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Chicagoland Bicycle Federation
Geo 242
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Project Summary

We are working with the Chicagoland Bicycle Federation to analyze the crash sites in the city of Chicago of the year 2005. We chose to work with the CBF because we feel that bicycle safety is an issue that is not promoted enough. In this project we focused on the number of crash sites that there were in 2005, hopefully determining if more/different traffic policies are needed to be implemented in the city of Chicago. There were 962 bicycle related crashes in Chicago in the year 2005, which we feel is a number that should be closer to zero. We feel that the information of bicycle related crashes should be readily available to the public, for it will promote a more sustainable form of transportation.

In our project, we focused on the spatial information of the crash sites. We focused on where the crash sites were located in terms of zipcodes, streets, while looking at whether or not they were street-intersection related. In order to create a product that could be used to show the public that bicycling is safer than one would think, we needed to identify the hot-spots or trouble areas in the city in regards to bicycle traffic. We wanted to locate the hot spots by segment of road, to show visually where on particular streets accidents occurred most in 2005.

We ended up creating several different thematic maps to show the trouble-areas of the city for bicyclists. First, we created a map that shows the overall number of bicycle-related crashes located in each zip code of Chicago. We felt that this would best portray the size and complexity of the phenomena located in particular areas of the city. We then created a map that shows the number of bicycle accidents that occurred at street intersections. This will show the reader that there are a surprising amount of non-intersection related crashes. Lastly we located where the crash sites were pertaining to the streets in Chicago. Instead of focusing on a street in its entirety, we looked at streets in segments, therefore examining the number of crashes there were per street segment. We broke this map into three different maps: North Chicago, Central Chicago, and South Chicago. By doing this, we are able to portray the severity of the hot-spot per road segment in each of those sample areas. Splitting the information into three distinct zones enabled us to zoom closer to the characteristics that the map portrays.

We feel that our findings are beneficial to the city of Chicago, for it shows what segments of roads that are trouble areas. Dividing the information into street segments will enable the city to focus on particular areas of streets when deciding on traffic controls and bicycle safety implementations. Also, by creating maps that show the zipcodes that experience the highest number of bicycle crashes makes it easier for the city to identify the districts that should focus on bicycle safety promotion.

Table of Contents

Introduction:

We have chosen to work with the Chicagoland Bicycle Federation for this project. We will be working with director Mike Erickson for this project whom works for the CBF. The goal of this project is to identify the hot-spots or troubled areas of the city in regard to bicycle accidents. We feel that this is an important project because many residents of Chicago feel that bicycling in the streets of the city is very dangerous. It is obvious that when cycling one must take precautions, but we also want to show that bicycling in the city may not be as dangerous as one may think. Producing maps that show where the accident hot-spots are located, we will be able to portray to the reader where danger zones are and therefore educate them into taking different routes during commutes.

We completed the project in 5 steps, which will we look at next. First we asses our project. We complete a literature review of the issue of bicycle safety, and determine what we need to look at while concentrating on safety promotion. In this section we will decide what the need-to-know questions are and how we are planning on solving them.

Second, we look at the systems required in completing this project. We focus on the data that we need to do and the relationships between data entities and attributes. We created an entity relationship model that shows how our data relates to one another, and some of the processes needed to be completed in portraying our information.

Third, we focused on our data acquisition. In this section of the report we look at the sources of the data that we are going to use in our final project. This covers where we received our data from, and the steps we went through in acquiring that data.

Fourth, we went through a data analysis. We examine how we are going to process our data in producing our information products. We break down our analysis into three sections, showing the steps to produce information products for: Crashes per zipcode, per street segment, and which is intersection related.

Needs Assessment:

Background: We have met with member, Mike Erickson, of the Chicagoland Bicycle Federation recently to talk about improving bicycle awareness to promote bicycle usage. One of the issues that we discussed was bicycle safety, and how many opt to rely on public transportation or automobile for their daily commutes because their impression of how unsafe bicycling is in urban environments. The mission of the Chicagoland Bicycle Federation (CBF) “is to improve the bicycling environment and thereby the quality of life in the region” (BikeTraffic.org). The CBF is trying to educate and inform citizens of

Chicago the important aspects of energy-efficient transportation methods, which improves the quality of life in several areas.

One of the problems that Mike Erickson has encountered while working at CBF was that many people are still turned off to the idea of bicycle transportation as a safe and reliable means of mobility. Mike, as well as ourselves, feel that people do not think about using bicycles as a mode of transportation because of how unsafe they feel the method is. One of our group's goals in this project is to create and document crash and accident data to portray to its viewers where the problematic locations are referring to traffic. This would educate potential bicyclists into preferring this method of transport, for it will identify the areas that impose the highest level of threat for accidents.

Our understanding of educating people to realize how practical bicycling can be is that it will not only provide a means of alternative transportation, but will simultaneously identify problem intersection and areas where safety assistance is and may be needed. An article posted by Michael Neuman (2004) talked about how cities such as Madison, Wisconsin are promoting bicycle usage to better sustain the environmental quality of life. Neuman states that the reduction of automobile usage will aid in many different areas such as: air pollution and quality, traffic density and congestion, conservation of resources, and reduce the rapid development of sprawl. If more people chose to use bicycle as a means of transport the need for an automobile will diminish and people would choose to live closer to where they work, eat, and play.

David Tomlinson wrote in his essay, The *Bicycle and Urban Sustainability* (2003), about how bicycling in American cities has proven to be ordeal, whereas the in Europe it is the most popular form of transportation. Tomlinson feels that planning for urban sustainability cannot be to find a means to the end, but to rather focus on the negative and unsustainable practices that our nation is so involved in, such as automobile usage. To think of urban sustainability as a direction the government needs to take is an easier approach to gaining bicycle popularity in places where it posses none. Tomlinson states that he "…will argue that the methods used in some cities to promote alternatives to automobile transportation have made those cities more socially, environmentally, and economically sustainable, and that these strategies should be adapted and applied in cities such as Toronto" (pp. 4).

The city of Chicago has proposed a Bike Plan 2015 (2006) which builds upon the Bike Plan 2000 that is already in effect. Part of the plan consists of expanding the accessibility of the city by bicycle through different forms of infrastructure. The plan follows our beliefs that we need to locate the hot-spots of traffic and bicycle accidents to help in the aid of safety issues concerning bicycling. By 2015 the city hopes to produce a much friendlier and safer environment for not only bicyclists and pedestrians, but also automobiles. They hope to do this by: increasing the amount of miles of bicycle-only lanes, as well as shared lanes, increase the miles of shared lane and road markings regarding bicycles, and lastly to establish "bike boulevards" and raised bike lanes to facilitate safety in road sharing.

