Assessing feasibility of bike light-weight freight deliveries. A case study in Logan, Utah

Team B

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Overview

Over the last few years the difference between online and offline in business arena has become faded due to rapid growth of technology and change in consumer purchasing behavior. In particular, during the corona virus pandemic app based food delivery service sky rocketed. More than 60% of the Americans order delivery food or takeout at least once in a week (Bipper Media, 2023). With the continuous migration from the rural to urban areas the demand for different convenient services are increasing rapidly. According to (Statista, 2023) the number of meal delivery servicer users will be about 217.10 M by 2027. People often order online food delivery service to save their valuable time. Groceries are the most essential items required by the households on a regular basis and comes with specific challenges for their deliveries. The rise of the on-demand economy has led to a rapid increase in the food delivery service from the restaurants and fast food outlets by delivery drivers (DDs). These DDs use bicycles, E-bike, cars and many other different type of modes. In general the delivery service provider platform handles order, payment processing and, in many cases, the management of these deliveries. Many online platforms for food delivery service do not manage the delivery members by themselves as sometimes especially in peak hour due to high volume of online food order it becomes difficult to meet the demand while at other times there remains a very few orders (Ahmed, 2017). In general the platform pays a certain amount of money to the delivery drivers for every order but sometimes it becomes difficult to cover more than two orders within an hour given the time taken by the restaurants to prepare the orders and the platform to assign certain task to a delivery driver. Meal delivery services are often quite popular in the urban areas where food can be delivered from the outlet to the customers with a relative short time. Despite the freedom it gives the average consumer, the popularity of food delivery means more traffic on our roads, which will affect our transport system and the environment as well. In USA, the largest amount of GHG (27%) comes from the transport sector alone. According to (United States Environmental Protection Agency, 2018) on an average a passenger vehicle emits 404 grams CO_2 per mile. The emergence of bicycle as delivery service can be considered as the promising alternative to ensure the urban sustainability in the long run. Bicycle is way more preferable for its easier maneuverability in a congested traffic environment. However, this new source of urban freight transport has received little to no attention to date from researchers and the policymakers.

Logan City is a very desirable place to live in the cache valley because of its geographic location and distinctive community character. Majority of the population and the employment sectors are mainly located along the HWY 91 which results in a great traffic congestion on the main street. Because of the unique geographic location with access to different recreational sites, increasing population (students, lower than average income households), thriving downtown, and the rapid developments in the city the active transportation infrastructures demand is uprising rapidly. Due to the existing zoning layout, major percentage of the commercial land use are located on the western side along the main street corridor. Being a college town the popularity of the food delivery service is quite high here. Some of the available food delivery services in Logan are Uber Eats, Grub hub, Post mates, DoorDash, and DeliverClub. College students generally have limited mobility and often go places they can walk to. Quick serve and less waiting time provides more satisfaction to the consumers. (Mao et al, 2019) found positive association between customer retention and faster food delivery service. The study concluded that 10 minute early delivery is subject to an increase of one order from every customer. However, delay in food service delivery has stronger negative relation with the future order. According to the report of the

FoodServiceDirector.com 37% of the students plan to opt out from the on-campus dining and order meals via delivery (Byrnes, 2021). At least once a week Fifty-eight percent of the college students eat at an off-campus quick serve restaurant, while fifty-six percent of them eat at a fast casual store, according to the "College & University Keynote Report" (Baltazar, 2019).

