BIKE LINES: POLICY, IMPACT, AND IMPLEMENTATION

A RESEARCH PAPER

SUBMITTED TO THE GRADUATE SCHOOL

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE

MASTERS OF URBAN REGIONAL PLANNING

BY

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MUNCIE, INDIANA

MAY 2016
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Introduction

Bicycle Elements and the US

The United States is unique among developed countries around the globe. Our infrastructure is impressive. The interstate system is unparalleled in its ability to move large numbers of people quickly over long distances. Our network of highways has worked to increase our dependency on the automobile. We are dependent on our cars for even the shortest of trips. For most Americans during the twentieth century, the automobile was the pinnacle of style and luxury. As production levels increased and technological advances were made the automobile become more and more affordable. More Americans started driving and they started driving everywhere. Transportation planning towed the American line and focused on planning cities for automobile use and little attention was paid to alternate transportation methods. As time has passed, fossil fuel use has skyrocketed and become unsustainable. In response to this is a demand to develop alternate transportation methods. At the forefront of this demand is an old standby method of transportation, the bicycle. Large cities,
universities, and destination towns have led the charge to facilitate bicycle infrastructure and incorporate it into future plans.

The ensuing project illustrates the importance of implementing bicycle infrastructure into cities as a tool for redevelopment. Furthermore, it will explore the impediments and solutions that stand in the way of making transportation by bicycle a reality in cities of every size. The project will address issues that cities face with plans, funding, policy, and safety of users. The important topics discussed over the course of this project will be how cycling infrastructure enhances overall quality of life, the need for policy change in order to promote bicycle infrastructure, bicycle and facility design, and the economic benefits of bicycle infrastructure.

Chapter two discusses the historical context from which bicycle planning has evolved over time. Chapter three discusses planning at the local level. Chapter four and five looks at problems that face local planners and potential strategies that can used to solve those problems. Chapter 6 looks at the economic impact that bicycle elements have on local communities. The focus for this chapter looks at employment and revenue that is generated from bike elements. Chapter 7 is a case study of Fort Collins which is one of the most bike progressive communities in the United States. Chapter 8 looks at how the solutions and practices can be implemented in Anderson, Indiana. Chapter 9 provides a conclusion and suggestions for how people can become directly involved in public policy decisions that directly impact bicycle infrastructure.
Chapter 1

Transportation Issues

In the last twenty years, various issues have become apparent affecting the sustainability of human settlements. City streets and highways are seeing more traffic than they were originally designed to accommodate. Dependency on automobiles has led to a decline in economic efficiency and the further development of cities. The subsequent issues that have risen from increased automobile travel are increased traffic congestion, higher costs for parking facilities and less efficient land uses. The fallout from these issues is greater consumer costs, increases in pollution, less efficient energy use, and increased health risks.

According to the U.S. Census in 2000, roughly one third of Americans cannot or do not drive. Within this is a number of Americans who are young or elderly. These are people who are not yet, or no longer able, to drive an automobile. One-third of Americans is a large number. Many cities have developed around the automobile. Due to this fact, there are large distances
between peoples’ dwellings and essential amenities. In very simple terms, grocery stores, drug stores, and department stores are too far away for people to safely walk or bike. To further illustrate this point, roughly ten percent of American households do not own an automobile. Most daily trips are made at distances that could be replaced by bicycle or even by walking. Approximately forty percent of all trips are shorter than two miles. This constitutes a bike ride of roughly ten minutes.

Traffic congestion and automobile dependency have led to an increase in pollution and subsequent environmental problems. The Bicycle and Pedestrian Clearinghouse states that vehicle transportation is responsible for “eighty-one percent of the carbon monoxide released in the United States.” More and more cars are sitting longer during peak traffic hours and are emitting more pollutants into the environment. This is reducing cities’ air quality. Recent rises in the price of gasoline have crunched household budgets and have gotten people thinking about alternate means of transportation.

Similarly, automobile dependency has led to significant decreases in fitness and health levels across the United States. The Center for disease control found that obesity is linked to heart disease, diabetes, and other serious health issues. A 1998 report of the American medical association stated that sixty percent of Americans lead sedentary lifestyles and forty percent are clinically

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overweight. One of the major causes for this is American’s dependency on the automobile. Americans will need to drastically change their lifestyles in order to reverse this trend. One way to do this is start taking short daily trips by bicycle.

Benefits of Bicycling

Bicycling provides numerous benefits to those who utilize it as daily mode of transportation. According to Deborah McCarthy, bicycling can significantly increase the overall quality of life for a person by simply increasing their level of physical activity.

• An adult who bicycles regularly typically has a level of fitness equivalent to someone 10 years younger and a life expectancy two years longer than the national average.

• Children who walk to school have higher levels of physical activity throughout the day and higher levels of cardiovascular fitness.

• Access to paths can lead to greater physical activity. After a bicycle and pedestrian path was built on the new Ravenel Bridge in Charleston, South Carolina – one of the most obese states in the nation – two-thirds of all users reported a significant increase in their physical activity. In addition to increasing people’s overall level of fitness, it can also aid in improving the environment. Short trips are more efficient if made by bicycle. If many of these short trips were made by bicycle, much of the congestion facing today’s cities could be eliminated. However, for these trips to become effective people have to be comfortable with traveling by bicycle.

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Cities are not currently set up to handle bicycle traffic in a way that people are comfortable traveling by bike. Making improvements for bicycle travel can help create a more balanced transportation system that reduces auto dependency and supports alternative modes of transportation. If cities can transform their existing roadways into bicycle friendly roads, then cities can begin to transform themselves into more efficient, economically productive entities. If they are bicycle first, car second cities then they can become more sustainable for the foreseeable future.

According to the AAA motor club, in 2010 the annual cost of owning and operating a medium sized sedan was roughly $8,100, excluding loan payments, for 15,000 miles. This is compared to $120 dollars for a bicycle which comes from the United States Department of Transportation. Even when factoring in bicycle parking, it is still cheaper and much more manageable. Bicycle parking can be incorporated into already available spaces like parking garages and down unused alleyways. Bicycles can also benefit low income families as they are more likely to be dependent on non-motorized methods of transportation.

Types of Bicyclists

The Federal Highway Administration has identified bicycle facilities as provisions under all Federal aid programs and has been included in the U.S. Code for funding eligibility. It is under these provisions a bicycle facility is defined as “a new or improved lane, path, or shoulder for the use by bicyclists

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and a traffic control device, shelter, or parking facility for bicyclists." All bicycle planning must follow these descriptions.

Bicyclists have special needs that must be considered when planning these transportation facilities. Planners must understand that in order to increase usage of bicycle facilities special provisions must be made. Todd Litman, one of the foremost planners and researchers in transportation policy, states that there are three types of cyclists. He defines them as children, commuters, and bold commuters. Most bicyclists are not experienced riders; therefore planners must keep this in mind when planning facilities. By classifying bicycle riders, planners can plan for the lowest ability level user and capture everyone else in the process. The following table illustrates this point.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>What They Prefer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced</td>
<td>Can operate under most traffic conditions</td>
<td>Efficiency, Maximum speed, few delays, ease of passing, sufficient shoulder area</td>
</tr>
<tr>
<td>Basic</td>
<td>New adult riders, teen-age riders</td>
<td>Direct Routes, low speed, low traffic volume, well defined or separate routes</td>
</tr>
<tr>
<td>Children</td>
<td>Children, usually monitored</td>
<td>Adjacency to schools, parks, low speed, well defined routes</td>
</tr>
</tbody>
</table>

Table 1: Classification of Rider Types (Litman)

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In addition to classifying rider types it is important to understand what kind of trips people make and will make by bicycle. Most trips are made for recreation and exercise. Fewer trips are made for purposes of commuting.

