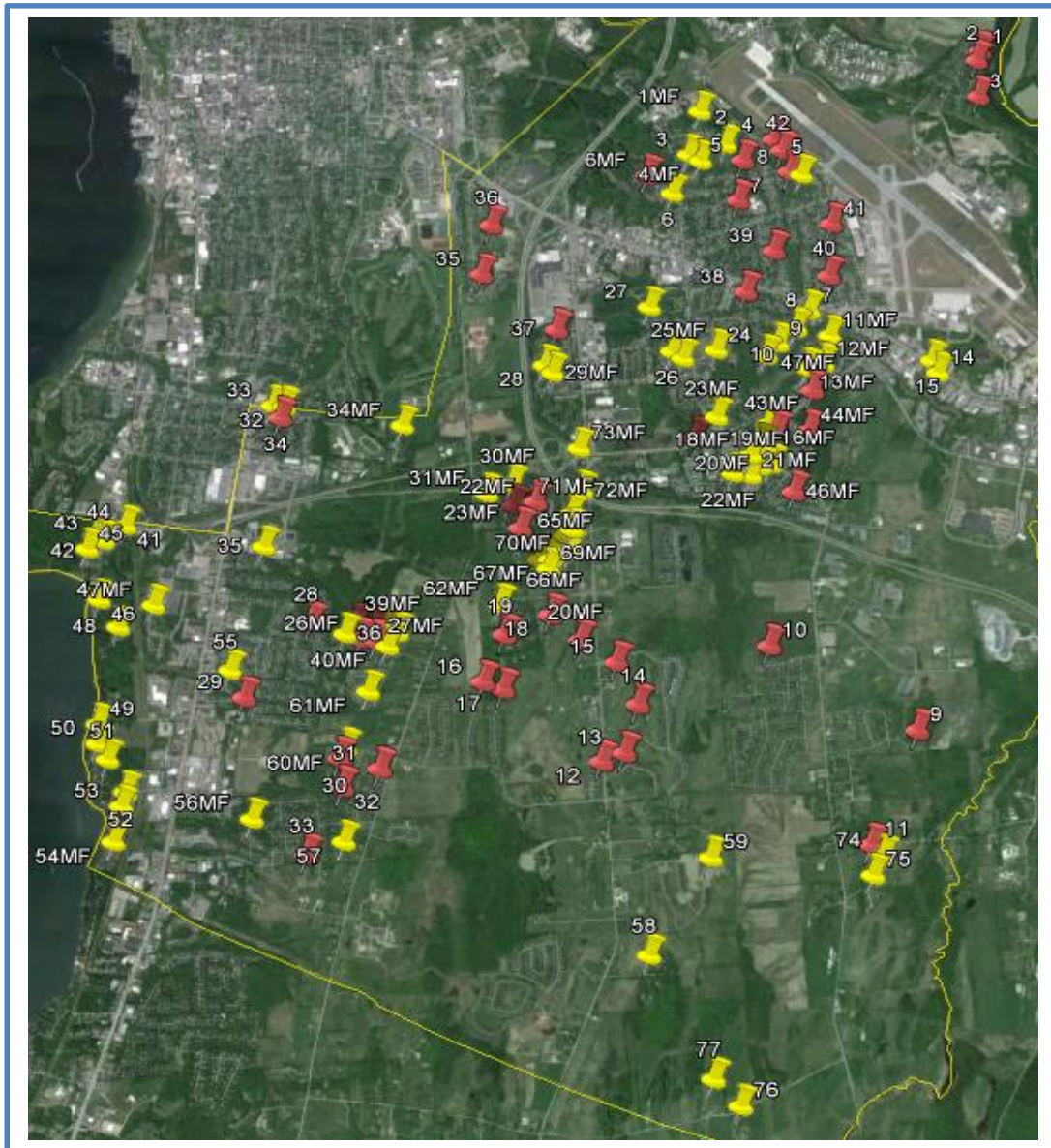
The following section contains figures that were developed using Google Earth mapping software. The location of all the cul-de-sacs and dead-ends streets in Burlington, South Burlington, Colchester, Winooski, Essex, Essex Junction, and Williston are labeled in individual maps. The yellow symbols indicate the location of a dead-end street, while the red symbols indicate the location of a cul-de-sac. Each street is numbered. Those that are marked with an “MF” signify that multi-family housing is located on the specified street.



