

IOWA STATE UNIVERSITY

COLLEGE OF DESIGN

iowa
state
bike
share
studio

IND 592

COMMUNITY AND REGIONAL PLANNING

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TABLE OF CONTENTS

EXECUTIVE SUMMARY.....	3
INTRODUCTION.....	9
OBJECTIVES.....	9
PRECEDENT STUDIES.....	10
RESEARCH.....	17
MAPS AND DATA COLLECTION.....	18
CAMPUS WIDE SURVEY.....	38
INTERVIEWS.....	39
VIDEO ANALYSIS.....	40
PROPOSAL.....	45
BIKE FRIENDLY UNIVERSITY.....	45
WEBSITE.....	47
PHASE 1.....	52
PHASE 2.....	55
PHASE 3.....	62
COST ANALYSIS.....	67
FUNDING SOURCES.....	71
CONCLUSION.....	73

EXECUTIVE SUMMARY

Iowa State University is continually breaking enrollment records without changing infrastructure to accommodate for the increase in population. The current bicycle infrastructure is poor and nonexistent in many places. In an effort to change the current situation, Industrial Design 592 was tasked with developing infrastructure solution. This multi-discipline class included Industrial Design, Mechanical Engineering, Electrical Engineering, Industrial Engineering, Computer Engineering, and Community and Regional Planning. Each discipline had its specific involvement in planning and design of the bike share. Community and Regional Planning's contribution to the class is creating a bike plan and bike share feasibility study to create more multimodal opportunities on campus. The objective of the Community and Regional Planning section was to create an innovative and robust bicycle transportation plan for Iowa State University, as well as conduct a feasibility and site location analysis to determine the optimal locations for a bike share system on the campus.

The Government of the Student Body (GSB) and the Senior Vice President of Student Affairs, Dr. Tom Hill, have identified the development of a bike share system for the Iowa State University Campus as a sustainability initiative. Both the GSB and Dr Hill have cited the environmental impact of the system, as well as the ability to help with existing transportation congestion and safety issues on campus make a bike share program a viable solution.

Our research has found there is a misunderstanding of current rules and regulations for bicycles, as well as safe place for pedestrians, cyclists and vehicles to interact. Our goal is to improve the outdated and stressed infrastructure. We suggest the implementation of new bicycle policy in cooperation with a bike share system, in order to make Iowa State University a safer and more multimodal environment for its entire community. Below we briefly discuss our methods of research, current efforts on campus, and the phases of our bike transportation plan which includes the implementation of a comprehensive bike share plan and the overall costs of the project.

Precedents

Precedent studies were a major part of our group's initial fact finding process. Ideally, we were looking for a University that was just like Iowa State University (ISU) in population and needs. However, there is no school that is just like ISU. Because of this we researched and when possible interviewed staff from the city or bike share analyzed. Our precedents include bike rentals, city bike shares, and university bike shares. Below are big picture questions addressed during the research and interviews:

Map

One component of our data collection was visual representation of data in map form. Three primary maps were created, each illustrating an aspect of student life that may impact a bike share system. The first map represents the density of student addresses across the city of Ames. The areas of highest concentration of students include Campustown, West Ames and the area just west of the ISU campus. The second map represents the density of bicycles in racks on the ISU Campus. From this map assumptions can be made about the most popular locations students ride to and leave their bike. The third map represents the amount of classroom usage per building on the ISU Campus. The third map allowed us to see that business classroom areas tended to be around Carver and Gilman Halls. However, buildings such as the library and Memorial Union did not appear because classes are not held in those buildings. All three maps paint a picture of where students are and where they travel to on campus during the day. They provide the basis for the proposed locations of new bicycle infrastructure and proposed locations of bike share stations

Survey

Part of our information gathering process included a university wide survey using Qualtrics. The 21 question survey was open from October 21–November 8, two weeks. It included questions about biking, general transportation questions, and thoughts regarding a bike share system. The importance of this survey to our study and recommendations was crucial. The survey was sent to all ISU students, faculty and staff via their Iowa State University email address. With approximately 40,000 email address we were excited at having 2,008 respondents, which is 5%.

The data showed many people were concerned about bicyclists' safety as well as information on different problems areas on campus. The survey asked questions that could be measured using qualitative analysis as well as open-ended questions. Along with the survey, the class also conducted interviews with willing participants. We interviewed eight people who were students, faculty and staff. The overall response from those interviewed was there is not enough designated bicycle paths across campus, the policies for riding on campus were unclear, and people being frustrated with the current situation of crowdedness between pedestrians and cyclists sharing the same space.

We recognize that there is potential for bias in the survey because many of the respondents were in favor of cycling and the bike share. However, the data pulled was of great value.

EXECUTIVE SUMMARY

Interviews

Along with the survey, the class conducted interviews with willing participants. At the end of the survey we asked respondents if they would like to be contacted for a possible interview. The result was 150 individuals who were willing to be interviewed. Then we categorized the individuals into students, staff, and faculty. We then randomly picked 7 individuals from each category. Interviewing 5 from each, with 2 extras interviewees if some were not available.

The main purpose of the interviews was to find our congested areas on campus, what the biggest bicycle issues for ISU are, and to see what the responders think needs to be added to our campus.

The overall theme was that ISU's campus is too crowded between classes and that there is not enough designated bicycle paths across campus. Most of the interviewees talked about pedestrians not liking bicyclists riding close to them or on the sidewalk, but that is because they have no specific paths for themselves. The interviews showed us that currently ISU does not have clear policies or signage that allows all modes of transportation to know the rules and regulations. The biggest reason people are frustrated with the current situation is because the students, staff, and faculty were not familiar with the policies or frustrated with infrastructure .

"Lots of pedestrians use the bike path, lots of bike riders use the pedestrian path, and it just doesn't really make a whole lot of sense." – Randal Foster

Video

To find hard evidence that there was a problem between bicycles, vehicles, and pedestrians around Iowa State University's campus, cameras were put in place to record the activity that was taking place in certain locations. The locations were strategically placed around campus from a vantage point that captured the entire area that was being studied. After these videos were taken, they were then analyzed to see exactly what was happening in that area between bicyclists, pedestrians, and vehicles. These videos helped identify where the problem spots around campus were, but the videos also gave good examples of infrastructure that worked properly.

The spots that were studied were: Osborn Drive, near the Gilman Hall bus stop; Morrill Road, east of the Parks Library; Osborn Drive, north of MacKay Hall; the intersection of Stange Road and Osborn Drive; and Osborn Drive, and the Kildee Hall bus transfer point. These points were selected from compiling multiple sources together and identifying places that were most commonly seen as problem areas for the interaction between bicyclists and pedestrians or vehicles. Osborn Drive was a main focus area in our study, due to the amount of comments that our team had collected from multiple sources. There was a video clip that was obtained from Cyride of footage that was taken of bus/bicycle interaction. A brief introduction to Osborn Drive is that it is the only street that goes east and west in the middle of campus. This road is currently gated so there is restricted access during the hours of 7:30 AM through 5:30 PM. Osborn Drive is also marked as a shared road between bicycles and automobiles. This is a high traffic area of all modes of transit; walking, driving, and bicycling. Due to the large amounts of traffic on this road, there is also a lot of congestion and concern for how all the modes interact with one another. When one mode does not respect the other couple modes, or invades their space, we see a tension that is built between those modes.

The aim of this research was to identify what the major concerns of people were in terms of traveling across campus, and to identify the specific locations that would benefit the most from infrastructure improvements.

Bike Friendly University

An important aspect of many well known biking communities and universities is becoming part of the League of American Bicyclists. The League's mission is to lead the movement to create a Bicycle Friendly America for everyone. In order to do this, communities and universities must apply to become either a bicycle friendly community or a bicycle friendly university.

For Iowa State University, it is important to apply because we want to create a master bicycle plan and improve many parts of our campus infrastructure. There are essential elements across five categories known as the Five E's that are consistent in making great places for bicycling. The five categories are listed below with a description of why they are important for a bicycle friendly university.

Engineering: Creating safe and convenient places to ride and park

Education: Giving people of all ages and abilities the skills and confidence to ride

Encouragement: Creating a strong bike culture that welcomes and celebrates bicycling

Enforcement: Ensuring safe roads for all users

EXECUTIVE SUMMARY

Evaluation & Planning: Planning for bicycling as a safe and viable transportation option

Filling out the application is important for Iowa State University because that is how we will find out what we are doing right and what we can improve in the future. The application is due in August 2015, and after submission the university will hear back with suggestions on how to implement parts of the application that we are currently missing or not up to standard.

Website

Currently, finding the essential information one might need to become a smarter bicycle rider can be very difficult to find. We looked at universities such as UC Davis and University of Colorado Boulder to help us get an idea of what a campus bike website should include.

We recommend creating a new website for Iowa State that will help bikers get more familiar with campus and the rules that go with it. We have created a working model of what we feel can be an effective website. The website is easy to use and brings all of the information together in a one location. Along with creating a website, we recommend adding a "Biking on Campus" link under the "B" section in the index. This will help students access the webpage quicker with less searching.

The website includes the following links with specific information regarding each subject:

Rules of the Road

Registration

Routes

Safety and Security Repair

Clubs and Activities

Etiquette (For Cyclists, Pedestrians, and Vehicles)

With the use of a website, we feel that it can solve many of the current issues with Iowa State and biking. Many of the reasons why biking on campus can be hard is because there is a lack of education for the students. We feel this is a very important step in helping Iowa State become a bike friendly campus.

Phases/Cost Analysis/ Additional Funding Sources Phase 1

The first phase of campus infrastructure improvement is composed of the most minor improvements, for minimal cost and ease of implementation. These changes do not require major construction and can be easily added on the existing infrastructure on campus. For phase 1 the emphasis is placed on encouraging proper interaction and behavior between pedestrians, bicyclists, and motorized vehicles.

Signage

The simplest step that can be taken to improve the safety and mobility of bicyclists, pedestrians and vehicles would be to improve the road signage on campus. Clear, consistent signage informs people of the rules of the road and encourages them to be aware of their surroundings. The current signage present on campus is sporadic and inconsistent, as identified through survey responses and interviews. In the current environment people do not follow the rules of the road because they are not sure what the rules are. It would therefore be of benefit to clarify what is expected of road users through increased signage. The following signs are recommended for campus:

Share the Road

Turning vehicles Yield to Bicyclist, Watch for Bikes

"Look left, look right" crosswalks

The existing shared paths on campus should be painted so there is a clear delineation between where pedestrians can walk and where bicyclists can ride.

EXECUTIVE SUMMARY

Category	Specifications	Cost per unit	Unit	Total Units	Total Cost
Bike Lane Striping	6" white stripe	\$3,275	Mile	0.52	\$1,705
Sign	Share the road	\$14-\$24	Sign	60	\$840-\$1,440
Sign	Bike route	\$14-\$24	Sign	6	\$84-\$144
Symbol	Sharrows	\$53	Symbol	400	\$21,200
Symbol	Bike Lane Indicator	\$50-\$100	Symbol	5	\$250-\$500
				Total Cost:	\$25,000

Phase 2

The second phase of campus infrastructure improvement is composed of policy changes and the implementation of the bike share. These changes require a bigger commitment of resources and a willingness to alter the environment for vehicles on campus. For phase two the emphasis is placed on policy change and reducing vehicle traffic on campus in order to prioritize bicycling and walking as forms of transportation. Below are the suggestions for the second phase:

Eliminating Osborn Drive on-street parking Delivery time restrictions

Osborn Drive Bicycle Lane

Implementing the bike share

Category	Specifications	Cost per unit	Unit	Total Units	Total Cost
Osborn Drive Striping	6" white stripe	\$3,275	Mile	1.6	\$5,205
Sign	Bike lane with symbol	\$14-\$24	Sign	40	\$560-960
Sign	No Parking	\$10-\$20	Sign	10	\$100-\$200
Symbol	Bike Lane Indicator	\$50-\$100	Symbol	20	\$1,000-\$2,000
Bike Share	2 Docking Stations and 1 Bike	\$2,500	Package	322	\$805,000
				Total Cost:	\$815,000

Phase 3

The third phase of campus infrastructure improvement should be comprehensive structural reform of bicycle infrastructure. This phase will require significant resource expenditure and a commitment to making the campus as bicycle-friendly as possible. This phase may take several years to complete but is ultimately necessary in order to ensure optimal safety and mobility for bicyclists, pedestrians, and motor vehicles. With the implementation of a bike share system, there will be more bicycle traffic than ever, and the current bicycle infrastructure is not equipped to handle the capacity. At the current capacity, issues frequently arise in terms of improper interaction between different modes of transportation on campus. Any increase in bicycle traffic will exacerbate these issues. It is therefore essential that the following major structural changes be taken under consideration:

Bissell Road Gate

New Bike Paths (across campus and connecting farmhouse rd and Wallace rd) New Bike Lanes (where feasible on streets)

Bike Boxes at Stop signs and stop lights

Category	Specifications	Cost per unit	Unit	Total Units	Total Cost
Concrete Bike Path	5" Class 47B-3000	\$271,392	Mile	1.6	\$434,230
Concrete Bike Path	6" Class 47B-3000	\$181,104	Mile	1.6	\$289,770
Concrete Bike Path	6" Class 47B-3500	\$166,848	Mile	1.6	\$266,960
Recreation Trail	6" Hot mix asphalt	\$141,457	Mile	1.6	\$226,335
Bike Lane Striping	6" white stripe	\$3,275	Mile	1.6	\$5,240
Sign	Bike route	\$14-\$24	Sign	30	\$420-\$720
Gate	Security access gate	\$50,000	Gate	1	\$50,000
				Total Cost:	\$280,000-\$490,000

EXECUTIVE SUMMARY

Additional Funding Sources

There are many sources of funding available to groups that are undertaking bicycle infrastructure improvement projects. Funding for infrastructure improvement projects is available from a variety of sources including the Iowa Department of Transportation, bicycle advocacy groups, and our own university. Federal grants are available from departments including the Federal Transit Administration, Federal Highway Administration, and the Environmental Protection Agency. While our proposal may not be able to be entirely funded by outside grants, they may provide a substantial amount of supplementary funding. Specific grant programs are outlined below.

Iowa Department of Transportation

People for Bikes Community Grant Program Live Green! Revolving Loan Fund

Conclusion

During the course of the semester Industrial Design 592/Community and Regional Planning's objective has been to create an innovative and robust bicycle transportation plan for Iowa State University as well as conduct a feasibility and site location analysis to determine the optimal locations for a bike share system on the campus. Our main concerns have been making campus less congested and safer for all forms of transportation to interact. This three phase project has the support of the Government of Student Body and the Vice President of Student Affairs Dr Tom Hill as a green initiative for campus. Through the use of precedent studies, GIS mapping, a campus wide Qualtrics survey, and interviews we feel that the recommendations presented will ensure the successful implementation of the bike transportation plan and bike share system for Iowa State University.

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INTRODUCTION

Iowa State University Industrial Design 592 is a multiple discipline class including Industrial Design, Mechanical Engineering, Electrical Engineering, Industrial Engineering, Computer Engineering, and Community and Regional Planning. Each discipline had its specific involvement in planning and design of the bike share. Community and Regional Planning's contribution to the class is creating a bike plan and bike share feasibility study to create more multimodal opportunities on campus.

The Government of the Student Body (GSB) and the Senior Vice President of Student Affairs Dr. Tom Hill have identified the development of a bike share system for the Iowa State University Campus as a sustainability initiative. Both the GSB and Dr Hill have cited the environmental impact of the system, as well as the ability to help with existing transportation congestion and safety issues on campus make a bike share program a viable solution.

Iowa State University has seen a significant increase in students over the last six years. As part of the effort to help reduce congestion on campus this class is proposing a comprehensive bike plan including sharrows, a cross campus bike path, bike lanes, bike boxes at intersections, and better signage to help guide not only cyclists but everyone on the Iowa State University Campus. The class utilized precedent studies, Geo-spatial Information Systems (GIS), interviews, a campus wide survey and video analysis to determine our recommendations. After all of research had been conducted we were able make recommendations on new signage, markings, bike lanes, street closures and new policy for the entire campus.

The other part of the class was to conduct a feasibility study for a bike share on campus. This innovative idea is becoming a popular alternative at forward thinking universities throughout the country that want to provide alternative transportation opportunities to students, staff, and faculty. Our research included analyzing bike rack counts, classroom data, student addresses, GIS mapping, interviews, precedent studies, and a campus wide survey to determine the interest in a bike share system. We were then able to make recommendations on cost, location of bike stations and the amount of bikes needed to create a bike share that would meet the capacity needs of the entire student, staff, and faculty of campus.

OBJECTIVES

It is the objective of the students participating in Industrial Design 592/Community and Regional Planning to create an innovative and robust bicycle transportation plan for Iowa State University as well as conduct a feasibility and site location analysis to determine the optimal locations for a bike share system on the campus. Minor components of the overall objectives include:

- Creating a more sustainable campus
- Making campus safer for all forms of transportation
- Providing transportation alternatives
- Making campus more walkable
- Improving the lives of students, faculty, and staff through cycling

PRECEDENT STUDIES

Precedent studies were a major part of our group's initial fact finding process. Ideally we were looking for a university that had similar features as Iowa State University (ISU) in population and needs. However, there is no school that is just like ISU. Because of this we researched and when possible interviewed staff from the city or bike share analyzed. Our precedents include bike rentals, city bike shares, and university bike shares. Below are big picture questions addressed during the research and interviews:

- Finances
- Political Will and Push-back
- Unexpected Challenges
- Which Bike Share is used
- How many bikes and stations throughout the system
- Changes the program has seen over time
- Whether infrastructure changes occurred
- What policies (regulations, code, registration,etc.) need to be changed or implemented.

NEW YORK UNIVERSITY (NYU)

NYU bike share was started in 2008 by two undergraduate students, Lindsy Seegmiller and Julia Ehrman. After two years of development the bike share program officially started in 2010. Today, it is used by thousands of university students, staff, and faculty. As of February 2014, NYU has over 2,000 registered users. Their website keeps an updated count, and today, September 24th, there are 3,173 riders. When the program started, they only had 30 bikes at two different stations. It has grown exponentially to 80 bikes across 13 different stations located in lower and midtown Manhattan. NYU's bike share was funded through a school-sponsored "Green Grant" and continues to operate under the watch and budget of NYU's Office of Sustainability. NYU Green Grants are awarded to improve the university's operational environmental performance, foster environmental literacy and community engagement, advance applied research and design, and demonstrate the viability of best practices and technologies for sustainability. One of their main goals is to reduce the carbon footprint as well as give the students the opportunity to learn skills on how to repair and maintain the bikes. Erik Battista NYU Bike Coordinator, said "at NYU there is no car parking's provided—quite literally 99% of everyone takes the subway, walks, or cycles in to work/school." This most likely helps their bike share program because people do not have the option of driving, and therefore using the bikes is much faster and easier than walking. With every program there will be start-up and continuing challenges. At NYU the challenges "are determining accurate annual operating budgets and periodic capital costs, as well as the hiring of quality mechanics to maintain fleet." Erik has stated that challenges are different at every institution and that we should have a team that knows ISU's divisions and operations. Lastly, he said for NYU that they "had to work with our legal team at great lengths during the first year, for example, to assure that the risk of providing bikes to NYU community would not be problematic in terms of insurance claims, injury, theft, etc." but he said as of now they have not had any problems with that.

Similarities to Iowa State

- Available for students, staff, faculty
- Cannot keep it overnight
- There are fines if the bike is not returned



<http://thevillager.com/2012/03/29/n-y-u-bike-share-on-a-roll/>

Differences to Iowa State

- Must return bike to same location as rented
- There are places to rent helmets if they want
- Some of the stations are open during the winter
- Use a key to rent bike
- Can use bike for the entire day
- Must register to use bikes

PRECEDENT STUDIES

UNIVERSITY OF NORTH CAROLINA

Tar Heel Bikes is the bike share program for the University of North Carolina Chapel Hill. A two year pilot program was launched in August 2012 and provided 30 bikes stationed at 4 residence halls on campus. The bikes are available for checkout by students who live in the residence halls. The system is somewhat low-tech in that there is no self-serve mechanism for checking out the bikes. A student must check out a bike using their student ID at a residence hall desk. They are given a key to unlock the bike from its station, and the bike must be returned to its station by the end of the day. This manual check-out system was created on a budget of \$40,000.

This bike share program was created by the UNC Residence Hall Association and the Bike Share Task Force Program, which is run by an all-student board. The program is managed by the Tar Heel Bikes Steering Committee. The pilot program was funded entirely through grants from the following organizations: Renewable Energy Special Projects Committee, Parents Council, Residence Hall Association, Strowd Roses Foundation, and Kryptonite Locks. The bikes themselves were created by Kona AfricaBikes. All of the proceeds of this company go towards providing free bicycles to charities in Africa. The program is available to approximately 3,000 students, and the 30 bikes have been checked out 4700 times in its first year. Of these checkouts, 52% of the trips taken were for academic purposes, and 80% of the destinations were on campus.

The bike share program has extended its pilot program into a third year and is looking to expand to the whole campus. The Tar Heel Bikes Steering Committee is now campaigning to increase the student transit fee by a small amount to fund the next generation of the program. In this next generation, checkouts would be available to all students, faculty and staff. Bike checkouts and check-ins would be completed via an app or text message instead of at residence hall desks and the bikes would be located at various hubs around campus. The new technology for these hubs would likely be outsourced to a third-party vendor such as Zagster or Social Bicycle. The long-term goal of this program is to integrate the system with the city of Chapel Hill.

Because the University of North Carolina bike share pilot program is currently only available to university students and uses the bicycle library check-out model, it was able to operate on its relatively small budget of \$40,000, and the system is free to students. There was no paid advertising and the system was developed entirely by students. The expansion of the program is able to be funded entirely through a small increase in student transportation fees. This bike share system is a perfect example of a program that started out small in order to gauge its success and determine whether expansion would be possible.

In terms of infrastructure, the UNC campus has bicycle side-paths for several roads on campus. This allows for easy mobility around campus and is a safer alternative to bike lanes on roads or shared roads. Side-paths would do well to accommodate a greater volume of bicycling as a result of the bike share program.



<http://respc.web.unc.edu/files/2013/01/Tar-Heel-Bikes.jpg>

PRECEDENT STUDIES

UNIVERSITY OF MICHIGAN

Arbor Bike is cooperative project between the city of Ann Arbor Michigan and the University of Michigan. Installation of the bike share stations was delayed due to legal issues concerning the stations being located on city property, but have since been installed as of the beginning of October. The bike share system itself is a B-Cycle System with six stations on campus, as well as downtown Ann Arbor. Future plans include one hundred twenty five bikes and fourteen stations.

The University of Michigan also has a bike rental program call Blue Bike. Blue Bike's can be rented daily, weekly, or for the semester. All of the Blue bikes include helmet and lock.

Cycling is thriving in Ann Arbor. The University of Michigan is one of the most cycling friendly Universities in America according to the League of American Cyclists. The City of Ann Arbor are a silver level Bicycle Friendly city according to the League. Kevin Mulder, Bike Coordinator of Arbor Bike, "admits the City and the Universities cooperation and building of infrastructure is important." The City of Ann Arbor has also added about 20 miles of bike lanes in the last 5 years.

Arbor bike is a cooperation between the city of Ann Arbor and the University of Michigan which is operated by the Clean Energy Coalition. Title sponsors include City of Ann Arbor, The Ride, and the Clean Energy Coalition. The program will cost between \$1.8 million and \$2 million to launch and operate for its first three years. The capital cost of the program could reach \$700,000 and operating costs are expected to reach \$350,000 annually.



http://recsports.umich.edu/files/recsports/field/image/photo_0.JPG

PRECEDENT STUDIES

WASHINGTON STATE UNIVERSITY

The Washington State University programmed started in 2009 when outdoor recreation was allowed to purchase 40 mountain bikes for students to commute around campus. The results were amazing. In the first years 585 different people rented the bikes 2800 times, and traveled 12,000 miles. The success of the rental program allowed the opportunity to ask for more money in 2010 from the student fee to purchase a bike share system. The University Recreation was able to implement the stations into a large capital project. The first purchase allowed for 4 stations. As of 2012 Washington State University had 9 stations with 80 bikes on campus. Since then the bikes have been checked out 70,000 times with over 13,000 unique users.