The US is starting to realize how important of a role bicycles have in, not only cities, but for national sustainability. Increased usage of bicycles will decrease usage of automobiles. Increased usage of bicycles will help environmental, social, and economical problems in cities. As Tomlinson talked about in his essay, we must not search for ultimate solutions to sustainability problems, but we must focus on

unsustainable issues and figure out how to correct them. Our group feels that bicycles may be a solution to many unsustainable practices.

Goal: The goal of our group working with the Chicagoland Bicycle Federation is to help people in the city of Chicago remain safe, whether they are riding their bicycles or vehicles. Many people do not feel safe riding their bikes on the streets and the CBF is hoping to change their opinions by showing them how safe they can be while transporting bike. We also want to help devise solutions to the problems that are present, such as why are there more crashes in this area compared to that area.

Objectives: The CBF wants to know if there is spatial relevance of all of the crash sites within the city of Chicago. The CBF wants to see if there are specific locations that should be identified as "hot-spots" or areas that need attention. By doing this they will be able to determine if the city needs to take action in certain areas of the city for improving the safety of automobiles, bicyclists, and pedestrians.

-CBF needs to know the frequency of vehicle/pedestrian/bicycle accident sites per street.
-They also need to know if there is a correlation between the severity of accidents and the speed limit posted in each incident.
-The CBF needs to know if there is a difference between the amounts of accidents there are during peak and off-peak hours of the work day.

Information Products: -We will make a thematic map using graduated colors to show the frequency of vehicle/pedestrian/bicycle accidents per street.
-We will make a scatter graph showing the relationship between the severity of the accident and the speed limit posted in each study area.
-We will produce two different graphs showing the disparities of similarities between the frequency of accidents during peak and off-peak hours.

System Requirements:

Introduction:

Our overall goal with working with the Chicagoland Bicycle Federation (CBF) is to try and find the inconsistencies and frequent occurrences of bicycling accidents throughout Cook County. We have concluded in Part 1 that one of the major reasons that people find bicycling extremely dangerous in the city is because of lack of information and knowledge that is provided to the public. We have identified some need-to-know questions that have guided us in constructing a strategy to help portray easy-to-read information to the public concerning the dangers of bicycling and perhaps where the danger-zones are spatially located in Cook County.

Now we need to identify some of the contributing factors to the bicycle and pedestrian accidents, and determine if a pattern exists. In order to do so, we need to organize the data that we have, and figure out how we are to manipulate and link certain data characteristics to one another, thus enabling us to form a strategy as to how we will visually represent the crash data.

Data Requirements:

Entities	Need-to-Know Questions		
	Hot Spots by Road	**Hot Spots by Zipcode**	**Cause of Accident**
Street	**x**		
Accident	**x**	**x**	**x**
Traffic Control	**x**		**x**
Zipcode		**x**	

Attributes:

Street - # of lanes
- Direction of Travel
- Road condition
- Surface Condition (eg. Wet, Dry)
- Time/Day

Accident – Time/Day
- Weather
- Longitude/Latitude
- Severity
- Intersection Relation
- Work Zone Relation
- Visibility

Traffic Control – Type of Devise (eg. Traffic light, Stop Sign)
- Devise Function
- Intersection Related
- Visibility

Relationship:

We will relate our entity classes with the following:

Accident – Street
- Many-to-One
- Relation: “Where on” (Where on Street are there Accidents)

Accident – Traffic Control
- One-to-One
- Relation: “Occurred where” (Occurred where Traffic Control Exists)

Street – Traffic Control
- One-to-Many
- Relation: “Controlled by” (Street controlled by Traffic Control)

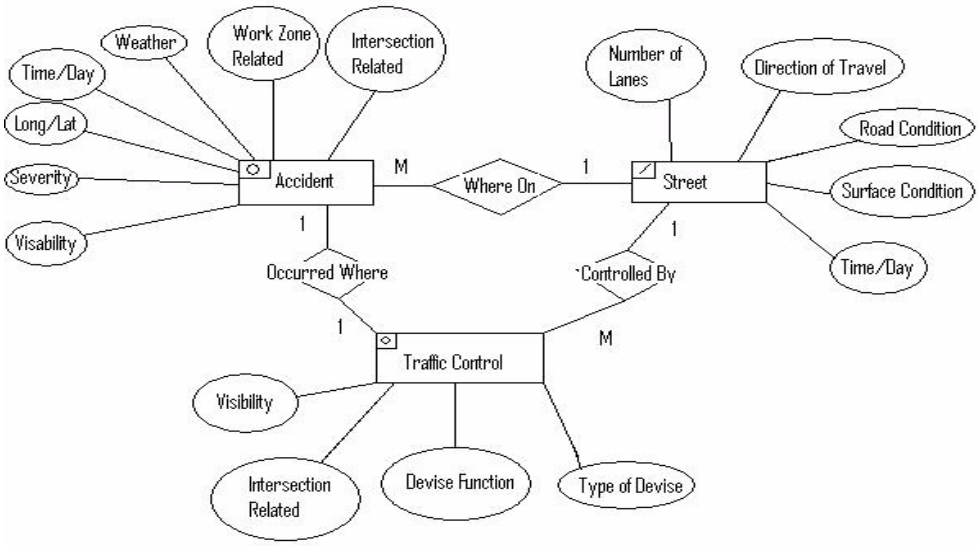
Spatial Object Type:

Street – Line

Accident – Point

Traffic Control – Point

Entity Relationship Model:



Software Matrix:

Functions — Need-to-Know Questions

	Hot Spots by Road	Hot Spots by Zipcode	Cause of Accident
Attribute Query and search	**x**	**x**	**x**
Thematic Mapping	**x**	**x**	
Direct Import	**x**	**x**	**x**
Spatial Overlay	**x**	**x**	
Aspect Analysis			**x**

Institutional Requirements:

To complete this project we will be using data that has been supplied by Mike Erickson of the CBF, as well as the StreetMap05 data that is available on the X:Drive in GIS Lab at DePaul University.

The data we have received from the CBF is highly organized crash data consisting of 68 organizational characteristics. The data is comprised of 2005 crash/accident reports that were provided by the State of Illinois to the CBF. Though we are sure that not all accidents have been reported to officials, we feel that the data we do possess is a large sample size, enabling us to make accurate depictions and to analyze the existence of bicycle accidents in Cook County.

