Energy Mobile: GIS for Accessibility

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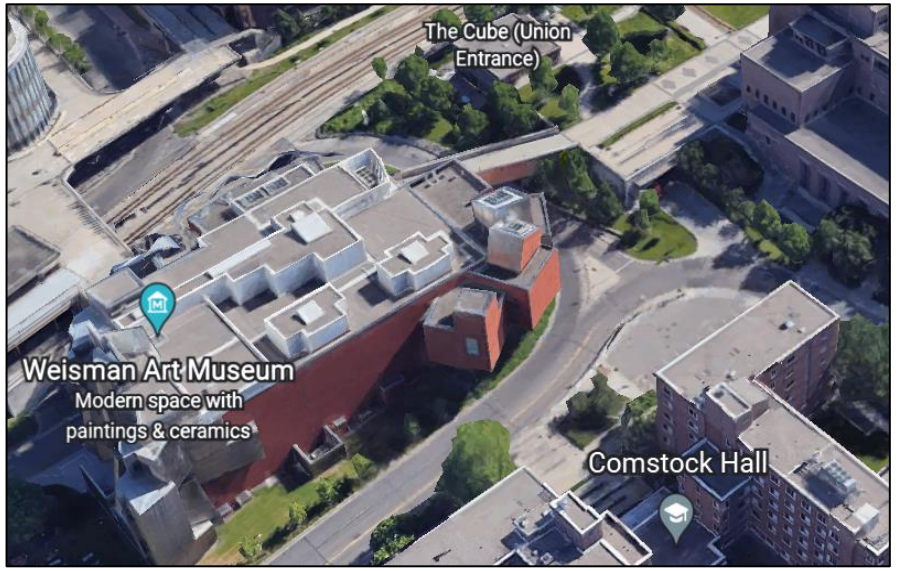
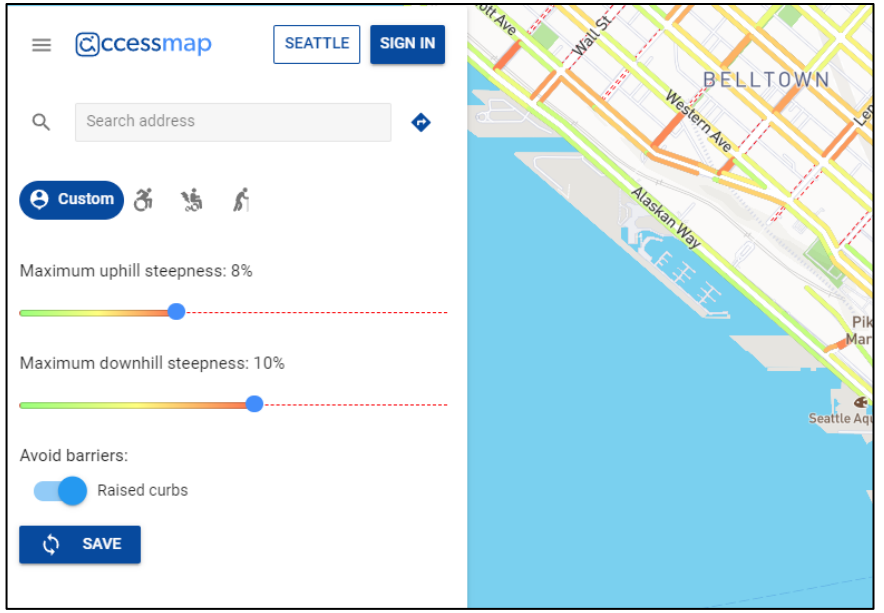
Github Repo: https://github.com/and04671/EnergyMobile/tree/Final-Items

Motivation

Lack of terrain accessibility information at UMN



AccessMap by TASKAR Center, UWS



Objective:

UMN proxy using street instead of sidewalk data with endpoints and weighted parameters for slope and distance

Background

Spring 2021 V 1.0: met the primitive criteria for these objectives

Reasons for improvement on V 1.0: Not adjustable, large numeric inaccuracy

Planned improvements for V 2.0 (this version)