The university has created a culture of cycling in the last few years. They offer bicycle safety classes as well bicycle repair classes teaching basic maintenance. In effort to make incoming students aware of the bike share they will do tabling at incoming freshmen events and in the residence halls.

Washington State University has spent roughly \$400,000 on 9 states and 80 bikes. The bike share coordinator, Lance Jackson, maintains a staff of 3 part time staff of mechanics who repair the bike share bikes as well as the rental fleet, working 20 hours a week which costs approximately \$9,000 a year. Replacement parts on the system costs approximately \$5,000 a year. Other costs include annual software costs of \$8,100 as well as wireless communication which costs \$3,300. The bike share is free to all students, staff and faculty using their Cougar Card and agreeing to the terms of use at the kiosk. The estimated cost of each station is \$35,000-\$50,000 which includes the kiosk, 15 docking stations, 12 bikes, and setup.

PRECEDENT STUDIES

WASHINGTON STATE UNIVERSITY

Lance Jackson recommended that when planning for a bike share, we strongly consider having one full time and part time staff member for the program as well. His other suggestion was considering the duration of time users are allowed to use the bike. As more stations have been added Lance thinks this time should be reduced at Washington.



<http://sustainability.wsu.edu/images/greenbike.jpg>

UC IRVINE

The concept to implement a bike share system to those used in Europe at UC Irvine had a unique beginning. In late 2006, UCI's Transportation and Distribution Service's Associate Director, Ron Fleming, was shopping at a local mall and rented a stroller for his young daughter from an automated stroller rental system, manufactured by Central Specialties, Ltd. (CSL). The automated stroller system got him thinking about using the same system for bicycles. The owner of the CSL stroller system, Jay Maher, was contacted in spring 2008 and was presented with Parking's vision and specifications for modifying his automated stroller system for use with bicycles. Parking staff met with him in June 2008 to talk about the details of creating an off the shelf bicycle share system. At Parking's request, Mr. Maher contacted the Collegiate Bike Company, a designer and manufacturer of collegiate licensed bicycles to see if their cruiser-style bike would work in the ZotWheels bike share system. It did and a formal partnership began in September 2008 when a contract between UCI and CSL was signed.

UCI's ZotWheels modeled its own system after the successes of these other programs. The ZotWheels system is run by a main server with software that releases and returns each bike, recognizes each user, and tracks each bike via RFID technology. The ZotWheels program uses preprogrammed membership cards that are assigned to individual users after a completed application has been filled out online. Members must also sign an online waiver of liability form and take an online bicycle safety course. ZotWheels software marries the user's contact information with RFID tracking technology so that a particular bike's check-in and check-out history is known in real-time. The user receives messages throughout the rental period acknowledging their rental and reminding them to return the bike before the three hour period is up. Finally, the user will receive a message that their bike has been checked back in and that the transaction has been completed. The automated aspect of the system ensures accountability by tracking the bike; thus, a better chance it will not be lost, stolen, or severely damaged.

UC Irvine's information technology department and CSL worked closely with a data management company, MilesData, to provide the software for the ZotWheels program and to ensure a seamless blend with Parking's and UCI's computing networks. The first four ZotWheels sites use WiFi technology to connect Parking's server, hardware, and software with MilesData software to maintain a fully integrated ZotWheels system.

Because ZotWheels is part of the UC system, there is no private advertising option as there is with cities and Clear Channel or JCDecaux. ZotWheels is fully funded by Transportation and Distribution Services as part of its sustainability mission of providing multi-modal transportation alternatives to mitigate climate change. ZotWheels is member supported at an annual cost of \$40.00. The membership fee allows unlimited three hour bike usage throughout the year. The only other fee that may be incurred by a user is a \$200 charge for a lost, stolen, or severely damaged bike. Parking has accepted the financial responsibility for the manufacture and installation of the ZotWheels systems, as well as all costs related to their upkeep and maintenance. This includes the purchase and maintenance of the bicycles themselves. The small membership fee offsets a fraction of the total system costs sustained by Parking.

Currently there are 4 stations throughout campus with 10 stalls per station and 20 bikes total. ZotWheels stations are located at four key locations on campus such as heavily used classroom buildings as well as the Student Center. UCI recognizes bikes may not always be available at a particular bike station at all times. Because of this it has created an interactive online map for current availability. UCI is planning an expansion of the ZotWheels. The expansion will include other areas in the campus core, student housing, recreation, the university research park, and perhaps into Irvine.



<http://www.metro-magazine.com/images/news/UCI-2.jpg>

BOULDER, COLORADO

Boulder, Colorado is often rated one of the top cycling cities in the United States. It is home to many professional cyclists and Colorado University. This particular precedent is slightly different because the B-Cycle Bike Share was started by the city of Boulder and is slowly expanding onto CU's Campus. However, despite its differences as a city based bike share rather than a university based bike share there are still lessons to be learned that could be useful when the Iowa State University Bike Share is integrated into the city of Ames.

Boulder B-cycles is an independently operated 501(c)(3) that operates under a master agreement with the City of Boulder. Boulder B-cycle relies on a significant amount of sponsorship to cover its operating costs. The primary sponsor is the healthcare provider Kaiser Permanente, followed by 30 other sponsors both local and nationally based. Because bike sharing requires sponsorship to remain financially sustainable, Boulder orchestrated an exception to the city's strict signage code to allow bikes and stations to display branding from sponsors.

Stations located in the public right of way have to be cleared through the City of Boulder, which has an extensive list of requirements that stations must meet before being installed. Because of this Boulder B-Cycles has developed a very close relationship with the city. Other needed infrastructure has been concrete pads to be poured next to existing sidewalks, parking, or bike paths for the stations to be located on. Also, A/C powered stations require electrical conduits to be run to them from the nearest power source. For this Boulder B-Cycle has contracted with electricians and construction companies.

The relationship with Colorado University is currently minimal, in part due to the fact that many CU students already ride. Any stations located on CU's campus have to be independently cleared through a variety of offices at the university. Boulder B-Cycle does make discounted annual passes available to CU students and faculty.

The City of Boulder actively put out the request for proposals for a bike share program. City officials really wanted bike sharing in Boulder. Because of this Boulder B-cycle has encountered very little political resistance to the program. However, Boulder B-cycle has had to navigate quite a bit of bureaucracy in both operations and any expansions due to the master agreement they have with the city.

PRECEDENT STUDIES

BOULDER, COLORADO

Periodically, Boulder has updated pricing structure, operating hours, messaging and many other components of the system since launching with the ultimate goal of operating a system that is financially sustainable, affordable and comprehensible for first-time users. Despite having a small footprint on CU's campus, Boulder B-Cycle offers students an additional transportation option. Many students already bike and use the bus, but B-Cycle allows an additional degree of flexibility and allows students to more easily combine modes of transportation.



<https://www.colorado.edu/pts/sites/default/files/styles/grid-4/public/CU%20B-Cycle%20in%20rack.jpg>

UNIVERSITY OF CINCINNATI

The University of Cincinnati(UC) Bike Plan is a simple plan: buy ten bikes, bike locks, and helmets allow UC Students to rent them. The overall cost of the UC Bike Plan is \$5145.00. This is by far the most economical plan we found. It also illustrates the simplicity that an original plan can entail. UC has implemented a 3 day rental period in order for students to have the chance to use the bikes for commuting purposes. The goal of the bikeshare is to allow students to experiment with bike commuting, and hopefully transition to bike owners and commuters after renting the bikes. UC has partnered with Campus Recreation Center, which operates a system for checking out other equipment. This eliminates the need for registration. Regarding policy on fines, it is similar to other recreation equipment rental which is also maintained by Campus Recreation. Due to the size of the bike rental system there are no outside sponsors. A survey was conducted to garner student interest. An allocation of student fees was voted upon by the Student Advisory Council on the University Budget, which allocates the student fee fund to cover initial costs. Maintenance costs are covered by the Office of Sustainability.

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RESEARCH

MAPS OF AMES/IOWA STATE

One component of our data collection was visual representation of data in map form. Three primary maps were created, each illustrating an aspect of student life that may impact a bike share system. The first map represents the density of student addresses across the city of Ames. The second map represents the density of bicycles parked in racks on the ISU campus. The third map represents the amount of classroom usage per building on the ISU campus. All three maps paint a picture of where students are and where they travel to on campus during the day. They provide the basis for the proposed locations of new bicycle infrastructure and proposed locations of bike share stations.

The first map, pictured in figure 1, displays the density of student addresses throughout the city of Ames. The densest areas are in dark blue, and the least dense areas are in yellow or white. Each blue area also has labeled the percentage of all student addresses that are found in that particular area. The areas with the highest concentration of students include Campustown, West Ames, and the area just west of the ISU campus. If in the future the campus bike share system were to extend out into the city of Ames, this map will provide a good basis for determining the areas of the city that would benefit most from a bike share station.

The second set of maps represents the density of bicycles on campus, based off of counts of bicycles at each bicycle rack. Figure 2 displays the density of bicycles based on the number of bicycles at each bicycle rack. The dark blue circles represent the racks with the highest number of bicycles while the yellow circles represent the lowest number of bicycles. From this map assumptions can be made about the most popular and least popular locations for students to leave their bikes, and about where students are the most concentrated across campus during the day.

Figure 3 displays the density of bicycles based on the percentage of spots at each bicycle rack that are being used. The percentages offer an interpretation of how the usage of racks compare to each other. The most underutilized racks are shown in yellow while the most popular racks are shown in dark blue.

Figure 4 offers a comparison of total capacity for each bicycle rack and percent usage for each rack. The green circles are the racks that have the greatest usage but have a small capacity, illustrating that these racks are used more than expected and may need to be expanded. The red circles are the racks that have the least usage but have a large capacity. These racks are the most underutilized, meaning that despite the capacity they are not convenient spots for students to leave their bicycles. This map helps to point out the areas of campus that experience more or less bicycle traffic than expected.

The third set of maps represents the density of students on campus throughout the day. This was represented by calculating the average number of students Monday through Friday occupying classrooms in each building on campus, from eight a.m. to four p.m. This data helps to show which areas of campus are most heavily congested with students. It also helps to show the flow of students throughout the day.

Figures 5-13 represent the average classroom density ranging from the hours of eight a.m. to five p.m. Figure 14 displays all of the hours overlaid. As can be seen, there is little variation on the most and least densely congested areas of campus. The most congested spots tend to be located around Carver Hall and Gilman Hall, while the least congested spots tend to be located around the periphery of campus. While these maps present a general picture of classroom density on campus throughout the week, it should be acknowledged that they are not a complete representation of students on campus. The maps do not include buildings such as the library or the Memorial Union, because there are no classrooms in these buildings. The maps also only include classrooms that are managed by the University, excluding the classrooms managed by individual colleges or departments. However, these maps do provide an accurate representation of where students may be traveling to throughout the day. The department-managed classrooms tend to be the locations at which students stay for long periods of the day, while the university-managed classrooms tend to be the classrooms that students travel back and forth from. Therefore the maps do well to reflect the locations students are actually traveling to and from throughout the day.

Despite the shortcomings of these classroom data maps, they were helpful in determining the spots on campus that would benefit the most from a bike share station. They also helped to identify the spots on campus that would benefit the most from improved bicycle and pedestrian infrastructure.

RESEARCH
MAPS OF AMES/IOWA STATE

FIGURE 1

Density of Student Addresses in Ames

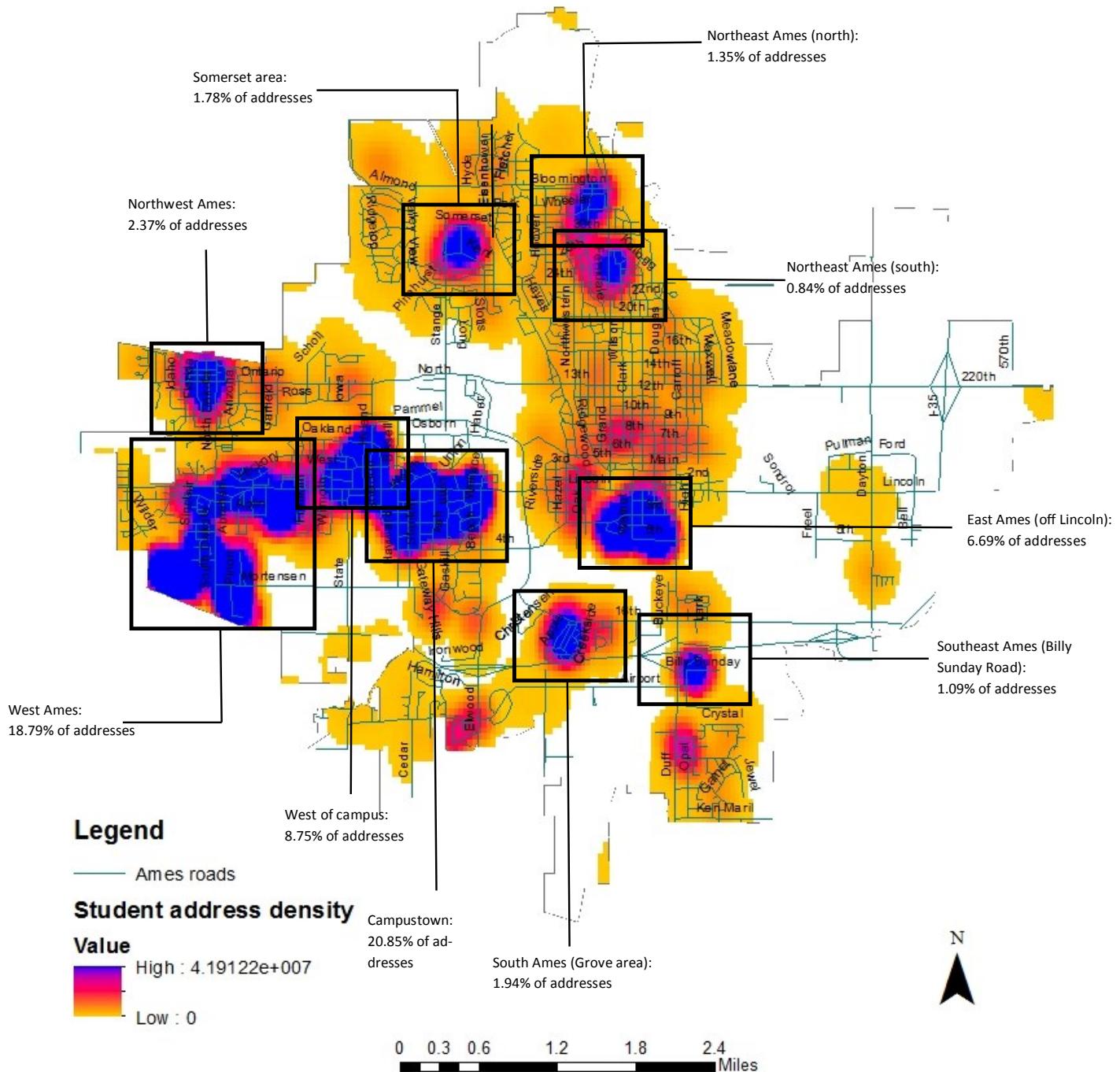


FIGURE 2

Bike Counts (Fall 2014)