<table>
<thead>
<tr>
<th>Purpose of Bicycling Trips</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health and Exercise</td>
<td>60%</td>
</tr>
<tr>
<td>Personal</td>
<td>20%</td>
</tr>
<tr>
<td>Recreation</td>
<td>10%</td>
</tr>
<tr>
<td>Commute to School/Work</td>
<td>6%</td>
</tr>
<tr>
<td>Required for Job</td>
<td>4%</td>
</tr>
</tbody>
</table>

Table 2: Purpose of Bicycling Trips Source: Bureau of Transportation Statistics, Personal Transportation Survey 2005.

Despite these low numbers for commuting to and from the workplace or school, if planners can increase the numbers of bike facilities and make them effective, then these numbers will increase. As stated previously, planners can make bicycle facilities effective by listening to user’s needs.

Examples of Bicycle Facilities
The preceding tables illustrate a sense of what the planner needs to understand to provide users with what they want in order to travel by bicycle. The following will describe the types of facilities that the planner has available to them in order to meet the needs of the cyclist. Cities have evolved in very specific ways. Land uses are often sprawled over the landscape because of the ease of movement provided by automobiles. It would be impossible to just wipe the slate clean and start from scratch. Therefore, a network of bike ways and facilities are necessary to move people from place to place. Bikeways mirror
their automobile carrying counterparts. According to the American Association of State Highway Transportation Officials, (AASHTO), bicycle facilities are “improvements or provisions made by public agencies to accommodate or encourage bicycling, including parking facilities, mapping all bikeways, and shared roadways that may not be specifically designed for bicycle use.”

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<table>
<thead>
<tr>
<th>Facility</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bikeway</td>
<td>Any road, path or way in which some manner is specifically designated as being open to bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other transportation modes.</td>
</tr>
<tr>
<td>Bicycle Path</td>
<td>A bikeway physically separated from the non-motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way</td>
</tr>
<tr>
<td>Bicycle Lane</td>
<td>A portion of the roadway which has been designated by stripping, signing, and pavements marking for the preferential or exclusive use of the bicyclist.</td>
</tr>
<tr>
<td>Bicycle Route</td>
<td>A segment of a system of bikeways designated by the jurisdiction having authority with appropriate directional and informational markers, with or without a specific bicycle route number</td>
</tr>
<tr>
<td>Shared Roadway</td>
<td>Any roadway upon which a bicycle lane is not designated and which may be legally used by bicycles regardless of whether such facility is specifically designated as a bikeway</td>
</tr>
<tr>
<td>Signing and Marking</td>
<td>Visual aids which alert cyclists to conflicts and indicate directions, destinations, route numbers, and names of crossing streets</td>
</tr>
<tr>
<td>Bicycle Parking</td>
<td>Parking facilities provided at trip origins and destinations including amenities such as bicycle lockers or racks.</td>
</tr>
</tbody>
</table>

Table 3: Types of Bicycle Facilities
Paved shoulders in rural areas, bicycle safe drain gates, bicycle friendly railroad crossings, and high traction paint for road markings are a few things that need to be considered when planning bicycle facilities.9

In current planning practices there are two kinds of facilities. Cities often choose one type or the other when implementing bike facilities. The two kinds of facilities are segregated and integrated. Segregated facilities are bike paths and trails. Integrated facilities are bike lanes, routes, and roadway improvements. To achieve the desired network of bike facilities, there should be a blending of these kinds of facilities.

The fact that cities prefer to only implement one type of facility over another is one of the reasons why people do not use their bikes more. Segregated facilities will be used more for recreation, since they are often closed systems that do not go anywhere other than where they began. For instance, Figure 1 is an example of a segregated facility. Usually with a segregated facility, it requires a car to travel to the facility because there is no safe network of bike facilities to reach the system. According to Litman, a large number of people prefer these types of facilities because they feel that they are more pleasant and safer to use.10 In addition to accessibility, there are issues with overcrowding from walkers, children, and other users on these systems.

10 Litman
These facilities can also be very expensive to build. Bike paths can cost anywhere from $90,000 to $200,000 per mile. The reason for the elevated cost relates to the acquisition of right-of-way, bridge assembly, and overpass construction. Bike lanes and routes are the least expensive option when implementing bicycle lanes. Bike lanes can range in cost from $3,000 to $30,000 dollars. These costs account for expanding the street shoulder or restriping.

Figure 2 shows a network and bikeways that will move people quickly and efficiently to their desired destinations. The important thing to note is that the yellow and orange bikeways are closed systems like the one pictured above. There is a system of bikeways that can move people to and from

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destinations. The added benefit of the bikeway network is that once segregated systems are now integrated into the overall bikeway network.

There is also the issue of safety with these two types of systems. Contrary to what most might think, the integrated system is the safer of the two. Most integrated systems are less crowded because they are only meant for bicyclists. Another reason that they are typically safer is because they are the bikeway of choice for more advanced cyclists. Bicyclists often have to share segregated facilities with joggers, walkers, and leashed pets. This can create confusion and can lead to more accidents. It is worth mentioning that although accidents are more frequent on segregated bikeways, they are typically less severe.14

Chapter 2

Historical Context

Traveling by bicycle is not a new concept. The bicycle has existed in some form or another since the early 19th century. In fact, the bicycle was the first machine to be mass produced for the purpose of individual transportation. By the late nineteenth century, there were over 300 bicycles operating each day in the United States. Since that time, the advent of the automobile and its widespread adoption led cities to change their blueprint. They were no longer set up for the pedestrian or bicyclist. Cities began accommodating for the automobile user. Then in the early 1970s, due to

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the gasoline crisis, the cost of owning an automobile increased dramatically. The early 1970s also saw the production of bicycles nearly double that of the automobile. This is illustrated in Figure 4. “After nearly doubling from 1950 to about 1970, worldwide bike production grew by a factor of six from just over 20 million units in 1970 to 130 million units by 2007.” Before this, cities were almost exclusively for the automobile. City streets were a place for automobiles to move from destination to destination. This purpose could be a contributing factor to declining downtowns. At one point, streets were a place where people meandered, shopped, and socialized. This is no longer the case. In the latter half of the twentieth century, even though bicycles were produced at a ratio of 2 to 1, cars were still the priority for many city planners. Also, playing a part in the history of the bicycle as a viable mode of transportation are climate and health. First, there have been dramatic changes in the science of climate change. Where climate change was once considered scientific propaganda, it is now more widely accepted and understood by the layman.

There is also the issue of economic development. There has been a significant increase in the economic development levels around the world since the early 1970s. Bicycles can be acquired at a fraction of the cost of automobiles. The average cost of a new car in the U.S. is $13,532. The average cost of a new bicycle in the U.S. is $385. As stated previously, one in three households does not own an automobile. There are 139 million automobiles
registered in the United States. There are just over 100 million bicycles in the United States.\textsuperscript{17}

There are portions of the United States where owning an automobile is not feasible. Dense urban environments are not conducive to operating automobiles. This leaves the bicycle and other forms of transportation as more viable options. The other groups of Americans that do not own an automobile are either cannot afford an automobile, are too old, or too young. Still these groups are often neglected in planning and many live cities that not densely populated and are left to travel long distances by undesirable means. Still there are rapidly developing, or developed, nations that do consider these groups. China is a great example of this idea. There are nearly 250 bicycles to every automobile in China. Bicycles are a sign of urbanization in China.