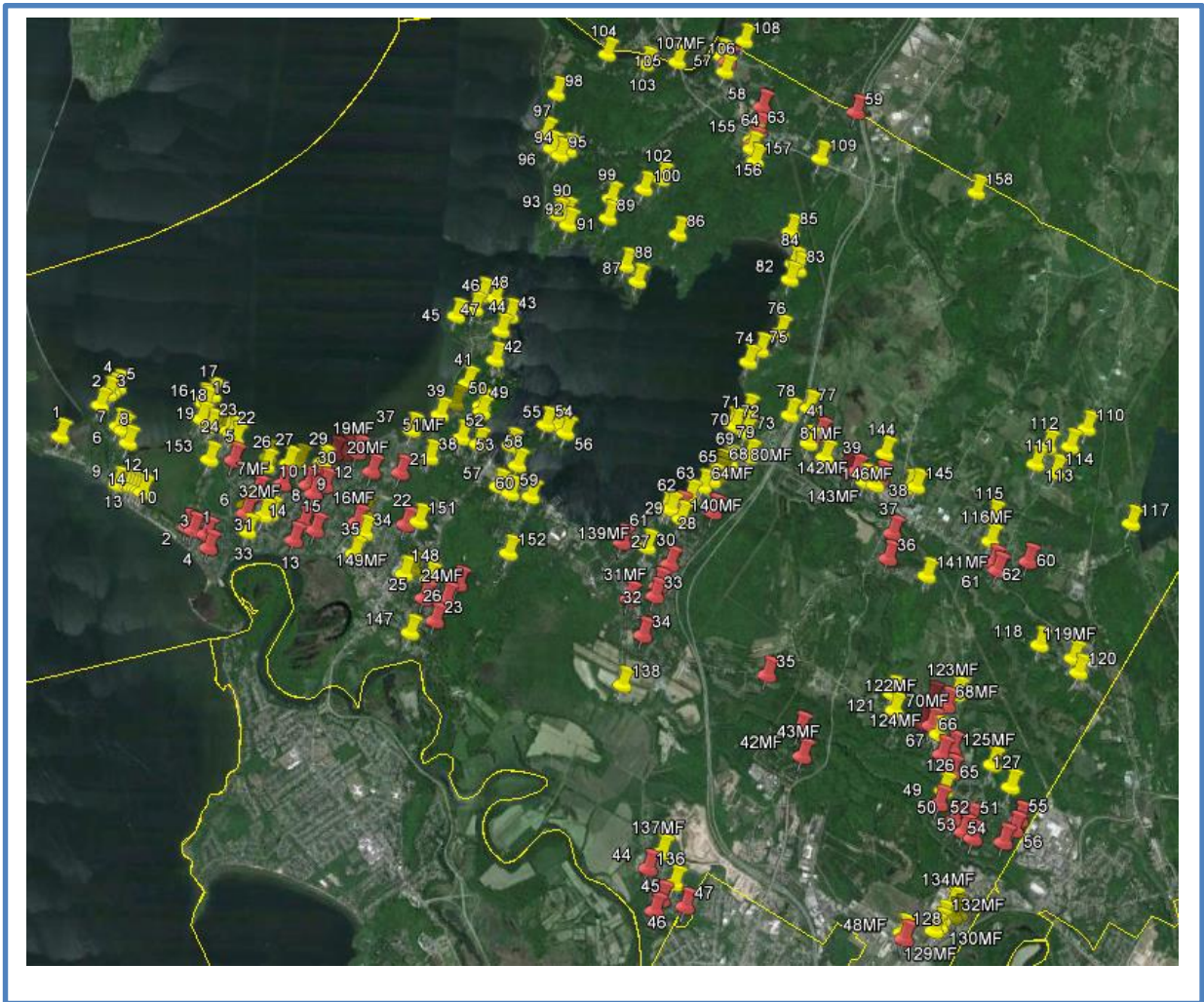
# Burlington



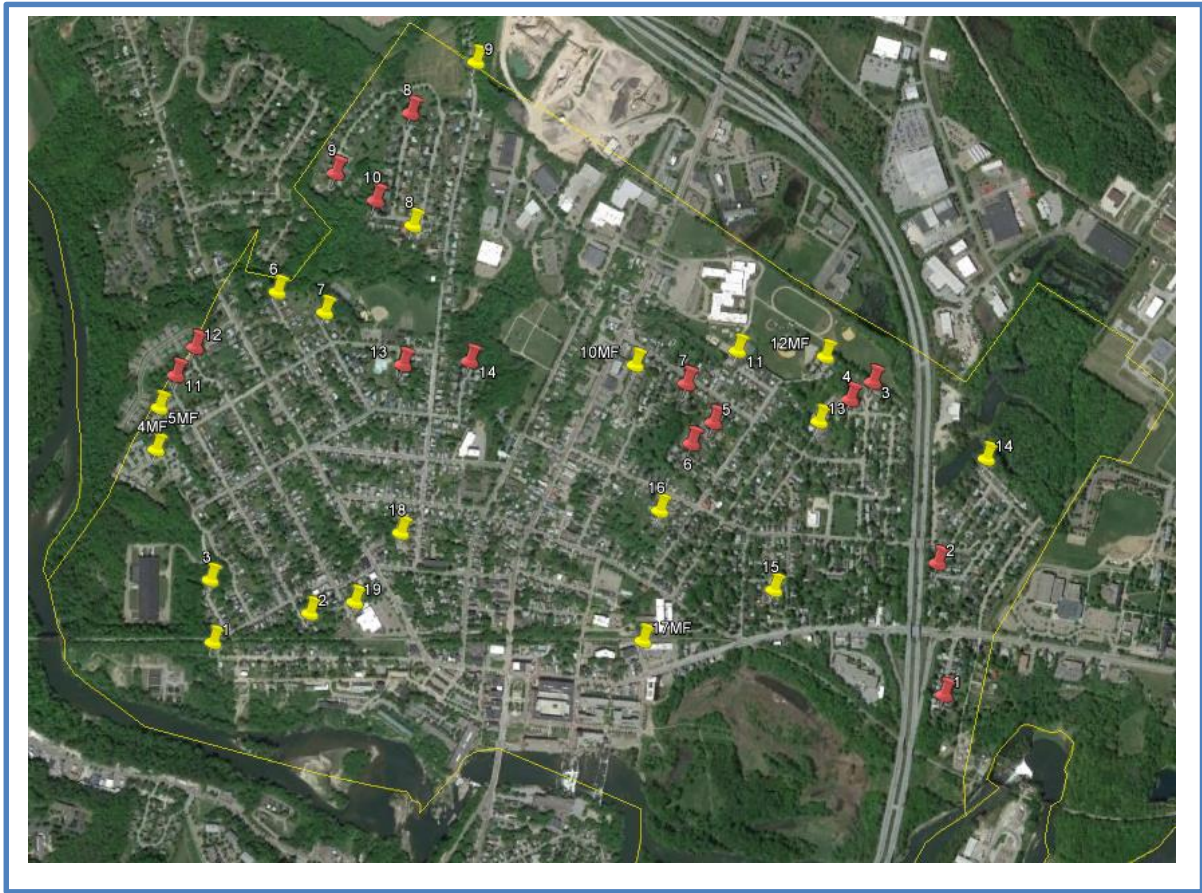
# South Burlington



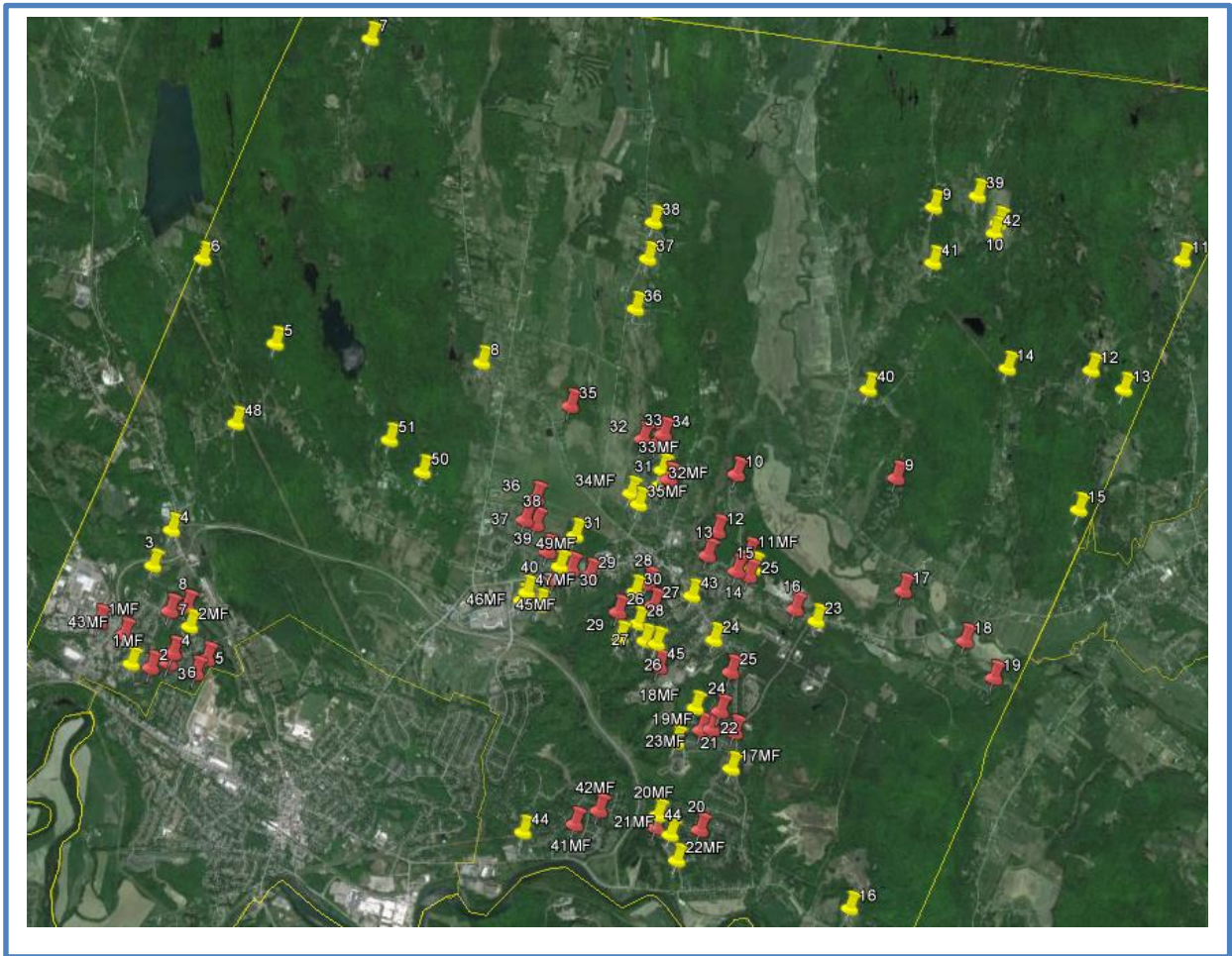
