

UTAH ACCESS

Analysis of Cycling Comfort, Efficiency,
and Sustainable Solutions using GIS

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Introduction

- Barrier to adopting cycling
 - Comfort, **perceived safety**
 - Lack of Cycling Infrastructure – **can be fatal**
 - Traffic
- Current Methods
 - Lack critical factors (Slope, Trails)
 - Complicated to Source Data
 - Need for Simplicity
- 1-4 Metric
 - Borrowed from Level of Traffic Stress (LTS)



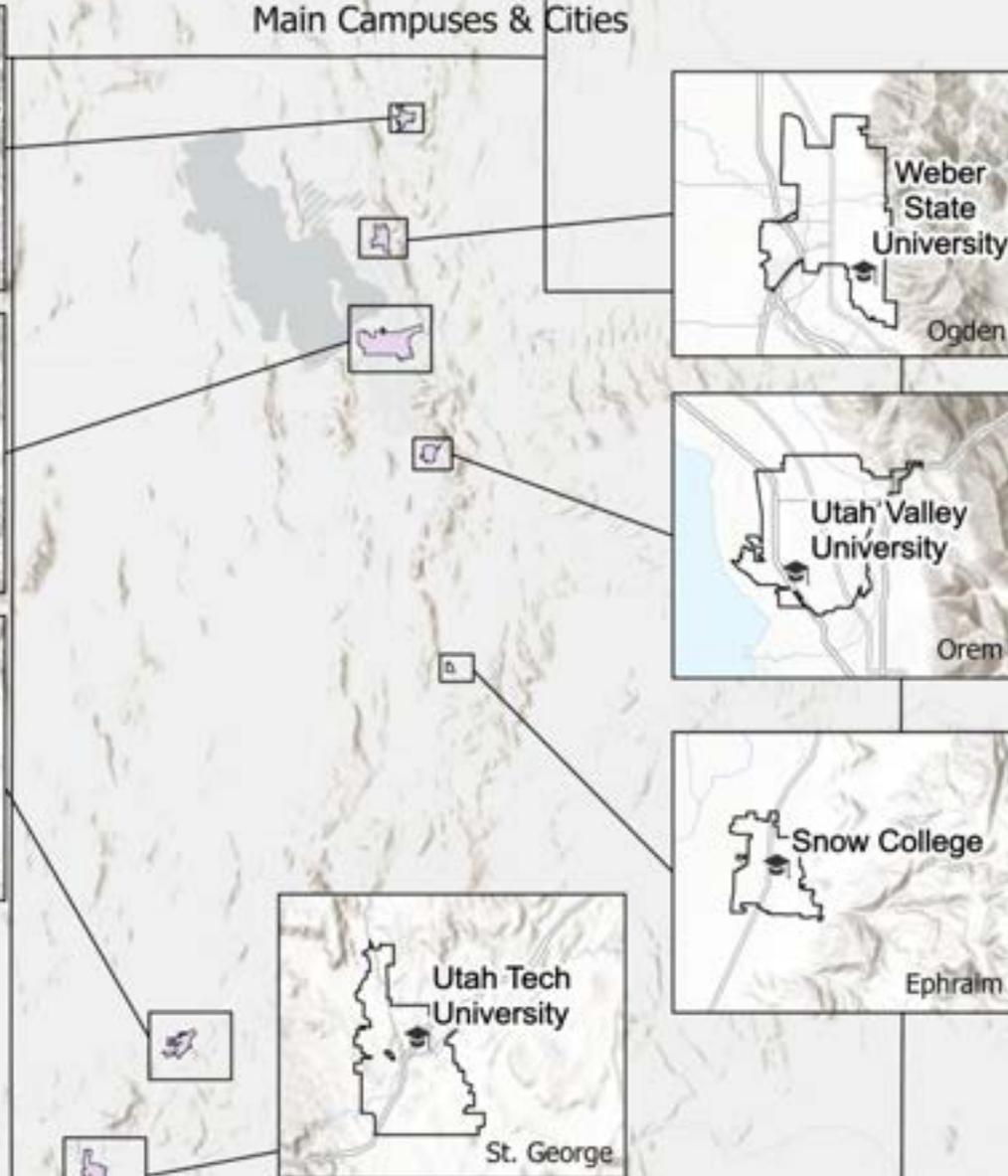
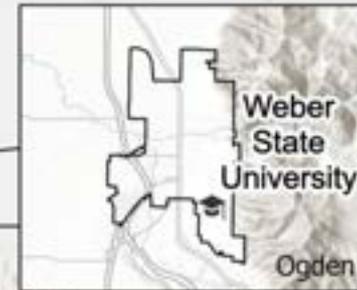
Study area

- College students
 - Transit costs
 - Campus design
 - Proximity
- Utah System of Higher Edu (USHE) Public Schools
 - Primary Campuses
 - Large range of city size and campus population
 - Student focused