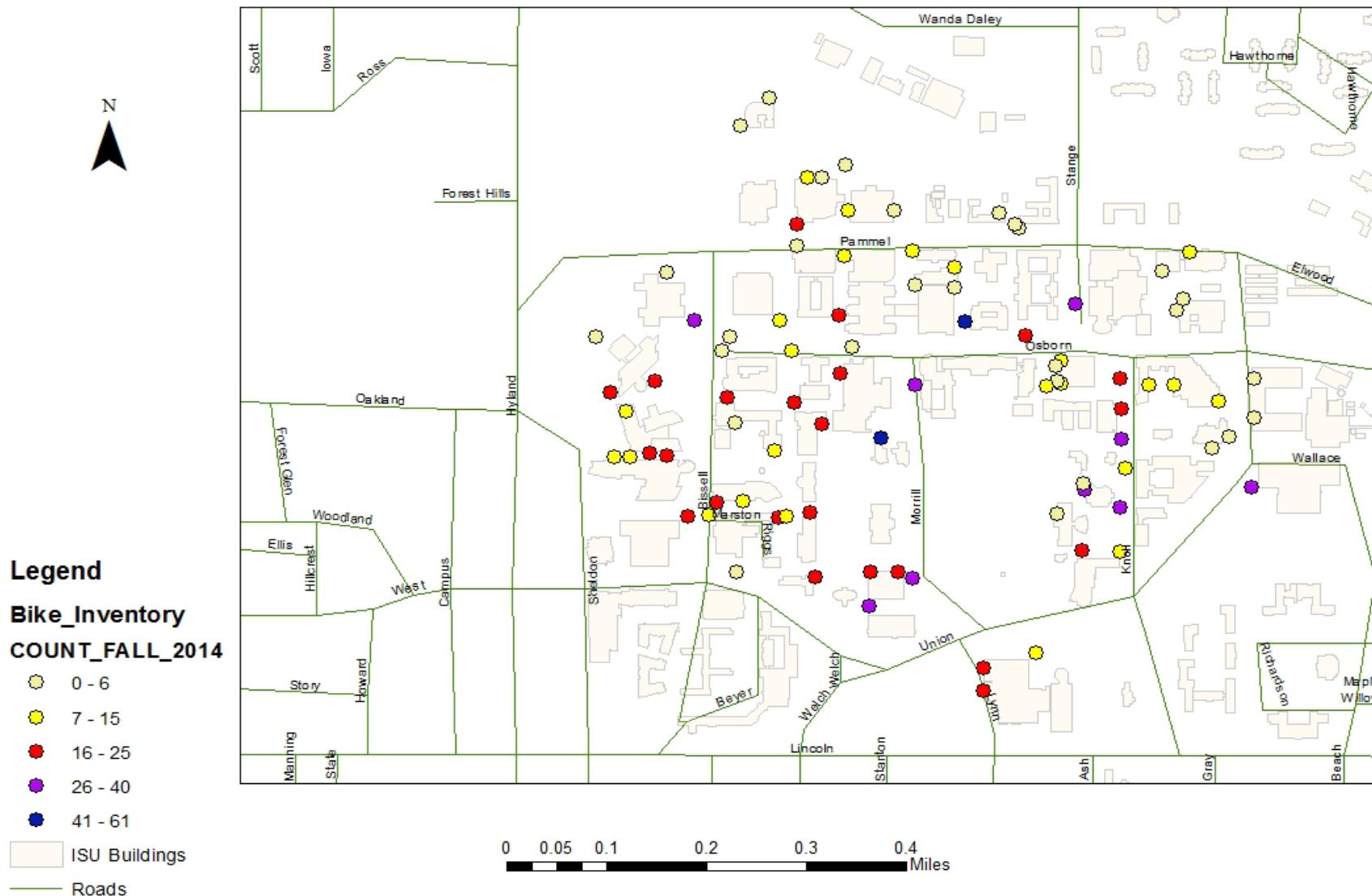


FIGURE 3

Percent Usage of Bike Racks

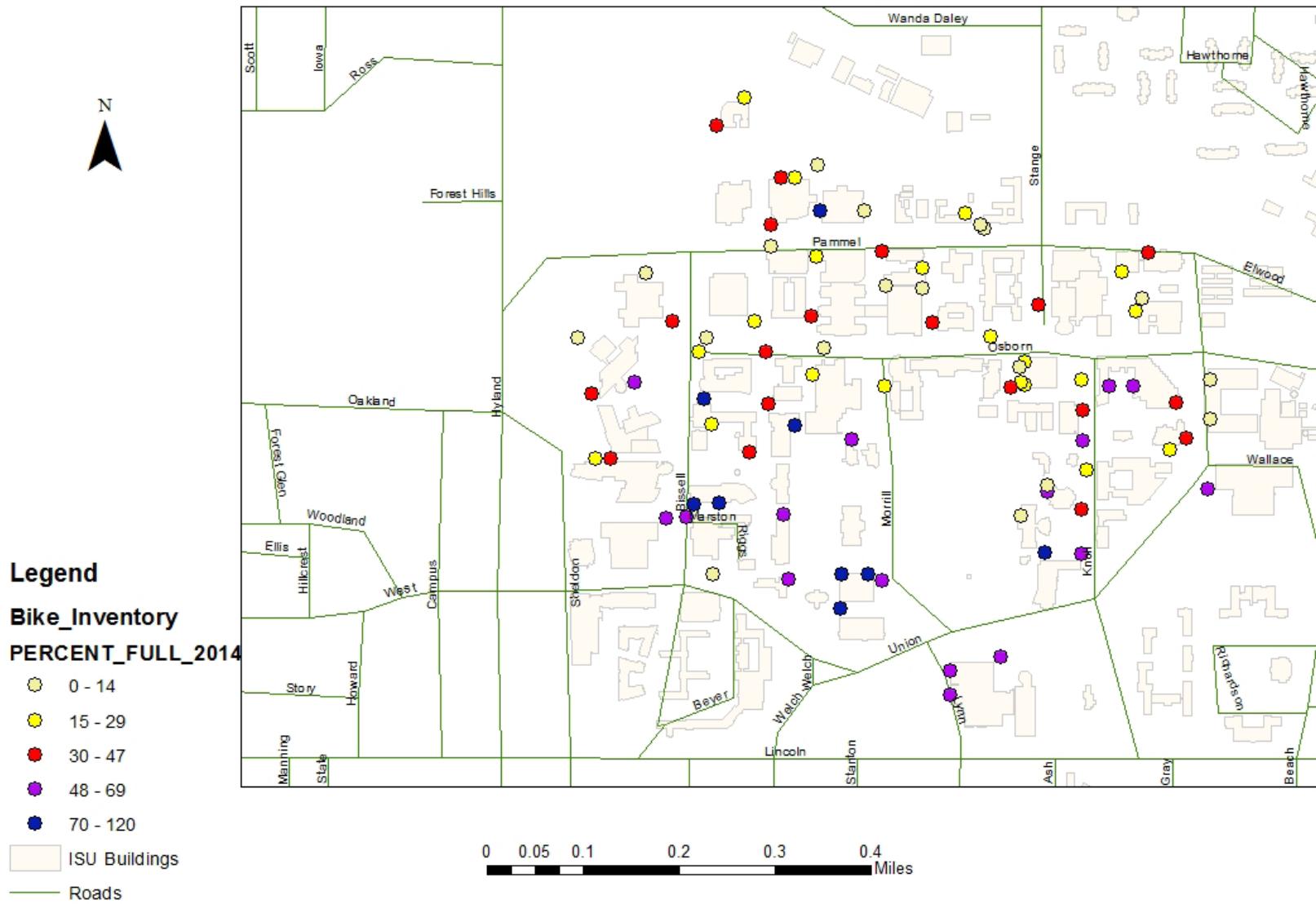


FIGURE 4

Bike Rack Usage and Capacity

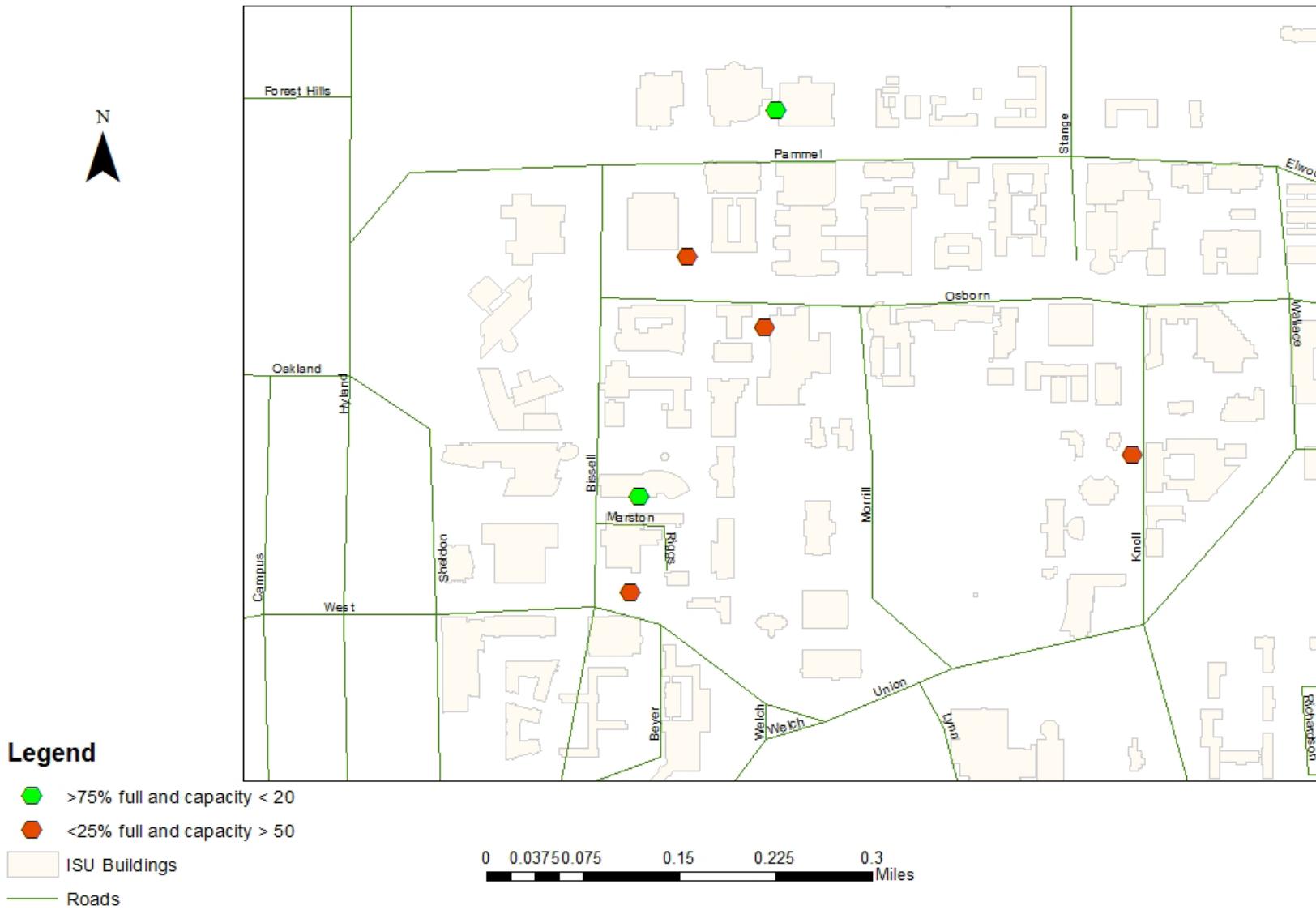


FIGURE 5

Classroom Density 8:00

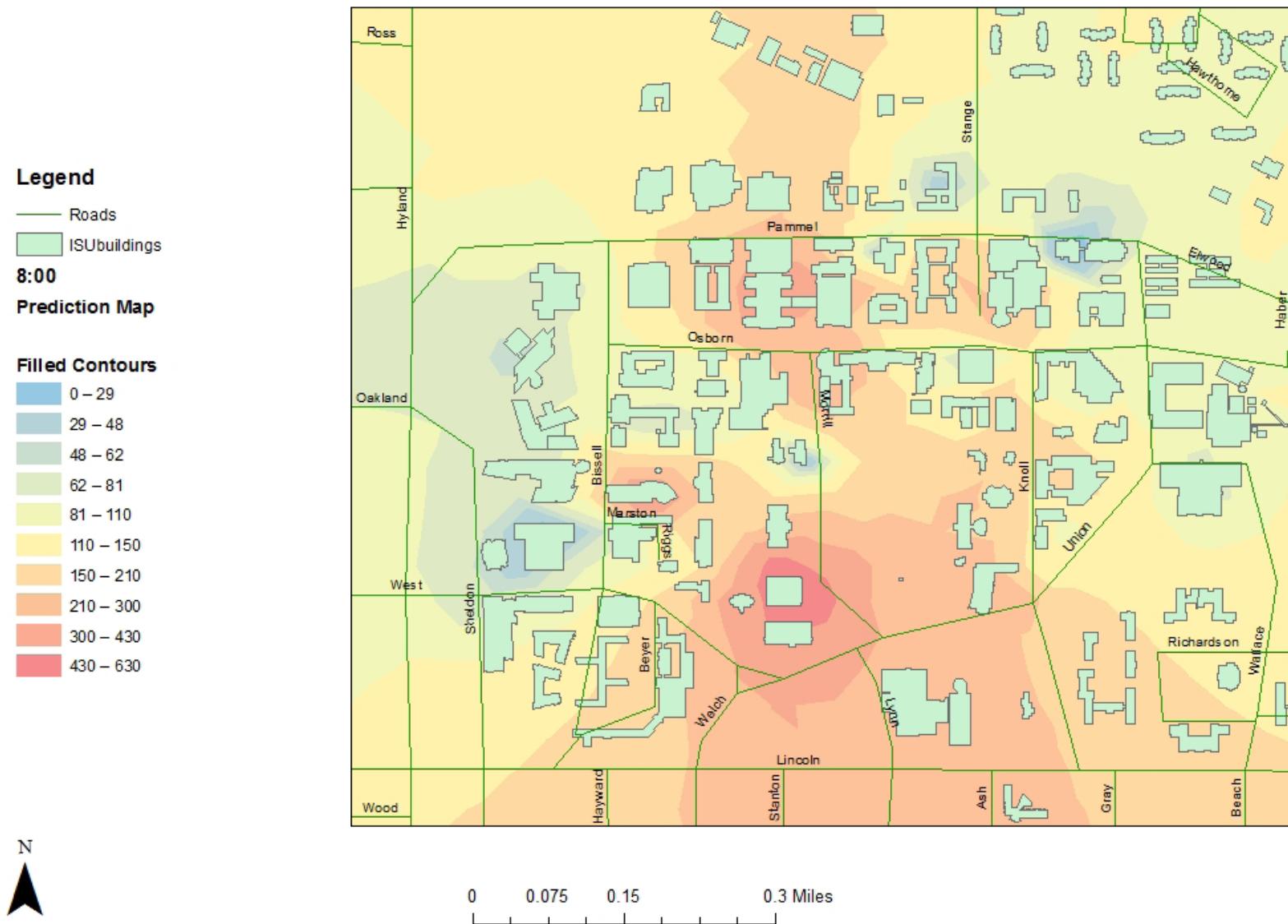


FIGURE 6

Classroom Density 9:00

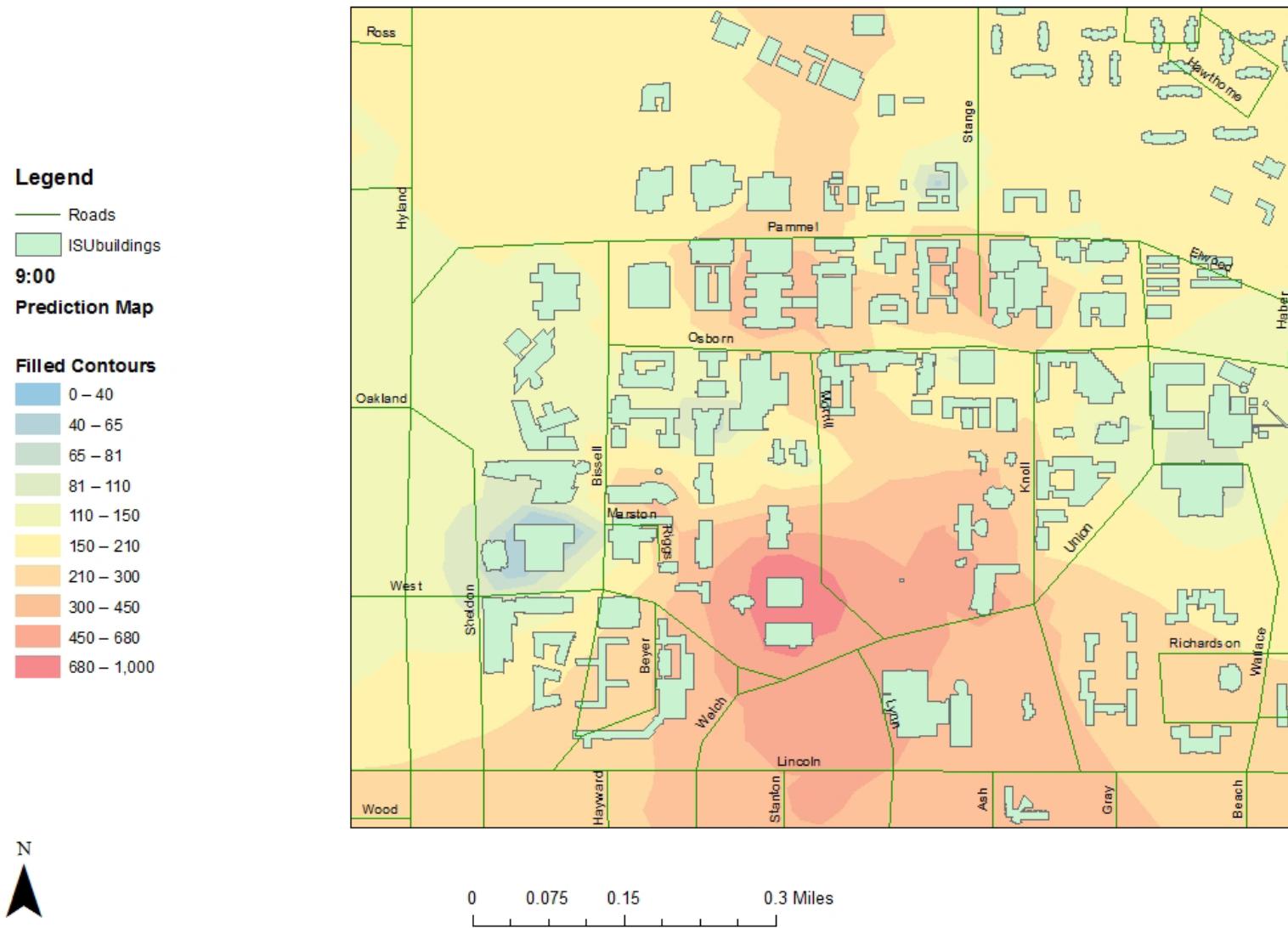


FIGURE 7

Classroom Density 10:00

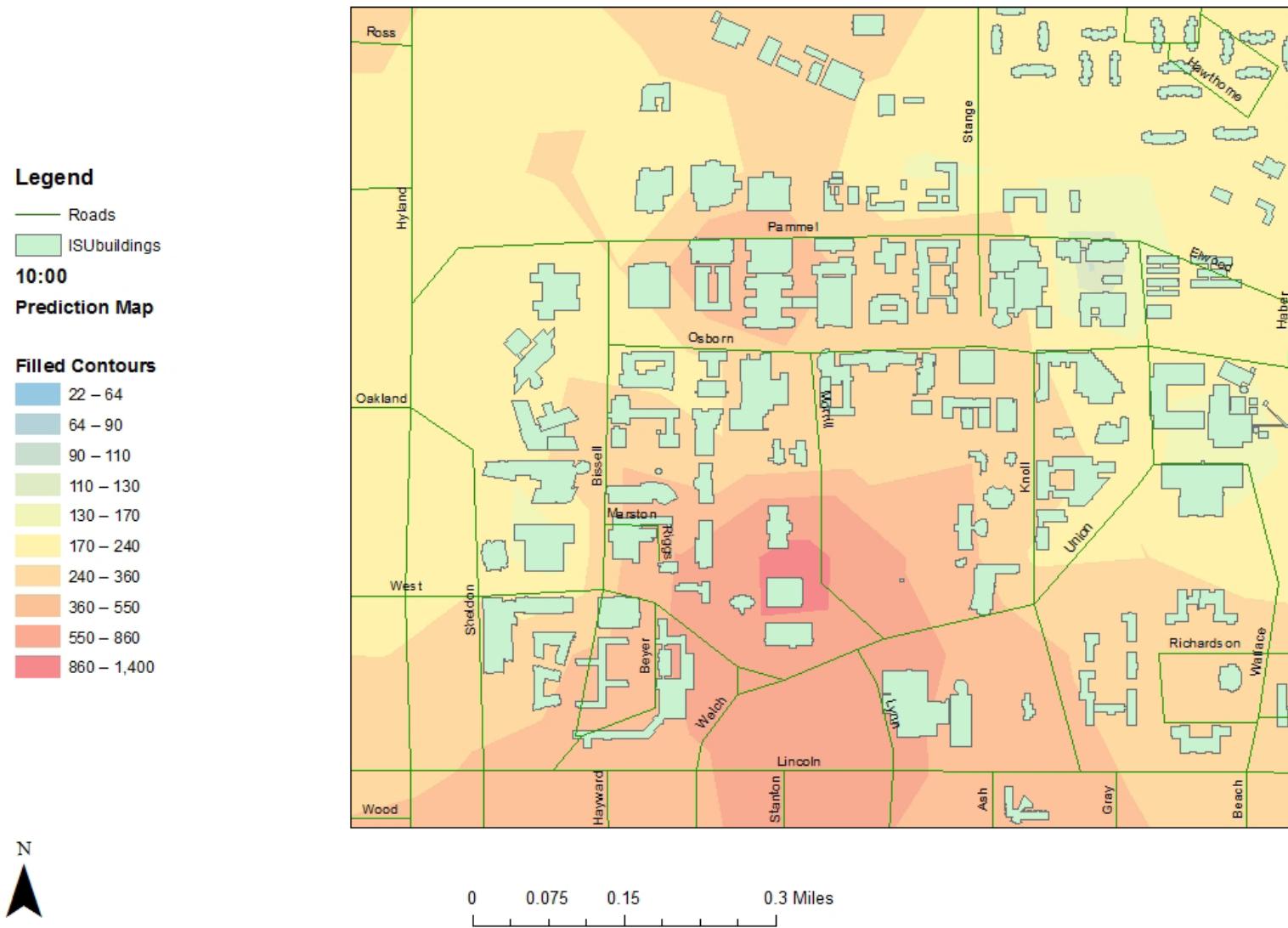


FIGURE 8

Classroom Density 11:00

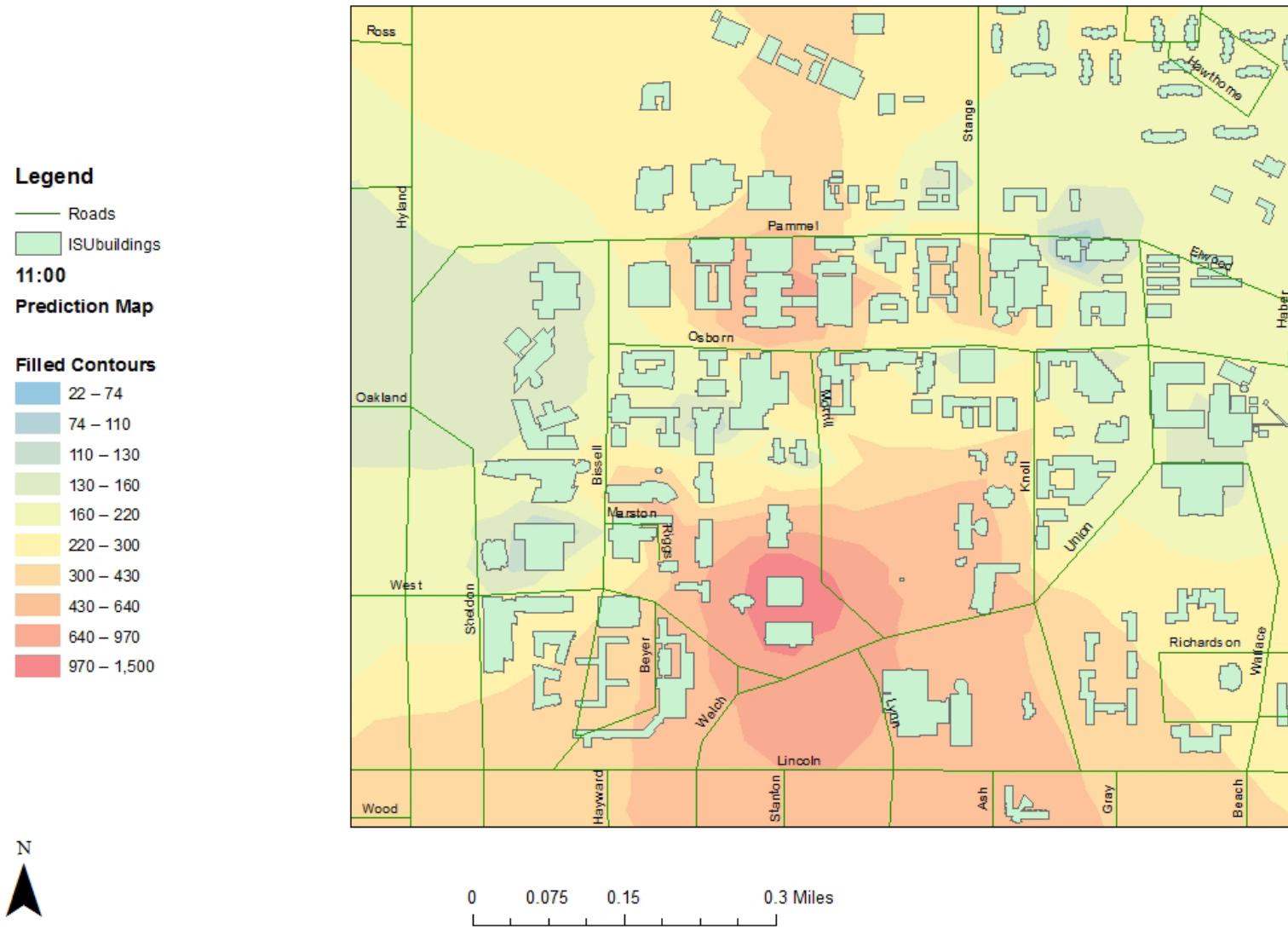


FIGURE 9

Classroom Density 12:00

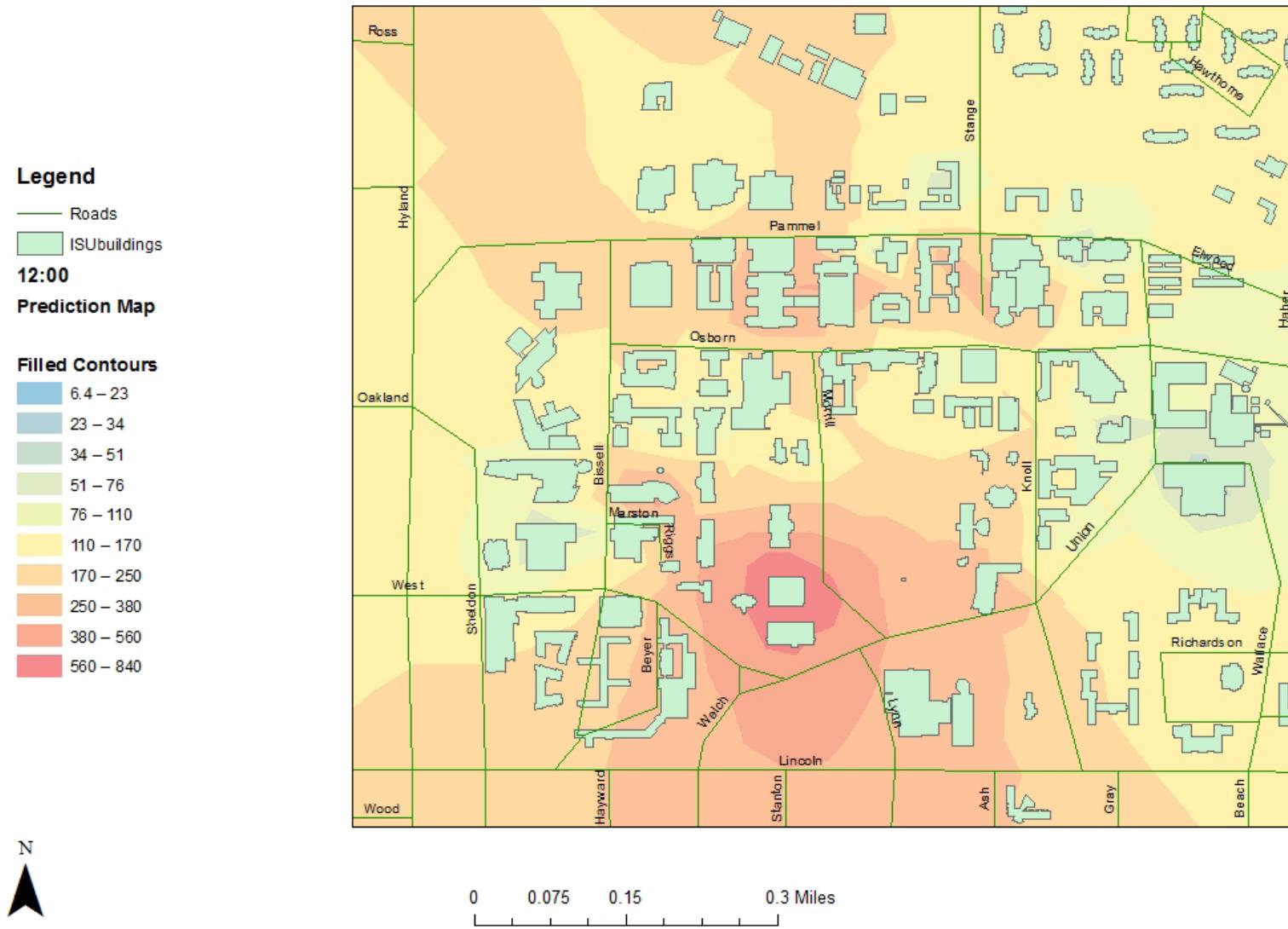


FIGURE 10

Classroom Density 1:00

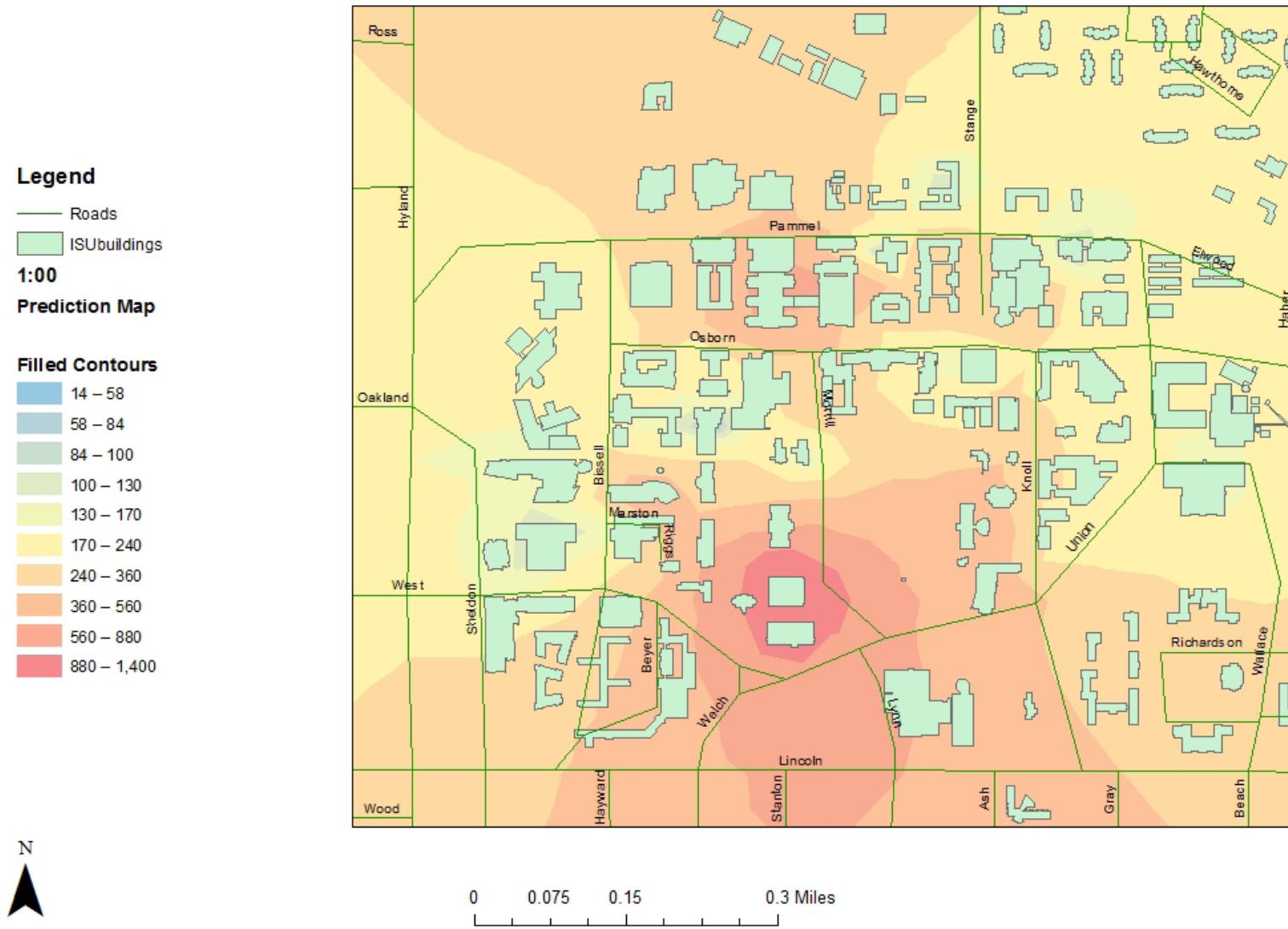


FIGURE 11

Classroom Density 2:00

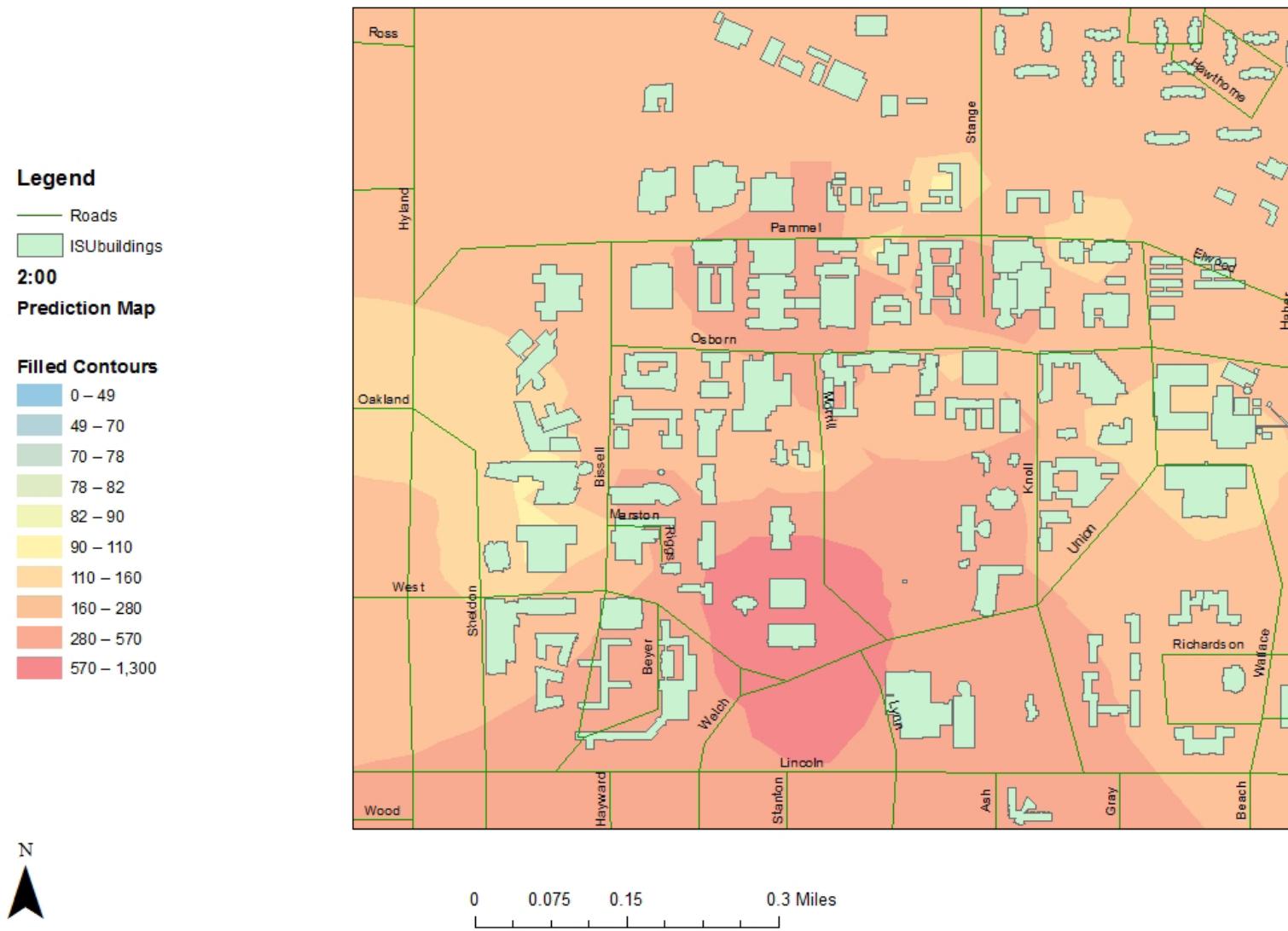


FIGURE 12

Classroom Density 3:00

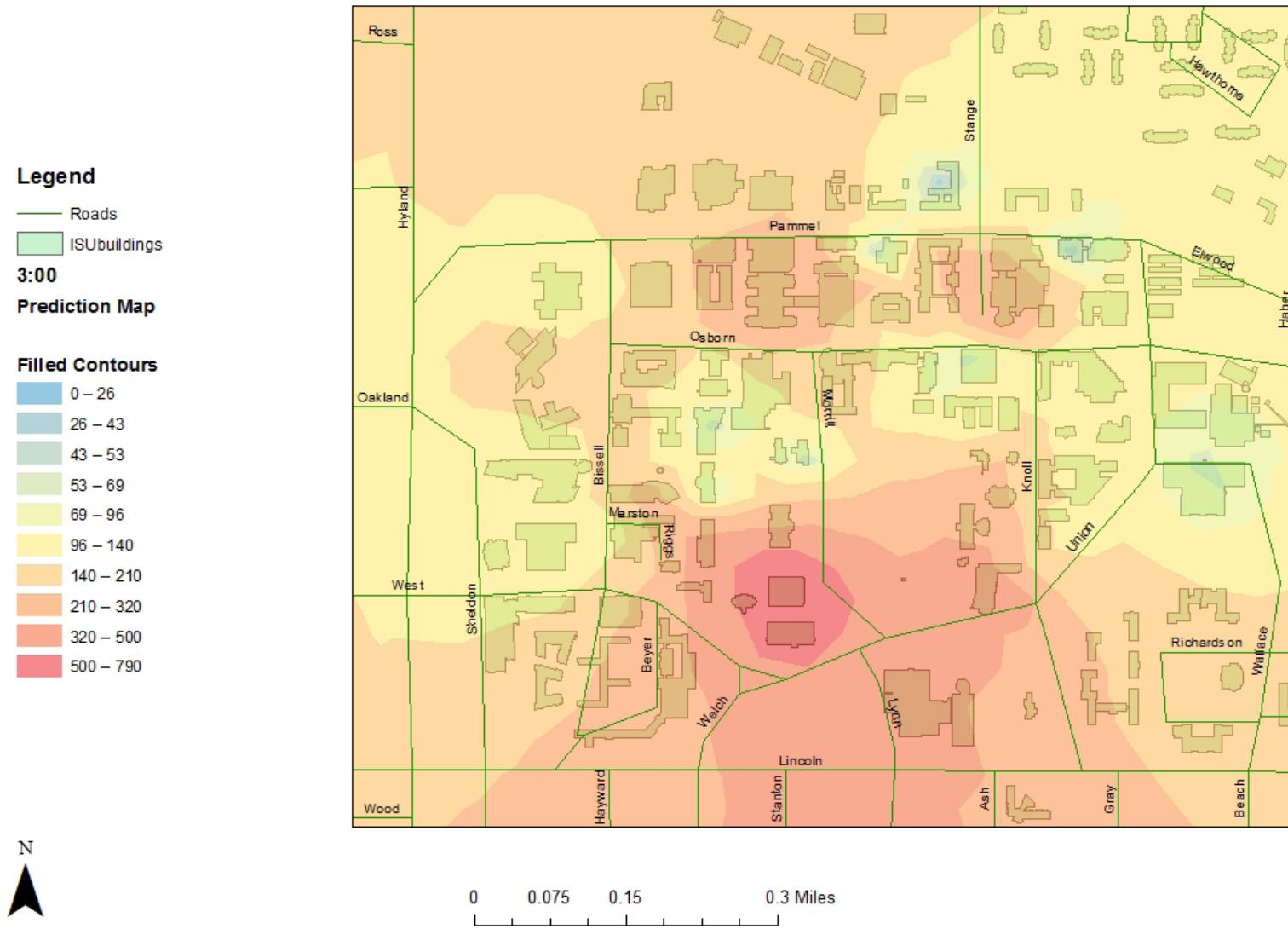


FIGURE 13

Classroom Density 4:00

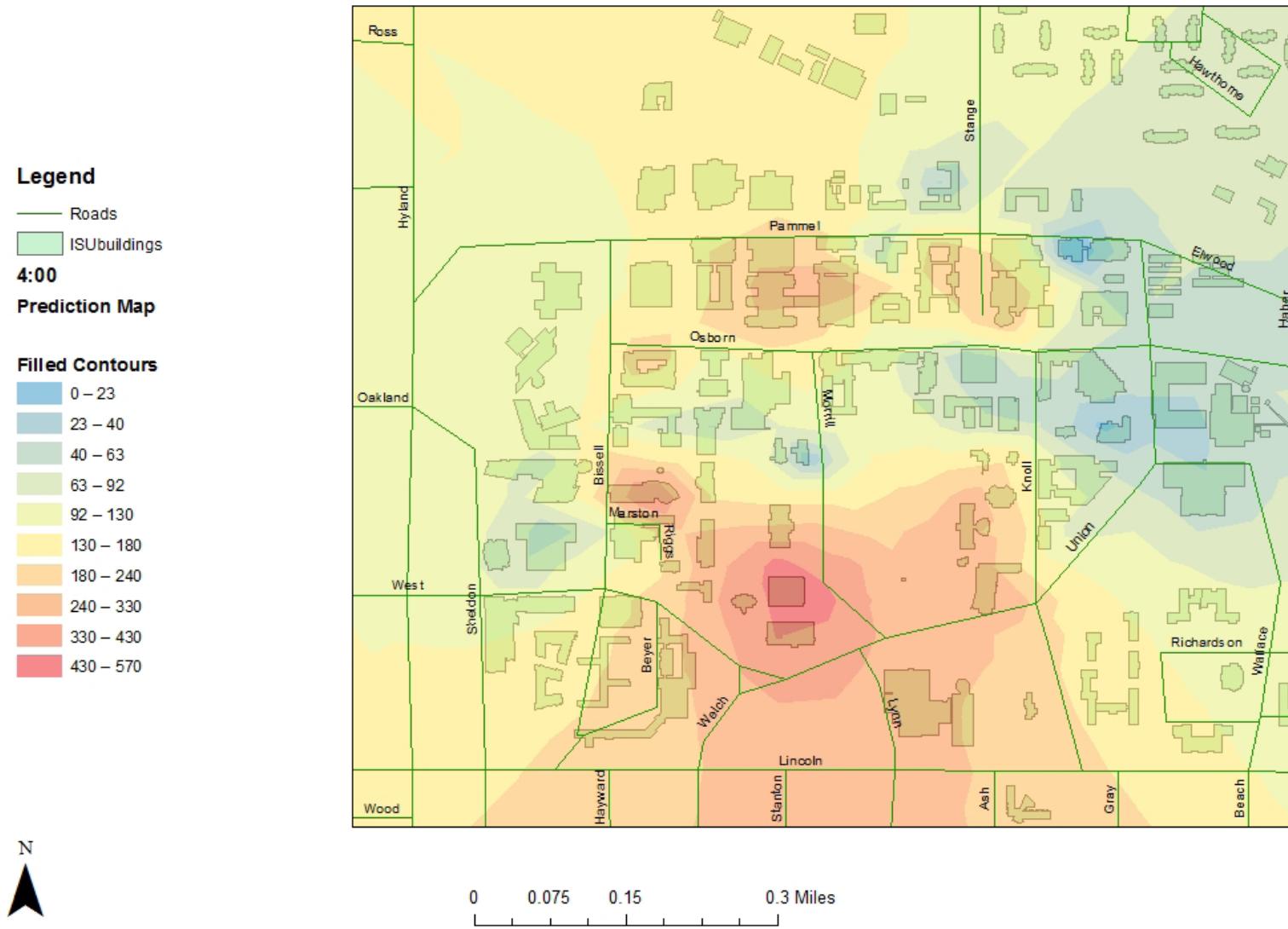
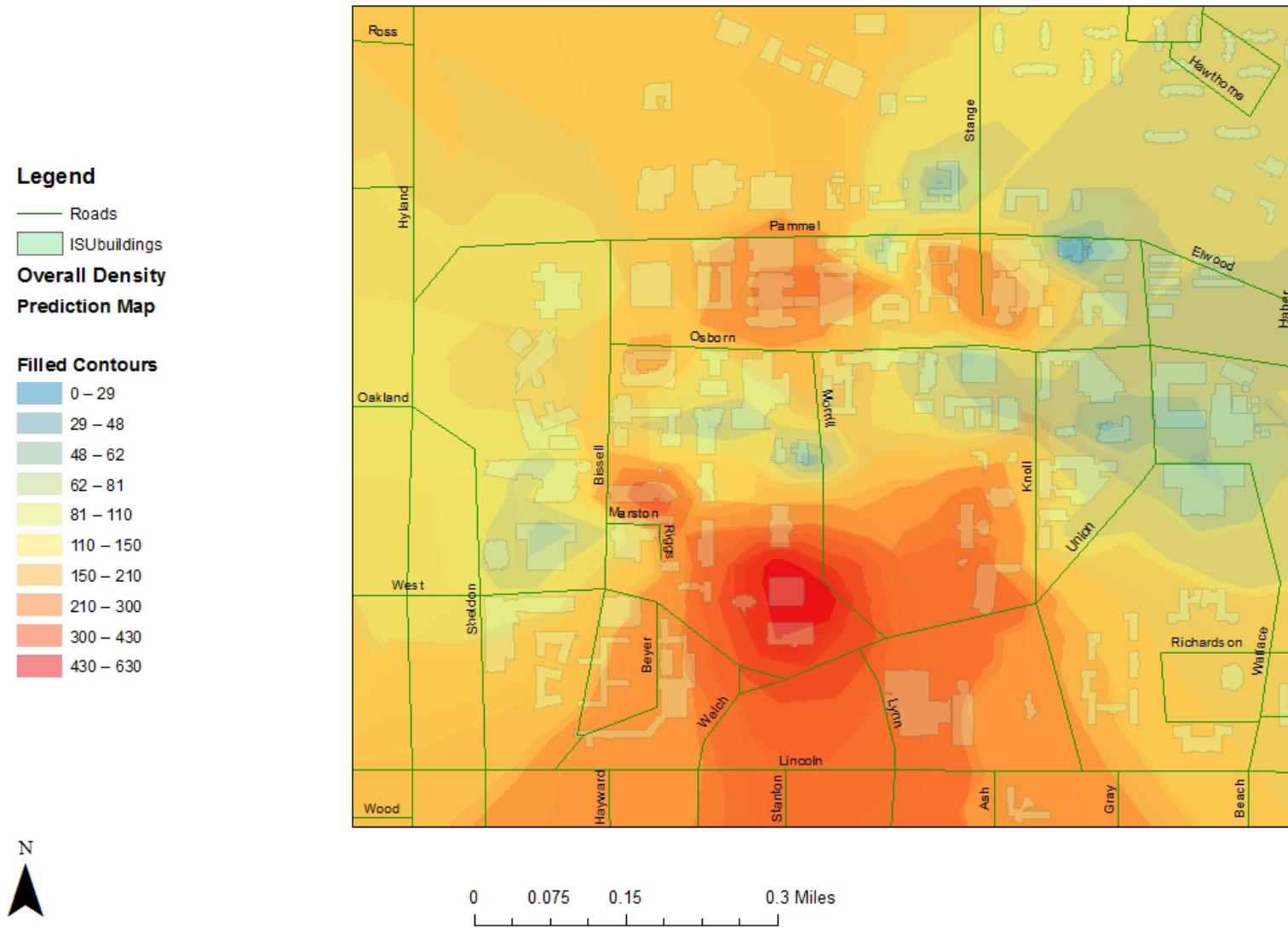


FIGURE 14

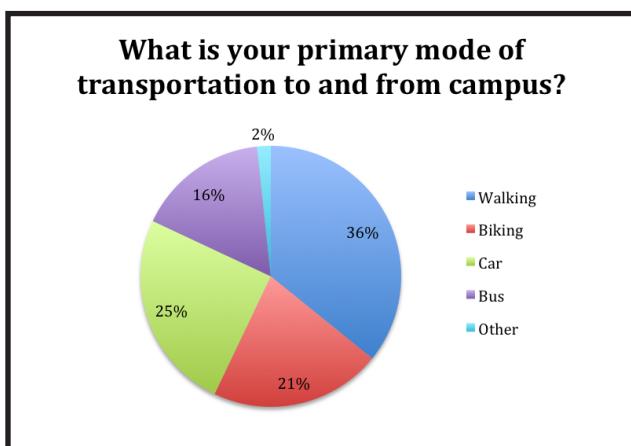
Classroom Density Overall



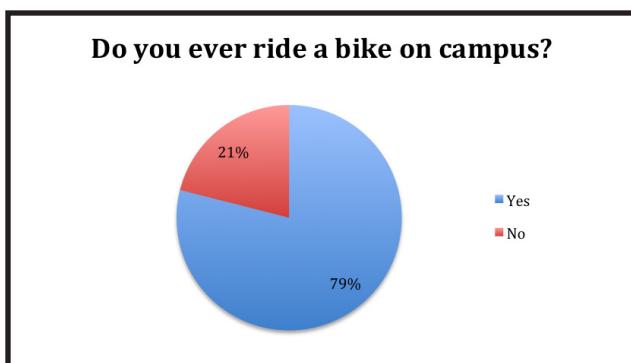
It is important when creating a plan or changing anything that feedback is gathered from all those affected. A survey was sent out that was open for around two weeks. The survey was 21 questions about safety with biking, and general transportation questions. Overall, the survey had 2,008 respondents. The importance of this survey to our study and recommendations is crucial. The data showed many people who were concerned about bicyclists' safety, as well as information on different problem areas on campus. The survey asked questions that could be measured using a qualitative analysis as well as open-ended questions that qualitative analysis was necessary. Below is the data is broken down and described through charts. The most important part of our survey was to make sure people understood what the survey was, why were doing it, and how it could benefit them. Here is our opening introduction that was sent with all emails.