# Colchester



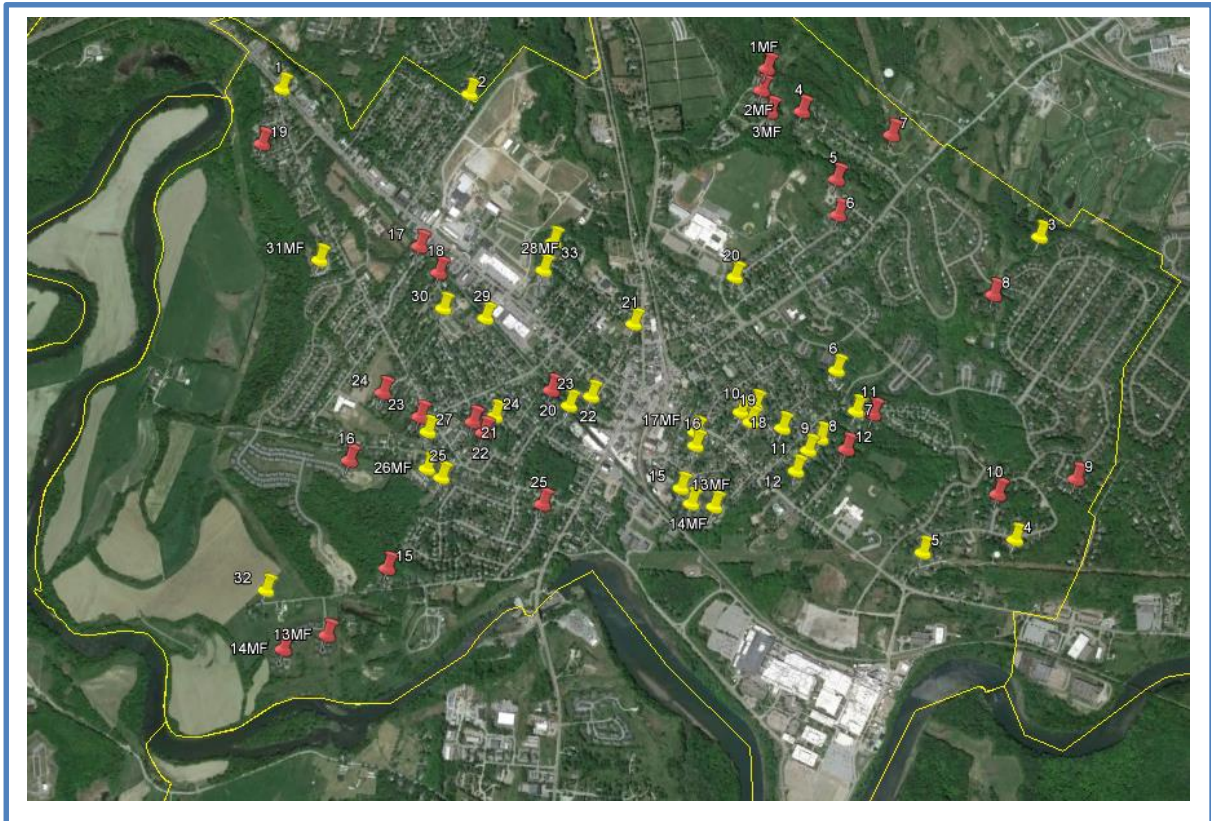
# Winooski



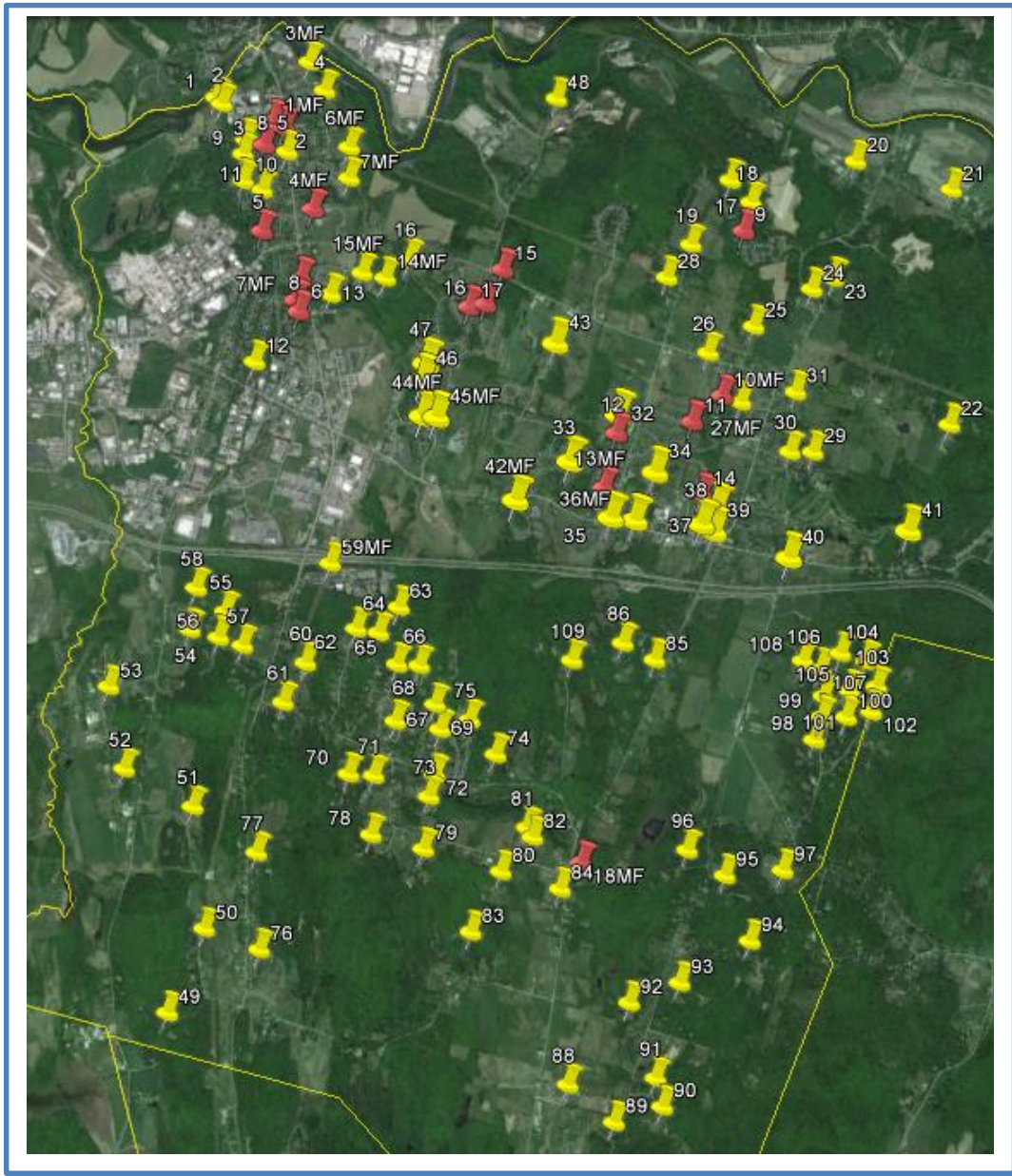
# Essex



# Essex Junction



# Williston



## **References:**

- Albers, Jan. (2000). "Hands on the Land: A History of the Vermont Landscape." Cambridge, MA: Published for the Orton Family Foundation, Rutland, Vt. by MIT
- Appleyard, Donald. (1981). "Livable Streets." Berkeley, CA: University of California.