The Utah travel study data represents that 63% of the Cache county trips are less than 3 miles which is highly feasible to promote active transportation mode (Alta Planning + Design, 2015). Given the demographic and geographic characteristics, Logan city is a suitable place for thriving food delivery service via bicycle. From national statistics, cyclist population can be categorized into four categories strong and fearless (1%), enthusiastic and confident (7%), refuse to ride bicycle as mode of transport (33%), and interested to bicycle but are concerned with their safety (60%) (Peikes, 2023). An investigation, in Portland, Oregon, USA from 164 cyclists by collecting data from tracking GPS on more than 1400 bike trips revealed that travel distance, turn frequency, slope presence of traffic signal, average annual daily traffic, and presence of bike lane influence their route choice (Broach et al., 2012). Another study in San Francisco, California, on developing a route choice model for bicyclists by designing a cell phone app to track GPS and ask for trip purposes from nearly one thousand participants with more than 7000 bike trips, shows that the existence of bicycle lanes, steep slopes, travel distance, number of turns were significant variables(Hood et al., 2011). Facilitating the bicycle movement will be helpful to encourage the DDs for participating in the program. Apart from this, by focusing on the maintainenece and development of the active transport infrastructures the city will be able to balance multi-modal transport demand, increase property value, link neighborhood with better connectivity, improve collective health, quality of life and environment. The economic benefits of active transportation range from more livable, desirable communities, more consumer spending, addition of jobs, increase in property values, and increase in tourism. Furthermore, increased bicycling also lowers local pollutant such as PM2.5 that pollutes the local environment and cause different physical diseases.

Problem Statement

There is a growing demand for home delivery of meals and groceries (Oviedo-Trespalacios et al., 2022). Sustainable transportation, such as bikes, could be good practice for delivering lightweight stuff to close destinations because bikes are accessible, affordable, and sometimes more adapted to the environment. In some cases, bikes offer more flexibility and maneuverability than motorist vehicles in crowded urban areas (Dybdalen & Ryeng, 2022). Furthermore, more important, bikes are much more environmentally friendly than other means of transportation. Moreover, the bike rider could do a workout and make money simultaneously (Nematchoua et al., 2020).

Hopefully, most food and stuff delivery apps in the United States of America, such as Uber Eats, Door Dash, Amazon, Postmates, and Grubhub allow bicycles for their deliveries and connect drivers, customers, and shopping or food centers. As a result, riders could get orders from different services and minimize wait times. Moreover, some food shopping would employ bike food deliveries directly.

However, bike deliveries should be economical for cyclists to join bike delivery services and bike infrastructure, such as bike lanes should be constructed to improve safety of cyclists. This study aims to assess the hourly income of a bike service from shopping centers such as Walmart branches and food services such as dominos and burger king in Logan. Furthermore, one purpose is to find the best location to increase per-hour earnings effectively. Parameters that determine the best location are the density of food services in each TAZ, population density or potential customer within 3 miles of each interest point's proxy for frequency of orders and travel distance, built environment such as existence of bike lane, hilly area, and slope of the road.

Data

During data collection phase, we considered the traffic analysis zone (TAZ) as unit of analysis. The number of population for each TAZ was found from the downloaded data. The population for each TAZ was estimated based on the population for 2015. The population projection (TAZ) data set was collected from the Wasatch Front Regional Council (WFRC). The North Logan and the Logan municipalities were considered from the cache county. The boundary data was collected from the UGRC website. WFRC and Mountainland Association of Governments (MAG) developed this projection to support the regional transport plan (RTP) program. For this study we considered the Domino's Pizza (1153 N Main St, Logan, UT 84341) as our point of interest (POI). The coordinates of the selected outlet (latitude 45.75286 and longitude -111.83306) was collected from the google map and then stored in the csv file. Later, the csv file was converted into the shape file to visualize the location in ArcGIS for future analysis. In our final report, we will also incorporate some other point of interest to assess the feasibility of bike based food delivery service. A buffer of 3 miles was made around the shop in ArcGIS to delineate the service area to be covered by the bicycle. The road network data was collected from the Utah Geospatial resource Center. The existing infrastructure for the bicycle was collected from the "Road Centerline" GIS data. The "Bike_L" and the "Bike_R" filed from the "Road centerline" file contains the necessary information regarding the available bicycle facility for the Logan city. The slope data for this study was collected from the elevation and terrain data collected from the UGRC website using GIS based analysis. For this study, all the coordinates of the selected datasets are projected to Utah coordinate system (NAD 1983 UTM Zone 12 N).