A College of Design studio course is conducting research on how to make the Iowa State campus bicycle and pedestrian friendly. We are conducting a survey to hear your thoughts about your experience on campus as a pedestrian or bicyclist. We will use the results of this survey to develop recommendations to improve bicycle and pedestrian safety. Please take a few minutes to fill out the survey using the link below. Your feedback will help enhance our already green and beautiful campus here at Iowa State University.

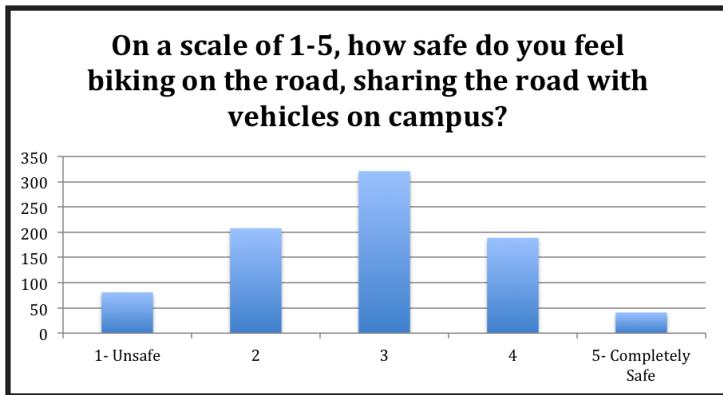
Question 1 asked what the primary mode of transportation is for that specific student. This enabled us to get a strong perception of who our audience was, and how the could possibly affect the rest of the data.



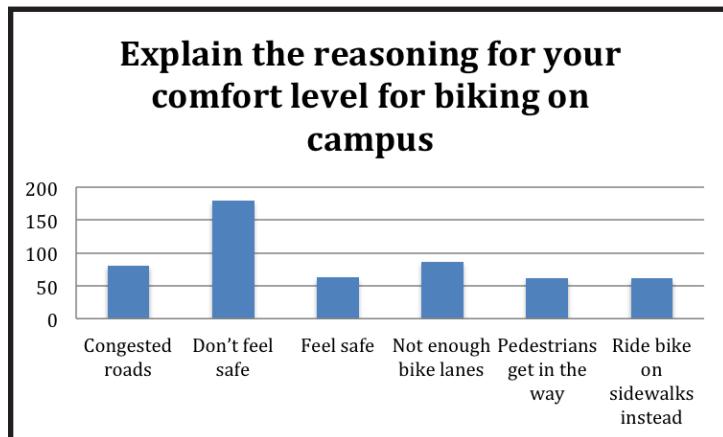
Question 2 asked if the student ever rides a bike on campus. If the student answered no, then they would automatically be sent to the end of the survey. This was because the questions after this one specifically asked about biking. That data shows that 79% of our responders do ride a bike on campus, and our responses will be honest and helpful for the future changes that need to be made to our campus.



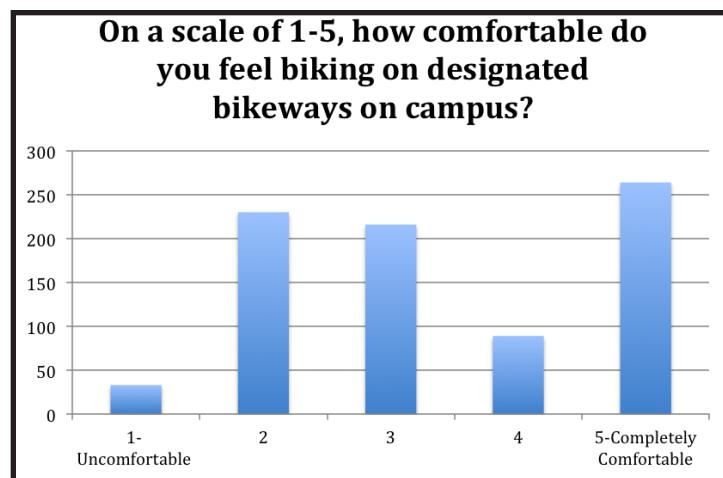
Question 3 was about safety. The university needs to ensure that students feel safe while on campus and using all types of transportation on campus. The data shows that most students who ride bikes are neutral or feel unsafe while riding on campus. By changing infrastructure and adding signage Iowa State could change these feelings and create a safer environment for all.



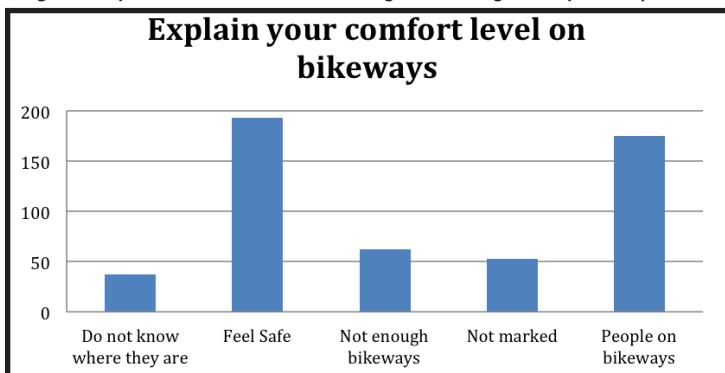
Question 4 asked to explain in more detail about question 3. Our goal was to gather valuable qualitative answers that allow us to understand why the participant put the certain number down for how safe they felt riding a bicycle on campus. A few of the specific spots that were mentioned in this question that people did not feel comfortable were multiple intersections on Stange Road, multiple intersections on University Boulevard, and multiple intersections on Lincoln Way. The top five general categories that the question 4 was answered in are shown below.