- Asabere, P. K. (1990). "The Value of a Neighbourhood Street with Reference to the Cul-de-sac." *The Journal of Real estate Finance and Economics*, 3(2), 185-193.
- Audirac, I., Shermyn, A. (1994) "An evaluation of neo-traditional design's social prescription: postmodern placebo or remedy for suburban malaise?" *Journal of Planning Education and Research*, 13, 161-173.
- Bajunid et al. (2013). "Assessing Cul-de-sac Neighbourhoods: A Methodological Prelude." *Procedia - Social and Behavioral Sciences* 84, 288-292
- Benfield et al. (1999). "Once there were Greenfields: How Urban Sprawl is Undermining America's Environment, Economy and Social Fabric." New York, New York: Natural Resources Defense Council.
- Ben-Joseph, E. (1995). "Changing the Residential Street Scene," *Journal of the American Planning Association*, 504-515.
- Ben-Joseph, E. (1997). "Traffic Calming and the Neotraditional Street. Institute of Transportation Engineers." Resource Paper for the 1997 International Conference. 47-52.
- Ben-Joseph, E. (1995). "Residential Street Standards and Neighborhood Traffic Control: A Survey of Cities' Practices and Public Officials' Attitudes." Institute of Transportation Studies, University of California at Berkeley.
- Ben-Joseph, E. (2005). "The Code of the City: Standards and the Hidden Language of Place Making." Cambridge, MA: MIT Press.
- Berry, B. (1975). "The Decline of the Aging Metropolis: Cultural Bases and Social Process." In Sternlieb, G. & J. Hughes (eds.) 1975. "Post Industrial America: Metropolitan Decline & Inter Regional Jobs Shifts." New Brunswick, NJ: Rutgers, pp. 175-185.
- Bossleman et al. (1999) "Livable streets revisited." *Journal of the American Planning Association*, 65(2), 168-180.
- Buckner, J. (1988). "The Development of an Instrument to Measure Neighborhood Cohesion." *American Journal of Community Psychology*, 16(6), 771-791.
- Campoli et al. (2002) "Above and Beyond: Visualizing change in small towns and rural areas." Chicago, IL: American Planning Association.
- CCMPO, (2003). "Year 2003 Transportation Plan Draft Update."
- CCRPC, (2001). "2001 Chittenden County Regional Plan."
- CCRPC, (2013). "Chittenden County ECOS Plan." Retrieved from the Partnership of Sustainable Communities website:  
[http://www.ecosproject.com/sites/default/files/ECOS\\_Plan\\_FPHdraft\\_chpt1-3\\_20130215.pdf](http://www.ecosproject.com/sites/default/files/ECOS_Plan_FPHdraft_chpt1-3_20130215.pdf)
- Charmes, Eric. (2010). "Cul-de-sacs, Superblocks and Environmental Areas as Supports of Residential Territorialization." *Journal of Urban Design* 15(3), 357-374.
- Congress for the New Urbanism. (2012). "Sustainable Street Network Principles." CNU Project for Transportation Reform.
- Cozens, P., Hillier, D. (2008). "The Shape of Things to Come: New Urbanism, the Grid and the Cul-De-Sac." *International Planning Studies* 13(1), 51-73.
- Duany, A., Plater-Zybek, E., & Speck, J. (2000). "Suburban nation: The rise of sprawl and the decline of the American dream." New York: West Point Press.
- Ewing, R. and R. Cervero (2001), Travel and the built environment. A synthesis, *Transportation Research Record*, 1780, pp. 87-114.



- Ewing, R. and E. Dumbaugh. (2009). "The Built Environment and Traffic Safety: A Review of Empirical Evidence". *Journal of Planning Literature*. 2009; 23(4), 347-367.
- Federal Housing Administration. (1936). "Planning Neighborhoods for Small Houses." 1-12.
- Freestone, Robert, and David Nichols. "Pacific Crossing? From the American Bungalow Court to the Australian Cul-de-sac." *Journal of Planning History* 12, no. 1 (2013): 3-27.