USHE Public Schools

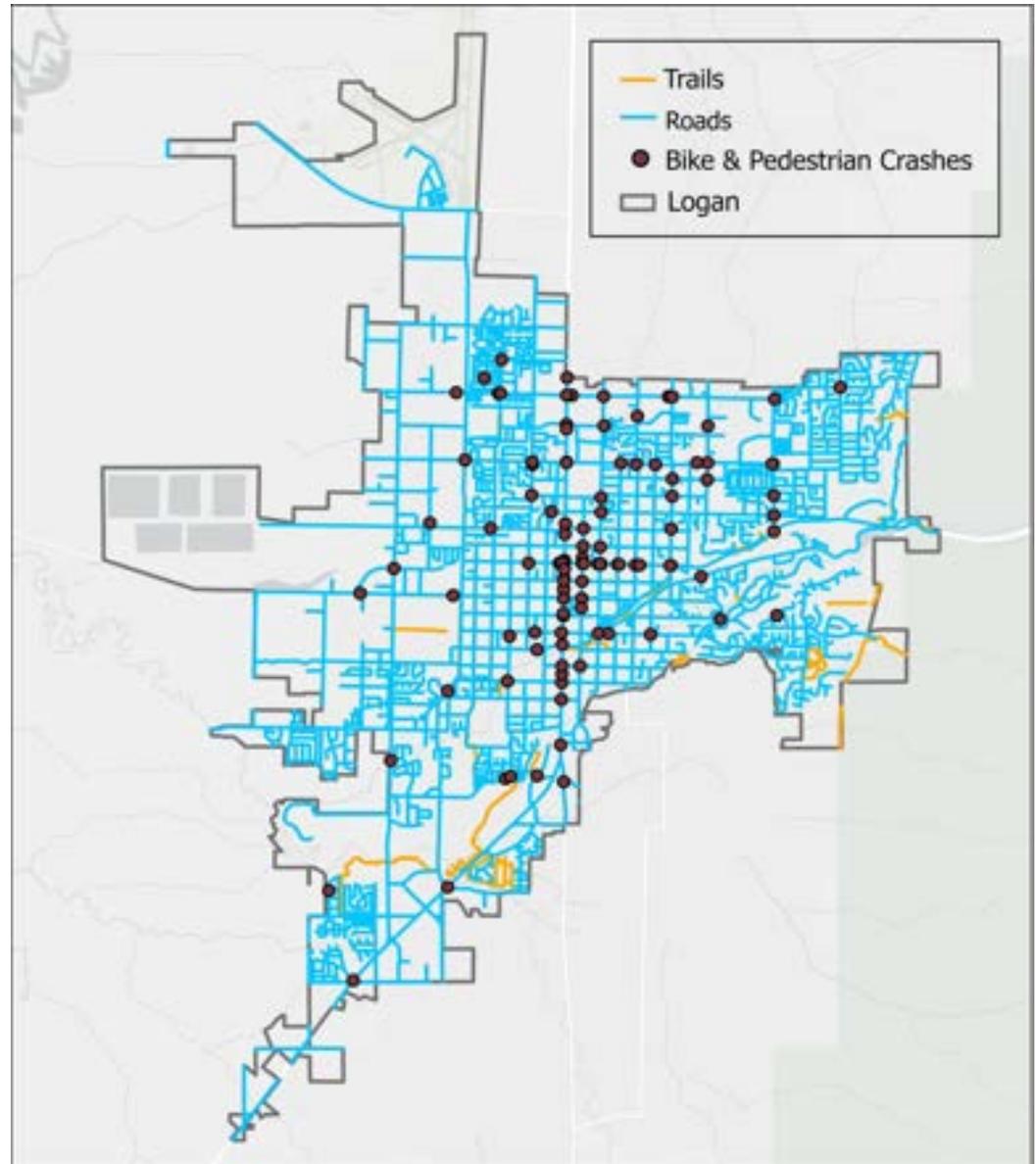
Main Campuses & Cities

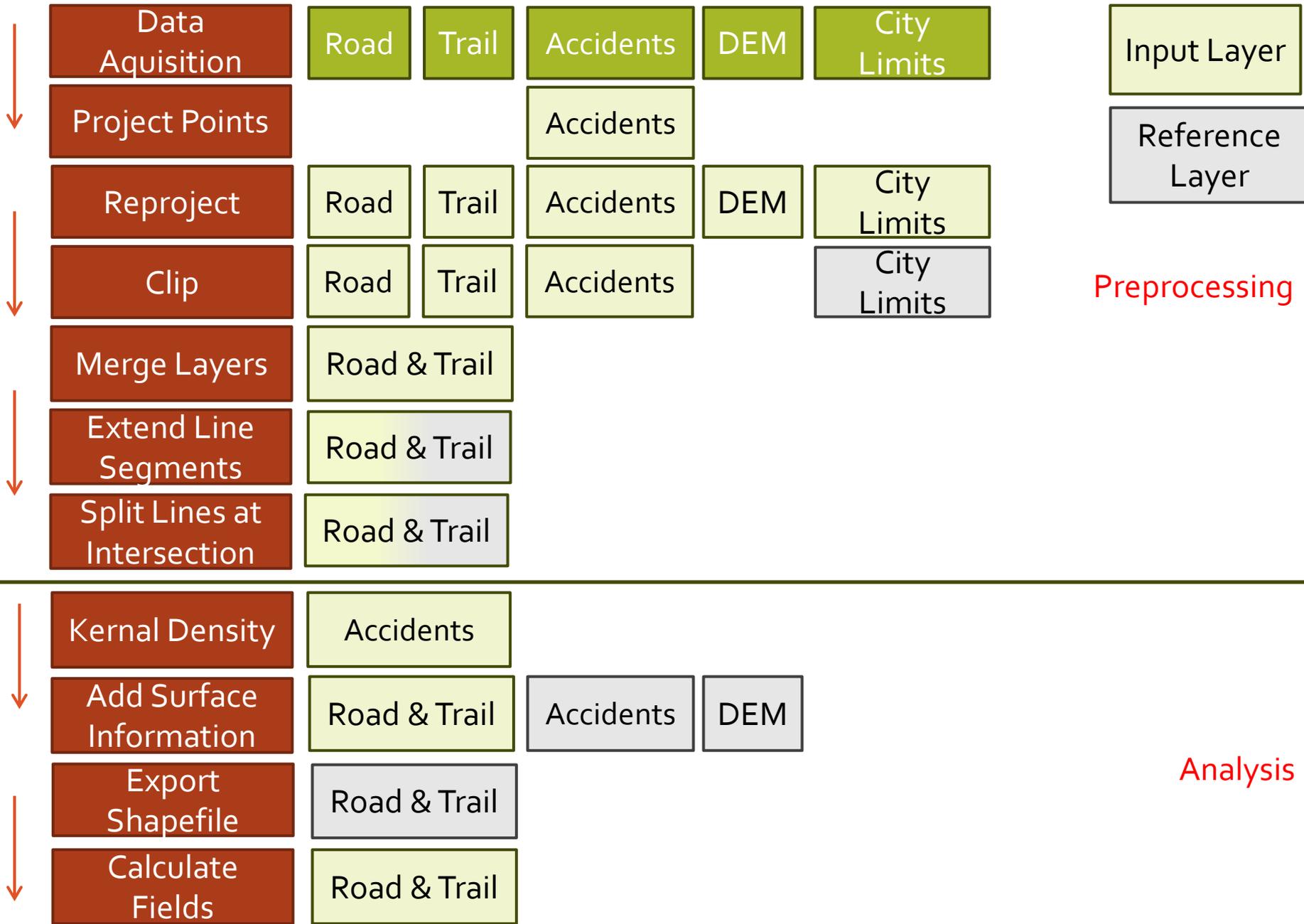


Data

Data Name	Relevant Fields	Source	Type
Roads	Bike Lane Type, Speed Limit, Annual average daily traffic	UGRC	Vector - Line
Trails	Trail Type	UGRC	Vector - Line
City Boundaries	City	UGRC	Vector - Polygon
Crash Data	Cyclists and Pedestrians	Utah Gov Open Data	CSV
10m DEM		UGRC	Raster