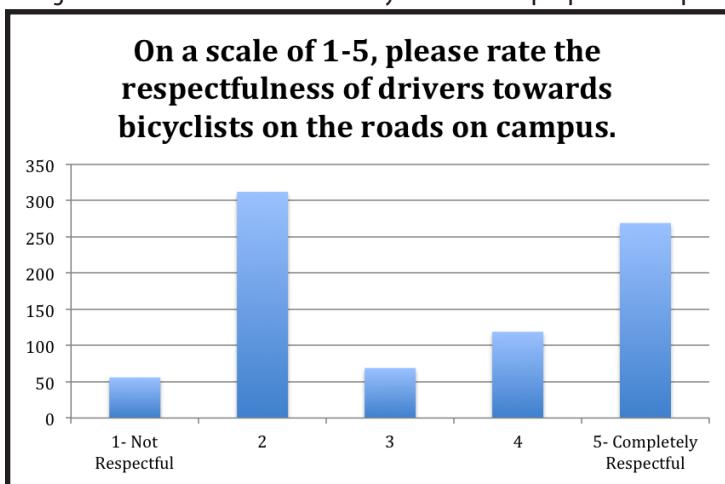
Question 5 was important to our study because it provided information about how infrastructure affects how safe people feel on campus. This spread of responses shows that either people are very comfortable riding on bikeways or they are neutral to uncomfortable. It made it much more difficult for cyclists to ride on campus when it is highly congested in certain areas. Taking the results into consideration we need to create more designated bikeways so that bicyclists feel comfortable riding on the road.



Question 6 asked the participant to explain what made them rate their comfort level on the bikeways on campus. This question made us realize that the bikers who are using these bikeways are pretty satisfied with the safety aspect of things. Complaints came mostly due to the number of pedestrians using the bikeways as sidewalks. This gives us great information that if bikers do use the bikeways, they will feel safe and satisfied as long as the pedestrians are not invading their designated pathways.



Question 7 focuses on how different modes of transportation interact with each other on the street and campus of Iowa State. Because many of the streets through campus are currently shared roads between vehicles and cyclists we needed information to see if the university is working or if changes need to be made. As the survey shows either people are completely respected when riding or they feel as though they are not respected.

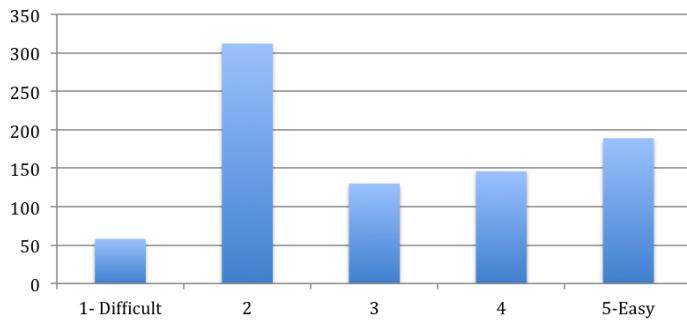


Question 8 was asked to see what kinds of interactions were given to bicyclists on the roads that go throughout campus. This question helped us realize the mixed levels of respect that people are seeing from drivers. It is also helping us realize that the respect level seems to be a problem, not only for the safety of the biker, but the vehicle driver as well. There were mixed reviews saying that bikers do not pay attention and expect the vehicle driver to watch out for them, but at the same time, there was feedback saying that cars only watch for pedestrians and ignore bicycles all together.



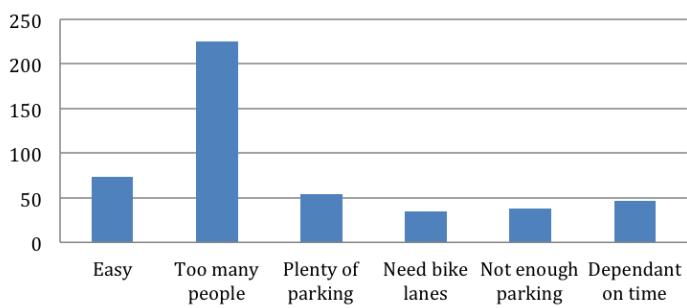
Question 9 wants responders to tell us how easy it is use a bike on campus. Again, many think it is difficult to use a bike on campus and that is because our infrastructure is not adequate for the current number of students and bicyclists on campus.

How easy is it for you to use your bike on campus?



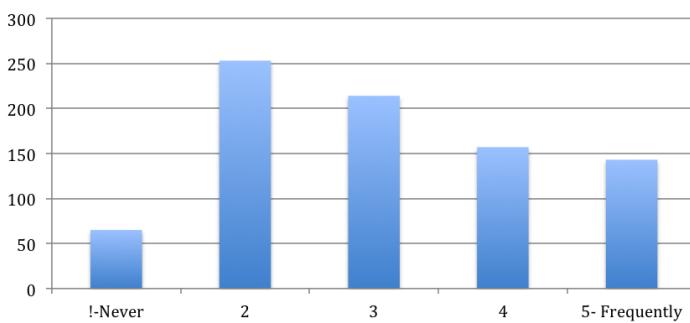
Question 10 was asked to explain why campus was or was not easy to bike through. The results were pretty heavily weighted towards that there are too many people on campus to easily ride a bicycle. This supported the idea of getting bicycles off the same pathways as all the pedestrians by either building their own bikeways or making sure the bikers know they are supposed to ride on the road.

Explain why it is/is not easy to ride a bicycle through campus

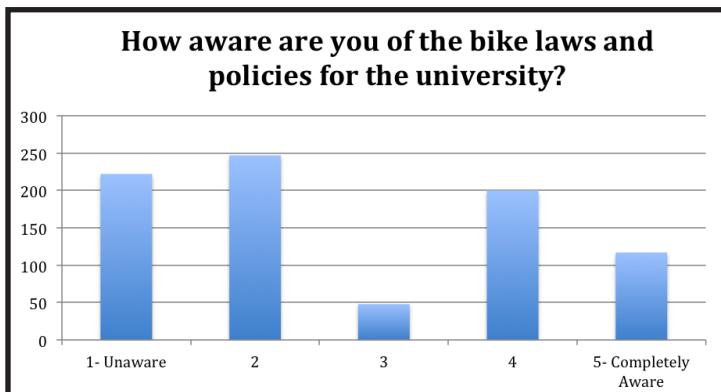


Question 11 was included in the survey because it is illegal to ride on the sidewalks, but most people do not know that. As well, there are not enough bike paths on campus, so that forces students to ride on the sidewalks in order to get to their classes.

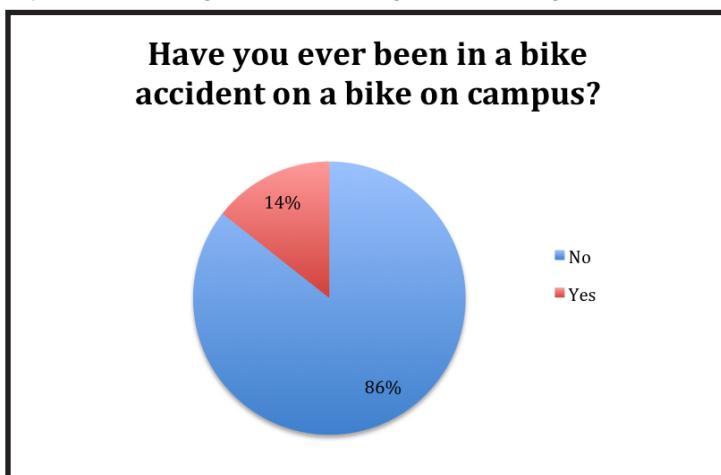
When you ride a bike on campus do you ride on the sidewalks?



Question 12 again helps us determine for the future how much work needs to be put into education and knowledge of bike laws and policy. As well, the university needs to create stronger policies that are easily found and monitored frequently.



Question 13 deals with safety again. We know most bike accidents go unreported to the police and by having the students share their own life experiences we can gain more knowledge about how big of an issue bike accidents are. This question specifically focuses on that person filling out

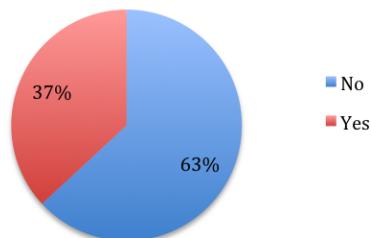


Question 14 shows that similar to question 13 most people filling out this survey have not been involved in an accident nor have they as a pedestrian been hit. This could be possibly biased because the main survey responders all ride bikes and most likely care about this campus and would not



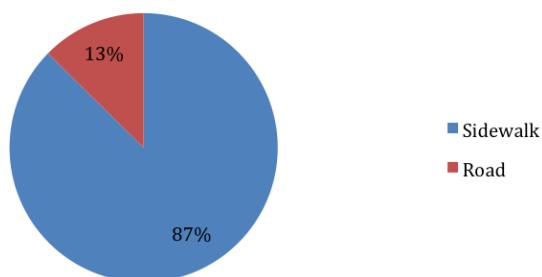
Question 15 asks if the respondent has ever seen an accident. This percentage is surprisingly higher than the previous two questions. Thirty-seven percent of the respondents had seen an accident.

Have you ever seen another pedestrian hit by a bicycle?



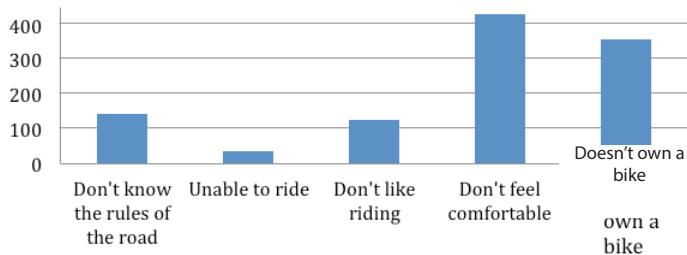
Question 16 asked to please describe the accident that they had seen or been in. The responses for this question showed us that the main part of the accidents happened on the sidewalks. Most responses had included something about the biker not allowing enough space or that the biker tries weaving through a group of people, which resulted in an accident. The accidents that happened on the road or parking lots seemed to be more towards the driver of the vehicles fault for either not looking, or being careless.

Where did the accident occur?

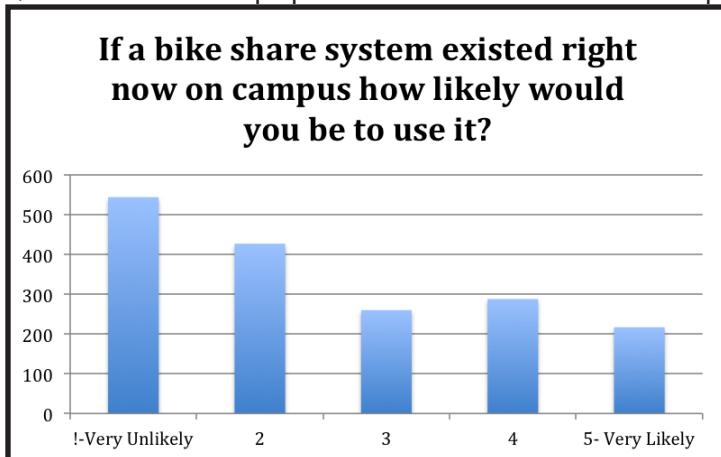


Question 17 was an effort to help identify why people do not ride a bike on campus. A majority of riders did not own a bike or feel comfortable riding on campus. This data helped validate the need for a bike share.

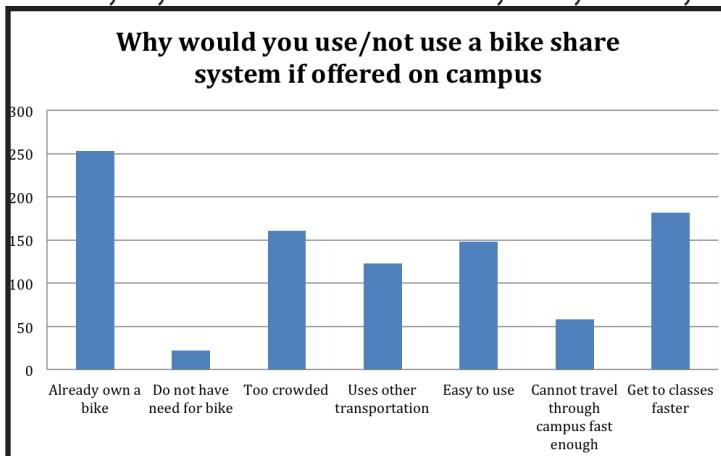
If you do not ride a bike on campus, why not? Select all that apply.



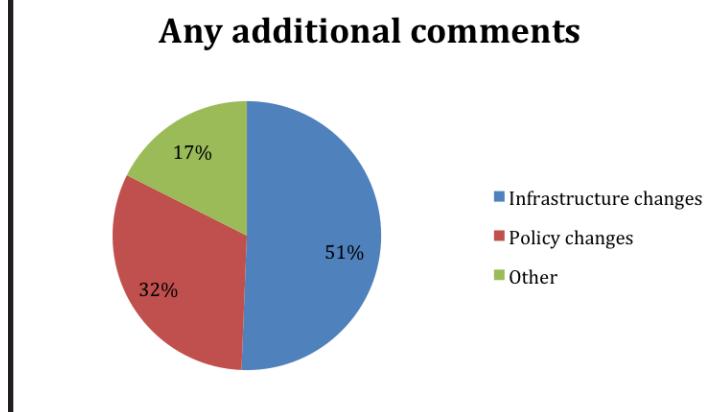
Question 18 was to see if people would use a bike share if it was on campus. This question may consist of a majority of "unlikely's" because respon-



Question 19 asked why the person would or would not use a bike share if it were currently on campus. Roughly, 20% of the respondents said the reason why they would not use one is because they already own a bicycle. The other results indicate that a bike share could be useful on campus



Question 20 was the feedback question. 25% of the respondents commented in this section. 82% of respondents mentioned some sort of infrastructure changes.



Along with the survey, the class conducted interviews with willing participants. The main purpose of the interviews were to find our congested areas on campus, what the biggest bicycle issues for ISU are, and to see what the responders think needs to be added to our campus. In addition to interviews, eight respondents volunteered to be contacted for individual interviews students, staff, and faculty were chosen randomly. Many of the responses were similar to areas the class had deemed a concern. As well, it was not only students sharing their experiences and input, but faculty and staff as well.

When looking at the responses, the overall theme is that ISU's campus is too crowded between classes and that there is not enough designated bicycle paths across campus. Most of the responses talked about pedestrians not liking bicyclist riding close to them or on the sidewalk, but that is because they have no specific paths for themselves. The future map created shows paths and infrastructure changes that were all suggested by our interviewees, the newest path being through central campus. The interviews showed that currently ISU does not have clear policies or signage that allows all modes of transportation to know the rules and regulations. The biggest reason people are frustrated with the current situation is because the students, staff, and faculty aren't educated on bicycle infrastructure and rules. Below are quotes from the interviews.

"Sidewalks become too crowded and walkers tend to get angry at bike riders."

— Graduate Student

"Lots of pedestrians use the bike path, lots of bike riders use the pedestrian path, and it just doesn't really make a whole lot of sense."

— Staff

"People just don't follow the rules. They run stop signs with no regard to the law."

- Undergraduate Student

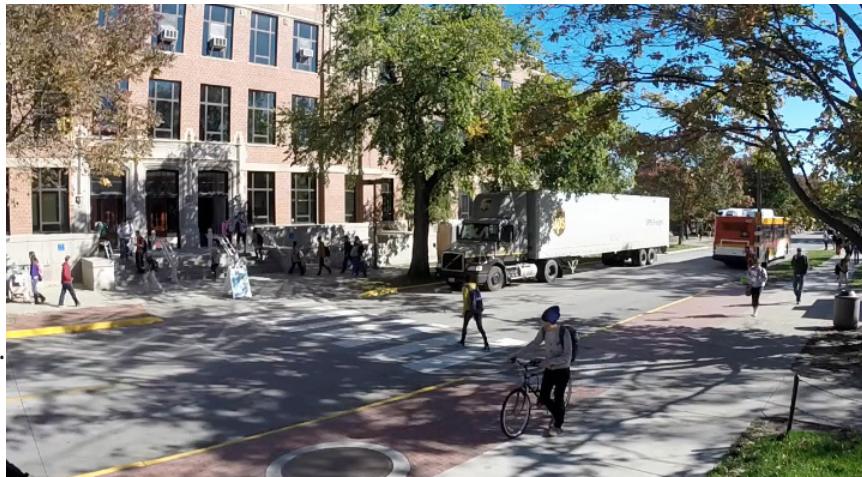
To find hard evidence that there was a problem between bicycles, vehicles, and pedestrians around Iowa State University's campus, cameras were put in place to record the activity that was taking place in certain locations. The locations were strategically placed around campus from a vantage point that captured the entire area that was being studied. After these videos were taken, they were then analyzed to see exactly what was happening in that area between bicyclists, pedestrians, and vehicles. These videos helped identify where the problem spots around campus were, but the videos also gave good examples of infrastructure that worked properly.

The spots that had been identified as spots that were to be studied were: Osborn Drive, near the Gilman Hall bus stop; Morrill Road, east of the Parks Library; Osborn Drive, north of MacKay Hall; the intersection of Stange Road and Osborn Drive; and Osborn Drive, the Kildee Hall bus transfer point. These points were selected from compiling multiple sources together and identifying places that were most commonly seen as problem areas for the interaction between bicyclists and pedestrians or vehicles. Osborn Drive is a main focus area in our study, due to the amount of comments that our team had collected from multiple sources. There was a video clip that was obtained from Cyride of footage that was taken of bus/bicycle interaction. A brief introduction to Osborn Drive is that it is the only street that goes east and west in the middle of campus. This road is currently gated so there is restricted access during the hours of 7:30 AM through 5:30 PM. Osborn Drive is also marked as a shared road between bicycles and automobiles. This is a high traffic area of all modes of transit; walking, vehicular, and bicycling. Due to the large amounts of traffic on this road, there is also a lot of congestion and concern for how all the modes interact with one another. When one mode does not respect the other couple modes, or invades their space, we see a tension that is built between those modes.

Osborn Drive at Gilman Hall

The first location that was looked at was on Osborn Drive, near the Gilman Hall bus stop. This location seems to be a location that a lot of people are constantly at. People are either going to class, getting on the bus, or just being dismissed from classes. Due to this, there seems to be congestion in the area at the peak times of the day. This congestion is caused by the large amounts of pedestrians, which in an ideal working model would still flow smoothly. In the case of Osborn Drive, one of the reasons why this is not a smooth flowing model is due to certain modes of transit invading other modes' spaces. As shown in the image to the right, there is a clear space invasion by the bicyclists as he tries to maneuver his way through the pedestrian crowds, when by rule, he is supposed to be on the road. There can be a couple things that are occurring here. Either the rider of the bicycle is uneducated on where they should be riding their bicycle on Osborn Drive; they have a reason to not want to ride their bicycle on the road due to being scared, uncomfortable; or another unknown reason why they are unintentionally/intentionally disobeying the rules of the road. With this happening, this puts stress on the threshold between the interactions of pedestrians and bicyclists. In turn, pedestrians then start to complain that the bicyclists are starting to take over their sidewalks.

Not everyone that is a bicyclists rides their bicycles on the sidewalks. There are a couple different options that one could take to get around campus on their bicycle. First, one could ride on the road, which as mentioned prior, is a shared road between automobile and bicycle. Second, is to ride the bicyclists could ride on the designated bicycle path. Third, the bicyclists could walk their bike along their side. This is shown with the picture to the right. This bicyclist has chosen to walk their bicycle instead of riding. Due



to this, the participant is then allowed, by policy, to walk on the sidewalk with pedestrians. With a little bit of bicycle education, this shows that the two modes of transit can correspond with one another and can mesh with one another, rather than clash with each other in conflict of who is considered the participant with the right of way.

Morrill Road

With the large number of pedestrians who go through campus every day, and the amount of traffic that is allowed to have access to the interior roads on campus, one spot that was studied via video was Morrill Road. The placement was in Morrill Hall facing north towards the intersection of Osborn Drive and Morrill Road. With this particular spot, we were able to view how the only marked shared road was utilized with the different modes of transit. Morrill Road is a one way road that runs south, which is most widely used as a bus route for the Orange and Gray CyRide buses. This road has a bicycle lane on the east side of the road, which rides against traffic, and a sharrows on the west side, going with traffic. As shown on the right, this is an image of Morrill Road being used how it was intended. There is a bicyclist riding against traffic in the correct lane, a bus giving that bicycle lane the proper space, and pedestrians crossing the road at the designated crosswalks. With this type of road in place, there seems to be no flaws in how the modes will interact with one another. This is what we had considered, after reviewing all the footage, to be the ideal situation that could be done for Iowa State University.



Osborn Drive at MacKay Hall

The population of each building is constantly changing throughout the entire day due to classes changing and people shifting from building to building. With that being said, there is bound to be some congestion during these passing periods. At MacKay Hall, we can see a lot of this moving traffic happen. With this movement, we can also see some of the problems that are occurring due to lack of infrastructure for bicycles. The pictures in this section will show how people are using Osborn Drive, at its current state. We observed a variety of things while reviewing these videos, but this was where we saw the most interaction between all three of our major modes of transit. In the picture that was first shown in this section, there are bicycles passing a moving car, who is passing a stopped bus. With things like this happening on the only major road that passes completely through campus, it is showing the need for an updated infrastructure for our modes of transit. The second picture (right) shows similar actions. With bicyclists riding along side of buses and also passing cars, it is clear that there is a congestion issue with Osborn Drive. We have clearly learned that there needs to be infrastructure changes made to help improve the safety of everyone involved. There seems to be a pretty tight window to pass any stopped bus with how things are currently working.



Strange Road and Osborn Drive Intersection

With the few existing bike lanes that are in, or leading to Iowa State's campus, observing the one on the intersection of Strange Road and Osborn Drive gave us valuable information as for usage of such paths. The interaction that was done between bicyclists and bike lane was done more often than expected. As shown in the picture to the right, there are three bicyclists that are correctly using the bike lane that is leading into, and out of campus. With positive interaction like this one, it shows us that students, faculty, and staff are aware of what these bike lanes. The interactions between the pedestrians and the bicyclists were stressed some times, as one mode was not looking out for the other, creating a complication.



Kildee Hall Bus Transfer Point

One of the most frequent thing that was observed in these videos were when bicyclists rode on the sidewalks instead of riding on the road. This can cause a lot of tension between pedestrians and bicyclists, it can also cause injury to one or more the people involved. The picture on the following page is showing a bicyclist attempting to ride through a large group of people who just exited the bus. This picture captures the moment where the bicyclist has actually lost her balance, and is forced to push her bicycle with her feet. While riding on the sidewalk is a commonly practiced action on campus, this can easily cause a lot of the congestion that is happening throughout campus. This person shown to the right is riding on the sidewalk instead of the road for an unknown reason, but we could assume a few options as to why she has chosen the sidewalk. First, the rider could simply be uneducated on where they are and are not allowed to ride a bicycle on campus; the bicyclist may have chosen this option due to safety and comfort; or this could also be a convenience factor. The route that may be considered legal, may not be the fastest way to the end destination.



CyRide Video

To help diversify our collection of videos, our team also reached out to CyRide, the campus/Ames bus system. With the help of them, we were able to catch an excellent example of a bicyclist riding where ever they want. The picture on the right is of a bicyclist who had came from off the grass and onto the road. He was about hit by a bus due to not paying attention to his surroundings before entering the road. Dangerous scenarios such as this one help emphasize the point of safety for all modes of transit.



In Conclusion

Having video footage of things that need to be improved on, along with footage that help point out what is working throughout Iowa State University's campus will better Iowa State's knowledge on what is occurring daily. From identifying the problem spots with multiple sources, filming those spots, and then analyzing those videos to see what is making them the identifiable spots on campus. These videos gave us visual evidence that there is a problem with the current infrastructure that Iowa State is using when it comes to the interaction between bicycles and pedestrians/ automobiles.

RESEARCH CONCLUSION

The aim of this research was to identify what the major concerns of people were in terms of traveling across campus, and to identify the specific locations that would benefit the most from infrastructure improvements. The survey that was conducted helped to illuminate the most common concerns expressed by people on campus, and there were several themes that came up again and again. The majority of students do not feel completely safe riding a bicycle on campus or sharing the campus with bicyclists, primarily because there is too much congestion. Most survey respondents were not completely aware of bicycle policy. When asked to express the reasons why they find it difficult to bike on campus, common responses were that they often have to ride on the sidewalks with pedestrians, and that there weren't enough bike lanes and bike paths. These survey responses help to demonstrate that amount of bicycle infrastructure currently in place is not sufficient to meet the needs of the campus. People on campus know what they want to see happen on campus, and have voiced their support for reform.