- Fulton et al. (2001). "Who Sprawls Most? How Growth Patterns Differ Across the U.S." The Brookings Institute. 1-24.
- Fusco et al. (2012). "Toward an understanding of children's perceptions of their transport geographies: (Non)active school travel and visual representations of the built environment". *Journal of Transport Geography*, 20 (1), 62-70
- Gaines, D. (1998). "Teenage Wasteland: Suburbia's Dead End Kids." University of Chicago Press.
- Glaeser, E. (2011). "Triumph of the City: How our Greatest Invention makes us Richer, Smarter, Greener, Healthier, and Happier." New York, NY: Penguin
- Handy, Susan (1993), *A Cycle of Dependence: Automobiles, Accessibility and the Evolution of the Transportation and Retail Hierarchies*, *The Berkeley Planning Journal*, 9, 21-43.
- Handy, S. (1991) "Neo-traditional development: the debate." *Berkeley Planning Journal*, 6, 135-44.
- Hanlon et al. (2010). "Cities and Suburbs: New Metropolitan Realities in the US." New York, NY: Routledge
- Handy et al. (2008). "Neighborhood Design and Children's Outdoor Play: Evidence from Northern California." *Children, Youth and Environments* 18(2), 160-179.
- Handy et al. (2003). "Planning for Street Connectivity: Getting from Here to There." Planning Advisory Service Report Number 515. Chicago, IL: American Planning Association.
- Hamilton, W. (1999). "How Suburban Design Is Failing Teen-Agers." *New York Times*. <http://www.nytimes.com/1999/05/06/garden/how-suburban-design-is-failing-teen-agers.html>
- Hillier, B. & Shu, S. (2000). "Crime and urban layout: the need for evidence." In Ballintyne, S., Pease, K. and McLaren, V. (Eds), "Secure Foundations: Key Issues in Crime Prevention, Crime Reduction and Community Safety." (London, Institute of Public Policy Research), 224-48.
- Hochschild, Thomas. (2014). "The Cul-de-sac Effect: Relationship between Street Design and Residential Social Cohesion." *Journal of Urban Planning and Development* 1-6.
- Hochschild, Thomas. (2013). "Cul-de-sac Kids." *Childhood*, 20(2), 229-243.
- Insurance Institute for Highway Safety. (2013). "Where Crashes Occur." <http://www.iihs.org/iihs/topics/t/roadway-and-environment/fatalityfacts/roadway-and-environment>
- Jackson, K. (1985). "Crabgrass Frontier: The Suburbanization of the United States." New York, NY: Oxford University Press.
- Jacobs, J. (1961). "The Death and Life of Great American Cities." (London: Jonathon Cope).
- Jay, Jessica. (1997). "The 'Malling' of Vermont." *Vermont Law School*. 1-37
- Johnson, S. D., and Bowers, K. J. (2010). "Permeability and burglary risk: Are Cul-de-sacs safer?" *Journal of Quantitative Criminology* 26(1), 89-111.
- Jones D. (2008). "Mass Motorization & Mass Transit." Indiana University Press.
- Lehigh Valley Planning Commission. (2011). "Street Connectivity: Improving the Function and Performance of Your Local Streets." 1-39.

- Lucy, W., Phillips, D. (2006). "Tomorrow's Cities, Tomorrow's Suburbs." Chicago, IL: Planners Press.
- Marx, L. (2000). "The Machine in the Garden: Technology and the Pastoral Ideal in America." New York: Oxford University Press
- Mason, S. G. (2010). "Can community design build trust? A comparative study of design factors in Boise, Idaho neighborhoods." *Cities*, 27(6), 456-465.
- Matthews et al., (2000) "The street as thirdspace." S.L. Holloway, G. Valentine (Eds.), *Children's Geographies: Playing, Living, Learning*, Routledge, London, pp. 63-79
- Matthews, J., Turnbull, G. (2007). "Neighborhood Street Layout and Property Value: The Interaction of Accessibility and Land Use Mix." *The Journal of Real Estate Finance and Economics*. 35(2), 111-141.
- Mayo, J. (1979) "Suburban Neighboring and the Cul-de-sac Street." *Journal of Architectural Research*. 7(1).
- Morrow-Jones et al. (2004). "Consumer Preference for Neotraditional Neighborhood Characteristics," *Housing Policy Debate*, 15(1), 171-202.
- Murphy, J. (2005). "Assessing the Land Use, Environmental Quality and Transportation Connection in Chittenden County, Vermont." Vermont Law School. 1-129.
- NACTO. (2012). "Urban Street Design Guide." 1-37.  