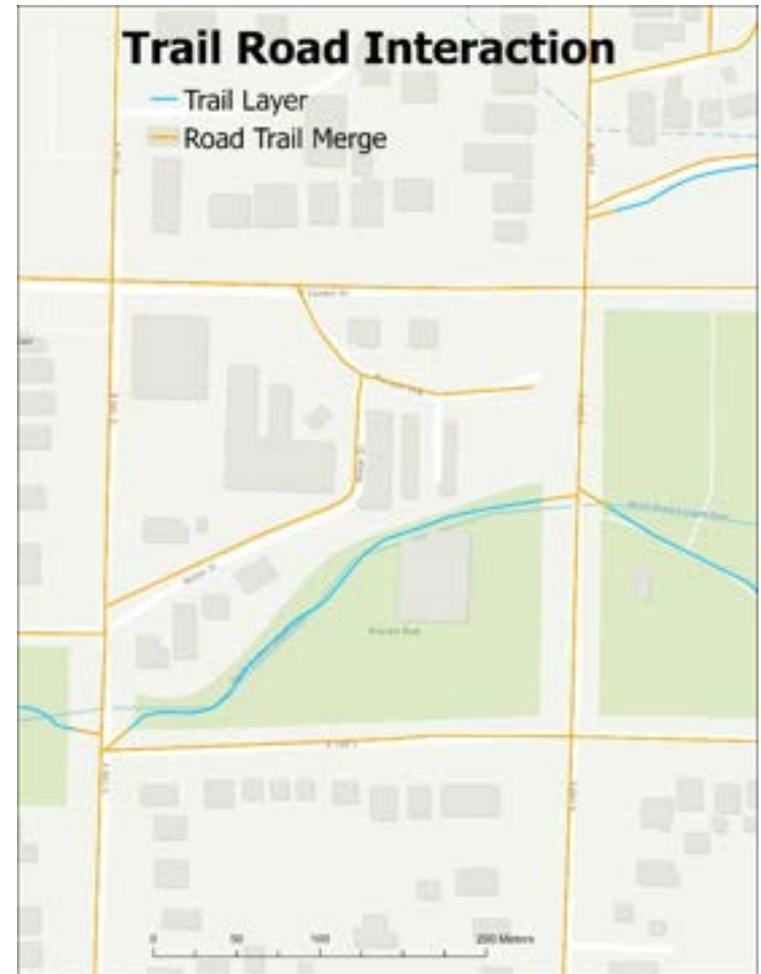
- Only 5 Data Layers
- Easy to Compile
- Trails help fill road network gaps





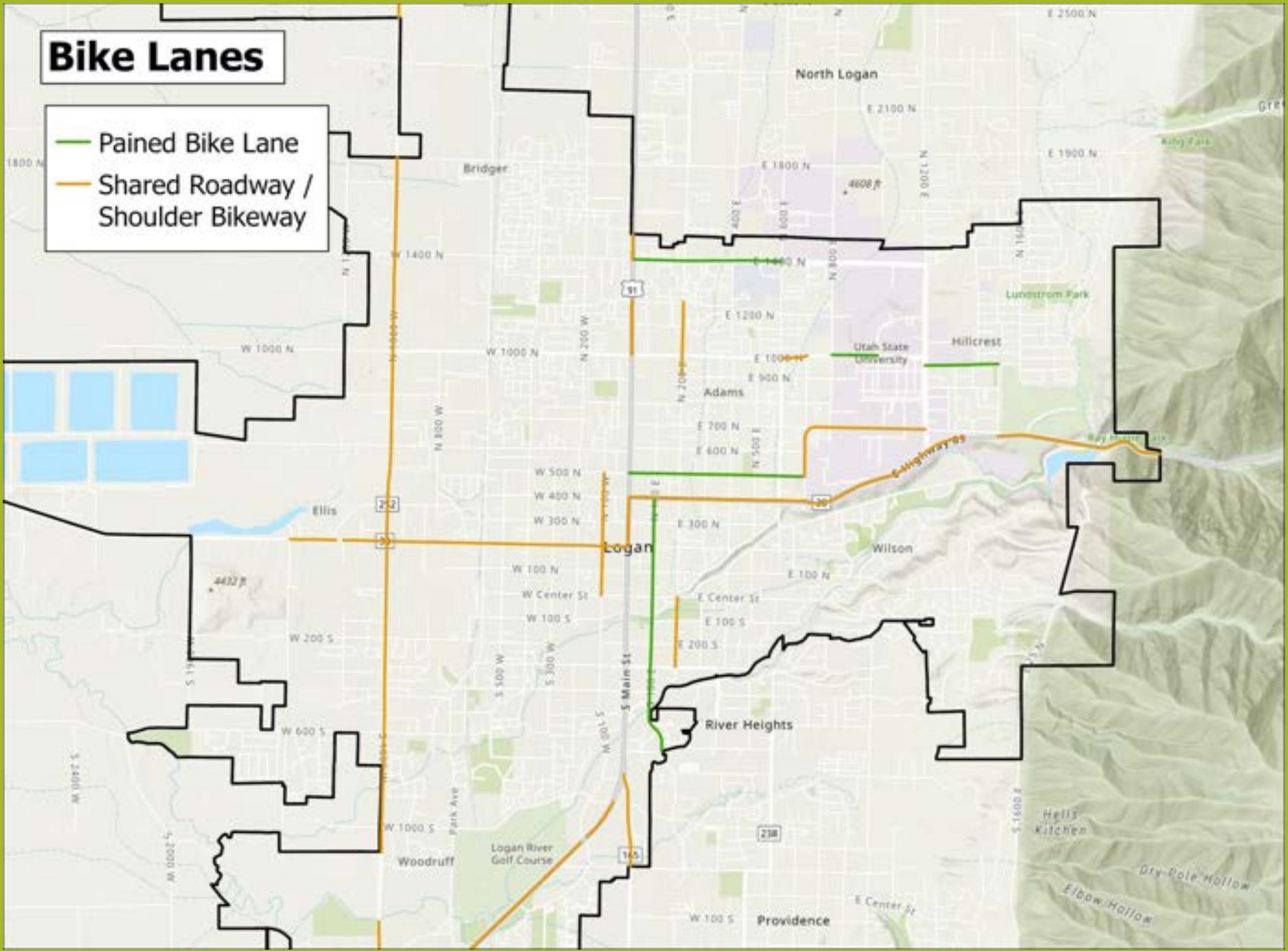
Final Combined Data Layer

- Bike Lane Types
- Speed Limit
- AADT (Average Annual Daily Traffic)
- Slope
- Crime (Crashes)
- Trails