Bicycling has attracted a renewed interest in the United States. Bicycling has permeated popular culture with the successes of professional American cyclists in European races. Subsequently, cycling has become extremely popular with affluent Americans. The phrase “cycling is the new golf” was coined by a Melbourne investment banker called Craig Bingham who noted that affluent middle-aged men were using cycling in the same way that they’d previously used 18-holes – to have fun, keep fit and make business contacts.\textsuperscript{18} Currently in the United States, there are over 5,400 specialty bike dealers that cater to American cyclists. Custom bicycles in the United States can cost up to $30,000.

\textsuperscript{17} \url{http://www.californiabikecommute.com}
The average number of trips made by bicycle has increased in the United States. Cities, like New York, Portland, and San Francisco that are known for being progressive in the terms of support of cycling have seen their bicycle trip numbers increase by an average of 100 percent. During the summer of 2002, there was an average 1.6 million commuter bicycle trips per day in the United States.\(^\text{19}\) It is studies like this one that demonstrate a renewed interest in bicycling as a viable means of transportation. This is conditioned upon the provision of safe and adequate facilities. Bicycling has the backing in popular culture and affluent communities and the industry has the infrastructure to produce bicycles at various levels of affordability to supply American cyclists.

\[\begin{array}{|c|c|}
\hline
\text{Year} & \text{Obligation (in millions)} \\
\hline
2008 & $541 \\
2007 & $564 \\
2006 & $395 \\
2005 & $400 \\
2004 & $427 \\
2003 & $423 \\
2002 & $416 \\
2001 & $339 \\
2000 & $296 \\
1999 & $204 \\
1998 & $217 \\
1997 & $238.70 \\
1996 & $197.20 \\
1995 & $178.60 \\
1994 & $112.60 \\
1993 & $33.60 \\
1992 & $22.90 \\
1991 & $17.90 \\
1990 & $6.60 \\
\hline
\end{array}\]

\^\text{19} National Survey of Pedestrian and Bicyclist Attitudes and Behaviors, 2002. National Highway Traffic Safety Administration (NHTSA) and Bureau of Transportation Statistics
Federal Planning Roles

ISTEA

Before the passage of the Intermodal Surface Transportation Efficiency Act of 1991, the Federal Government spent approximately $4-6 million per year on bicycling and walking facilities collectively. Contained within the legislation were new policy recommendations which stated that there was a need for an “increased use of bicycling, and encourage planners and engineers to accommodate bicycle and pedestrian needs in designing transportation facilities for urban and suburban areas.” The passage of ISTEA was the first time that the federal government recognized bicycling as a viable mode of transportation. Since that time, bicycling has fallen under the control of the federal government. The federal government has been pushing local governments to implement bicycle facilities. Specifically, ISTEA created a significant amount of funding, ten percent, to be spent on enhancing bicycle facilities. It also freed up funding from the Highway Safety budget and the National Highway system. These funds significantly increased the number of bicycle facilities around the United States. In Table 4, you can see that after 1997 there was a decrease in obligated funds dedicated to Bicycle facilities. This was the first decline in spending since the passage of ISTEA in 1991. Despite the cut in funding, bicycling continued to grow in demand as a transportation mode. The direct result of this demand was a doubling of available funds for bicycle facilities. During this period, federal

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legislation required all Metropolitan Planning Organizations to consider bicyclists in their long range transportation plans. It is during this time, that many localities begin to require bicycle and pedestrian elements in new and future construction projects.

TEA-21

Following the 1997 decrease in bicycle facility funding, Congress replaced ISTEA with the Transportation Equity Act for the 21st Century. This piece of legislation continued the federal government’s commitment to the bicycle related programs established under ISTEA. More importantly, it further increased funding levels for those programs. Furthermore, the Federal Highway Administration stated that they had the expectation that every transportation agency accommodate bicyclists in all of their projects. They called it an integral part of our future transportation system.22

In 2000, the US Department of Transportation directed the practice of incorporating bicycle facilities into future plans by requiring states to make those considerations in all transportation plans, unless “exceptional circumstances” exist.23 Today, only half of the states currently follow these recommendations. Although TEA-21 strongly encouraged the inclusion of bicycle elements in future plans, it does not make it a requirement for federal funding. This does not make implementation a high priority for local governments. This makes it difficult for planners to address the needs of bicyclists.

SAFETEA-LU

In 2005 The Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) went into effect. SAFETEA-LU’s goal was to make “substantial improvements in the safety of the Nation's surface transportation” by more than doubling funding for highway safety improvements over TEA-21 levels through a new core highway safety infrastructure program in lieu of the existing Surface Transportation Program safety set-aside.\(^\text{24}\)

Federal Funds at Work in Indiana

One of the programs created under ISTEA, continued under TEA-21, and further enhanced by SAFETEA-LU was the Transportation Enhancement (TE) Program. The TE program is the portion of legislation that requires ten percent of the available funding under ISTEA to be spent on bicycle and/or pedestrian related facilities. Each state has some flexibility within the law on what funds can be spent so long as it is within the limits of the law. Indiana has approximately twenty million dollars available for them to spend on transportation enhancements. From those funds, the Indiana Department of Transportation will reimburse up to eighty percent of an eligible projects cost. The number one project that Indiana will fund is the provision of pedestrian and

bicycle facilities.\textsuperscript{25} Below is the criteria listed under the Indiana Transportation Enhancement Program for bicycle facilities to be considered for funding:

- Viable transportation alternatives capable of relieving congestion and/or improving air quality, especially projects supportive of multi-modal transportation.
- Projects requesting funding to acquire land for bicycle/pedestrian facilities.
- Multi-jurisdictional projects.
- Projects that join or extend an existing bicycle/pedestrian facility.
- Contributes to a local or state bicycle/pedestrian system identified in plans adopted by the appropriate governing entity.
- Multi-use facilities accommodating more than one group (i.e. hikers, walkers, runners, bicyclists of all types, cross-country skiers, skaters, horse riders, the physically challenged, families, the elderly, etc.), especially facilities serving utilitarian and recreational travel needs. Typically, such facilities are more than 10 feet wide.
- Projects that include support facilities to enhance pedestrian/bicycle travel, such as rest rooms, drinking fountains, picnic shelters and bicycle racks.
- Applicants that have not received Transportation Enhancement funds for bicycle/pedestrian facilities in the past.\textsuperscript{26}

It is important to note that there is emphasis on these projects being transportation oriented, these are not to be recreational projects and if they include recreational areas, they must connect to other facilities that enhance the way people move throughout a community. It is noteworthy that priority is given to projects that can meet multiple criterions.