The video footage taken of various spots on campus helped to identify the specific locations around campus that are particularly congested and troublesome. There were several instances caught on film of bicyclists having to dangerously weave around pedestrians and vehicles. These spots tended to be locations where bike lanes or paths ended and there was no connection to other bicycle infrastructure. These videos also served to show the spots on campus that worked well. Morrill Road functioned well because of the bike lane. The Morrill Road footage proves that bike lanes can improve mobility of bicyclists and vehicles on campus.

Applying to become a bicycle friendly university also helped us identify the shortcomings of the campus bicycle infrastructure. The results of the application will provide the university with further resources to help plan for improved infrastructure, and will provide a network of support.

Becoming a bike friendly university demonstrates a commitment to accommodating bicycles on the Iowa State University campus.

The maps created helped to show the flow of students throughout campus. They pinpointed the most frequently traveled areas of campus. The information garnered from these maps allowed us to identify the areas most in need of increased bicycle infrastructure, and the spots that would benefit the most from bike share stations.

Our research began by recognizing that there is a problem and collecting evidence of the shortcomings of the current bicycle infrastructure. It then went further by identifying the areas of campus most in need of improvement. The data collected was used as support for the following proposed infrastructure and policy changes.

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PROPOSAL

BIKE FRIENDLY UNIVERSITY



An important aspect of many well known biking communities and universities is becoming part of the League of American Bicyclists. The League's mission "is to lead the movement to create a Bicycle Friendly America for everyone. As leaders, our commitment is to listen and learn, define standards and share best practices to engage diverse communities and build a powerful, unified voice for change." In order to do this, communities and universities must apply to become either a bicycle friendly community or a bicycle friendly university. For Iowa State University, it is important to apply because we want to create a master bicycle plan and improve many parts of our campus infrastructure.

The Application

There are many parts to the application that not only makes the university think about planning, but other important aspects that will affect the connectivity and mobility of bicyclists, pedestrians, and cars. The League of American Bicyclists have a website that detail all of what goes into the application.

"Each type of application is different with their own natural benefits and challenges from climate and topography to culture and population density. But there are essential elements across five categories known as the Five E's that are consistent in making great places for bicycling." The five categories are listed below with a description of why they are important for a bicycle friendly university.

- Engineering: Creating safe and convenient places to ride and park
- Education: Giving people of all ages and abilities the skills and confidence to ride
- Encouragement: Creating a strong bike culture that welcomes and celebrates bicycling
- Enforcement: Ensuring safe roads for all users
- Evaluation & Planning: Planning for bicycling as a safe and viable transportation option



Why is it Important?



PROPOSAL

BIKE FRIENDLY UNIVERSITY

Filing out the application is important for Iowa State University because that is how we will find out what we are doing right and what we can improve in the future. The application is due in August 2015, and after submission the university will hear back with suggestions on how to implement parts of the application that we are currently missing or not up to standard. The application is broken into many sections that cover the 5 E's. We have worked with many faculty and staff to ensure we are the correct answers for all the questions. It is also important because it will benefit other areas of the university besides just biking. We will more about how to implement programs to increase safety and education of the producers and policies we have or will have in place. By completing the application we will be able to create a master bicycle plan with all the necessary requirements and recommendations. Increasing knowledge will increase safety for all students, faculty, staff, and visitors here at Iowa State University.



PROPOSAL

WEBSITE

Biking across Ames has become more and more popular each year with more people coming to Iowa State for schooling. In the past four years, the enrollment of freshman classes would break the record for the largest incoming class. With the greater amount of students, there are more bicycles on campus. These new students come from many different areas of the world and are likely to not be familiar with the policies and regulations Ames and Iowa State have implemented.

Currently, finding the essential information one might need to become a smarter bicycle rider can be very difficult to find. Using the current resources, it takes several websites, several offices to visit, and several buildings to go to just to get the correct information. Many of today's colleges and universities have a central resource just for bicycling on their campus. The use of a website is one of the most popular techniques to get this information out to the riders. Iowa State is behind in informing students about the rules, regulations, and other important information.

Ames, currently, has their own website, but is missing much of the information that is important to know and much of the information deals strictly with the city and not the university. Going through the Iowa State website, a bike rider would have to go through parking division in order to find any information on biking on campus. If a student goes to the "B" under the index tab, they wouldn't find bicycle listed on there, which creates an issue because many students wouldn't relate parking division with bicycles. Once the student finds the bicycle page under the parking division, there is a good chance that they would not find the information they are looking for. There are two subjects on the website and that is bike regulations and locating their serial number. A common question students have with biking on campus is, "Where can I ride?". Looking at the current website, there isn't a single line or paragraph that tells the student where they can and cannot ride on campus. Since students don't know where they can find much of the important information on biking, campus becomes chaotic with bikers biking where they shouldn't and creating a higher risk of injury for everyone. We looked at universities such as UC Davis and University of Colorado Boulder to help us get an idea of what a campus bike website should include.

We recommend creating a new website for Iowa State that would help bikers get more familiar with campus and the rules that go with it. We have created a working model of what we feel can be an affective website. The website is easy to use and brings all of the information together in a one location. Along with creating a website, we recommend adding a "Biking on Campus" link under the "B" section in the index. This will help students access the webpage quicker with less searching.

Our model website includes information from bike routes to the different clubs that bikers can join. The homepage gives a brief overview of what is all included on the webpage. On the left side there are seven links that go to the different information that can be very useful when biking on campus.

The screenshot shows a web browser window with the URL <http://iastate.edu/Desktop/View%20Website/index.html>. The page title is "Bike Policy Homepage". The header includes links for GyMail, Outlook, Blackboard, AccessPlus, and a navigation bar with letters A-Z and links for Directory, Maps, and Contact Us. The main content area features a large image of a person riding a bike in front of a building. To the left is a sidebar with links: Home, Buses, Vehicles, Pedestrians, Bicycles, Rules of the Road, Resources, Maps/Routes, Safety and Security, Repair Stations, Clubs, and Path Etiquette. The main text area discusses bike policy and provides links to resources like the Rules of the Road and Safety and Security.

PROPOSAL WEBSITE

The first link is the “Rules of the Road” link. This is important link to have on any bicycle webpage. The rules of where to bike vary from city to city and even from Ames to Iowa State’s campus. The webpage has both Ames and Iowa State’s rules for riding bicycle. Because the rules vary depending on where the biker is, it is important to have both listed. Many bikers will also bike off of campus and this allows them to take one less step in finding the rules on biking in the city of Ames.

The screenshot shows a Mac OS X desktop environment with a browser window open to the Iowa State University On-Campus Transportation website. The URL in the address bar is <file:///Users/Tom/Desktop/Bike%20Website/rules.html>. The page title is "Rules of the Road". The main content area contains the heading "Ames and Iowa State Rules and Regulations" and a list of regulations for bicycle drivers. The sidebar on the left lists various transportation-related links, with "Rules of the Road" currently selected.

Rules of the Road

Ames and Iowa State Rules and Regulations

The City of Ames has other regulations in addition to the state laws pertaining to the use of bicycles. Drivers of bicycles within City limits must:

- Ride no more than two abreast while riding on a street, except on designated bicycle paths.
- Operate a bicycle equipped with a brake that will enable a braked wheel skid on dry pavement.
- Yield the right-of-way on an off-street bicycle path to traffic traveling on a public roadway.
- Operate at reasonable and prudent speeds under existing conditions.
- Yield the right-of-way to pedestrians on sidewalks, in designated crosswalks, and to traffic on streets, while emerging from alleys, drive-ways, and buildings.
- Not be attached to or towed by any vehicle.
- Not carry articles that prevent the rider from having at least one hand on the handle bars.
- Yield the right-of-way and give audible signals before overtaking pedestrians.
- It is unlawful for any person to operate a bicycle, tricycle or unicycle upon any sidewalk on the following streets: Main Street from Duff Avenue to Clark Avenue, Lincoln Way on the south side from Stanton Avenue to Hayward Avenue, Hayward Avenue on the east side from Lincoln Way to Hunt Street, and Welch Avenue from Lincoln Way to Kinnear Street.

The next link is a resource page. This page has all of the information needed to register a bike with the City of Ames or Iowa State. Many students do not know that they have to have their bike registered to ride on campus. If students do know, there are some that don’t know where they can register or that they can register right online. This page gives students a resource about where they can register their bike and also provides a link to the registration form. When a student begins to register their bike, they may not know what is needed to complete the registration. We have included a list of items that are needed for the registration form. We are hoping that with an easy access to the registration form that more students will register their bike on campus.

The screenshot shows a Mac OS X desktop environment with a browser window open to the Iowa State University On-Campus Transportation website. The URL in the address bar is <file:///Users/Tom/Desktop/Bike%20Website/Resources.html>. The page title is "Resources". The main content area contains sections for "How to license your bike" and "Where to register". The sidebar on the left lists various transportation-related links, with "Resources" currently selected.

Resources

How to license your bike:

All bicycles on the ISU campus must be registered. The City of Ames also recommends bicycle owners in the community to register their bikes. Iowa State and Ames use the same bicycle registration system. If your bike is registered with Iowa State, it is also registered with the city. By registering your bicycle, you will help deter bike thefts and assist in returning recovered, stolen or lost bicycles to their owners. ISU and the City of Ames bicycle registration program is simple, free of charge and never expires. Bicycle owners fill out a short form either in person at the locations listed below or on-line. Your information is recorded in our system and you receive a sticker with a registration number to affix to your bike. It's that easy!

Where to register:

Online Registration Form

Iowa State University
Rm. 27 or Rm. 55, Armory

City Finance Department, City Hall
515 Clark Avenue

PROPOSAL WEBSITE

We have provided a page with the map of campus and the bike routes. This helps the student to see where they can ride and not just read about where they can and cannot ride. We also provided a link to Iowa State's interactive map to help them get a better image of where they are allowed to ride on campus. This will help get bikers to ride where they are suppose to and decrease the risk of injury on the crowded sidewalks.

The screenshot shows a web browser window for the Iowa State University On-Campus Transportation website. The URL is <file:///Users/Tom/Desktop/Bike%20Website/maps.html>. The page features a red header with the university logo and navigation links for CyMail, Outlook, Blackboard, AccessPlus, a search bar, and a menu with letters A-Z, Directory, Maps, and Contact Us. The main content area has a sidebar with links to Home, Buses, Vehicles, Pedestrians, Bicycles, Rules of the Road, Resources, Maps/Routes (which is highlighted), Safety and Security, Repair Stations, Clubs, and Path Etiquette. Below the sidebar is a "Smart Cards" section. The main content area displays a large map titled "Map of Campus" showing the university's grounds with various buildings and a network of roads and paths. At the bottom of the map, there is a link labeled "Interactive Map".

The fourth link is a safety and security page. This page is very important bicyclists and motorist. There are many safety guides to follow to help students stay safe when riding around campus. This page offers a list of recommendations to help with the interaction between bikers, pedestrians, and motorists. At the bottom of the page, there is a helpful reminder to lock up your bike. There is also a useful tip to help students know the correct way of locking their bike up.

The screenshot shows a web browser window for the Iowa State University On-Campus Transportation website. The URL is <file:///Users/Tom/Desktop/Bike%20Website/safety.html>. The page layout is identical to the previous screenshot, with the same red header, sidebar, and main content area. The "Maps/Routes" link in the sidebar is highlighted. The main content area features a section titled "Safety and Security" with a sub-section "Safety Tips for Bicyclists:". It lists several tips: "Always wear a helmet.", "Ride on the right. Ride in the right lane, except when passing a vehicle, preparing for a left turn, or to avoid hazards.", "Obey traffic signs and signals. Use hand signals to advise motorists you plan to turn, change lanes, or stop.", "Make eye contact with the motorists. Never assume a motorist sees you or that you have the right-of-way. Expect the unexpected such as: parked vehicles pulling into traffic; vehicle doors opening into your path; and debris in the road.", and "At night, use headlight, taillight, and reflectors." Below this is another section titled "Safety Tips for Motorists:".

PROPOSAL WEBSITE

Across Iowa State's campus and Ames, there are several locations that a bicycle rider may get their bike repaired. On campus, there are two locations that allow the rider to do self repairs quick and easily. We have included those locations along with locations where someone may need more extensive repairs to their bike. This is very important because many students are unaware of these locations where they can fix their bike by themselves and not have to pay someone to do simple repairs.

The screenshot shows a web browser window with the URL <file:///Users/Tom/Desktop/Bike%20Website/repair.html>. The page title is "Repair Stations Around Ames". The left sidebar has a "Bicycles" section with links to "Rules of the Road", "Resources", "Maps/Routes", "Safety and Security", "Repair Stations", "Clubs", and "Path Etiquette". The main content area lists repair stations on campus and around Ames, including the West side of the Memorial Union, Bike Rack located between the HUB and the Library, and State Gym. It also mentions bike shops like Skunk River Cycles, Bicycle Plus, Bicycle Surplus, Triad Bicycle Company, and Bike World.

Many students bike on campus, but they may be unaware of the clubs that Iowa State and the city of Ames has available for them. This page offers a resource opportunity for bicyclists to learn more about joining a cycling club and also how to contact someone in the club to join. Joining a club can help an individual have a voice on the different issues with biking on campus.

The screenshot shows a web browser window with the URL <file:///Users/Tom/Desktop/Bike%20Website/clubs.html>. The page title is "ISU Cycling Club". The left sidebar has a "Bicycles" section with links to "Rules of the Road", "Resources", "Maps/Routes", "Safety and Security", "Repair Stations", "Clubs", and "Path Etiquette". The main content area describes the mission of the club as "Promote and participate in bicycling in the form of racing, recreation, and transportation". It lists projects like "Live Green! Riding Bikes!". It provides information on how to get involved, mentioning meeting times and places, and a Facebook page. Contact information is provided for Conrad Benczel, including an email address: cbenczel@iastate.edu. To the right of the text is a photograph of a person riding a bicycle in front of a large, ornate building.

PROPOSAL WEBSITE

The final link provides a list of several path etiquette tips that help the biker and pedestrian interaction become much smoother. These are helpful reminders that can help prevent an accident from happening. Many times it can be easy to forget some of these tips, but with a website, a student can easily see and remind themselves of these helpful reminders for biking on campus.

The screenshot shows a web browser window with the URL <file:///C:/Users/Ismael/Desktop/Ike520/Website/education.html>. The page title is "Bicycling Education". The left sidebar has a navigation menu with links like Home, Buses, Vehicles, Pedestrians, Bicycles, Rules of the Road, Resources, Map/Router, Safety and Security, Repair Stations, Clubs, and Path Etiquette. The "Path Etiquette" link is highlighted. The main content area contains two sections: "All Users" and "Bicyclists". The "All Users" section lists rules such as yielding to pedestrians, giving audible warning when passing other users, and riding at a safe speed. The "Bicyclists" section lists rules such as showing courtesy to other trail users, using the right side of the trail unless otherwise designated, moving to the side when conversing or taking in a scenic view, letting other users know when you are passing them, always passing on the left, keeping dogs on a leash, removing pet feces from trail, and obeying all traffic signs. At the bottom, there is a link to "Pedestrians, Runners and Rollers". The top of the page features the Iowa State University logo and a search bar.

With the use of a website, we feel that it can solve many of the current issues with Iowa State and biking. Many of the reasons why biking on campus can be hard is because there is a lack of education for the students. Students may not know the rules and regulations and by providing a user friendly website we can ensure that the policies are clearly available for all. We feel this is a very important step in helping Iowa State become a bike friendly campus.

The first phase of campus infrastructure improvement is composed of the most minor improvements, for minimal cost and ease of implementation. These changes do not require major construction and can be easily added on the existing infrastructure on campus. For phase 1 the emphasis is placed on encouraging proper interaction and behavior between pedestrians, bicyclists, and motorized vehicles. While this phase can be completed on its own, it is recommended that it is treated as a first step in a multi-stage process that will culminate in significant changes to the campus infrastructure.

Signage

The simplest step that can be taken to improve the safety and mobility of bicyclists, pedestrians and vehicles would be to improve the road signage on campus. Clear and concise signage informs people of the rules of the road and encourages them to be aware of their surroundings. The current signage present on campus is sporadic and inconsistent, as identified through survey responses and interviews. In the current environment people do not follow the rules of the road because they are not sure what the rules are. It would therefore be of benefit to clarify what is expected of road users through increased signage. The following signs are recommended for campus:

Share the Road



'Share the Road' signs should be placed along the roads on campus in order to remind motorized vehicles that bicyclists are supposed to be riding on the road and should be treated as vehicles. These signs differ from the current "shared road" signs on some campus streets because they are larger and more visible. They also directly tell vehicles to act a certain way, so the behavior expected of them is clear. These signs should be placed along all shared roads on campus, in order to create consistency and minimize confusion.

Turing Vehicles Yield to Bicyclists



Turning Vehicles Yield to Bicyclists' signs should be placed at the intersection of Stange Road and 13th Street. This intersection was identified through survey responses and interviews as being particularly dangerous for bicyclists, because bicyclists are meant to ride on the shared path next to Stange instead of in the road. When they reach the intersection, vehicles aren't expecting to see bicyclists riding across the crosswalk and they feel free to turn without looking for them. This has caused accidents in the past. This sign will inform drivers that they must look out for bicyclists before they turn.

Watch for Bikes

Watch for bikes' signs should be placed along campus streets and crosswalks. These signs will be particularly useful to pedestrians as they cross streets such as Osborn, as they will remind them to look out for bicyclists before crossing. One of the most common complaints from the survey was that pedestrians don't look where they are going, which causes difficulty for bicyclists. These signs will minimize that difficulty.

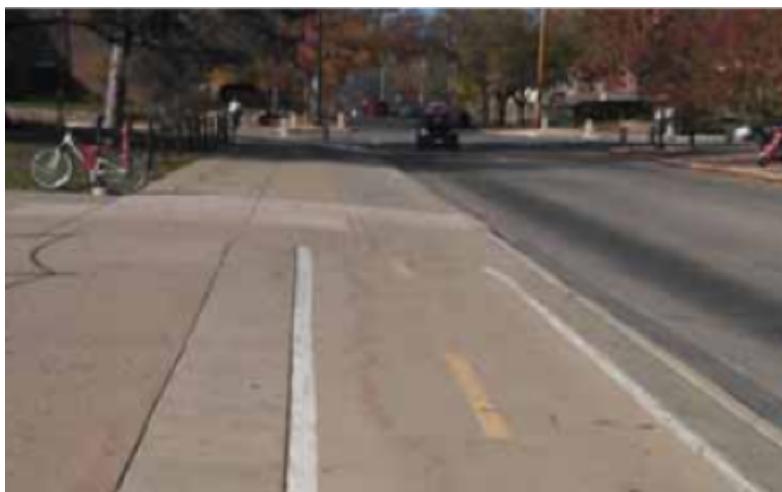
**Look left, look right' crosswalks**

These crosswalks have painted messages saying 'look left' or 'look right,' which pedestrians view just as they are about the step off the curb, and should be placed on various roads on campus. These messages serve as an extra reminder for pedestrians on campus to look before crossing the street. When pedestrians wait for the appropriate time to cross, road conditions become much more controlled and manageable.



Repainting Shared Paths

The existing shared paths on campus should be painted so there is a clear delineation between where pedestrians can walk and where bicyclists can ride. These painted paths serve two purposes. The first is to increase safety and mobility along the path for both pedestrians and bicyclists. When each party sticks to their respective side of the path, bicyclists do not have to weave in between pedestrians and pedestrians do not have to worry



about being hit by a bicyclist. The second purpose of these paths is to differentiate them from regular sidewalks. In the current state of campus, certain sidewalks are designated as shared paths while others are not, despite the fact that they look identical. As a result, people often ride on sidewalks because they are unsure whether they are supposed to or not. If the shared paths actually looked like a path meant for bicyclists, the confusion would be eliminated. On the existing shared paths on campus, lines or sharrows should be painted that designate approximately half the path as a bike path, as seen in the image above.



The second phase of campus infrastructure improvement is primarily composed of policy changes. These changes require a bigger commitment of resources and a willingness to alter the environment for vehicles on campus. For phase two the emphasis is placed on policy change and reducing vehicle traffic on campus in order to prioritize bicycling and walking as forms of transportation. While the university has put certain restrictions on car traffic throughout the university, such as the gates on Osborn Drive, the existing restrictions are ineffective in discouraging vehicles from driving through campus. While the gate on Osborn Drive is meant to limit traffic to buses and vehicles making deliveries, other vehicles have no trouble getting through the gate. It is therefore necessary to institute further restrictions on vehicles. Reducing car traffic through campus will create a safer and less congested environment for bicyclists and pedestrians, which will facilitate traffic of bike share bikes.

Eliminating Osborn Drive on-street parking

The first step towards reducing congestion on Osborn Drive would be to eliminate the on-street parking that currently exists. The cars parked along the street on Osborn create additional obstacles to people traveling the road, complicating the interactions between bicyclists and vehicles. The parked cars force bicyclists further into the middle of the street, forcing bicyclists and vehicles to share the same space, which slows traffic. Eliminating the on-street parking on Osborn Drive is an immediate step towards improving the flow of traffic on Osborn Drive and improving safety for travelers on the road. Cars that would normally park on the street may instead park in the various parking lots located just off of Osborn Drive. Eliminating on-street parking would also free up space on the road for a dedicated bike lane.

Delivery time restrictions

Another step towards reducing congestion on Osborn Drive would be to limit the time vehicles may make deliveries to buildings along Osborn to a two-hour block per day. This would theoretically eliminate all vehicle traffic apart from buses for the majority of the day, dramatically decreasing traffic along the road. The reduction of traffic will make it easier for bicyclists to share the road, and will increase safety for bicyclists and pedestrians.

Osborn Drive Bicycle Lane

A dedicated bicycle lane should be painted on to Osborn Drive during phase two. This should be a two-way lane that runs down the middle of the road. Placing the lane in the middle of the road as opposed to along the sides, as is traditionally done, would be the optimal solution for Osborn Drive because of the extremely high amount of bus traffic along the road. There are five bus stops along each side of the road, which means buses are frequently pulling over to the curb in order to let students out. A bicycle lane on the side of the road would often be blocked by buses pulling over, and by masses of students entering and exiting the buses. Therefore the bicycle lanes should be placed in the middle of the road in order to eliminate interference with the buses. At the intersections, bicycles will be expected to follow the same regulations as motor vehicles and make their turns accordingly. These bicycle lanes should be clearly marked and painted a different color than the rest of the road, in order to clearly differentiate between where motor vehicles should be and where bicyclists should be. With the elimination of on-street parking on Osborn Drive, there should be enough space on the road to accommodate these new bicycle lanes.

Bike Share System

In phase 2, we would begin to implement the bike share system. After analysis of all of the maps and data collected above we would implement 57 stations totaling in 644 docks. When implementing a bike share system, it is a rule of thumb to have a 2:1 dock to bike ratio. We would have 322 bike available to every staff, student, and faculty. We would want to add a high number of docks and bikes due to the large number of members using the system. The system would have to accommodate to nearly 40,000 members. It must also cover all of campus. A big reason why a bike share system fails is due to the lack of convenience factor. If the bike share isn't convenient for someone using the system, they will stop using it because it would require more work for them than other forms of transportation.

The third phase of campus infrastructure improvement should be comprehensive structural reform of bicycle infrastructure. This phase will require significant resource expenditure and a commitment to making the campus as bicycle-friendly as possible. This phase may take several years to complete but is ultimately necessary in order to ensure optimal safety and mobility for bicyclists, pedestrians, and motor vehicles. With the implementation of a bike share system, there will be more bicycle traffic than ever, and the current bicycle infrastructure is not equipped to handle the capacity. At the current capacity, issues frequently arise in terms of improper interaction between different modes of transportation on campus. Any increase in bicycle traffic will exacerbate these issues. It is therefore essential that the following major structural changes be taken under consideration.