Bike Lanes

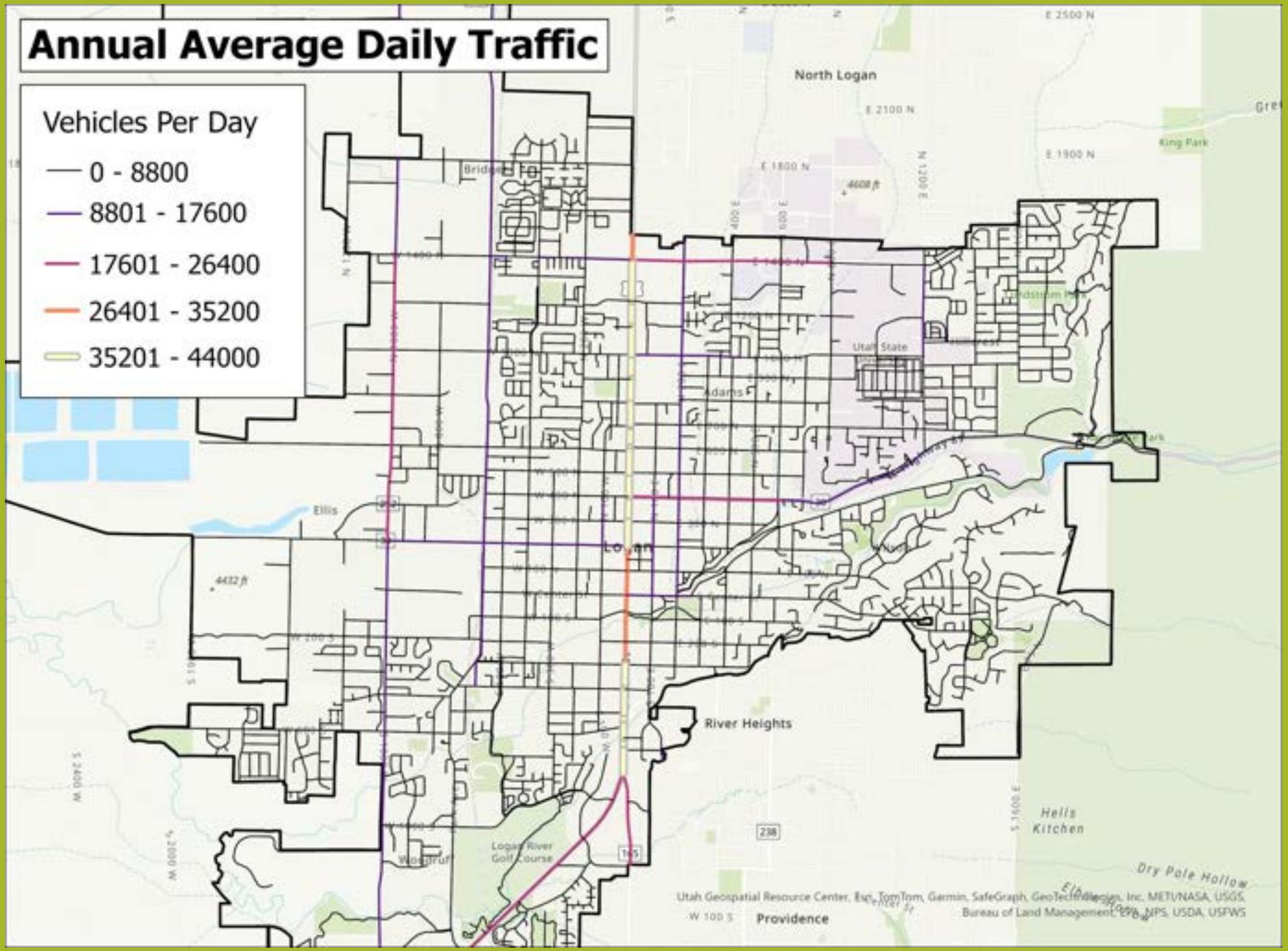
-  Pained Bike Lane
-  Shared Roadway / Shoulder Bikeway