\textsuperscript{25} A Summary of Highway Provisions in SAFETEA-LU. Federal Highway Administration Office of Legislation and Intergovernmental Affairs Program Analysis Team. August 25, 2005
Chapter 4

Planning at the Local Level

As was previously stated, ISTEA required MPOs to include bicycle improvements in the long range transportation plans. As such, many localities have undertaken ambitious bicycle plans. Many of these plans are satisfy requirements from the federal and state levels of government. These regionally oriented bicycle plans are often broad and do not consider the “detail” oriented issues that are necessary when planning bicycle related facilities. “The goal of bicycle planning at the local level is to provide for bicycle travel within the community.”27 The regional plans do not take into account that a drainage gate can catch a wheel, traffic barriers between destinations, and a lack of lanes on certain streets.

Anderson, IN will be considered later in this paper as a prime example of how a city and its citizens can benefit from proper implementation of bike lanes. Today, the city has nearly ten miles of bike trails that connect with a county wide network. They were planned by the Madison County Council of Governments. They are not sufficiently signed; do not take drainage gates into account, or roads with shoulders. This is the kind of example as to why bicycle planning should be done a small scale. The following chapter will detail what many localities deal with in planning for bicycle facilities and how they can take state and regional bicycle initiatives and improve upon them while creating a bike able community.

Problems and Solutions for Bike able Communities

Many cities encounter trouble building steam to begin implementation of bicycle facilities. Many owe these setbacks to the ambitiousness of overall goals. However, cities should start small and continue their work in phases. For instance, it is easier to replace a storm grate than it is to build brand new facilities. It is easier to restripe a road to create facilities than it is widen roads to include facilities. Plans should be created that phase development, placing the less expensive projects toward the beginning of the process and more costly projects toward the middle or end of the process to allow time for funds to be allocated. The other added benefit of front loading less expensive projects toward the beginning is that they are often more common and are easily visible to the community. They can garner local support and, with the support, make it easier to receive funding in the long run. “In one southern community, for
instance, striping bike lanes on two collector streets near the local university—a project that took several days of work and less than $1000 to accomplish—helped build support for an important $500,000 bicycle bridge.” The goal is to start small, building and expanding on plans making them more ambitious in nature as the community matures in its relationship with bicycle facilities and bicycle planning. This is the strategy, but there are specific things that cities can do to solve problems and make their communities more bikeable.

A study done by the Federal Highway Administration lists thirteen potential problems that cities will likely encounter in transforming their landscape to include bike elements. These are categorized by the way they impact the current transportation system. They are further classified by the general improvements that can be made to mitigate these problems. These categories include major urban streets, minor urban street traffic, crossings, bicycling barriers, trail networks, transit connections, railroad crossings, signals, drainage gates/utility covers, rural road shoulders, bicycle parking, and maintenance.

Major Urban Streets

Major urban streets play an important role in bicycle facilities for many reasons. First, they serve many of the major destinations within a community. Often, they are continuous and are usually in better condition than minor arterials and collectors. The downside to these types of streets is that they...
usually suffer from higher levels of automotive congestion and riders generally feel less safe because of the higher volume of auto traffic. Improvements on these kinds of streets require an understanding of the overall bike network, or where people want to go in a given locality. These routes can be the most difficult to plan for because there is no guarantee that cyclists will utilize the route once it is established and how will landowners along the route react to facility implementation. These routes can be established through the reallocating of space (restriping) or by widening streets through the elimination of parking or expanding existing roadway. Either way special attention must be paid to how each major roadway impacts the other. The idea is create a city wide network that will connect people, by bicycle, to destinations that were otherwise unreachable.

**Minor Urban Street Traffic**

This problem stems from motor vehicle traffic through neighborhoods. Motorists often utilize neighborhood streets as bypasses for more congested arterial streets. Neighborhoods have higher volumes of children and where most bicycle trips will originate. The problems in many of these places are sight distance and automobile speed. These can be mitigated by significantly altering the environment that automobile is entering. The general idea is to build neighborhoods for bikes, the way many urban streets are designed specifically for cars. Diverters are a way to slow down automotive traffic entering a neighborhood. New subdivision developments often utilize cul de sacs and curvilinear streets, but these are not adequate traffic calming elements and often
impede bicycle traffic and should not be considered when building bike friendly neighborhoods. Traffic diverters of any kind are not suitable as retrofit options to calm traffic.

<table>
<thead>
<tr>
<th>Technique</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Circle</td>
<td>A raised traffic control device (see photo earlier in this section) located in the middle of an intersection to slow traffic. Usually, vegetation is planted In the center.</td>
</tr>
<tr>
<td>Speed Hump</td>
<td>A section of raised roadway surface (2.4 m to 3.6 m [8 ft to 12 ft] long) that forces motorists to slow down. Not to be confused with speed bumps (typically less than 1 m [3 ft] long), often found in parking lots or mobile home parks, which can be a hazard to bicyclists.</td>
</tr>
<tr>
<td>Diverter</td>
<td>Structure placed at intersection designed to prevent through traffic by forcing motorists onto another street. They can be designed to allow bicyclists to ride past.</td>
</tr>
<tr>
<td>Partial Street Closure</td>
<td>Access to a road is essentially eliminated in one direction through the use of a barrier across half the street. The rest of street remains two-way. They can be designed to allow bicyclists to ride past.</td>
</tr>
<tr>
<td>Street Closure</td>
<td>All through motor vehicle traffic is stopped by a curb-to-curb barrier. Slots are cut to allow bicycle traffic to get through. Can cause problems if motorists must use nearby driveways to turn around.</td>
</tr>
<tr>
<td>Curb Bulb</td>
<td>Sidewalk extensions at intersections narrow the road width and reduce crossing distances while increasing pedestrian visibility. Often used in downtown shopping districts and typically match the width of on-street parking.</td>
</tr>
<tr>
<td>Chicane</td>
<td>Obstacles (e.g., expanded sidewalk areas, planters, street furniture, or parking bays) are staggered on alternate sides of the roadway, requiring motor vehicle traffic stream to move side-to-side in the right-of-way.</td>
</tr>
<tr>
<td>Choke Point</td>
<td>The narrowing of a street over a short distance to a single lane, forcing motorists to slow down and, occasionally, negotiate with on-coming traffic.</td>
</tr>
</tbody>
</table>

Table 5: Traffic Calming Elements


In addition, these design elements can make what would otherwise be a five minute bike trip into a twenty minute bike trip. This works to promote the automobile and not the bicycle. Working with neighborhood associations to find
specific traffic problem areas and implementing traffic calming measures is essential for creating bike able neighborhoods.

**Street Crossings**

The longer the bike trip, the more necessary it becomes to cross through major intersections. Earlier in the paper, cyclists were placed into three categories. These were advanced cyclists, basic cyclists, and children. For the advanced cyclist crossing an intersection comes with the territory of riding a bike. However, for the basic cyclist and for children, street crossings can become dangerous undertakings, especially when traffic on the crossing street does not stop or slow. This limits the number of bicycle trips that people would otherwise take during the course of the day.

There several ways to make street crossings safer for all levels of cyclists. “One way is to encourage neo-traditional designs that include a combination of more compact and mixed land uses and a street system that more closely resembles a grid.”

This is a way to alter future land use and development for the inclusion of bicycle facilities and make them more attractive to bicycle users. However, this may be the most difficult due to potential zoning changes and other administrative problems. Easier ways to make crossings safer include signals that respond to bicycles and green lights that last long enough to allow the casual bicyclist to make it safely through the intersection. At intersections

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where no signal is warranted, installing raised medians can provide protection for non-motorized traffic during times with higher traffic volumes.