Data Acquisition:

Introduction

Through our discussions with Mike Erickson, and after discussing the Chicago Bicycle Federation's needs, it was decided what information we would need and what we were going to accomplish through the use of GIS. From these discussions, we found that looking at the street information of the accidents, along with certain details of each accident, relevant and usable maps showing the situation of each accident and where it is located will be the most useful maps. The maps will show hot spots by road and hot spots by zip code. This portion of the project is describing the type of data we have, where the data came from, and how useful it will all be. While we did not have much influence in the information collected or what to do with the information, the process is still important.

Data Dictionary

Street Data

File Name: ChiStreets

Description: Data representing location and relationship of all roads in Illinois that will be narrowed to show only Chicago in the final project.

Spatial Type: Line

Source of Data: The data was gathered from the file StreetMap05 located on the X: Drive in the GIS lab at DePaul University.

Accident Data

File Name: Accidents

Description: Data collected describing the details of each reported pedestrian accident on the road. Data includes the date, time, and longitude/latitude of accident site, severity, intersection relation, work zone relation, visibility, weather and injury.

Spatial Type: Point

Source of Data: Individual data was collected by the Chicago Bicycle Federation and inputted into the computer by the CBF. The information was then emailed for the project's production. Mike Erickson is the Director of the CBF. (xxx)xxx-xxxx.

Data Source Steps

The first step was to meet with Mr. Erickson downtown at the CBF office. From there, we discussed what our requirements and how they worked with what the CBF needed. After the meeting, he emailed us the information they had collected. The street data was already on the X: Drive in the GIS lab at DePaul University, used for other projects.

Fitness for Use

The data collected is just right because the CBF only gave us the data they had collected that they wanted us to use. While much of the data is mixed up, it is our duty to organize it all in a way that can be easily viewed and understood. In order to do this, we will create choropleth maps that will sort out any confusion in the data. The limitation to using the data given to us is that it leaves very little room for our own creativity and basically sets out exactly what we need to do.

Data Acquisition Constraints

Due to some miscommunication with Mike Erickson about what our time and duty constraints were, all data acquisition was up to the CBF to collect. In turn, we were stuck with what we had been given the path to creating maps was set out for us and we had to follow it. If we had our choice, we could have done more surveying, attempting to decide what roads could use bicycle lanes, interviewing bikers and local residents of hot spots and deciding what areas could use the most improvement.

Data Analysis:

Introduction: In stage 4 of our project, we are going to look at how we will analyze our data, which focuses on our need-to-know questions. Recently, Mike Erickson of the CBF asked us to also include the information of traffic signals to determine if the accidents were intersection related. He wants us to see if there is a correspondence between the accident site and traffic regulations. If we are able to distinguish a cause to the accident(s) we can then further implement a strategy to asses this problem. For example, an accident may have been caused by the biker him/herself for they may have ignored a traffic signal. Instances such as these are important to recognize because it shows that some accidents are not caused by wreckless driving or lack of infrastructure (traffic signals, speed limit, and road markings).

In all we will have to incorporate many different criteria to our accident hot-spot analysis. Once we have located the accident sites, we will organize the severity by street and by zip code. By analyzing the frequency of crashes per street, we will be able to determine and/or hypothesize if the cause of the accident was infrastructure related or wreckless driving. By analyzing the frequency of crashes per zip code, we will be able to determine if there are certain districts within Chicago that provide little support to bicycle safety (perhaps by not fixing faulty road surfaces and/or properly marking bicycle lanes). We will also single out cases where the accident was intersection related and/or traffic signal related.

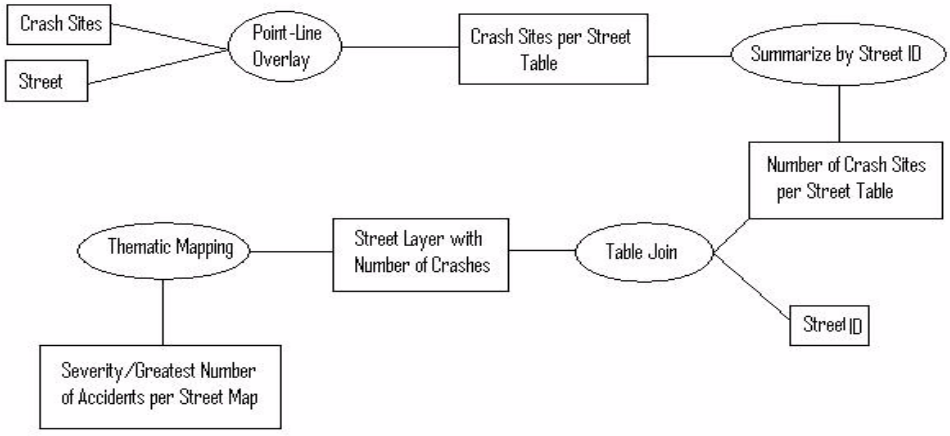
It is easy to generalize about how accidents were caused. But there are many instances where the cyclist was the catalyst of the accident. Perhaps the cyclist was traveling the wrong direction on a one-way street or failed to obey a traffic signal. Determining the cause of the accident is highly important because infrastructure implementation can only bring forth a fraction of safety. We want to focus on the cases where the accident caused was a result of infrastructure, proving that certain roads and districts (zip codes) are failing to improve the safety conditions for bicyclists.

Analysis Plan: First we will determine the amount and location of each accident in relation to the road throughout the city of Chicago. By doing so we will input our crash data by latitudinal and longitudinal location and overlaying this data over the streets layer in the X:\StreetMap06\usa\census for city boundary data. This will give us the spatial location of the crash sites per street. This will probably result in a dot-density or proportional symbol map emphasizing its severity. We will have to create two different maps, one showing the location of crash sites throughout Chicago, and another more-