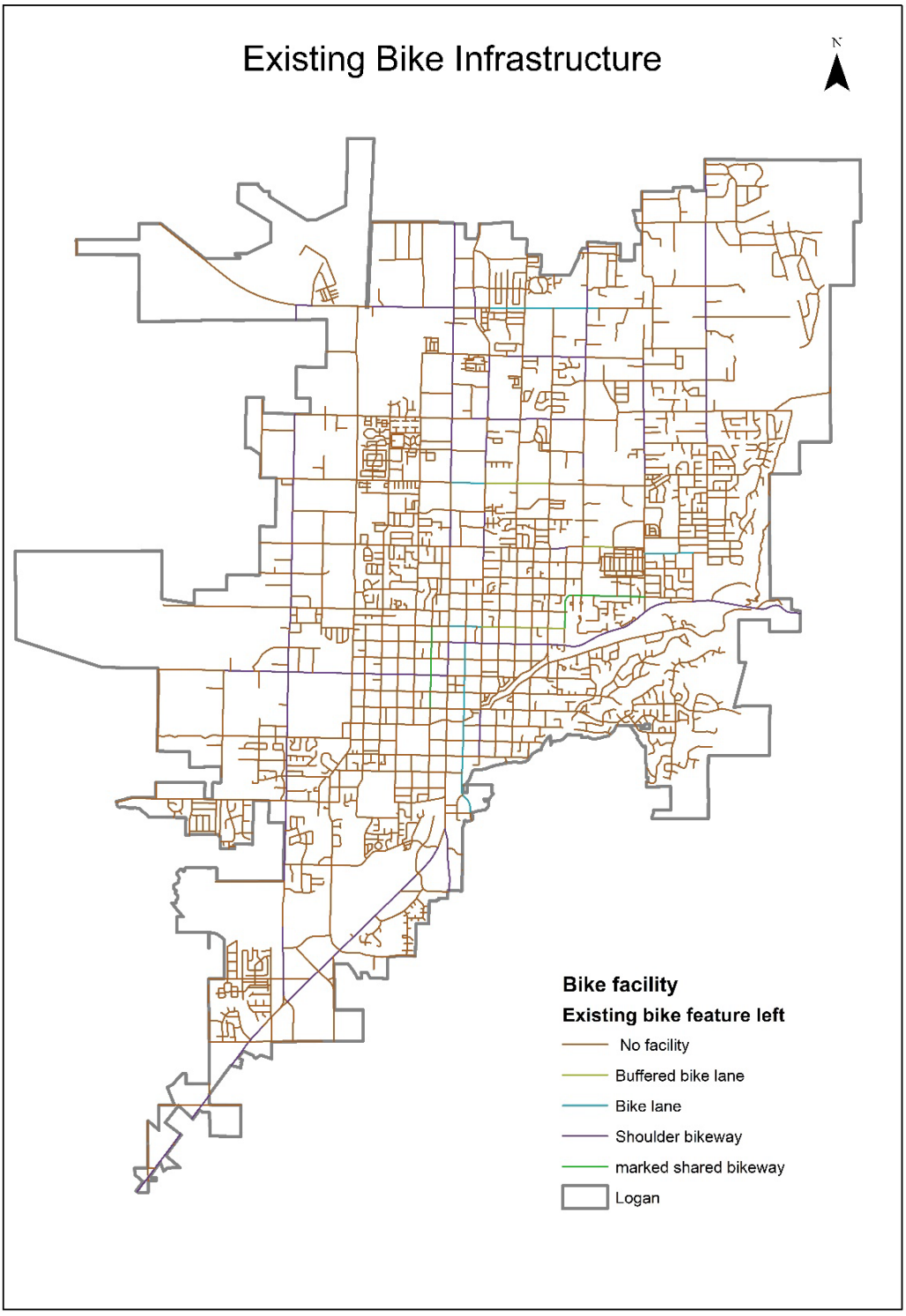

Figure 1 Existing infrastructure for bicycle (left side of the road)