**Physical Barriers**

Physical barriers include rivers, freeways, rail corridors, or other major obstacles. Most bike trips are about one to two miles in length. These barriers then become important because they can add additional miles to the trip. Any trip over two miles reduces the likelihood of that trip being made by bicycle. The solution to this problem may seem easy and in some instances, it is easy. However, land ownership disputes and jurisdictional disputes can create problems. “For instance, one agency in Massachusetts recently built a bicycle/pedestrian trail with a 15.2-m (50-ft) gap where the trail crosses a railroad line.” The city is then left with an incomplete bike facility. One way to combat physical barriers is to piggyback bicycle specific facilities with other transportation improvements. For instance, bike only bridges can be built alongside highway bridges, paths can be built under elevated transit lines. These solutions are limiting, but can, coupled with the reallocation of existing roadways aid in the elimination of physical barriers to cyclists.

**Trail Networks**

It is important to keep in mind that majority of bicycle trips are made for recreational purposes. Recreation is supposed to be a low stress activity. This is probably why many cyclists prefer segregated facilities such as trails. As stated

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previously, segregated facilities are problematic because they are often long
distances from the bicyclists’ homes. The solutions for problems with trail
networks are simple. There need to be more trails. More trails means greater
accessibility. Trail networks need to be connected though other bicycle
facilities. One creative way this can be done is encouraging all developers to
include trails in their developments. Trails are existing bicycle infrastructure
that can be used to enhance the overall bike network.

**Transit Connections**

Multi-modal transportation has been the desired goal from the beginning
of the early 1990s with the creation of ISTE. The bill states, “The National
Intermodal Transportation System shall consist of all forms of transportation in a
unified, interconnected manner, including the transportation systems of the
future, to reduce energy consumption and air pollution while promoting
economic development and supporting the nation’s preeminent position in
international commerce.” (PL 102-240, Sec. 2) Public transit is more efficient
because it can move large numbers of people in a more energy efficient way than
singular personally operated vehicles. Public transit has suffered much the same
fate as the bicycle. It was relegated to near extinction in many communities
because of their design towards the automobile. As such, many transit lines are
hard to reach and do not easily accommodate large portions of the population.

Bicycles, given adequate facilities, are efficient ways to extend the reach
of public transit. Bicycles face several problems in regard to transit connections.
Many transit facilities lack safe bike parking. Bicycle theft is estimated to cost
Americans more than $400 million per year, the lack of safe bicycle parking can be a deterrent to this form of multimodal transportation. Solutions to this problem are to provide paid access parking facilities at transit stations or to equip transit vehicles with bike racks. Many large cities have public transit outfitted with bike racks; most small to mid-size cities do not have such facilities. Linking transit and bicycle facilities is another way for cyclists to bridge the physical barriers that limit their ability to make longer trips.

**Rail Road Crossings, Drainage Gates, and Shoulders**

Railroad crossing present numerous problems for cyclists. They can make an otherwise bike friendly route dangerous. On diagonal railroad crossings, the gap next to and on the inside of the rail (called the “flange way”) can trap a bike’s front wheel causing it to divert. Crossings can become very slippery when it rains. The solution to the problem of dangerous railroad crossings is to perform frequent maintenance on crossings and to replace dangerous crossings with non-slip concrete or rubberized traction strips. As long as frequent maintenance is performed then rail road crossings should limit their hindrance to cyclists.

Raised or sunken drainage grates pose similar hazards as the rail crossing to the cyclist. Makers of both drainage gates and utility covers offer bicycle safe alternatives. It is important to note that it is more cost effective to implement these elements at the beginning than it is to retrofit them after the fact. Rural based cyclists should not be ignored when implementing bicycle elements. Rural roadways are often narrow and have higher traffic speeds than their urban
counterparts. The majority of users on rural roads are advanced cyclists. More often than not, these cyclists make up most bicycle advocacy base. In order to make rural roads more bike friendly, their shoulders should be smoothly paved. It is a simple, albeit somewhat expensive; fix in order to make rural roads more bike able.

**Traffic Signals**
There are several problems with traffic signals that impact cyclists. Demand-actuated signals were not created with bicycles in mind. Many cyclists find it difficult, if not impossible, to get green lights at these intersections. Minimum green times are not sufficient for the average cyclist to make it through a large intersection. Additionally, synchronized signals are timed to accommodate average vehicle speeds, but not bicycle speed. This can lengthen the amount of time that a cyclists trip make last negatively. Again, the solution is relatively simple. New technology exists that can detect a cyclist at demand-actuated intersections. Green light time should be lengthened to allow sufficient time for cyclists to cross multiple lanes of traffic. Finally synchronized signals need to sync their times with slower speeds to accommodate bicycle traffic.

**Bicycle Parking**
Many bicycle trips end at places other than the bicyclists’ homes, thus, bicycle parking is required for the user. Lack of parking is a huge deterrent for cyclists when deciding which mode of transportation to utilize. If there were no automobile parking at a Wal-Mart, what kind of transportation would people use to go shopping? This is merely hypothetical, but interesting to think about.
Many cyclists do not use their bikes as much as they would like due to a lack of parking. As was previously stated, bicycle theft costs Americans roughly $400 million dollars a year.

Providing secure bike storage will not solve the problem of theft entirely, but it will improve the overall experience for cyclists. There are three kinds of bicycle storage. They include bike racks, bike lockers, and bicycle lock ups. Bike racks work well for short term parking. Areas that require long-term parking should consider placing bike lockers for potential users. Bike lockers are just like lockers found in any school building with the exception that they fit all sizes of bikes. They provide an element of security for people who must leave their bikes for long periods of time. Specific recommendations are made in Chapter 8. Bike lock-ups offer similar options to that of bike lockers, but can be reserved for individual businesses where the access can be tracked in case of theft.

The other issue with parking is where parking should be located. Popular destinations are the obvious locations for bicycle parking. These types of destinations include, but are not limited to high density residential neighborhoods, commercial centers, and any place with an existing parking garage. The idea behind linking bike parking with parking garages is that if large numbers of auto spots are necessary, there is a need for bicycle transportation. Bicycle parking can be implemented by cities through placing them on public rights-of-way in neighborhood, commercial, and downtown business districts. Cities should also encourage private business owners to
provide bicycle parking to their customers, including bicycle parking at transit centers, schools, and other civic centers. They should further cement this into the city’s policy by making building permits contingent upon the projects provision of bicycle parking. A positive example of this is the Bonneville Transit Center in Las Vegas, NV. The transit center has bike racks, locker rooms for changing, showers and a bike repair area. This kind of development displays a strong commitment from a municipality to alternate forms of transit. They can combine car, bike, rail, and bus modes and enhance the image of public transit within a given municipality.
Chapter 5

Solutions and Strategies

The preceding chapter illustrates ways in which a city can make itself more bikeable. The types of facilities available to planners have also been highlighted. The question then remains which solutions apply to which areas of the existing transportation network. Through specific development patterns and societal changes, cities and their subsequent neighborhoods lay in different levels habitation and development. Different neighborhoods develop, or decline, at different rates. Since neighborhoods lay in different stages of development, there are several problems that arise when trying to plan bike elements. Which neighborhoods need bike facilities? Which kind of bike facility best suits which type of road? These are questions that planners have to ask themselves in order to implement bike elements.