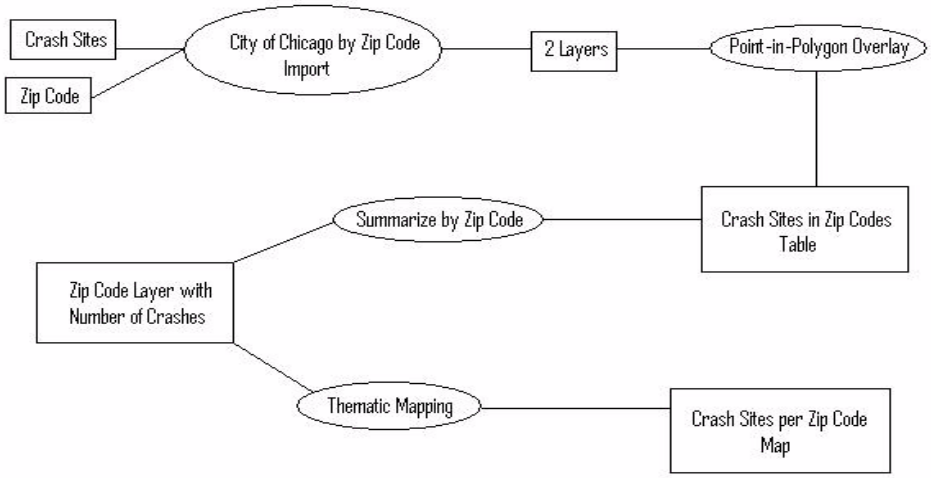
detailed map of the Loop area. We need to create individual maps for the Loop because of the large frequency of crash sites located there.

Next we will use the same crash data and overlay it with a Chicago zip code layer. Doing this we will be able to create a choropleth map showing the severity/frequency of accidents per city district.

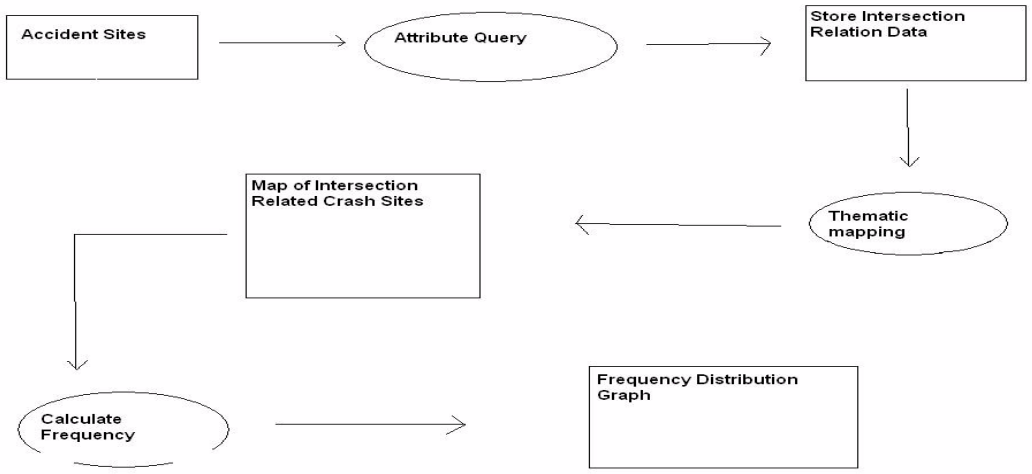
Lastly we will have to manually interpret whether or not the accident was intersection related or not. We will be able to select the cases where it was/was not due to how our crash data is organized.



We need to first overlay the crash sites data with the streets layer. We will then be able to identify the number of accidents that occurred on each street through means of attribute query. We are not sure as to how we will portray our findings onto a map, but we feel it will either be a proportional symbol map showing the severity of accident sites, are we will do an aggregate color map, differing the color of the street segments depending on the number of accidents located there.



We will first import a layer containing the City of Chicago organized by zip codes. Next we will perform an attribute query to identify the number of accidents that are located in each zip code, enabling us to decipher which areas of the city are most problematic for bicyclists. For the portrayal of this information, we will choose to use a color choropleth map, where the darker zip code districts will be where more accidents occur.



For this segment of our project we are going to perform an attribute query to select the accidents that were intersection located. We will then use another attribute query to see if the accidents at the intersection were caused due to a malfunction of infrastructure (traffic light, stop sign, etc.) We will then calculate the frequency of intersection related accidents compared to those non-intersection related. To display the frequency of

intersection related accidents, we will use a color categorical scheme, where intersection related crashes will be of different color than those non-intersection related. We will also produce a frequency distribution graph showing the percentage of all crashes that were intersection related.

One issue we are going to face is the large abundance of accidents that are located within the loop district. We are going to have to cerate different maps that show the same three (accidents per road, accidents per zip code, and frequency of intersection related accidents) entities for the loop district, as well as the entire city of Chicago.

Results:

As a result, we were successful in creating thematic maps that explain our phenomena. Figure A (See Appendix C) is a choropleth map that shows the total number of accidents that are located in each zip code of Chicago. This map shows what areas of the city need to address their bicycle safety issue. We were able to complete this map by spatially joining our XY Crash data with a zipcode layer of the city of Chicago. Once we joined the two layers, the resulting layer contained the number of crashes that occurred in each zipcode. Figure B shows the intersection-related crashes with the non-intersection-related crashes in Chicago. The intersection-related crashes we symbolize in red, and the non-intersection-related crashes are symbolized in green. We were able to complete this map by simply overlaying our XY crash data over the same city of Chicago by zipcode. We performed an attribute query where we located the crashes that occurred in intersection and those that did not. We feel that this map successfully shows that many of the accidents that occurred in 2005 were not intersection-related, which most would assume is the case.

Figure C is a thematic map that shows the number of bicycle crashes that occurred on each street segment in Chicago. We were able to complete this map by clipping the road layer from X:streetmap05/streets layer. Once we clipped, we had all of the local and major roads that are present in Chicago. We then spatially joined our XY crash data to the streets layer to show how many accidents occurred per street segment and the quantity. We felt that this map was a little to overwhelming for it encompasses a large area. We then decided to break down the same image as Figure C into three images: Figures D-F. Figures D-F have the same information as Figure C, but we broke Chicago into three sections: North, Central and South. By dividing figure C into three maps, we were able to zoom in closer to the city, and better portray the crash location information.

We have found that there are many areas and street segments that are trouble areas for bicyclists. There were many instances where there were more than one crash that occurred in the same location as another accident. By identifying these crash locations and trouble areas, we are now able to point out to policy makers where problems are arising, therefore promoting bicycle safety to addressed in those areas.

Summary/Conclusion/Recommendation:

Though we were under a time constraint, we feel that we produced an above par information product. Depending on how the city decides to approach bicycle safety and infrastructure, we provided maps that show the city by zipcode, and the city by street segment. By creating a map that shows the number of crashes that occurred in 2005 per zipcode, the city can then focus on an entire community when implementing new bicycle policies and policies for traffic safety. By creating a map that breaks down the crashes by street segment, the city is able to locate the trouble intersections and segments of streets.