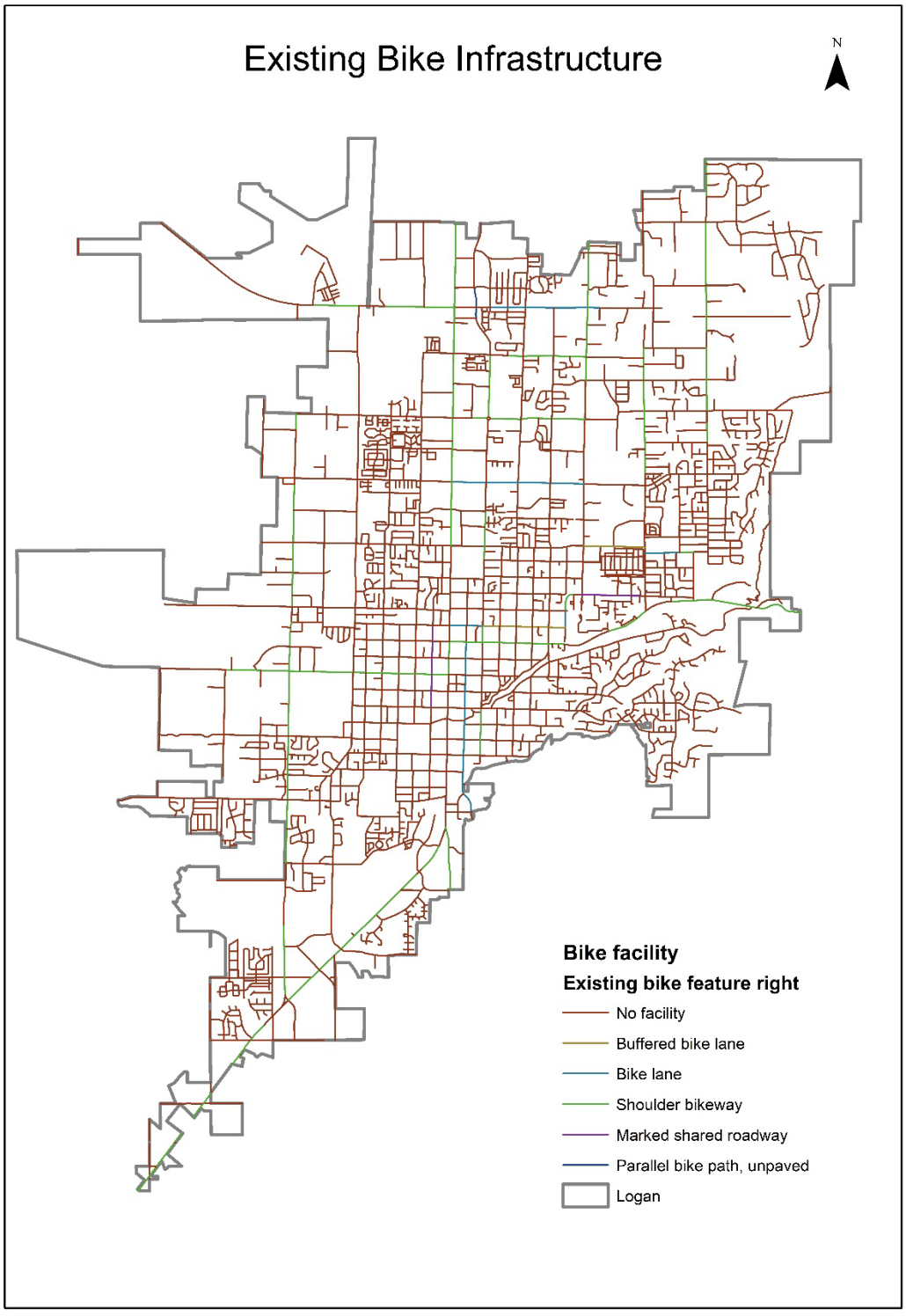

Figure 2 Existing infrastructure for bicycle (right side of the road)