There are tools available to planners to assess how bike facilities can best suit their unique communities. Planners need to identify specific community characteristics in order to assess where demand will be strongest within the
community. These community characteristics include activity centers, trip
distances, demographics, land use, climate, geography, and, maybe most
importantly, level of community support. The consideration of all these relevant
factors will assist planners in the implementation of bicycle elements. There are
several ways to assess the current standing of the existing road network. It will
be important look at historical crash data, traffic patterns, and bicycle ownership
in order to adequately implement facilities.

An important factor in measuring current facilities is to measure its
current Level of Service. The model for measuring the level of service for
bicycle improvements was developed in Florida. The following equation is the
mathematical formula that the city of Baltimore, Maryland uses to rate its streets.

\[ a_1 \ln \left( \frac{\text{Vol}_{15}}{L_n} \right) + a_2 \text{SP} \left( 1 + 10.38HV \right)^2 + a_3 \left( \frac{1}{PR} \right)^2 + a_4 \left( W_c \right)^2 + C \]

Simply this equation looks at the width of individual travel lanes, traffic speed, road
conditions, and average daily traffic. The specific inputs into the equation are what kinds
of facilities are provided. This specific measure looks at the width of the right-most
travel lane which typically is the space that cyclists utilize. It measures possible conflict
points. These conflicts are further classified as driveways and side streets, whether its
 barrier free, whether or not on street parking exists, whether medians are present,
available sight distance, and intersection implementation. It also measures speed
differential. This is figured by comparing the average motorized traffic with the speed of
non- motorized traffic. It takes into account motor vehicle LOS and multi-modal qualities
of the street. The output of the LOS model is a ranking of A through F with A being the best and being the worst. The graphic on the next page displays various bike facilities and what each kind of facility would receive based on its implementation. It is important to understand the current LOS in order to prioritize future projects. This adds another level that the planner can utilize to phase implementation of bike elements.
Chapter 6

Economic Impact

Bicycle elements provide huge returns for taxpayers’ dollars. Elements offer users a variety of options. They can be used for fitness, recreation, or for travel. They can be used to make roads safer through traffic calming and encourage increased activity levels. One of their more important contributions to a community is their positive impact on its’ economy. In early 2012 a study was conducted at the University of Massachusetts, Amherst on the employment benefits of cycling. Their findings are encouraging for cities looking to implement bicycle elements. The study looked at 58 separate projects. The study concluded that for each $1 million spent, the cycling projects in the study created a total of 11.4 jobs within the state where the project is located.\textsuperscript{31} The types of jobs created from these projects are engineers, construction workers, asphalt workers, and road sign makers.

\textsuperscript{31} Garrett-Peltier, Heidi, Pedestrian and Bicycle Infrastructure: A National Study of Employment Impacts. Political Economy Research Institute University of Massachusetts, Amherst June 2011
There are 19 jobs created for every $1 million spent on bicycle infrastructure. The Florida Department of Transportation estimates that to mill and resurface and urban arterial would cost roughly $1 million per mile. According to the FHWA, the maximum cost for one mile of bike lane would be $50,000. The city could build twenty miles of bike lanes for the cost of 1 mile of urban arterial. Building bike lanes is more cost effective than road construction. One of the reasons, for this difference is the cost of hot mix asphalt. It has steadily risen since 2009. The process of bike lane construction is less material intensive than road only construction. This means that more lanes can be built with less material. More bike elements can be built and more people can be put to work because bike elements place less strain on the city budget. Also, it encourages bike traffic which will reduce traffic congestion, improve air quality, improve the overall level of health in the community, and streets will see less wear and tear over time due to decreased levels of auto traffic.

**Impact on Local Businesses**

A small business owner opened a bike shop in Hattiesburg, Mississippi in the mid-1980s. For the first sixteen years of operation his annual sales averaged around $220,000 dollars. Following the passage of ISTEA, the

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region received a Transportation Enhancement grant. This grant along with another one under TEA-21 in 1999, the region constructed the Longleaf Trace multi-use trail. The year the trail opened in 2000, his sales doubled. Since the boom in his business, the owner has been able to employ 2 full time employees and up to 4 part time students from the local university. This bike shop has generated over $175,000 in sales tax for the state and $31,500 for the city of Hattiesburg. Furthermore, the owner was forced to move to a larger, formerly vacant, building. In addition to the renovation performed on his new shop, the owner purchased nine nearby lots that had become overgrown in order to turn them into a test ride facility. As a result, the owner pays an additional $7,000 dollars in property taxes per year. This is one example from downtown Hattiesburg. The downtown is currently undergoing a renaissance of economic redevelopment which many attribute to the Long Leaf trail.

Revenue

The League of American Bicyclists reports that the national bicycling industry contributes an estimated $133 billion a year to the U.S. economy. It supports nearly 1.1 million jobs and generates $17.7 billion in federal, state, and local taxes. Another $46.9 billion is spent on meals, transportation, lodging, gifts and entertainment during bike trips and tours.\textsuperscript{33} States and cities that effectively market themselves as bicycle friendly and soundly invest in their bike elements have reaped the economic benefits from these efforts. In 2000, Colorado

estimated that bicycling contributed $1 billion dollars to its economy. Ski towns in the state market themselves as bicycle destinations in the summer and as a result have seen an additional 700,000 bike specific visitors since 2000. Additionally, seventy percent of those people stated that they would have traveled elsewhere if bicycling would not have been available.

Another state that markets itself as bicycle friendly state is Wisconsin. The state account for 20% of the bicycle manufacturing industry in the United States, thanks largely to the Trek Bicycle Company. This twenty percent provides $556 million and over three thousand jobs to the Wisconsin economy. Maine generates roughly $66 million dollars in bicycle tourism. Select cities in North Carolina have spent 6.7 million dollars on improving bicycling infrastructure. Their return is an estimated income of 60 million dollars a year from bicycle related facilities. There is sufficient evidence that show that bicycle elements foster business and boost economy and job creation, but they also create revenue for cities in the form of increase income tax revenue. Additionally, bike elements can raise property values allowing cities to collect more money in property taxes.

A 2008 study examined the Little Miami Scenic Trail and its impact on single family property values. The study concluded that for every foot a

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property was from the trail decreased its sale price by $7.05. Homes that are closer to the trail are worth more. Several arguments have been made that when a Realtor sells a house, they are also selling a community. Proximity to a bike trail means ease of movement, quick access to recreational facilities, and health benefits. In Indianapolis, a study was conducted on home values on the Monon Trail. Two identical homes were studied; one was within a half mile of the trail while the other was farther away. The home closer to the trail was worth 11 percent more than the home farther away.