As we said before, we feel that there are many trouble areas in the city. There are many zipcodes that experienced over 40 crashes in 2005. There are also many street segments that experienced two of more crashes in 2005. We feel that something needs to be done to reduce these crash cases, and to imply traffic safety more aggressively.

Taking the information that we have produced, we would recommend that the cause of the accident be looked at more thoroughly. We did not have enough time to go back and look at the times of the accidents and the weather conditions during the accidents. By taking the crash data that we have created, one could go back and see if it was because of road conditions, whether or not there are bike lanes marked, and time of day the accident occurred. By doing this, the city would be able to narrow down the true causes of bicycle accidents, and prove if the accident was causes by wreckless bicycling not driving.

Now that we have determined the locations of the bike crashes and the troubled areas of the city, we would recommend that one would then focus on the cause of accident to determine the policy or process one should take to address the problems.

Appendix:

Appendix A:

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Appendix B:

Works Cited

City of Chicago. *Bike Plan 2015*. <http://www.bike2015plan.org/execsumm.html>.

Neuman, Michael T. Rebates *for Driving Less: a Nonstructural Alternative to Expanding the Capacity of Highways*. August 2004. <http://www.bicyclefixation.com/altdrive.htm>.

Tomlinson, David. The *Bicycle and Urban Sustainability*. January 2003. York University. <http://www.yorku.ca/fes/research_pub/pubs/pdf/david_tomlinson.pdf>.

Appendix C:

Fig. A

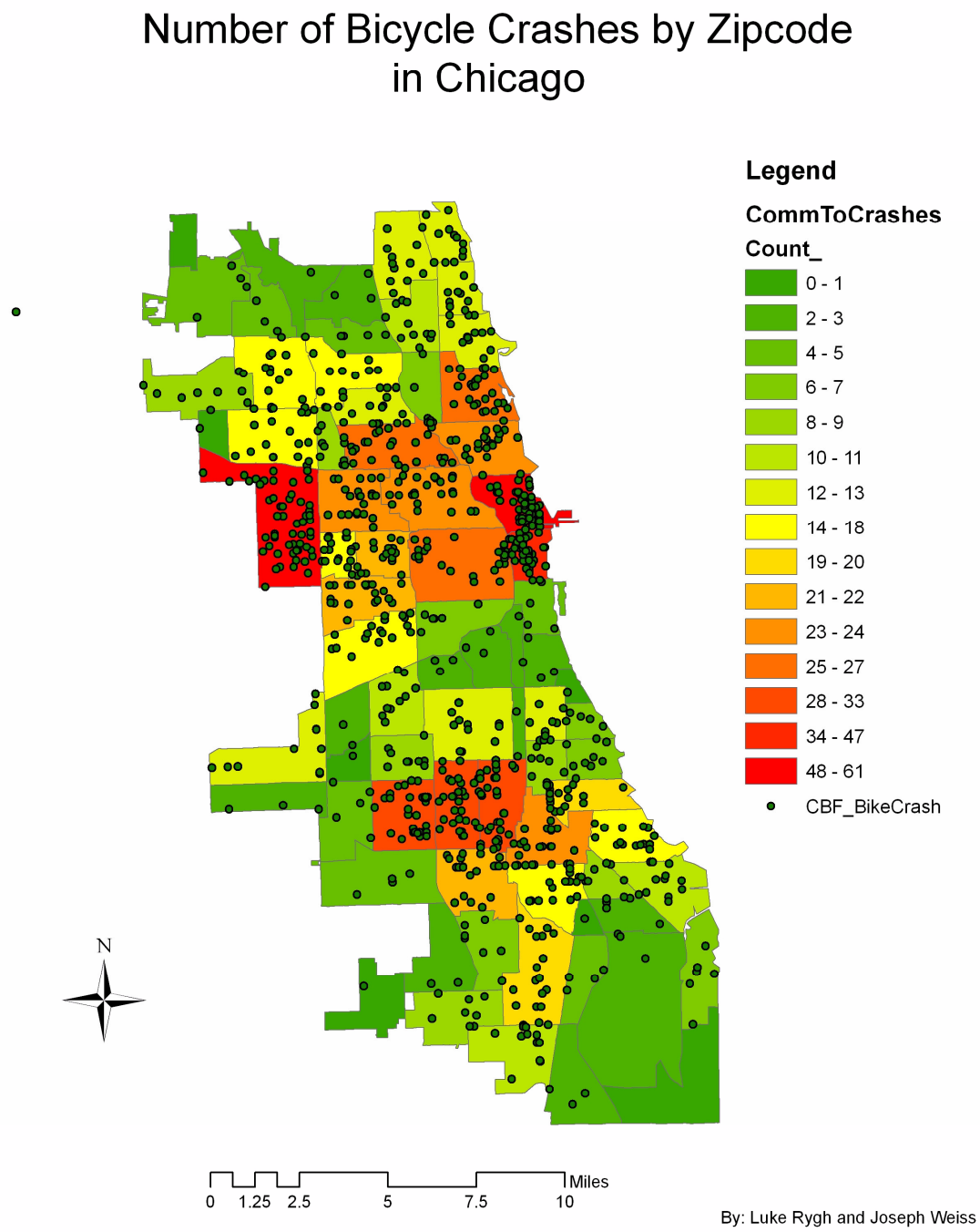


Fig. B

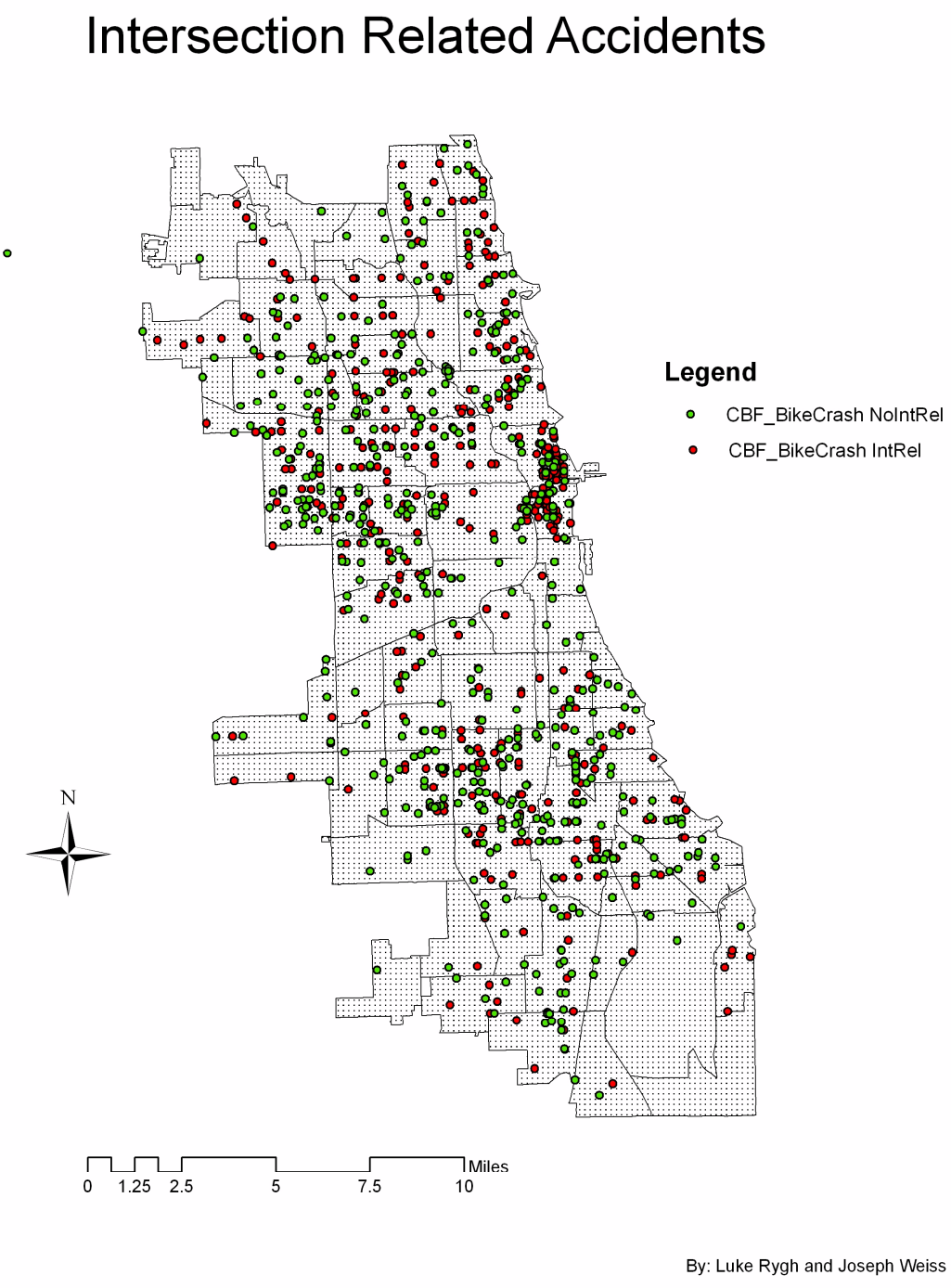

Intersection Related Accidents
Legend
CBF_BikeCrash NoIntRel
CBF_BikeCrash IntRel
N
0 1.25 2.5 5 7.5 10
Miles
By: Luke Rygh and Joseph Weiss

Fig. C

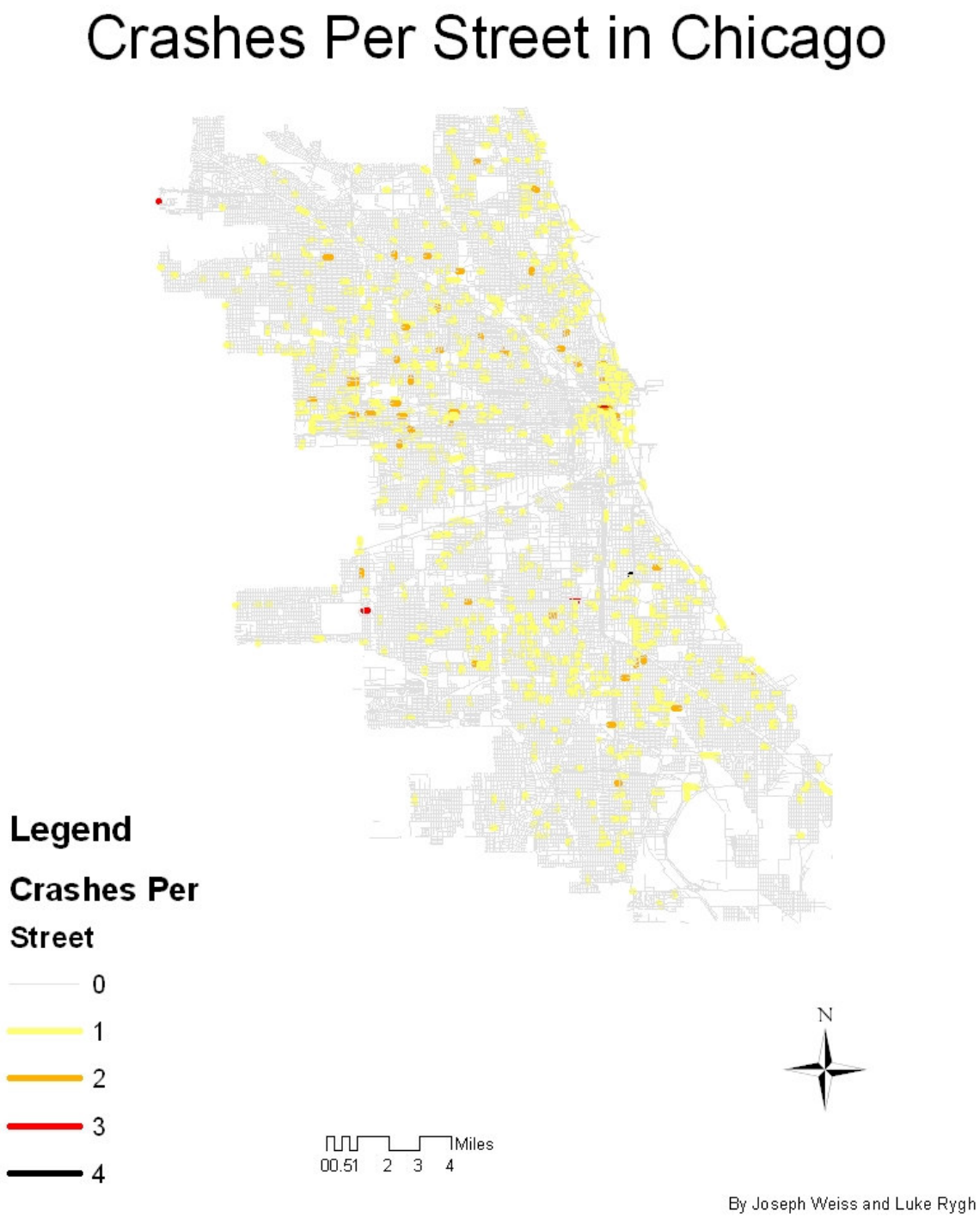

Crashes Per Street in Chicago
Legend
Crashes Per Street
0
1
2
3
4
N
Miles
00.51 2 3 4
By Joseph Weiss and Luke Rygh