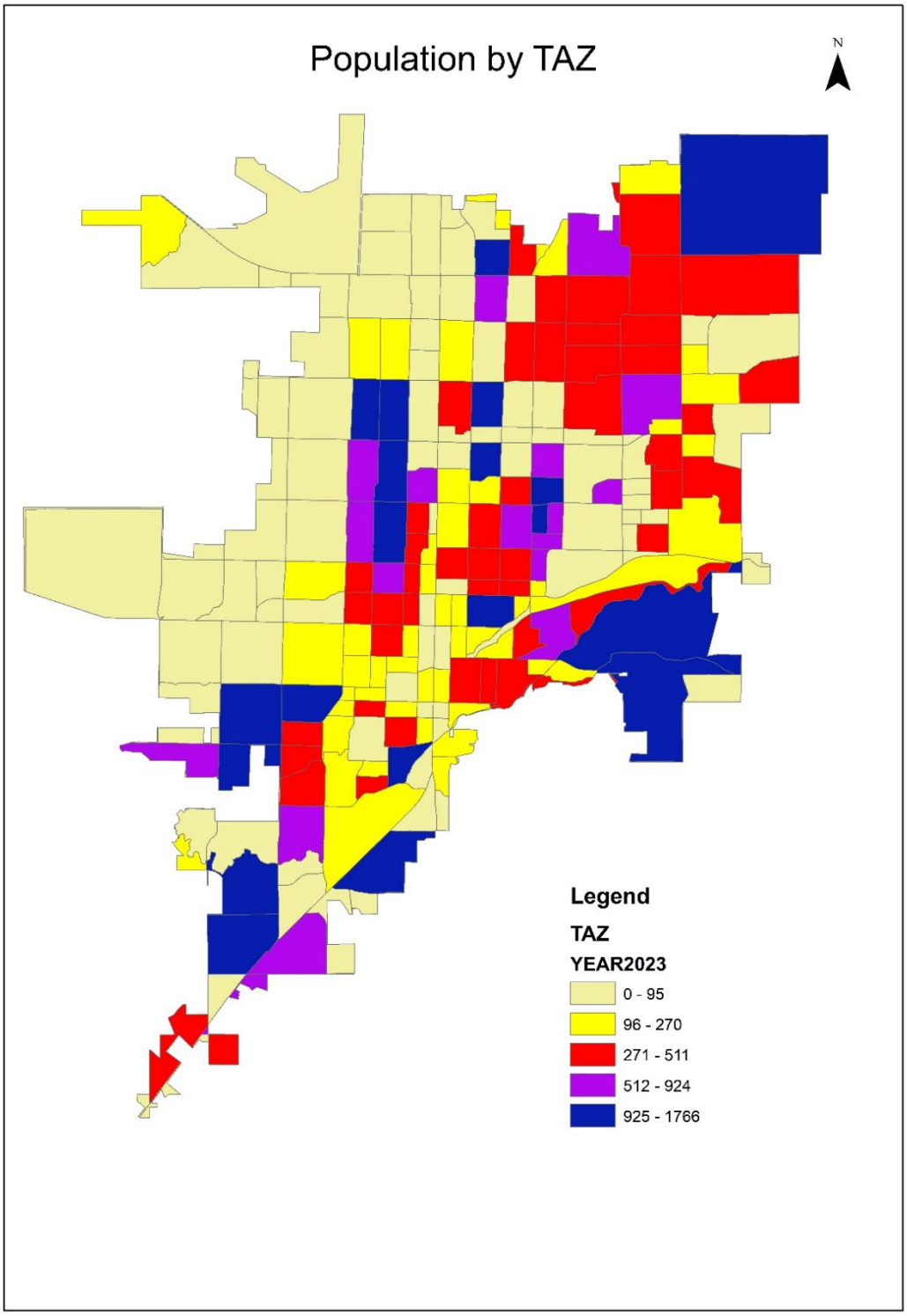

Figure 3 Population of Logan by TAZ for 2023

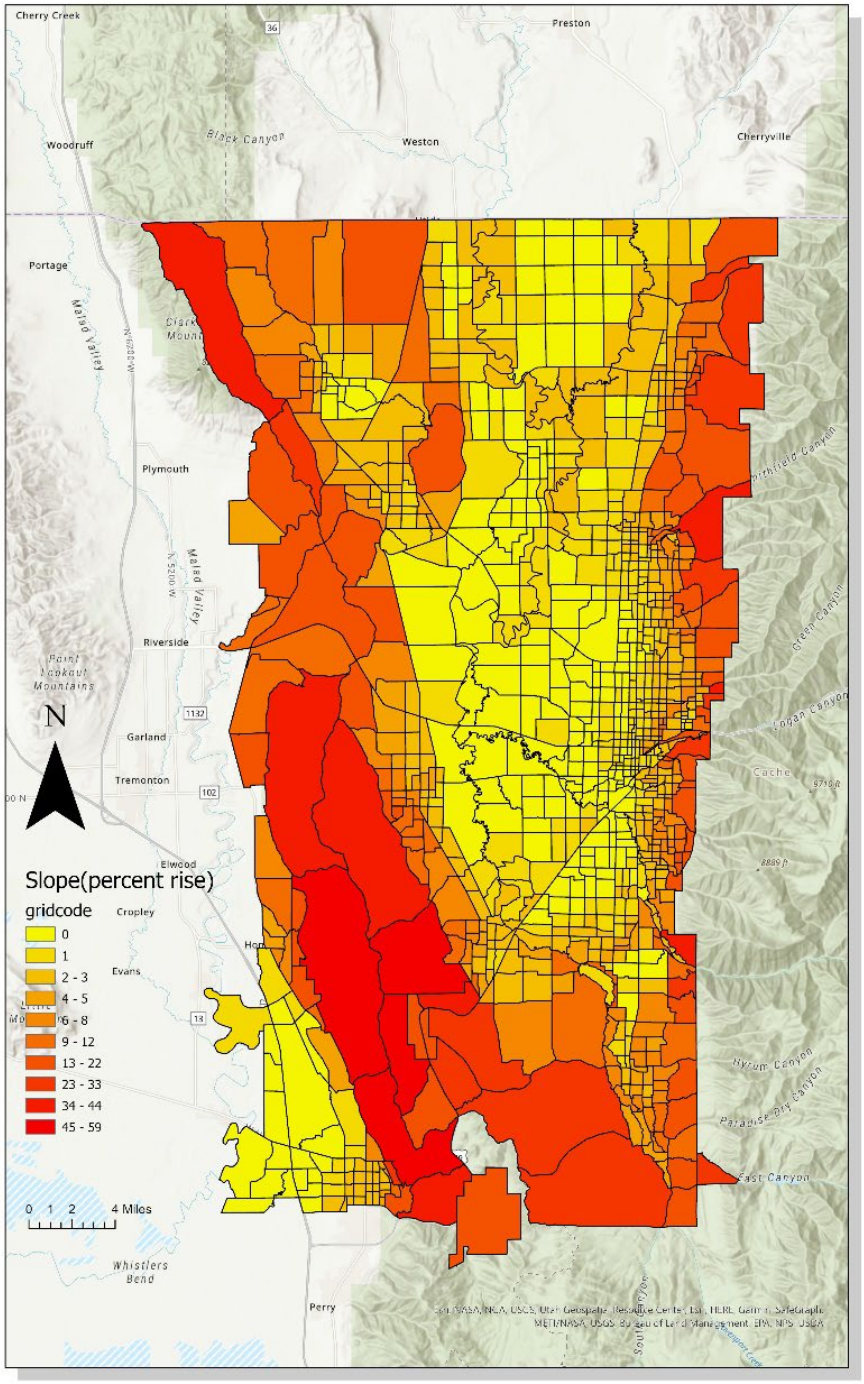

Figure 4 Slope for each TAZ

Analysis

In this project, as we do not have any data about the destination and frequency of orders from the POI, we are going to consider the centroid of each TAZ within 3 miles buffer of POI as a possible destination. The "centroid" tool from the GIS will be used to find the centroid of each of the TAZ. Later, a network dataset will be prepared to find the shortest path based on travel time and distance from the POI to the centroid of the TAZ's that fall within three miles buffer. The "Network Analyst" extension from the ArcGIS will be used to calculate the shortest path. A hypothesis was made regarding the demand for the food delivery service based on its population. We considered the higher the population there will be more demand of food and food delivery service.