Cost Differential

Operating a bike is far less expensive than operating an automobile. First, and most apparent, is the relative cost of a new car to new bike. This is easy for the single user to see, but it can be more difficult to see the overall community benefits of riding a bike instead of driving a car. Todd Litman of the Victoria Transport Policy Institute states that a bike trip saves $2.73 per mile. Americans drive roughly 200 billion miles each month. Currently bicycle account for between ten and fifteen percent of trips made in the United States. If we were to up the mode share to 35 percent, an increase of 20 percent, this could save Americans over one hundred billion dollars a month. This is huge savings for the American public. There would also be time gained from workers who

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spend less time in traffic that could be translated into more hours at work or time spent pursuing recreation.
Chapter 7

Case Study: Fort Collins

Fort Collins has over two hundred eighty miles of bike lanes and six percent of the population commutes to work by bicycle. Bicycling is important to the overall transportation system in Fort Collins. Fort Collins is committed to bicycling year round. The city and police department offer a registry service. The Fort Collins Police Department recovers more than two-thirds of the bikes that are stolen each year. The city and the chamber of commerce sponsor monthly bike-to-work days and have established online resources to alert cyclists of changing road hazards. Fort Collins was recently voted by the League of American Bicyclists as one of the nation’s most bicycle friendly cities.
The city has its own bike sharing program. The bike library operates 3 locations and has nearly 60 bikes available for loan during the hours of operation. The map to the left shows the chief station which sits at the heart of Old Town which is the commercial and cultural area of Downtown Fort Collins. The service is absolutely free and people can rent bikes from one hour to seven days. All someone needs to rent a bike is an ID and a valid credit card to place on deposit for any damages to the bike.

There are several problems with using bicycles as primary modes of transit. First, ancillary facilities develop secondary to bike lanes and paths. Ancillary facilities are defined as parking, showers, and locker rooms. Parking is as important to the cyclist as it is to the driver of a car. Think in terms of utilizing a bicycle to run errands. A trip originates at home. The trip includes stops at the grocery store, drug store, and hair salon. If you spend one half hour in each place, then the bike is left alone for a total of one and one half hours. Bicycle parking affords the bicyclist a safe place to leave their bicycle. Fortunately, one can park more bikes in a space than a similar number of cars. Fort Collins has done a good job of building these ancillary facilities. Numerous Fort Collins businesses, such as the New Belgium Brewing Company, have bicycle-only parking lots and locker rooms with showers for their employees. The New Belgium Brewing Company also sponsors several bicycle races and bicycling education.
classes for community members. Fort Collins has also included bike cages in several of the city’s parking garages. The cages work similarly to the rest of the spaces in the garage. Cyclists can purchase single day tickets or monthly passes. Cyclists are issued swipe cards which will allow them access to the cage to retrieve their bike whenever necessary.

Bicycling is a highly regulated activity in the downtown area. As the map shows, bicycling is only allowed in certain areas in the downtown. This is done to keep the downtown a walk first, bike second, and drive last area. However, there is no area of the downtown that is inaccessible by bike and a short walk. The access of Fort Collins residents to bikes, safe bike lanes, ancillary facilities, and other infrastructure has made bicycling a major component of the city’s transit system.
Implementing Bicycle Elements: Anderson, IN

There are 57,189 people living in Anderson, IN. It has a land area of 40.5 square miles. It is roughly six and one half miles from the northern edge to the southern edge of the city. It is just less than six miles from the eastern edge to the western edge. The city has undergone structural unemployment since the closing of numerous automotive factories beginning in the early 1980s. There are 45,679 people over the age of 16. There are 18,925 people over the age of 16 not participating in the workforce. There are 8,104 people over the age of 65.

The city of Anderson currently has a 7 percent unemployment rate. This leaves 23,459 people who commute to work on a daily basis. There are 18,219 people who work within the city of Anderson who also live within the city limits. Of those workers 14,532 have commute times twenty minutes or under. Half of those workers have commute times of 10 minutes or less. Ninety-three percent of those people drive to work alone. Three percent share a vehicle with just one other person. The average commute distance for people living within the city
limits is 3.64 miles. That is a total of 7.28 miles a day. According to the League of American Bicyclists, the average bicycle commuter travels at 10mph. For the average commuter in Anderson, this would mean a 22 minute commute by bicycle.

The size of Anderson and its population’s needs fit the need for bicycle lanes. Its economy could use a boost that bicycle related facilities have given other cities of similar size. The investment in bicycle lanes would improve the overall safety of Anderson’s roads. The bike lanes and their subsequent economic benefit will eventually attract new businesses and a younger, more educated, population.

**Things to Consider**

There are numerous variables that come into play when considering the establishment of and outcomes of building bicycle infrastructure. In this instance, bike lanes are to be utilized as a tool for redevelopment. In order for bicycling to a viable mode of transportation, there have to be numerous facilities to enhance the experience of the user. So the first and probably most important variable is the user. User groups are important when studying bicycling. Which groups of people would be most likely to use a bicycle for transportation purposes? For that matter, which groups are more likely to own a bike at all? In most instances, the two largest groups to own and use bikes on a regular basis are the poor and the very wealthy. More often than not, the majority of responses on the issue of bicycling are from people with average yearly incomes
over sixty-thousand dollars. The other primary user group includes those who do not have the available funds to own and operate a motor vehicle. There will need to be a balance during the construction of bike lanes in order to benefit both user groups. Also, there will need to be some research on how to incorporate the middle class into the user group equation.

Commute distance and commute time are important and related very closely to user groups. As stated above, many of the residents working inside Anderson’s city limits already have very short commute times. This indicates that they live within a few miles of their place of work. This variable can be studied by looking at how constructed bike lanes will impact their commute distances and commute times. If there is no real change in distance and time, will people be more apt to choose their bike in order to get to work than their car.

Related to these variables is weather. Bicycling leaves people exposed to the elements. Indiana experiences all four seasons. Weather can also be unpredictable at times. Therefore, how people react to the weather will impact how the bike lanes are used. Another thing to consider when building bicycle infrastructure is ancillary facilities, some of which are showers at work, bicycle parking, and water fountains, and how they impact bike lane usage. These can be fairly inexpensive, but are sometimes up to individual businesses and therefore hard to regulate. This is more of a qualitative variable. Will businesses be willing to install shower facilities and locker rooms for employees
who bike to work? What kinds of incentives would be necessary to entice these businesses to construct these facilities? A survey would need to be done of local businesses to assess their willingness to participate. Along with the survey of business owners, a survey of attitudes and a bike count can be conducted in order to determine the feasibility of bicycle related infrastructure. Most of the information regarding user groups and traffic information can be done from census data and other housing information. The completed survey would be used to draft an ordinance to further promote the use of newly constructed facilities.

**Recommendations**

**Programs**

Education should become a priority for the city. The more educated the public is about bicycling and safety the more people will utilize these facilities. This will ensure a return on the cities’ investment. Another program that will increase the level of ridership in the city is a bike sharing program. Many larger cities across the United States have already implemented similar programs. A bike sharing program will help introduce cycling to people who may not have otherwise utilized the bike network.

**Showers and Locker Rooms**

Most employees will not bike to work without the promise that they can shower once they arrive at work. Showers also allow employees to exercise at lunch time. Buildings with fifty to one-hundred employees, one shower should be sufficient. In buildings with one hundred to two hundred employees, one shower for each sex would be appropriate. More than two hundred and fifty employees should double the number of
shower and locker facilities. The number of lockers should mirror the number of bike parking spaces.

**Parking**

The city currently has ordinances in place that require on street bike lanes or sidewalks to be included in all new developments. It has been discussed in earlier chapters that bike lanes will not be utilized fully unless ancillary facilities accompany on street facilities. One of the most important of these ancillary facilities is parking. It is recommended that all new developments require at least four bicycle parking spaces onsite. This is the minimum number of required parking spaces. In addition, if automobile parking is provided indoors or with some protection from the elements, i.e. parking garage, the bicycle facilities should share the same protection from the elements. The accompanying table illustrates the recommended number of parking spaces dependent on land use.