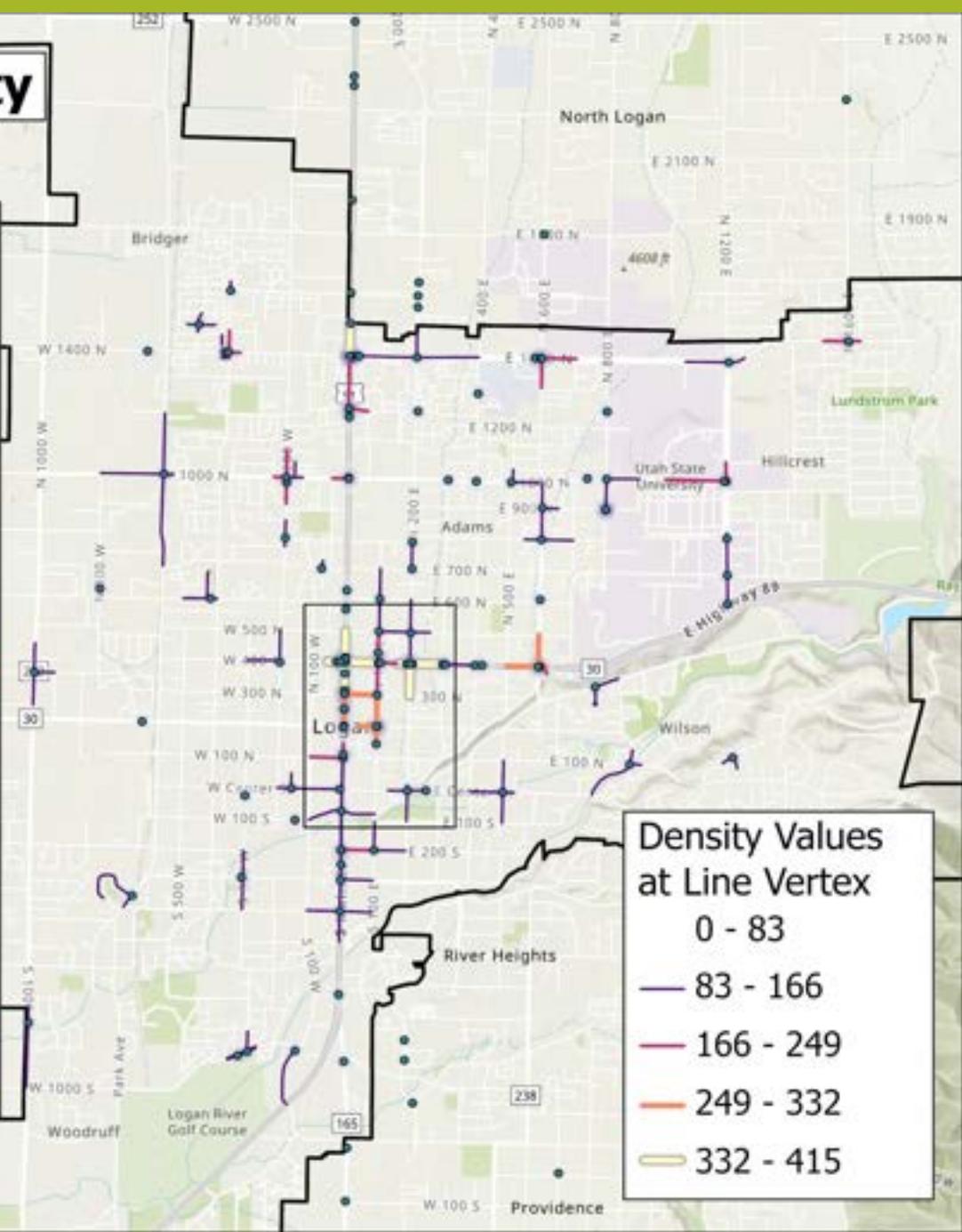
Annual Average Daily Traffic

Vehicles Per Day

- 0 - 8800
- 8801 - 17600
- 17601 - 26400
- 26401 - 35200
- 35201 - 44000



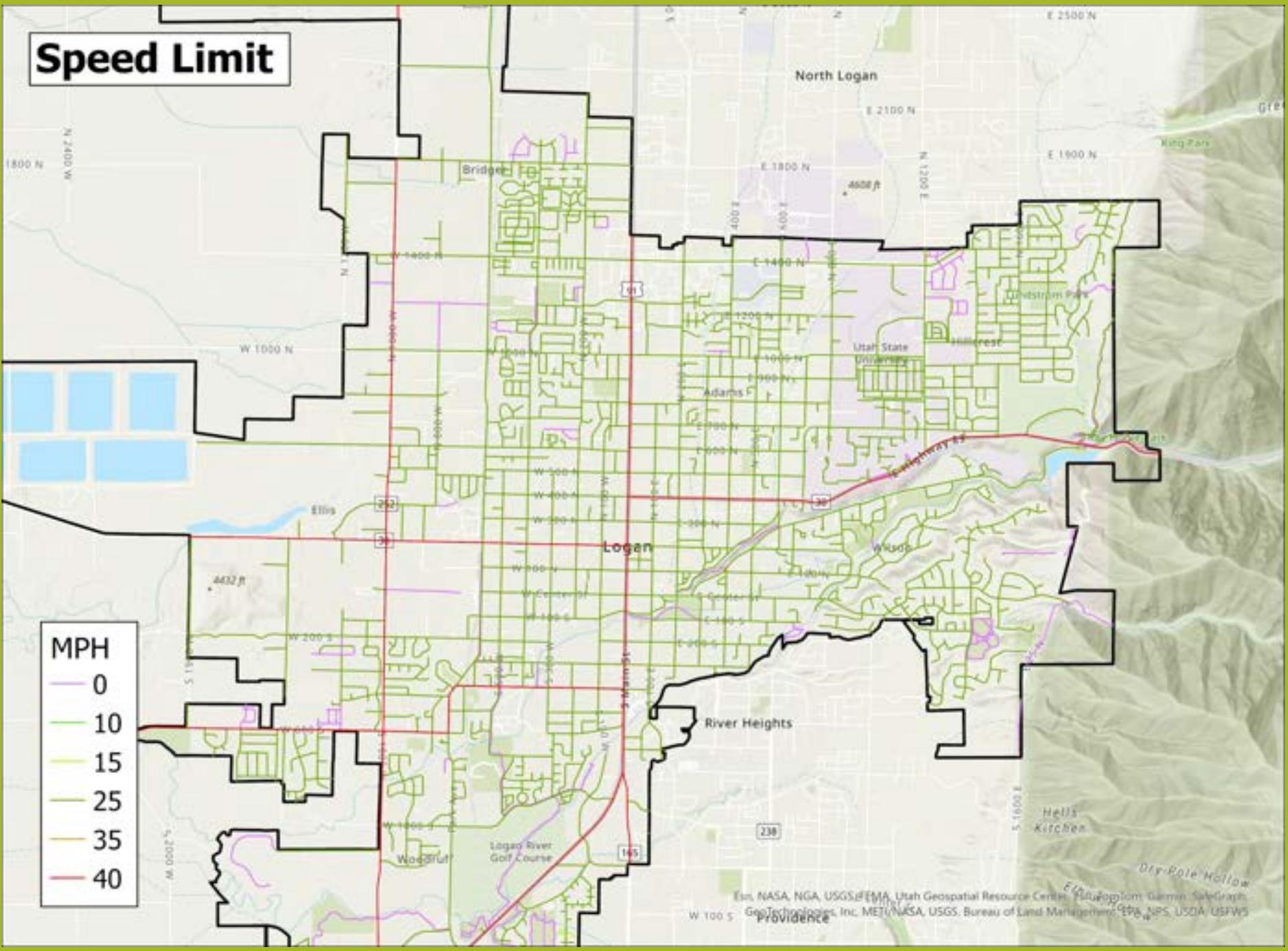
Crashes - Kernel Density



Density Values at Line Vertex

- 0 - 83
- 83 - 166
- 166 - 249
- 249 - 332
- 332 - 415

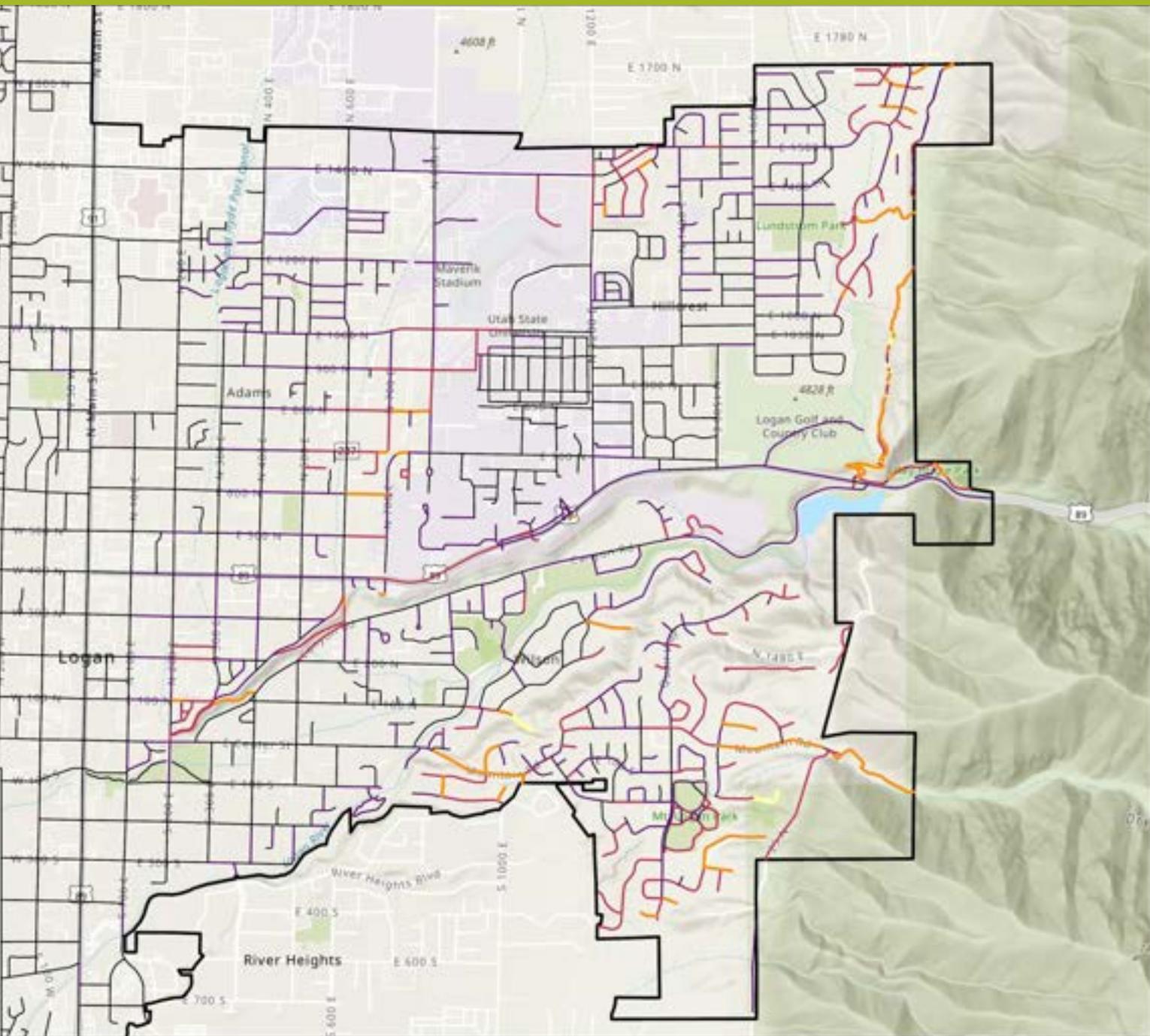
Speed Limit



- MPH
- 0
 - 10
 - 15
 - 25
 - 35
 - 40

Slope

- Average Slope**
- 0.00 - 1.73
 - 1.73 - 4.84
 - 4.84 - 10.06
 - 10.06 - 17.93
 - 17.93 - 35.57



Manual scoring Method

- Each field was scored from 1 to 4 based on perceived comfortability and LTS criteria
- After manual scoring, each field is added then divided by 5 and rounded to compute a final score.
- Final score range – 1- 4
- 1 indicates the highest comfort, 4 indicates the lowest comfort
- Very hands on
- Extremely Tunable based on feedback
- Currently less accurate (Crash & Slope)

Normalized Method

- Normalizes each fields value 0-1 (except bike lanes) and each field is added together
- Each field equally contributes to the final comfortability score
 - Bike lanes improve scores but do not penalize
- Final comfortability score calculated using quantile break condition
- Helps remove some bias in scoring
- Can still be tinkered with post score bins
 - Currently Quantile Scores

```
min_val, max_val = min_max["SPEED_LMT"]