A time series can define order frequency over time, there is more order frequency near noon (lunch) and evening (dinner). To make it clear, here is an example, for noon, the time series defines three orders, and randomly three destinations with regards to their probability will be created. A weighted route choice model that considers the shortest travel distance, bike lane score, slope, and travel time will be implemented, and store the travel time and distance of the path taken. Finally, for the working hours of a cyclist (6 consecutive hours) we have total travel time, distances, and delivered orders and we can define the hourly income of a bicyclist and the equivalent reduction of GHG emission from transferring by a vehicle. We can do the same process for a different POI and compare the income of a cyclist and environmental effects. A food delivery bike makes $13/hour in Logan, UT (ZipRecruiter, 2023). Moreover, with tip a DD makes $10 or $20 for every order in the DoorDash platform (Helling, 2023). For this study, to understand the feasibility of bicycle based food delivery service we will consider an hourly wage of $13 and a tip of $5 for every order.

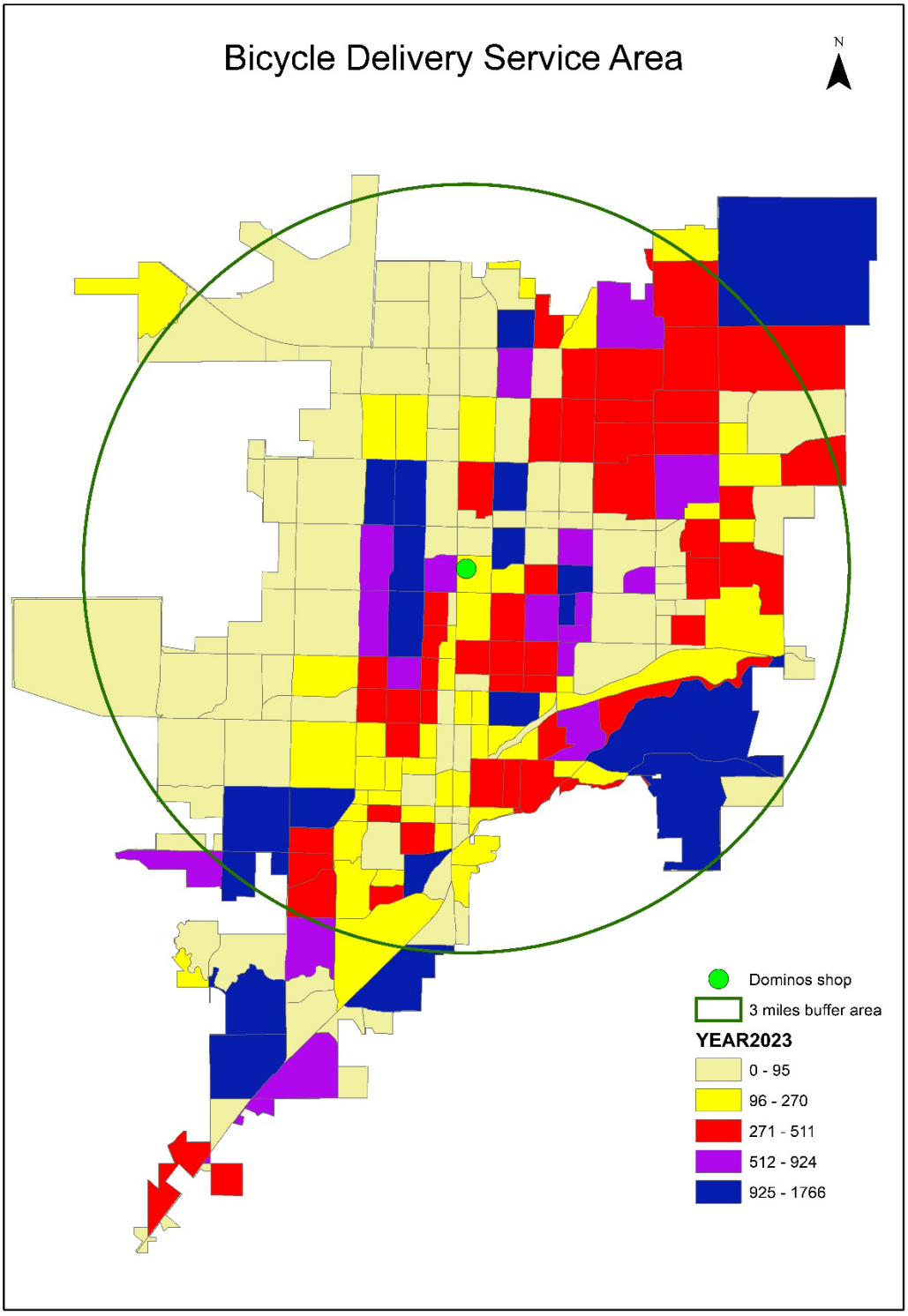

Figure 5 Bicycle Delivery Service Area for Dominos (North Logan)

The slope for each TAZ was calculated from the downloaded Digital Elevation Model (DEM) raster file by using the “Slope” tool in ArcGIS. Later, we derived the average slope within each TAZ by using the “zone statistics” tool and convert it to a vector file for future analysis. We have calculated average slope (percent rise) within each TAZ. We will calculate the length of routes within each defined slope within TAZ and assign a weighted slope to each route.

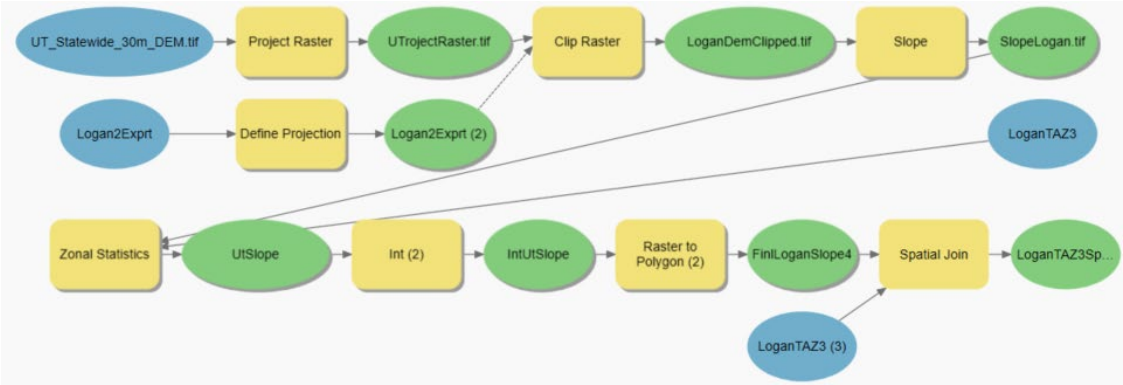

Figure 6 GIS based model to estimate average slope for each TAZ

Design