<http://www.nyc.gov/html/dot/downloads/pdf/2012-nacto-urban-street-design-guide.pdf>
- National Household Travel Survey. (2009). "Average Number of Vehicles and Vehicle Travel per Household."
- O'Brien et al. (2000). "Children's independent spatial mobility in the urban public realm." *Childhood*, 7, 257-277.
- Othman, S., Said, I. (2010). Affordances of Cul-de-sac in Urban Neighbourhoods as Play Spaces for Middle Childhood Children. *Procedia - Social and Behavioral Sciences*, 38(0), 184-194
- Randall, G. (2002). "The Effects of Subdivision Design on Housing Values: The Case of Alleyways." *Journal of Real Estate Research*. 23(3), 265-273.
- Randall, Todd., and Brian Baetz. (2001). "Evaluating Pedestrian Connectivity for Suburban Sustainability." *Journal of Urban Planning and Development* 127, 1-15.
- Rose, Mark. (1979). "Interstate Express Highway Politics 1941-1956." Lawrence, KS.
- Ross, Benjamin. (2014). *Dead End: Suburban Sprawl and the Rebirth of American Urbanism*. New York, NY: Oxford University Press.
- Sanoff, H., Dickerson, J. (1971). Mapping Children's Behavior in a Residential Setting." *Journal of Architectural Education*. 25(4).
- Schwartz, Joel. (2005). "The Social Benefits and Costs of the Automobile." *21st Century Highways*, 1-30.
- Slater, Cliff. (1997). "General Motors and the Demise of Streetcars." *Transportation Quarterly*. 51(3).
- Smith, Barry. (1973). Cul-de-sac Means Safety, Privacy for Home Buyer." *The Atlanta Journal and Constitution*. Section H.
- Southworth, M., and Ben-Joseph, E. (2004). "Reconsidering the Cul-de-sac." *Access*, 24, 28-33.
- Southworth, M., Ben-Joseph, E. (1995) "Street Standards and the Shaping of Suburbia," *Journal of the American Planning Association*, 61(1), 65-81.
- Southworth, M., and Ben-Joseph, E. (2003). "Streets and the Shaping of Towns and Cities." Washington, D.C: Island Press.
- Squires, Gregory. (2002). "Urban Sprawl: Causes, Consequences & Policy Responses." Washington, DC: The Urban Institute Press

- Sternlieb, G. & J. Hughes (eds.) 1975. "Post Industrial America: Metropolitan Decline & Inter-Regional Jobs Shifts." New Brunswick, NJ: Rutgers, pp. 175-185.
- The Champlain Initiative. (1999) "History of Sprawl in Chittenden County". Sustainability and Growth Center Initiative. Burlington, VT.
- Transportation Research Board. (2000). "Highway Capacity Manual." National Research Council. 1-1207.
- U.S. Department of Transportation. (2008). "Table 1-11: Number of U.S. Aircraft, Vehicles, Vessels, and Other Conveyances." Bureau of Transportation Statistics.
- U.S. Environmental Protection Agency. (2010). "Putting Smart Growth to Work in Rural Communities." Washington, DC: ICMA.
- Veitch et al. (2010). "Individual, social and physical environmental correlates of children's active free-play: a cross-sectional study." *Australia International Journal of Behavioral Nutrition and Physical Activity* 7, 11.
- Vermont. (2013). State and County QuickFacts: U.S. Census Bureau.
- Vermont Agency of Transportation. (2013). "Strengthening Vermont's Economy by Integrating Transportation and Smart Growth Policy." Montpelier, VT: Smart Growth America.
- Victoria Transport Policy Institute (VTPI). (2012) "Roadway connectivity: Creating more connected roadway and pathway networks." Online TDM Encyclopedia.
- Villanueva et al. (2012). "Where Do Children Travel to and What Local Opportunities Are Available? The Relationship Between Neighborhood Destinations and Children's Independent Mobility." *Environment and Behavior* 45, 680-705.
- Weiss, E. (2009). "New Virginia Rules Target Cul-de-Sacs." The Washington Post.
- Western Australian Planning Commission. (1997). "Liveable Neighbourhoods Community Design Code," a Western Australian Government Sustainable Communities Initiative.
- Wilson-Doenges, G. (2000). "An Exploration of Sense of Community and Fear of Crime in Gated Communities." *Environment & Behavior* (32) 5, 597-611.
- Zhang, Ming. (2013). "On the Cul-de-Sac vs. Checker-Board Street Network: Search for Sustainable Urban Form." *IRSPSD International* 1, 1-16.