**Table 6: Bike Parking Requirements**

<table>
<thead>
<tr>
<th>Off-Street Bicycle Parking Guidelines</th>
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</thead>
<tbody>
<tr>
<td>Land Use</td>
<td>Bike Space</td>
</tr>
<tr>
<td>Dwellings</td>
<td>1 per dwelling unit or 3 lodging rooms</td>
</tr>
<tr>
<td>Library/Museum</td>
<td>1 per 10 automobile spaces</td>
</tr>
<tr>
<td>Hotels</td>
<td>1 per 20 employees</td>
</tr>
<tr>
<td>Schools</td>
<td>1 per 4 employees plus 1 per 4 students</td>
</tr>
<tr>
<td>Commercial, Institutional, Recreational</td>
<td>1 per 10 automobile spaces</td>
</tr>
</tbody>
</table>
Hierarchal Bike Lane Network

Many problems that bicyclists in Anderson face are that they cannot reach existing bike lanes. They may live in a neighborhood east of Scatterfield Road which has four traffic lanes and an average daily traffic of over twenty thousand cars. Having to cross a major road like this can discourage even experienced riders. What is needed is a bike network that separates the cyclist from the motorist based on average daily traffic.

The above map is a proposed network of bicycle infrastructure for the city of Anderson. It was stated above the City of Anderson poses a unique canvas for bike elements. Proposed are five different kinds of bicycle elements. These elements include shared roadway, bicycle lanes, bicycle routes, bicycle path, and bikeways. These elements are discussed from most to least segregated.
Scatterfield Buffered Bike Lane

Referring back to Figure 13, the black lane represents a segregated bike path which will run along Scatterfield Road. Scatterfield Road has an average daily traffic count of 28,000. Scatterfield Road runs the length of the city from North to South. From figure, you can see that there is a concrete buffer that provides a safety element for the cyclist and motorist. The construction of such a facility will give bicyclists access to the numerous commercial, institutional, and recreational uses that line Scatterfield road.

Downtown Bike Network

The Yellow represents roads that will have striped and signed bike lanes. These roads have average ADT of 10,000-15,000. The proposed network of bike lanes downtown would receive on street markings and signs. The
average daily traffic in the downtown is less and does not warrant the need for separated facilities. Figure illustrates the kind of markings that would be utilized in the downtown.

**Andersontown Sharrow Network**

The red represents signed-shared roadway that have an average ADT of 5,000-8,000. These roads only see higher volumes of traffic at peak travel times when commuters are traveling to and from work. These roads do not require dedicated facilities, but will require markings to indicate that the road is a shared space. Streets that would become shared roadway include Raible Avenue, Cross Street, 53\(^{rd}\) Street, and Rangeline Road.

**Lenape and River Bike Routes**

The traffic on these roads is significantly lower than others and thus no on street markings are required. However, there will be signs posted so that cyclists understand that the route connects to the larger citywide network. The main purpose of these facilities is to connect people living in suburban areas to the urban areas. These routes are represented by the green roads on the above map. Traffic along these routes has an average daily traffic of 2,000-4,000.
Park Road Bikeway

Finally, the last facility in the citywide network is represented by the purple bikeway which has an ADT of less than 2,000. This route is intended to be scenic as well as provide a connection for bicycle commuters. The traffic counts were taken from the Madison County Council of Governments Traffic Map. This map can be found in Appendix 1. These streets were chosen because of their access to major commercial and residential development with the city limits. Roads with higher ADTs were given more segregated facilities. Specific designs for these facilities can be found in Appendix 2.

Neighborhoods and Signals

Neighborhoods are where most bicycle trips in Anderson will begin and eventually end. Anderson has a large number of children who live in suburban neighborhood development. These neighborhoods, new and existing, should be retrofitted with traffic calming elements. These elements can be found in the chapter discussing implementation at the local level. This will significantly increase the level of safety for children and basic cyclists.

Anderson uses several different kinds of signals throughout. In the downtown central business district the city uses synchronized signals. These signals are timed at 20MPH for auto traffic. These could easily be timed at 15
MPH to accommodate both cyclists and motorized traffic. On collectors and main arterials they use demand-actuated signals. The city can simply upgrade the wires used at these intersections to pick up cars and bicycles a like. The standard green time on these signals needs to be increased, about ten more seconds, to allow the average cyclist enough time to cross through the intersection.
Chapter 9

Conclusion

Bicycle planning has come a long way since the 1970s. Its first real boost came with the passage of the ISTEA legislation and continued into the next century with SAFETEA-LU in 2005. Interest in bicycling has grown steadily and local governments have not been able to keep up with the demand for proper facilities. Much of this is due to insufficient funding and lack of community support. For continued growth, community involvement will have to increase.

The social and economic benefits have been well documented, both in this paper and in academic research. Cycling elements make roads safer and provide a substantial boost to local economies, in the form of revenue and employment. The end result in the implementation of bicycle facilities is an overall increase in a communities’ quality of life.

One subject not covered in this paper, but worth mentioning is the increased opportunities for bicycling. Numerous bicycle related organizations and even
local bike shops offer programs on bike maintenance, commuting, as well as bike to work days. The Safe Routes to School program is essential in educating young people on alternative safe ways to travel. These efforts with local support can work toward changing local policy which is the final catalyst in making bicycling a viable mode and efficient alternative to motorized travel. In closing, there is currently a bill before Congress that will reauthorize funding for bicycle planning under the Surface Transportation Extension Act of 2011 by continuing a gas tax that was put in place in 1993.
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<table>
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<tr>
<th>Technique</th>
<th>Definition</th>
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<tr>
<td><strong>Figure 2.3  Traffic circle</strong></td>
<td>A raised traffic control device (see photo earlier in this section) located in the middle of an intersection to slow traffic. Usually, vegetation is planted in the center.</td>
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<td><strong>Figure 2.4  Speed bump or table</strong></td>
<td>A section of raised roadway surface (0.4 m to 3.6 m [1 ft to 12 ft] long) that forces motorists to slow down. Not to be confused with speed bumps (typically less than 1 m [3 ft] long), often found in parking lots or mobile home parks, which can be a hazard to bicyclists.</td>
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<td><strong>Figure 2.5  Diverter</strong></td>
<td>Structure placed at intersection designed to prevent through traffic by forcing motorists onto another street. They can be designed to allow bicyclists to ride past.</td>
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<td><strong>Figure 2.6  Partial street closure</strong></td>
<td>Access to a road is essentially eliminated in one direction through the use of a barrier across half the street. The rest of street remains two-way. They can be designed to allow bicyclists to ride past.</td>
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<td><strong>Figure 2.7  Street closure</strong></td>
<td>All through motor vehicle traffic is stopped by a curb-to-curb barrier. Slots are cut to allow bicycle traffic to get through. Can cause problems if motorists must use nearby driveways to turn around.</td>
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<td><strong>Figure 2.8  Curb bulb</strong></td>
<td>Sidewalk extensions at intersections narrow the road width and reduce crossing distances while increasing pedestrian visibility. Often used in downtown shopping districts and typically match the width of on-street parking.</td>
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<td><strong>Figure 2.9  Chicanes</strong></td>
<td>Obstacles (e.g., expanded sidewalk areas, planters, street furniture, or parking bays) are staggered on alternate sides of the roadway, requiring motor vehicle traffic stream to move side-to-side in the right-of-way.</td>
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