We do not have any special design in this project. However, we investigate current situation and geographic features of bike lanes and bicycling. The bicycling infrastructure of North Logan is mainly characterized by signed bike routes, painted bike lanes, one signed shoulder bike way, and minimum 3ft. painted bike lane with signage. Some other types of cycling infrastructure that are currently not present in North Logan include marked shared roadways (also known as "sharrows"), buffered bike lanes, and various types of cycle tracks (Sutton, 2022). Based on future analysis, we may consider designing certain intersections that are frequently used by the bike riders while delivering food.

Plan

This study could encourage policymakers to extend bike lanes, provide bike parking, and support sustainable light freight transport. We could design bike lane elements for bike freight deliveries where there is high demand for bike delivery and suggest providing bike parking.

Conclusion

The rapid growth of the online based food order has not only increased the number of food-delivery service drivers on our roads, but also a subject of growing concern for traffic safety and environment. Because of having less resources and time this study followed certain assumption to understand the online food delivery service demand rather following a standard procedure. This analytical strategy may have certain drawback. However, the project elements covered by this study will play a crucial role to answer some important questions like what will be the magnitude

of online food delivery service trips and whether the existing facility is good enough to support the demand and ensure safety for the bicyclists. This will help the decision makers to identify the major hubs of trips and propose the locations of future transport projects accordingly. It will also help to under the possible amount of GHG gas that can be minimized by facilitating the bike freight for food delivery service system. To ensure traffic safety and promote bike based food delivery service different stakeholders (delivery platforms, DDs, traffic safety professionals) involved in this process should work together.

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