Bissell Road Gate

Bissell Road should become a gated road, as Osborn Drive is. Bissell Road was one of the roads most often cited by survey respondents as being dangerous because of motor vehicles. Problems cited included vehicles running stop signs and speeding, vehicles not watching for pedestrians as they cross, and improper interactions between bicyclists and vehicles. Bissell Road would therefore be improved by putting in gates that restrict traffic to buses and delivery vehicles during the day. This would immediately reduce traffic and increase safety.

New Bike Paths

A new network of dedicated bike paths should be created throughout campus. In the current environment, there is only one path on campus that is restricted only to bicycles. As a result, bicycles often ride on the sidewalks and must navigate around pedestrians. Many survey respondents complained about bicyclists riding on the sidewalks, citing instances of collisions and near misses. In order to prevent these occurrences, bicyclists should be given their own space on which to ride. A primary bike path should run east to west through central campus. Bike paths should also be located on the campus side of Lincoln way, and running north-south approximately from the enrollment services building to the library. In order to ensure bicyclists ride on these paths and pedestrians stay on the sidewalks, the bike paths should be painted a different color from the sidewalks with sharrows and clear signage indicating their intended purpose. The exact proposed locations for these new bike paths can be seen in the next section.

New Bike Lanes

All roads on campus that have the capacity to potentially contain a dedicated bike lane should have bike lanes added to them. This will ensure optimal connectivity between bike routes on campus. It will also improve safety and mobility for bicyclists. The roads on campus that would most benefit from a bicycle lane include Farmhouse Road, Bissell Road, and Pammel Drive. The new proposed bike lanes can be seen in a renderings in the next section.

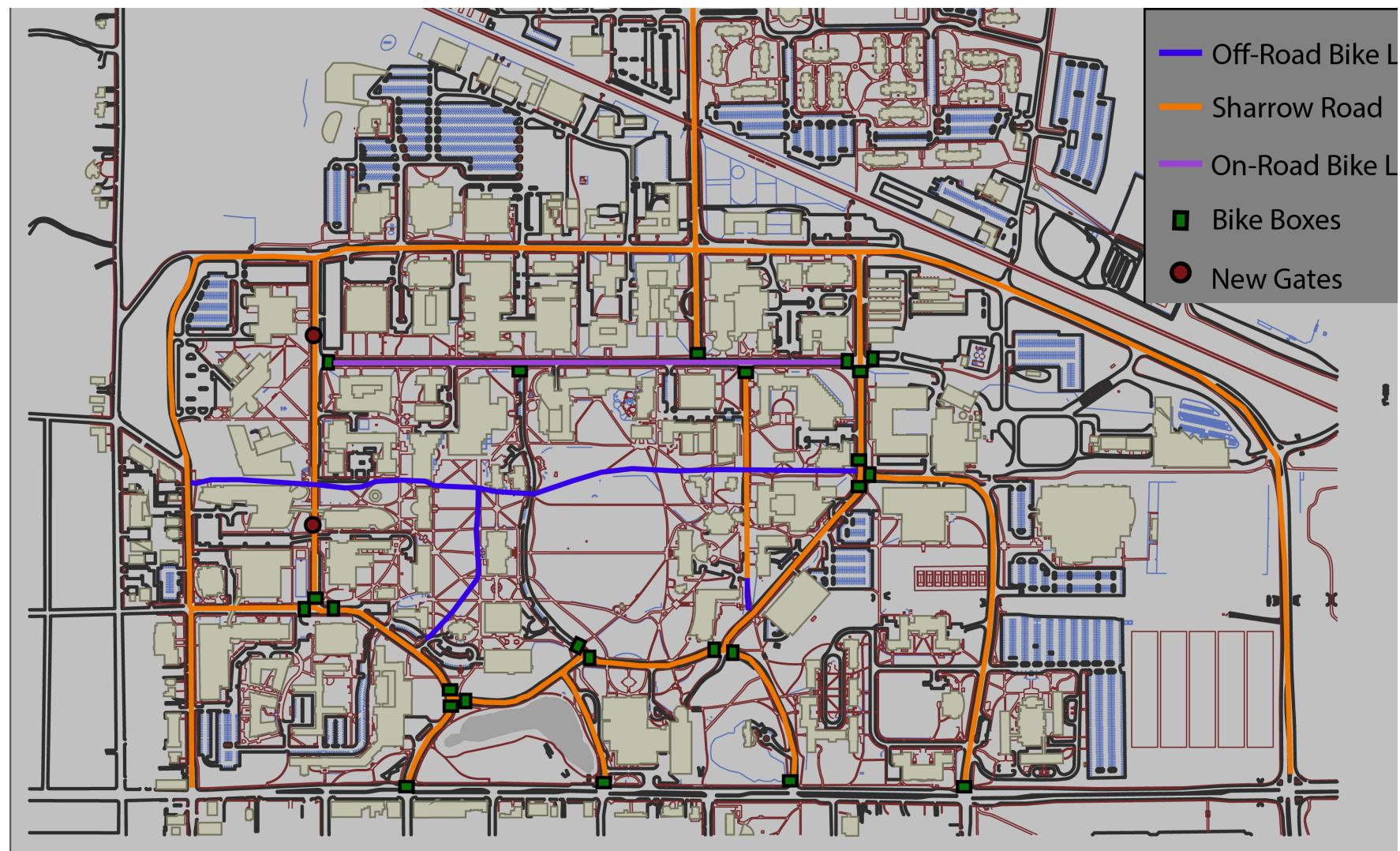
Bike Boxes

Bike boxes should be placed at the intersections of all roads with dedicated bike lanes. Bike boxes are designated boxes of space at the front of each lane at an intersection that are meant for bicyclists to occupy. These spaces put bicyclists in clear view of cars when they are stopped at the road, and provide more space for bicycles to wait for their light. When bicyclists are placed directly in front of cars in the intersection, it is much easier and safer for them to make turns, as it guarantees that the cars will see them do so.

PROPOSAL CAMPUS MODEL

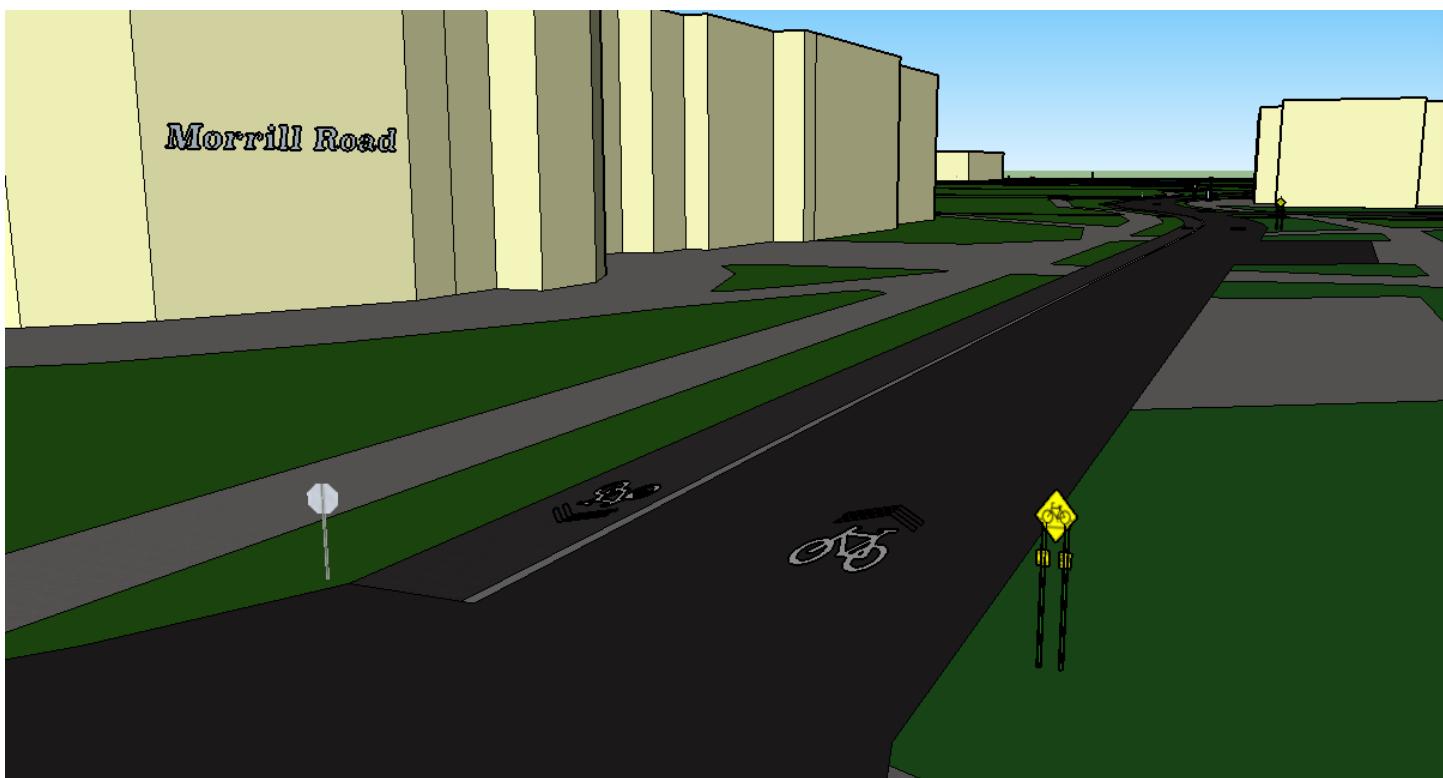
We wanted to provide a way of showing what campus would look like if Iowa State began to implement each of the stages. We created a Google SketchUp 3D model to help show the changes we propose. We created the model based on phases to show the progress over time on how campus would be affected.

The ultimate goal of our proposal is to create a campus that safe for all forms of transportation and organize any of the confusion of where people should be when moving around campus. We began with an map of campus and mapped each of the phase 3 changes. Below, we recommend three new bike paths that are located off of the road. There is an east to west route, north to south route, and a Farmhouse Lane extension path. We also have the new bike gates on Bissell which would be a study of how the gates would affect the traffic patterns of the area. The third implementation would be bike boxes. These boxes would remind the biker to stop at the intersections and also provides a safe spot for the rider to come to a complete stop.

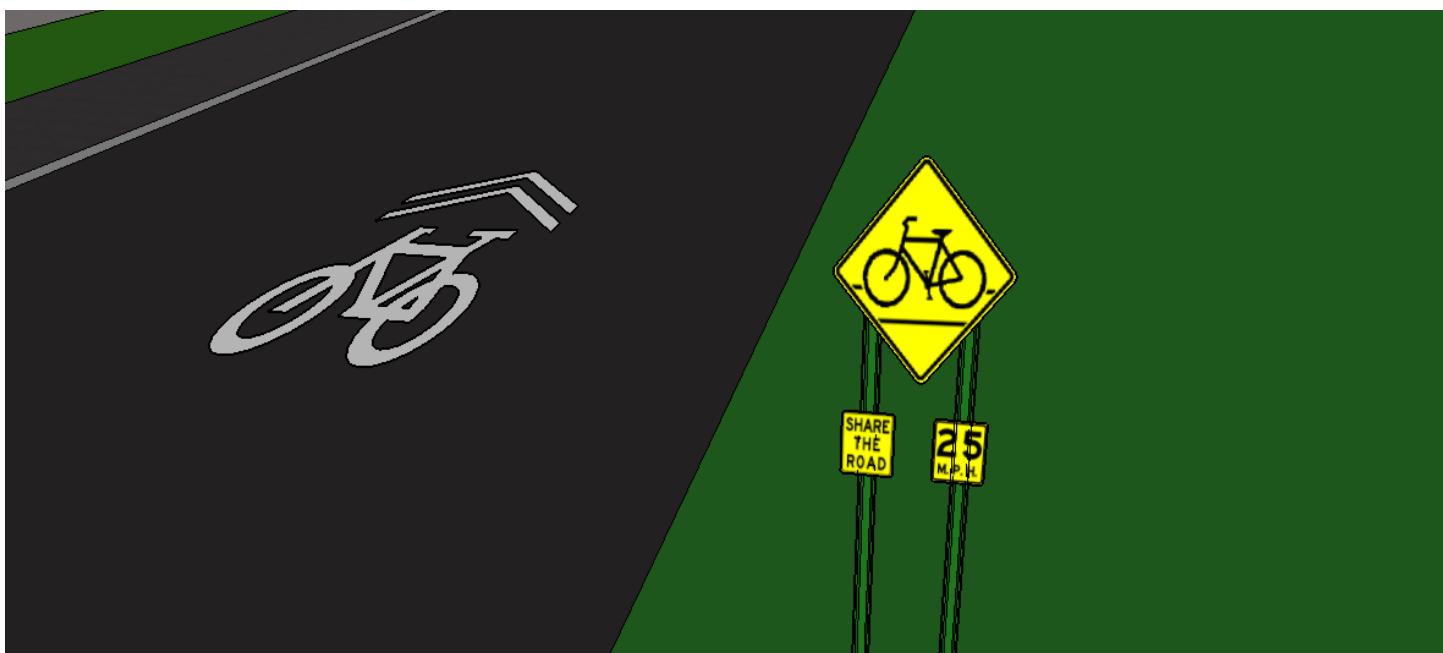


PROPOSAL CAMPUS MODEL

Phase one focuses on minimal changes that are easy to implement. We suggest signage changes and re-striping the current bicycle infrastructure. It is important to provide a way for people biking on campus to know where they should be riding their bike.



Currently, Morrill Road has the paintings on the road to show bikers where they should be riding. We want to repaint the markings due to fading from the daily wear and tear. We also want to make sure that there are enough signs along the side of the road to let drivers know they need to be cautious when driving along Morrill.



PROPOSAL CAMPUS MODEL

We propose that the street markings be placed on all roads to help educate the bikers that they belong in the street and that they have a place to ride. With just the signage and the markings on the road, there will be improvements immediately. The current issue right now is that bikers don't know if they belong in the street or on the sidewalk. We want to organize that and direct them to correct route.



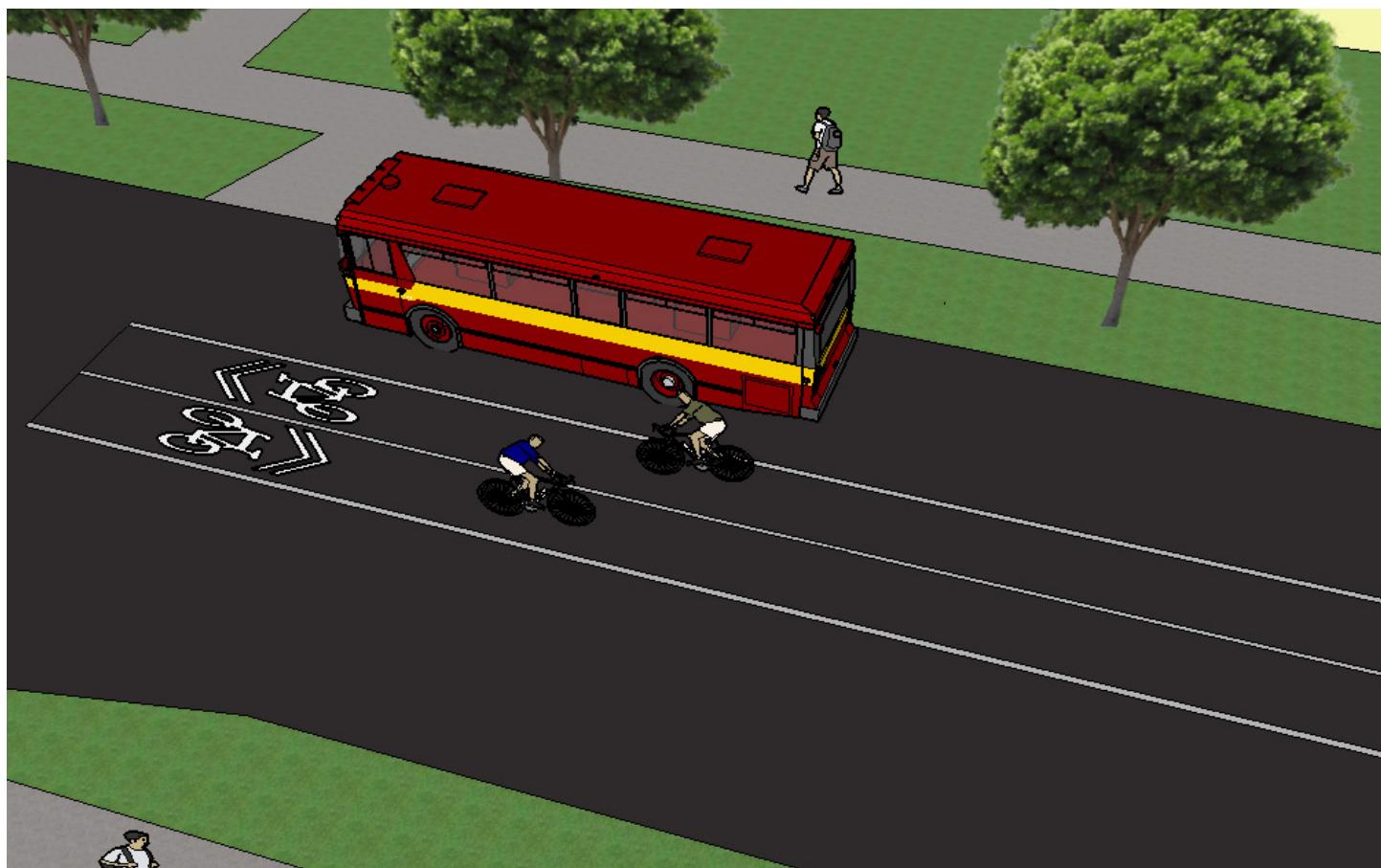
The image above shows the new markings on the 3-way intersection near Lake Lavern and Friley Hall. This intersection can be a mess due to the hill and crowded sidewalks. Bikes have been seen trying to weave around groups of people on the sidewalk while going down the hill. This presents a larger safety issue and can be solved if bikers feel more comfortable to ride in the street.

Phase 1 is a quick and immediate fix, but wouldn't solve all of the issues because of the high congestion on the streets with buses and cars. Phase 2 would build upon phase 1 and continue to make campus safer for all modes of transportation.

In phase 2, we proposed more policy changes that would help free up the congestion on campus. The one infrastructure change we propose for phase 2 is a center bike lane on Osborn Drive. This would be a 10'6" bike lane down the center and would only require the re-striping of the road as shown on the next page.

PROPOSAL

CAMPUS MODEL



With a bike lane down the center of Osborn, there will be minimal interaction between bicycles and other forms of transportation. Buses wouldn't have to worry about bikers being on their right as they pull over to pick/drop off students at the several stops along Osborn. With the removal of on street parking, the buses will have more space to get around and they wouldn't have to crowd the center line to get to the next stop. The more space between a biker and another vehicle will increase the comfort of the biker. As more bikers feel comfortable to ride on the road, the congestion on sidewalks begins to be relieved. Osborn can be the start of the larger improvements to campus to increase the safety on campus. With the increase of more bikes with a bike share, it is important for people to feel safe whether they are riding their own bike or a bike share bike.

The second phase includes the bike share system and we have mapped out potential locations. While mapping out the stations, we kept the user in mind. If we needed to drop off our bike, how far from the building we needed to get to would we want to go to park the bike. We also felt that we couldn't put the stations only in certain parts of campus because then it wouldn't be convenient for those that needed to get to a building without a station near it. We decided to implement three different station sizes to accommodate the different densities of campus. Some areas of campus do in fact have a higher number of students so those stations would have more docks. For the three sizes we have 8 docks for the small, 12 docks for the medium, and 16 for the large stations. The larger stations would be around buildings such as Carver, Gilman, and Gerdin. The map on the next page will show how the stations are dispersed around campus. We included stations in Richardson Court and UDCC as well. There also stations located in Fredrickson Court. As the system grows, we would begin to implement the stations in the Towers, University Village, and Buchanan Hall. In the future, we would implement the system throughout the city of Ames.

PROPOSAL BIKE SHARE LOCATION

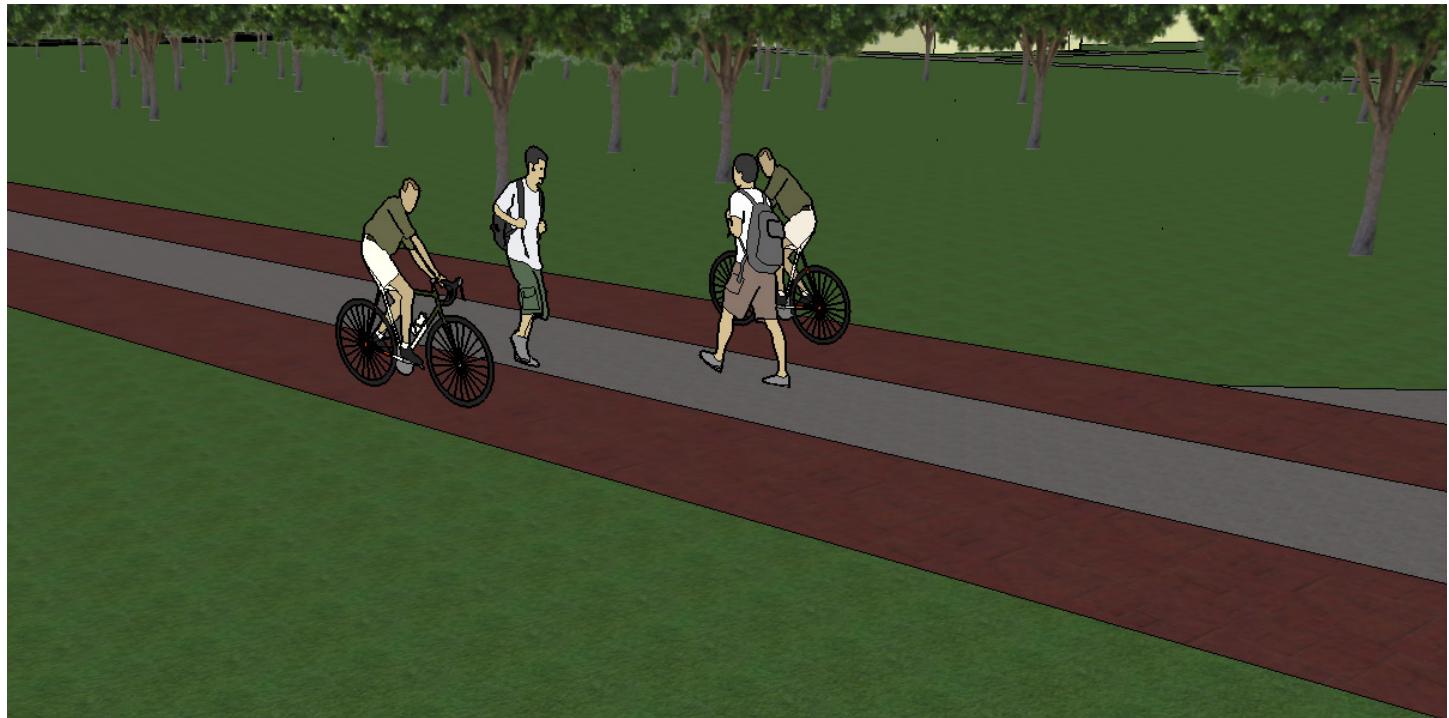


PROPOSAL

CAMPUS MODEL

In the third and final phase, there are much more infrastructure changes that will greatly change the way campus will look. These changes would be a much larger project, but in the end, we feel they will create ultimate safety for all forms of transportation.

One of the biggest take from our survey was the need for a center bike path across campus. We wanted to implement a path without changing too much of the current infrastructure of campus. We looked at the map of campus and noticed a streamline route from Wallace Road to Bissell Road. This route already had a sidewalk implemented and also connected with the current bike path between Farmhouse Lane and Wallace Road. We decided to remove the current path and create a path that was 15 feet wide to provide room for two bike lanes and a pedestrian path.