Fig. D

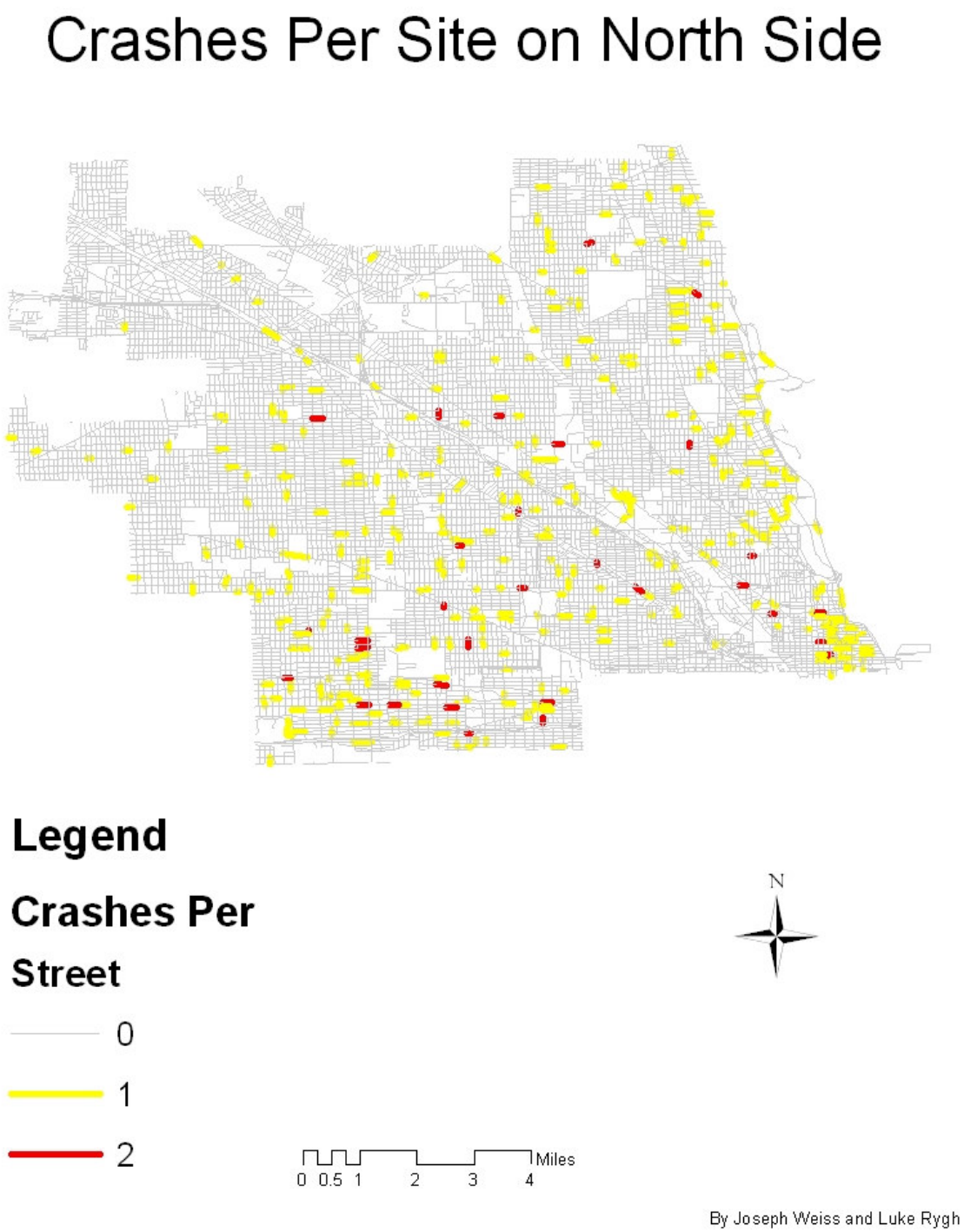

Crashes Per Site on North Side
Legend
Crashes Per
Street
0
1
2
N
0 0.5 1 2 3 4
Miles
By Joseph Weiss and Luke Rygh