if speed_limit == max_val:
    norm = 1.0
elif speed_limit == min_val:
    norm = 0.0
else:
    norm = (speed_limit - min_val) / float(max_val - min_val)
```

```
BL = 0

if bike_left is None and bike_right is None:
    BL = 0
elif bike_right == " " and bike_left == " ":
    BL = 0
elif bike_right.startswith("1") or bike_left.startswith("1"):
    BL = -0.8
elif bike_right.startswith("2") or bike_left.startswith("2"):
    BL = -0.4
elif bike_right.startswith("3") or bike_left.startswith("3"):
    BL = -0.1
```


Cycling Comfortability Web Tool

- Key Features:

- Interactive Map Interface
 - Route Planning Based on Comfort Scores as Opposed to Shortest Time
 - Real Time Route Calculation
 - User Friendly, Intuitive Design
-
- Tool Rated with Comfortability Scores from 1-4, with 1 Being the Most Comfortable

Benefits of this Type of Tool

- Personalized and Informed Route Planning for Cyclists
- Data-Driven Urban Planning
- Public Health and Engagement
- Educational Value for Local Communities

Technical Architecture

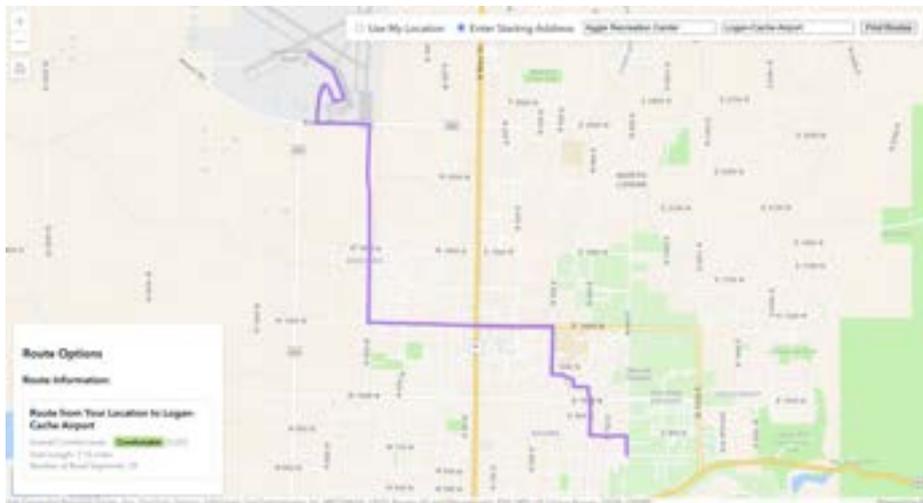
- Front End

- ArcGIS Javascript API for Mapping
- Modern HTML5/CSS3 Interface
- Responsive Design for All Devices

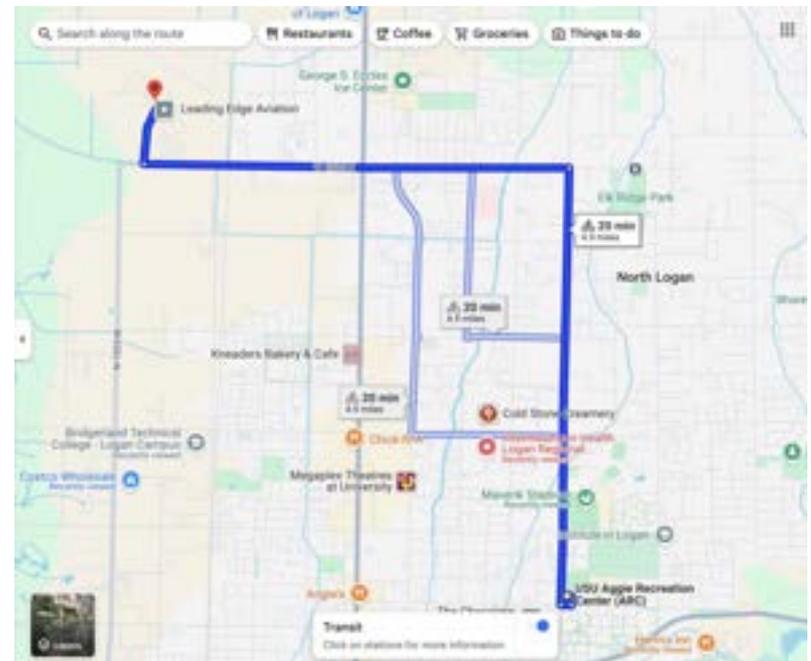
- Back End

- Flask (Python) Server
- GeoPandas for Processing, OpenStreetMap for geocoding
- Custom Comfort Scoring Algorithm