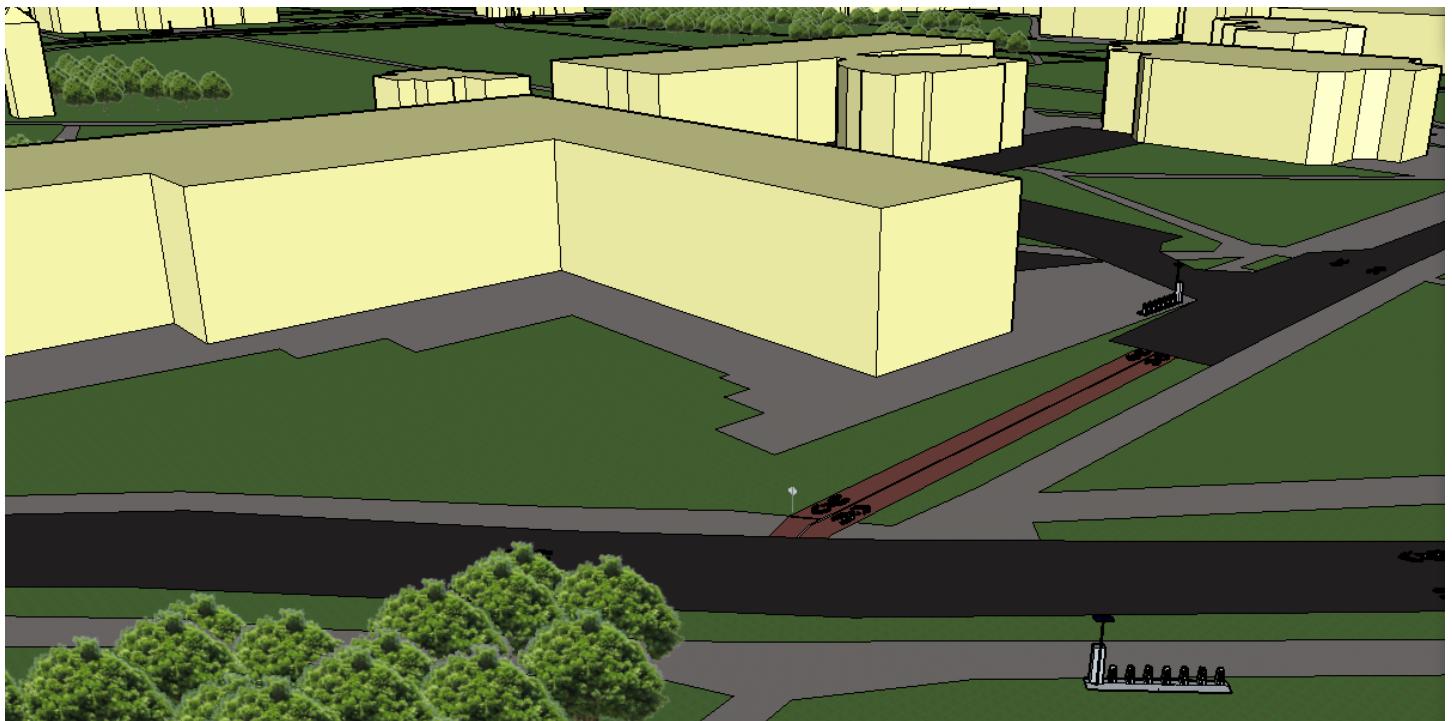
PROPOSAL

CAMPUS MODEL

The bike lanes would be on the outer sides and each would be 5 feet wide. The bike paths would force bikers to ride on the right side of the path and to stay in their lane. We also decided to change the look of the bike path and added markings to make it clear that it was a bike path. We got this idea from the University of Colorado Denver where they have implemented a similar path on their campus.

We created the path to be red to show that it is for bikers and not for pedestrians. This path runs across campus and ends on Bissell Road near Hoover and Howe Hall. The previous image shows the connection between the east to west route and the north to south route.

The third bike path that we recommend to implement is an extension to Farmhouse Lane. This would be a bike only path that would be to the west of the current pedestrian path. This path would connect Farmhouse Lane with Wallace Road and create an efficient route for bikers without having to ride on a sidewalk or ride up Wallace and ride around campus to get to Farmhouse Lane. This lane would have the same markings and dimensions as the previous two paths that we recommended.

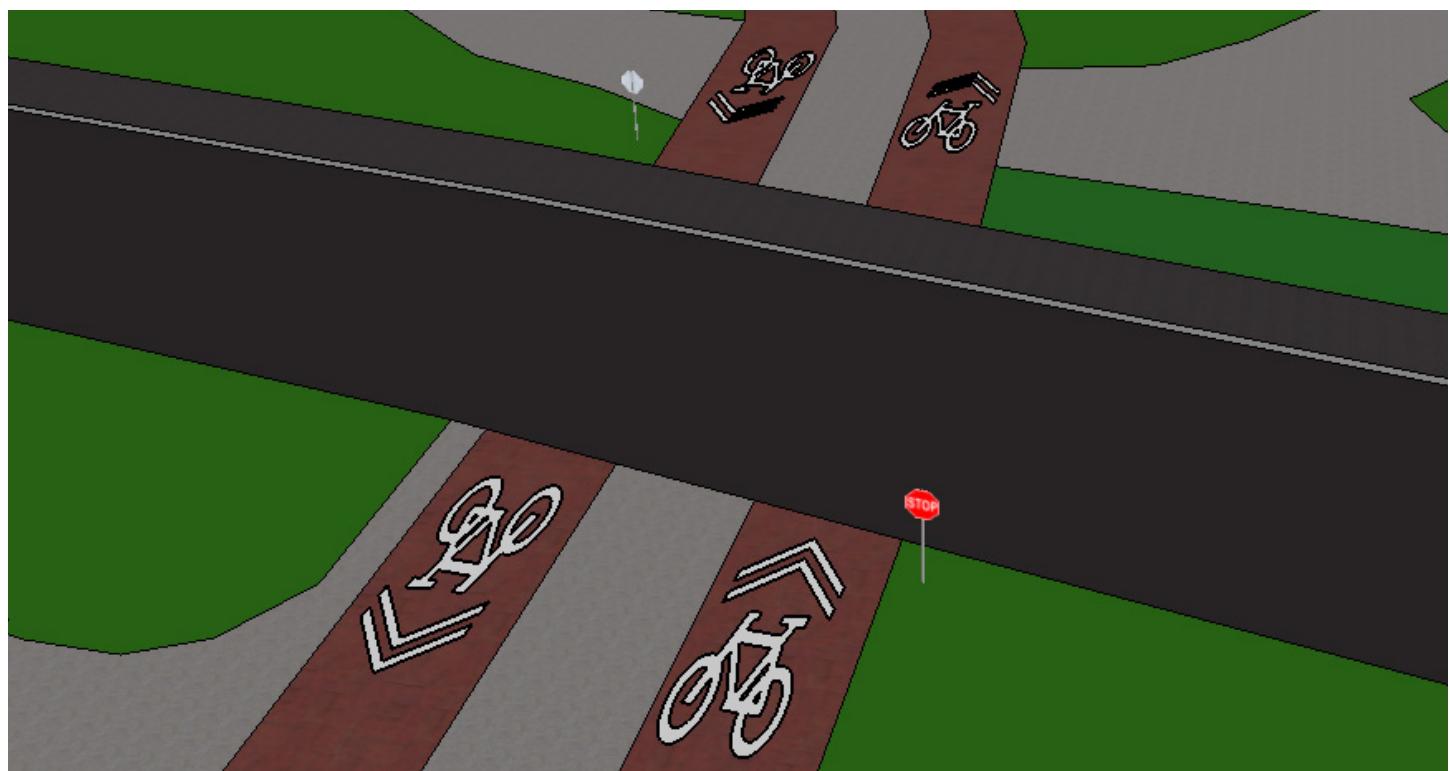


PROPOSAL CAMPUS MODEL

With the implementation of an East to West path across campus, we looked at a North to South path as well. This path would connect with the East to West path and would run south from Parks Library to Union Drive. This path is 10'6" wide and is strictly for bikers only. It is clearly marked.

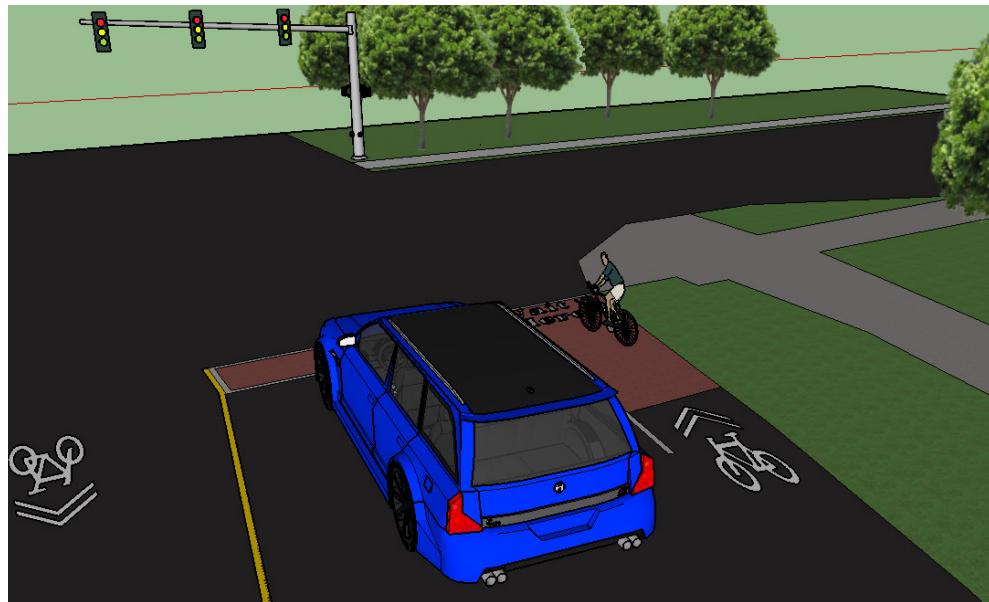


We have also implemented stop signs whenever the paths intersect with a road.



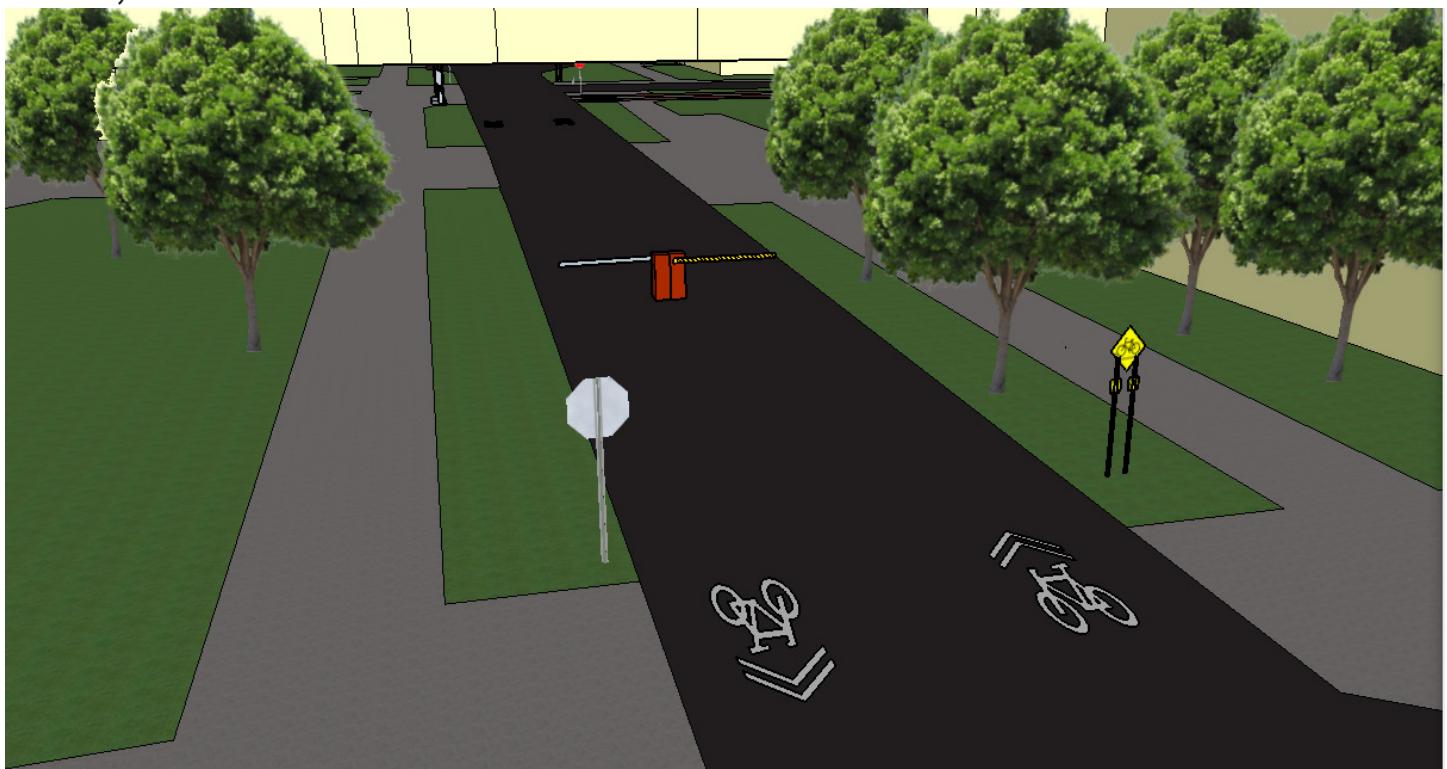
PROPOSAL CAMPUS MODEL

Another issue that was presented to us is the lack of bikers following the laws when approaching stop signs and stop lights. We proposed a new bike box that would tell the biker they need to stop and not ride through the intersection. The intersection will become much safer because bikers will begin to act more like cars and have to follow the laws.



Bike boxes are used across the world to help give bikers a safe place to stop and not have to worry that they are going to be hit by a car coming up from behind them. Cars would be able to pull up to the left of the biker and not have to sit behind the biker.

To help decrease the amount of cars entering campus, we have proposed that Bissell Road have gates on both ends. These gates would be similar to those on Osborn. Decreasing the number of non-university vehicles and CyRide buses will free up more space on the road and increase the comfort zone for bicycles and drivers.



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COST ANALYSIS

COST OF PHASES

Determining whether a project is worth the overall investment is something that is always up for debate. With this project, there are so many things that are going to go into the project. Some of these things are going to be expensive and time consuming, while others are simple changes that can be done in a short amount of time, and less expensive. While we determined what was all going to be recommended for infrastructure changes throughout Iowa State's campus, we examined all of our previous material and research to see exactly what was working with the current infrastructure, what was priority of change, and what we needed to make things better for biking on campus. After we had our prioritizing done and our phases were set for the future, determining what type of money will need to go into this project over the phases was one of the last steps.

Phase 1

Adding more signs to campus is something that will be an inexpensive step, but help educate the public about where they are supposed to ride their bicycles. Iowa State University orders their signs through the Iowa Prison Industry, these signs range from \$14 to \$24 depending on the grade of sign that is ordered. Signs such as the three signs below are typical signs that are put up for designated bike lanes, shared roads, or designated bike routes.



With the addition of signs around campus, another thing that will be added in these phases will be repainting the current bike paths and making them more identifiable. One way to do this is to simply add stripes and identifying them as a bike lane only. Bike lane striping cost roughly \$0.62 per linear foot. Another thing that is being recommended is that the shared roads currently around campus need to have painted sharrows markings on them. The price to put sharrows on roads cost roughly between \$50 to \$100 per unit. These sharrows markings would look similar to the image below. Painting maintenance is usually done twice per year on all stripes, signals, or lines, depending on the usage amount.

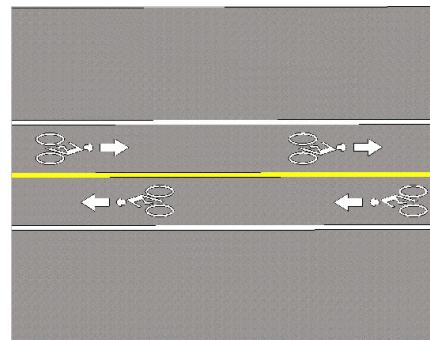


The breakdown of the total cost of phase 1 is shown in the spreadsheet below.

Category	Specifications	Cost per unit	Unit	Total Units	Total Cost
Bike Lane Striping	6" white stripe	\$3,275	Mile	0.52	\$1,705
Sign	Share the road	\$14-\$24	Sign	60	\$840-\$1,440
Sign	Bike route	\$14-\$24	Sign	6	\$84-\$144
Symbol	Sharrow	\$53	Symbol	400	\$21,200
Symbol	Bike Lane Indicator	\$50-\$100	Symbol	5	\$250-\$500
				Total Cost:	\$25,000

Phase 2

Phase 2 is where things start to become more physically different. The changes are more focused towards the space changes, rather than just educational changes. The biggest thing that is going to be done in this phase would be implementing a middle bike lane down Osborn Drive. To do this bike lane, we would need to remove the on-street parking from Osborn Drive, remove the parking signs; replace those signs with no parking signs, which cost \$10 to \$20; stripe the center with lanes and bicycle lane indicators, striping costing \$0.62 per linear foot, and the indicator costing \$50-\$100 per unit. Below are the examples of the things that would need to be added to Osborn Drive in order to achieve this part of the phase .



The next part of this phase was to include the bike share program into this time. With the bike share being implemented at full scale, we would need to put 322 packages into place. In these packages there are 2 docking stations and 1 bicycle. The breakdown of phase 2 is shown in the spreadsheet below, which includes all of the parts that are being proposed in this phase.

Category	Specifications	Cost per unit	Unit	Total Units	Total Cost
Osborn Drive Striping	6" white stripe	\$3,275	Mile	1.6	\$5,205
Sign	Bike lane with symbol	\$14-\$24	Sign	40	\$560-960
Sign	No Parking	\$10-\$20	Sign	10	\$100-\$200
Symbol	Bike Lane Indicator	\$50-\$100	Symbol	20	\$1,000-\$2,000
Bike Share	2 Docking Stations and 1 Bike	\$2,500	Package	322	\$805,000
				Total Cost:	\$815,000

Phase 3

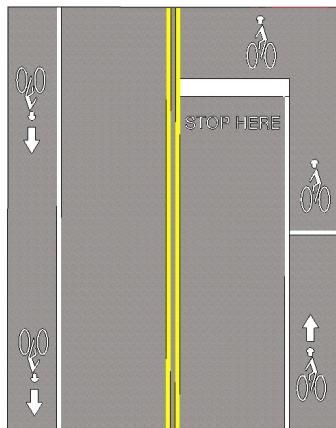
The biggest phase that we are recommending is phase 3. In this phase, we are trying to accomplish our to creating a completely bike friendly university. This phase involves creating a designated bike path along Lincoln Way, a shared bike path through campus, an extension of Farmhouse Road, a complete street for Pammel Road, along with the addition of a gate on Bissel Road to restrict the traffic flow, and also to add bike boxes at busier intersections with stop lights around campus.

The improvements in this stage have a lot of new infrastructure to be built, instead of refacing the old existing infrastructure like we had used in the prior phases. Building new paths on campus is going to cost between \$87,000 and \$140,000 per square mile that is built. This price ranges due to the material that would be used, concrete or asphalt, and also the material grade that would be chosen. The signs from phase 1 and the markings from phase two would then also need to be applied to these newly constructed areas, indicating what their intended uses are.

The other two improvements that are in this phase that were mentioned were to gate Bissel Road so that it no longer allows public traffic to pass through Iowa State University's west end. These gates are very technological and each gate that is added would cost around \$50,000 for all the components that Iowa State's current gating system uses. And lastly, bike boxes would be recommended to put at stop lights that are along busier, more congested routes, which will cost the same as striping did in the previous two phases of \$0.62 per linear foot, plus adding bicycle only symbols that would cost \$50-\$100 per unit. An example of the bike box component can be seen on the next page.

COST ANALYSIS

COST OF PHASES



Phase 3, with all these listed components would be the most costly, as far as funding goes, but it would give the university a feel that it would be completely bicycle friendly and people would use these new changes to their advantage in getting around campus. The grad total of phase 3 with all of the components are shown below in a spreadsheet.

Category	Specifications	Cost per unit	Unit	Total Units	Total Cost
Concrete Bike Path	5" Class 47B-3000	\$271,392	Mile	1.6	\$434,230
Concrete Bike Path	6" Class 47B-3000	\$181,104	Mile	1.6	\$289,770
Concrete Bike Path	6" Class 47B-3500	\$166,848	Mile	1.6	\$266,960
Recreation Trail	6" Hot mix asphalt	\$141,457	Mile	1.6	\$226,335
Bike Lane Striping	6" white stripe	\$3,275	Mile	1.6	\$5,240
Sign	Bike route	\$14-\$24	Sign	30	\$420-\$720
Gate	Security access gate	\$50,000	Gate	1	\$50,000
					Total Cost: \$280,000-\$490,000

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FUNDING SOURCES

There are many sources of funding available to groups that are undertaking bicycle infrastructure improvement projects. Funding for infrastructure improvement projects is available from a variety of sources including the Iowa Department of Transportation, bicycle advocacy groups, and our own university. Federal grants are available from departments including the Federal Transit Administration, Federal Highway Administration, and the Environmental Protection Agency. While our proposal may not be able to be entirely funded by outside grants, they may provide a substantial amount of supplementary funding. Specific grant programs are outlined below.

Iowa Department of Transportation

The Iowa Department of Transportation awards funding to public agencies for bicycle infrastructure improvement projects. The Federal Transportation Enhancement Program is awarded through the Iowa Department of Transportation, which may fund new bike lanes or paths. Iowa DOT has recently worked with bikes share systems in Iowa City and Des Moines. The deadline for the Federal Transportation Enhancement Program is October 1st and applications may be obtained through the Iowa Department of Transportation.

People for Bikes Community Grant Program

The bicycle advocacy organization People for Bikes offers funding to organizations seeking to improve their community's bicycle infrastructure through its Community Grant Program. This grant would primarily fund new bike paths and lanes, but does not cover signage. Applicants may request funding up to \$10,000. For the spring 2015 grant cycle, the deadline to submit an application for a grant is April 3rd, 2015, and award notifications are made by May 31st, 2015. The applications are evaluated based on the set of following factors: Project quality, benefits to the community, measurement and evaluation, community support and partnerships, role of People For Bikes funding, and diversity. Approximately 10-15% of applications are given grants. The application can be submitted through the People for Bikes website.

Live Green! Revolving Loan Fund

Live Green is Iowa State University's sustainability campaign run through the ISU Office of Sustainability. The Live Green Revolving Loan Fund provides loans to university groups for projects that aim to increase the sustainability of campus. Improving the campus bicycle infrastructure may be applicable, as it promotes bike riding as an alternative to driving. The program typically funds smaller-scale projects, but it may be enough to aid in the repainting of bike paths or new signage. The application requires the following information: Project scope, project goals, project deliverables, project timeline, anticipated annual savings, estimated project cost, matching funds, requested amount of funding, and anticipated payback. Applications may be sent to the ISU director of sustainability.

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CONCLUSION

Through our research and analysis, we have developed recommendations that can improve the bicycle infrastructure and policy, as well as implement a bike share system for campus. We began with precedent studies to help us educate ourselves on bike share systems on university campuses. A main take away from doing the precedent studies was that all of the universities had high quality infrastructure and strong policy. The first way Iowa State can increase their policy is by implementing a bike website. We developed a website that will help cyclists understand the rules of the road and know where to ride. We surveyed over 2,000 faculty, staff, and students, developed maps of bike population on campus and classroom density. Our group interviewed a small sample of participants from our survey. The participants included staff members, graduate students, faculty, and undergraduate students. Before we began our proposal, we recorded how the current infrastructure and bikers interact. We found many problem areas that we felt needed to be address to make a safe and successful bike friendly campus. Using our survey and our data collected along with our videos, we began to make changes to Iowa State's campus. We developed three phases to help create a bicycle friendly campus. The first phase is about creating more signage and paint markings placed on the current infrastructure. This is a quick fix that can provide an immediate impact. The second phase is more about policy. We recommend removing Osborn on-street parking, delivery times during non-peak hours, and adding a bike lane down the center of Osborn. The second phase is when we recommend implementing the bike share system. Using our data, we propose 57 stations for campus and Fredrickson Court. For the 57 docks, there would be 644 docks and 322 bikes. The third and final phase is to add better infrastructure to campus. We propose to add three bike paths that would help connect the university. We also would like to add bike boxes to intersections to increase the safety of bike when stopping. The third addition to campus is to do a study of Bissell Road with a gate on it. We would like to see how the traffic patterns would change. With the recommendations that we propose, we feel that these changes will help create a safe and efficient bicycle friendly campus. Our goal is to become a platinum level bicycle friendly university.

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