Fig. E

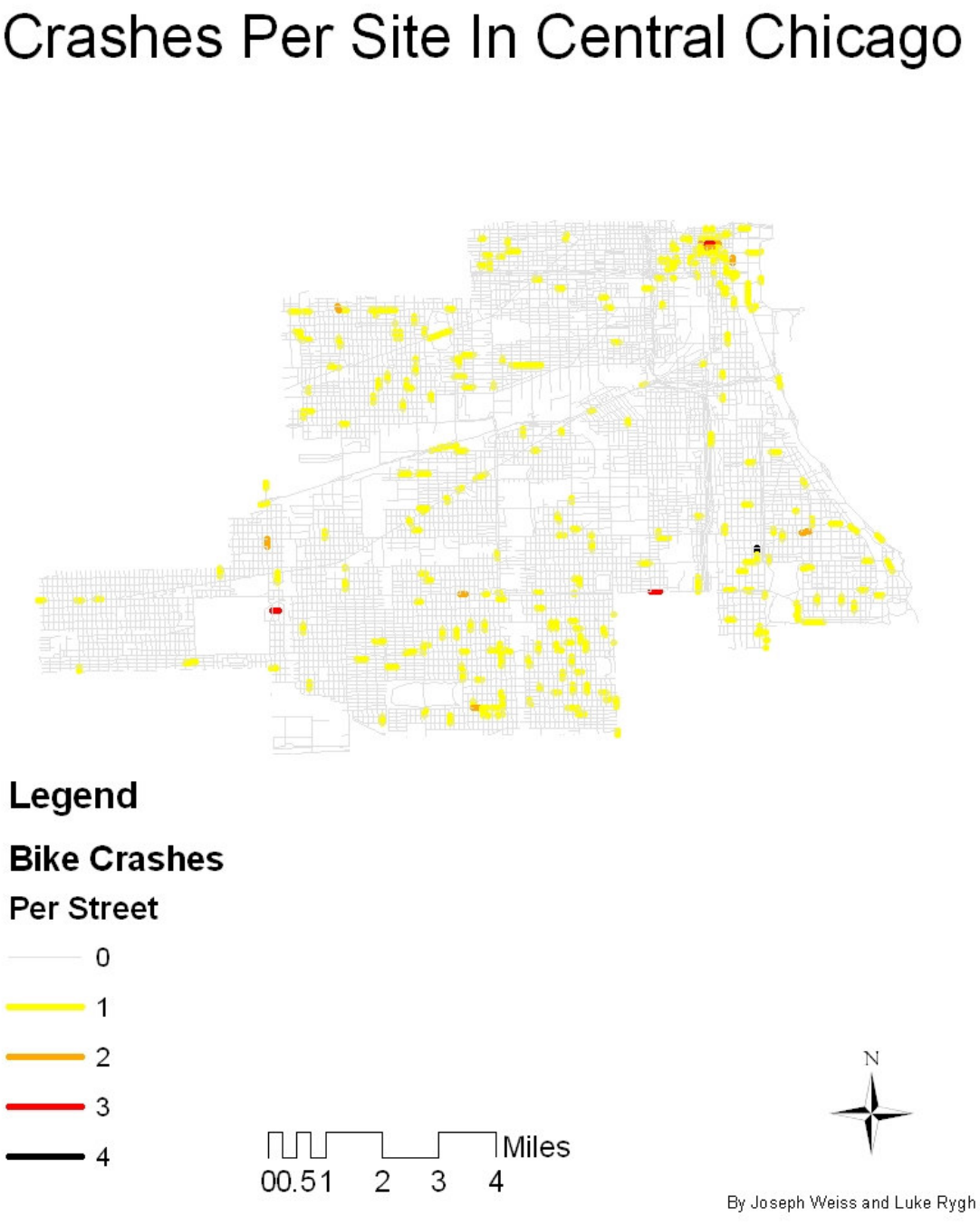
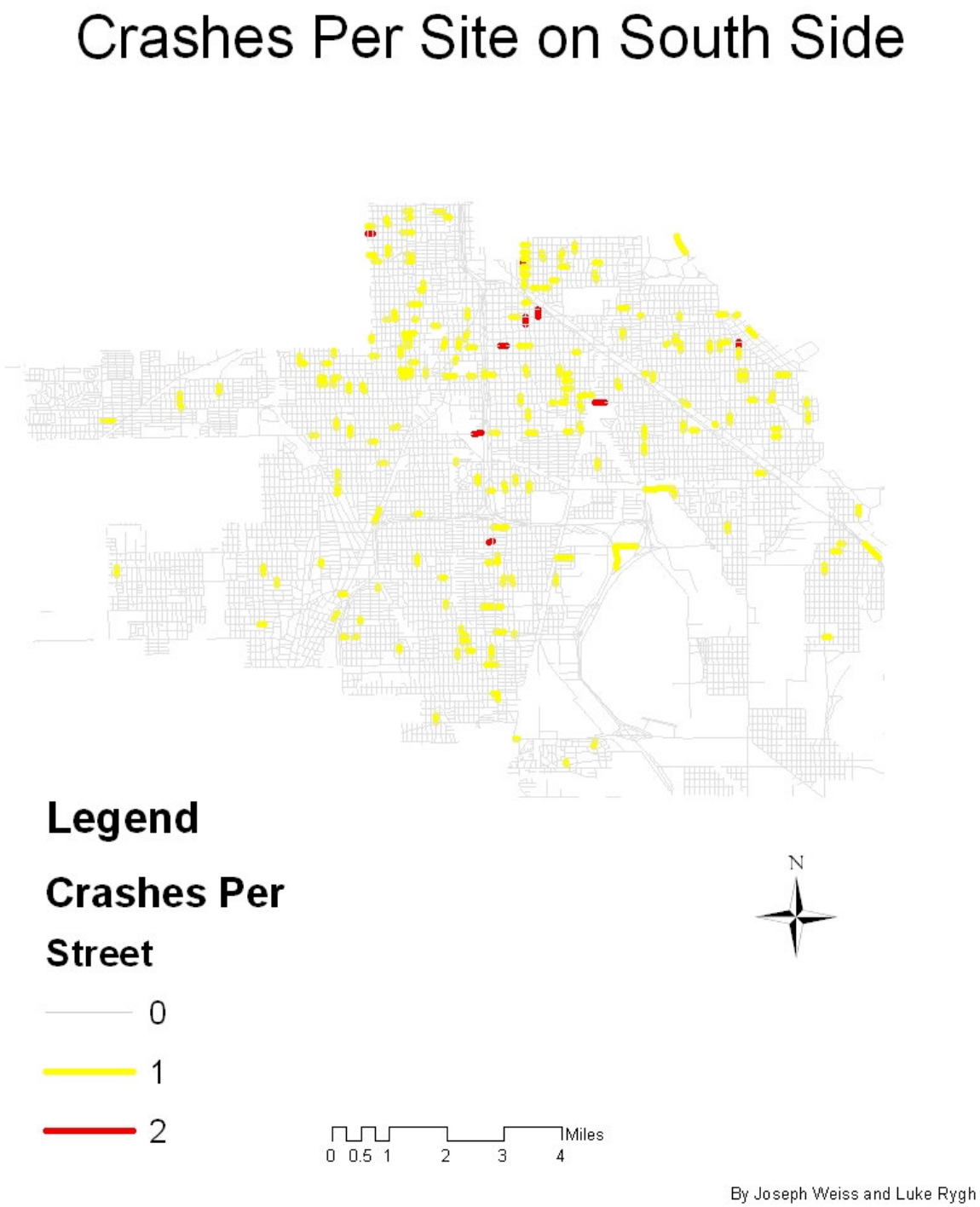

Crashes Per Site In Central Chicago
Legend
Bike Crashes
Per Street
0
1
2
3
4
Miles
00.51 2 3 4
N
By Joseph Weiss and Luke Rygh

Fig. F


Crashes Per Site on South Side
Legend
Crashes Per
Street
0
1
2
N
0 0.5 1 2 3 4
Miles
By Joseph Weiss and Luke Rygh