Route Planning Comparison – Aggie Recreation Center to Logan-Cache Airport

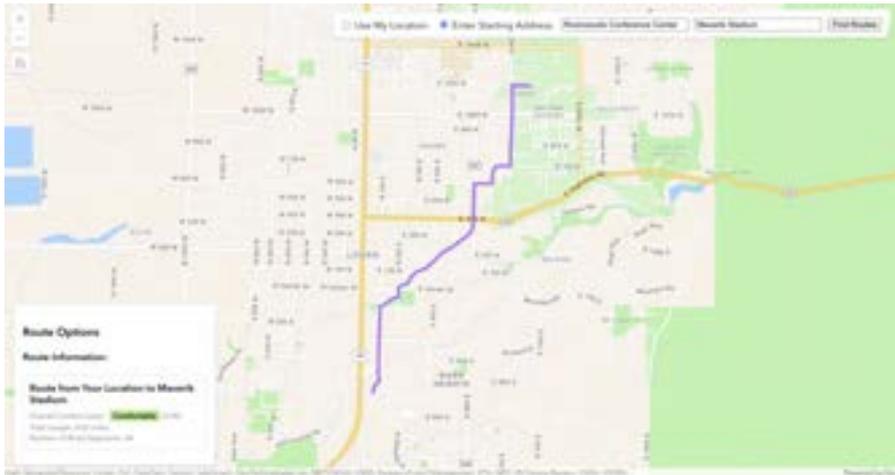


Normalized Method

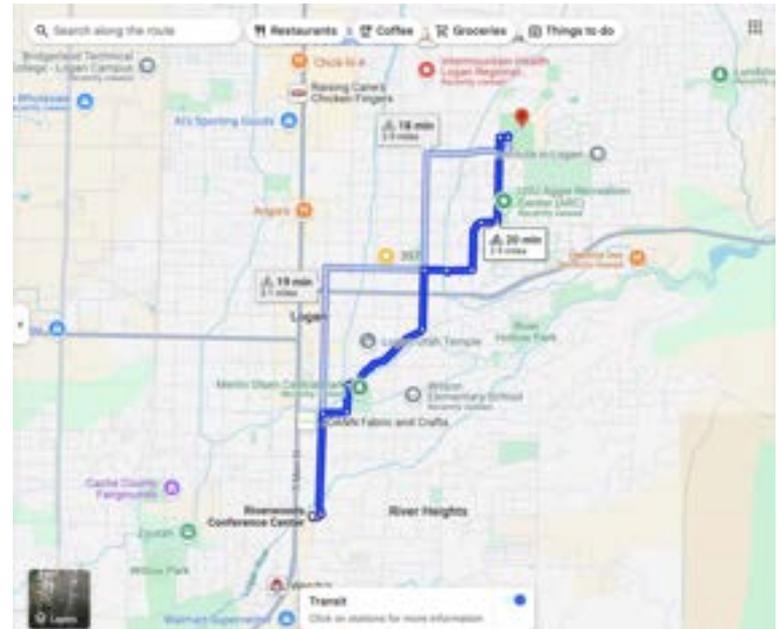


Google Maps

Route Planning Comparison – Riverwoods Conference Center to Maverik Stadium

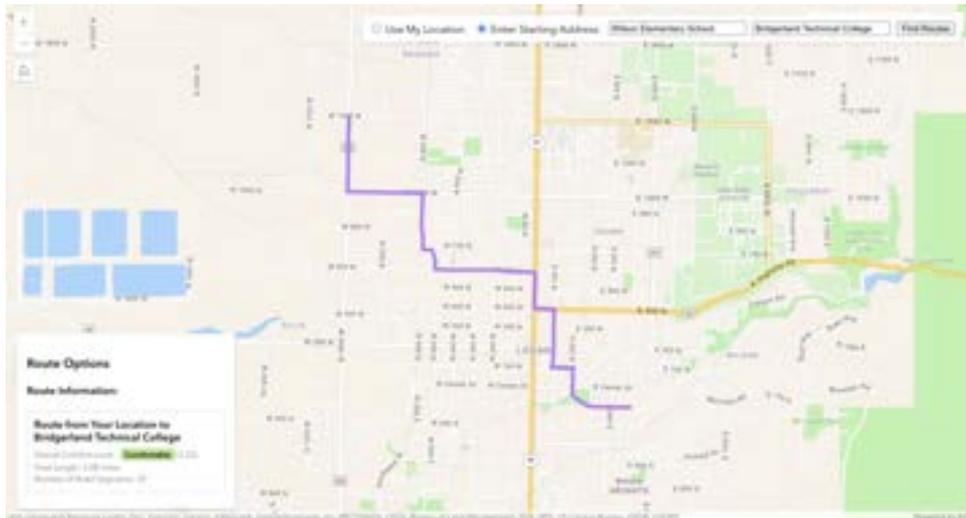


Additive Method

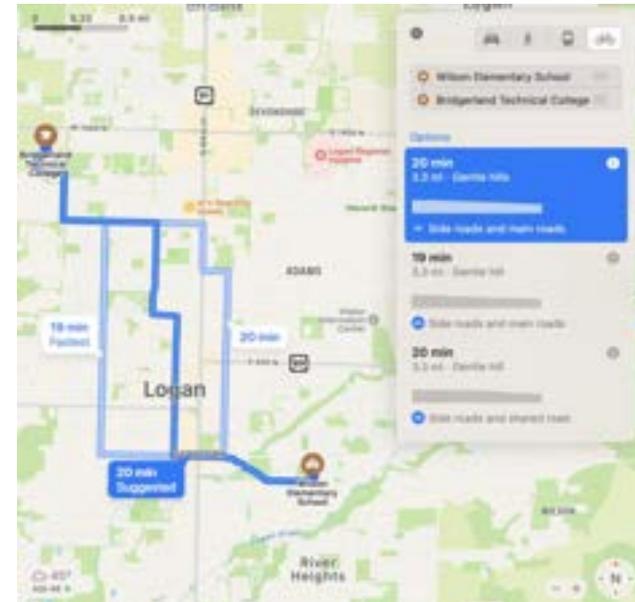


Google Maps

Route Planning Comparison – Wilson Elementary School to Bridgerland Technical College

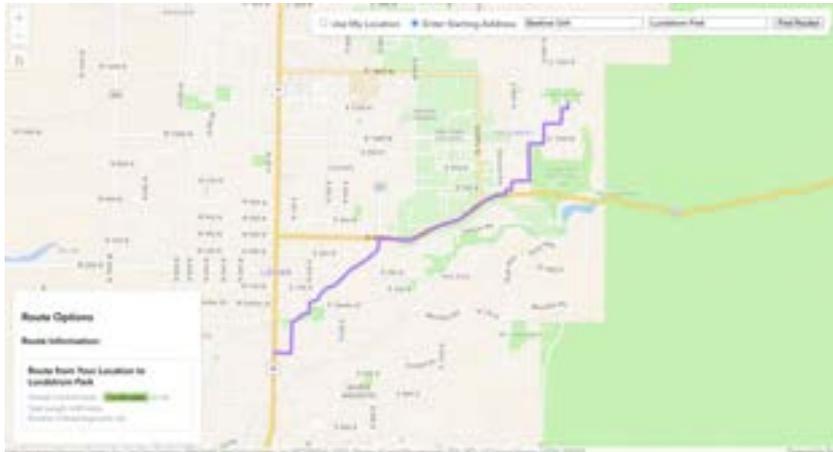


Normalized Method

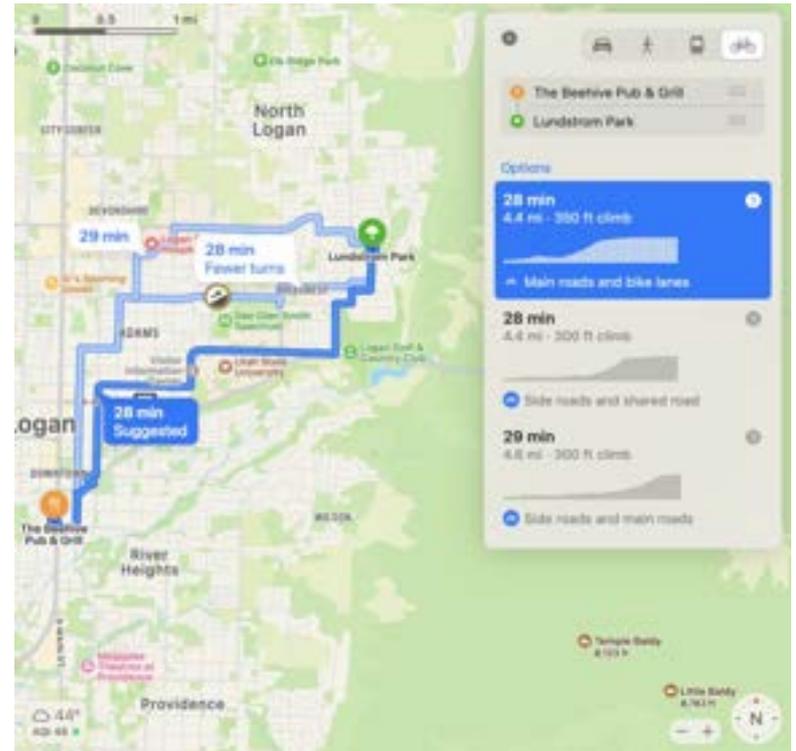


Apple Maps

Route Planning Comparison – Beehive Grill to Lundstrom Park

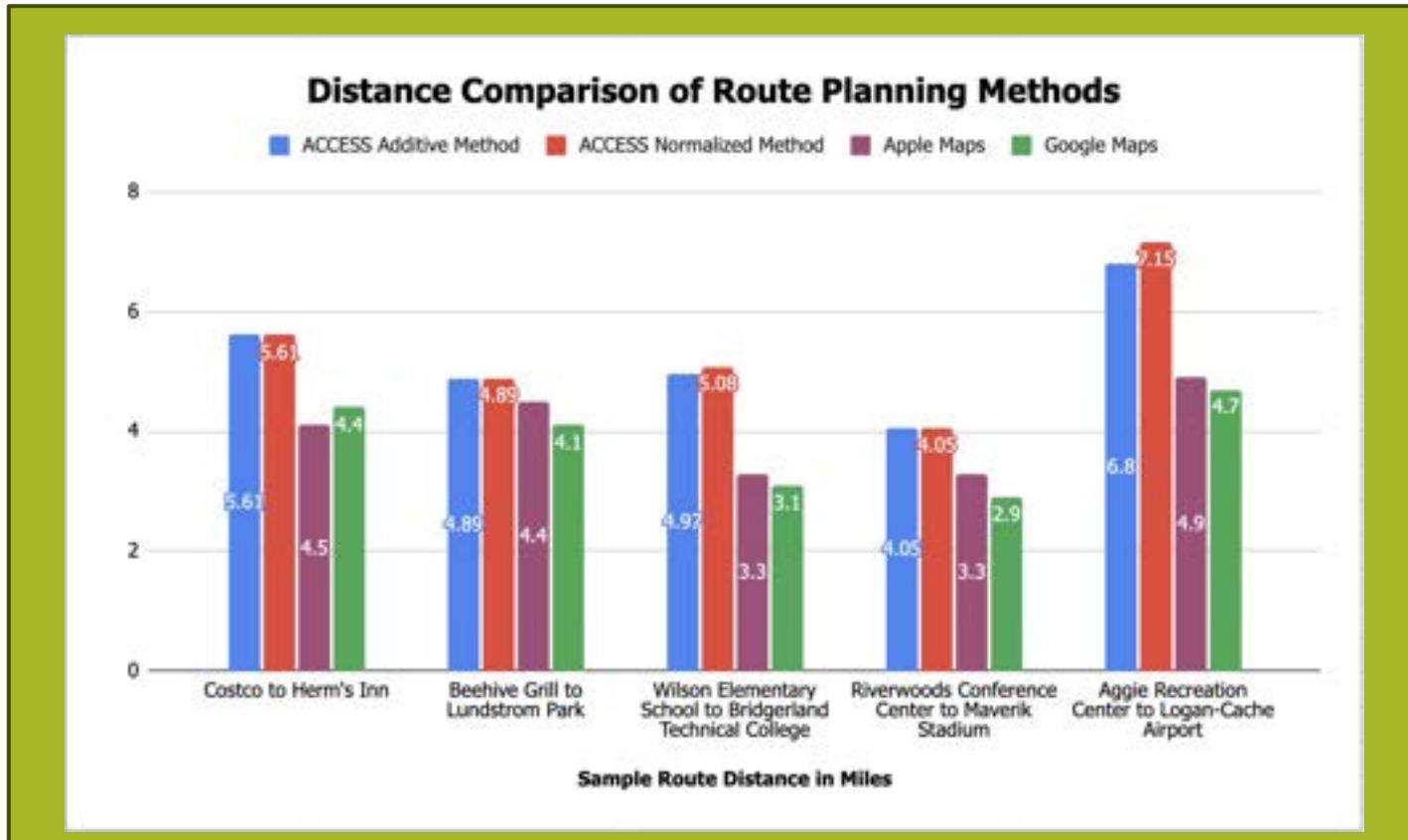


Additive Method



Apple Maps

Route Planning Comparison



Discussion

- Data Gaps / Issues
 - Data Updates
 - Incorrect Information (WRFC)
- Factor Adjustments
 - Speed Limit for Trails
 - Add in travel lanes?

	Manual Method	Normalized Method
Ease to calibrate		✓
Intuitive		✓
More prone to outliers	✓	
More adjustments	✓	

Future Work

- Data
 - Strava
- Aggie Blue Bikes
 - Survey
 - Distribution
 - Calibration
- Cycling Comfort vs LTS
- Relative scoring for Cities?
- Optimized Webtool Routing