User customization, more accurate energy calculations, added restrictions

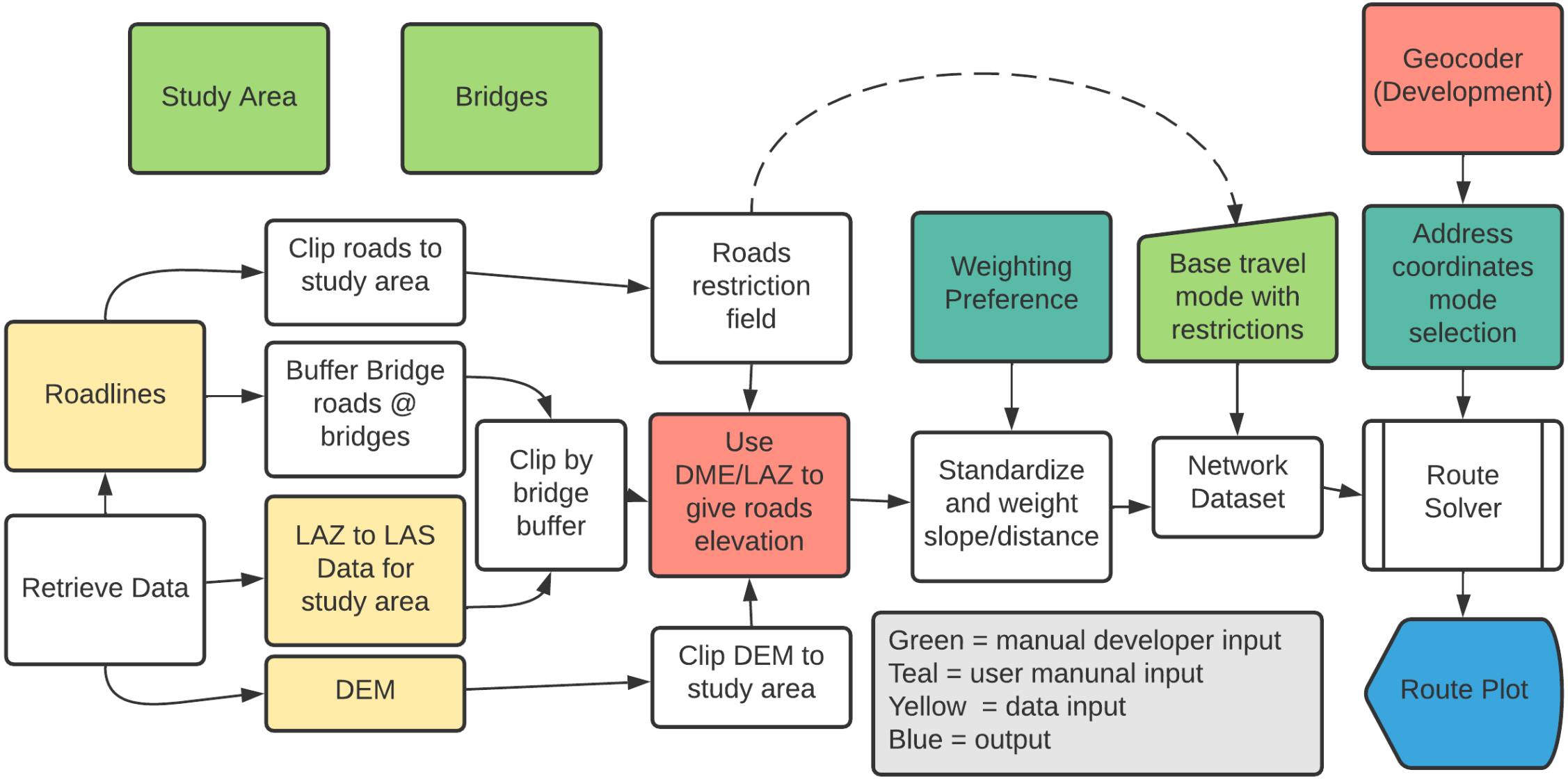
Methods Data

Road Data: Greater Metro counties, UTM-15 NAD-1983, 2020

DEM Data: 1:24000 from USGS, 30m resolution

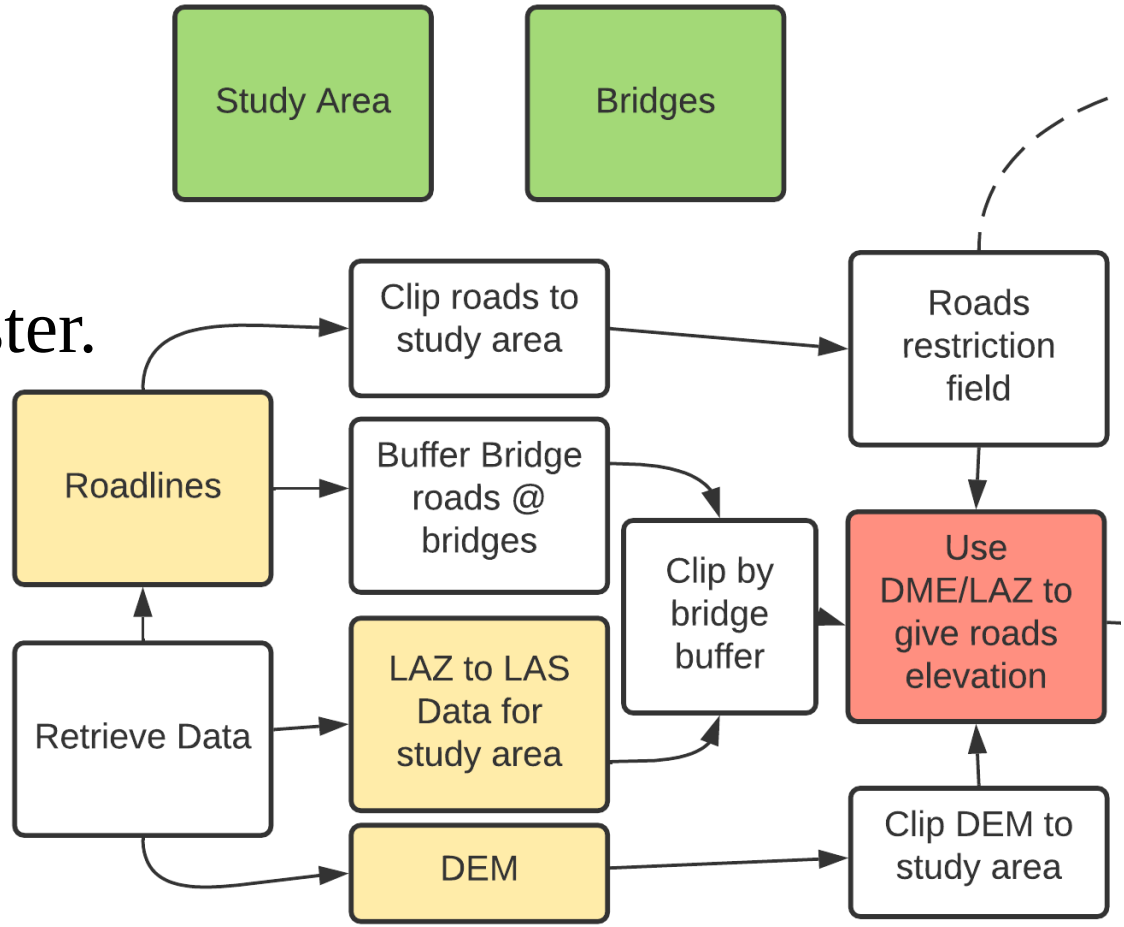
LAS Data: MNDNR, 12 ‘tiles’

Methods Diagram



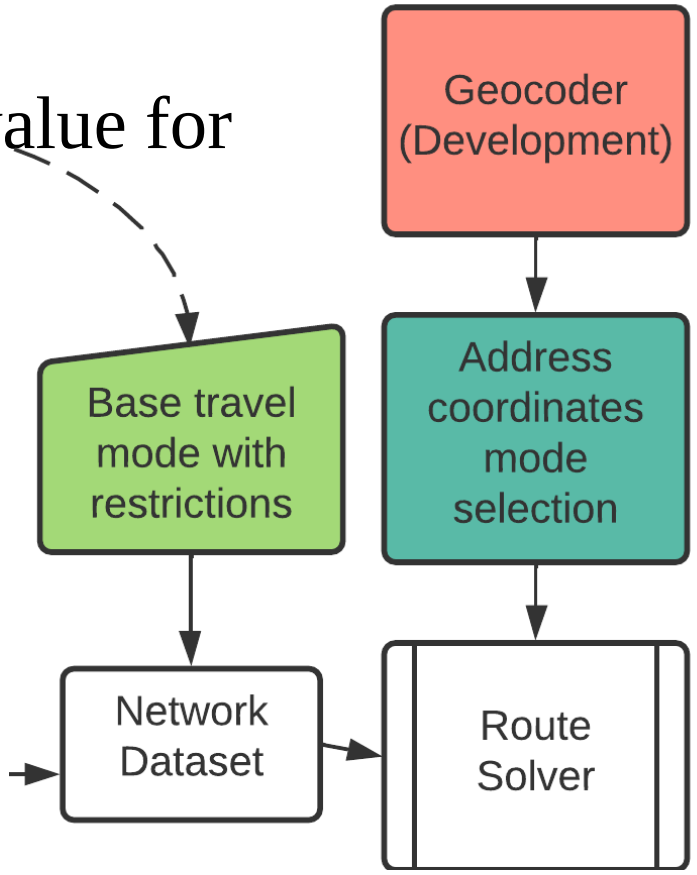
Methods Walkthrough

- Modules for the project: **arcpy, requests, json, zipfile, geopy, and utm.**
- Download/Extraction
- Define and Clip to study area
- Buffer bridges
- LAS files to one UTM 15 raster file
- Use buffered bridges to mask for LIDAR raster.
- AddSurface values tool: DEM then LIDAR
- Standardize slope and distance



Methods Walkthrough

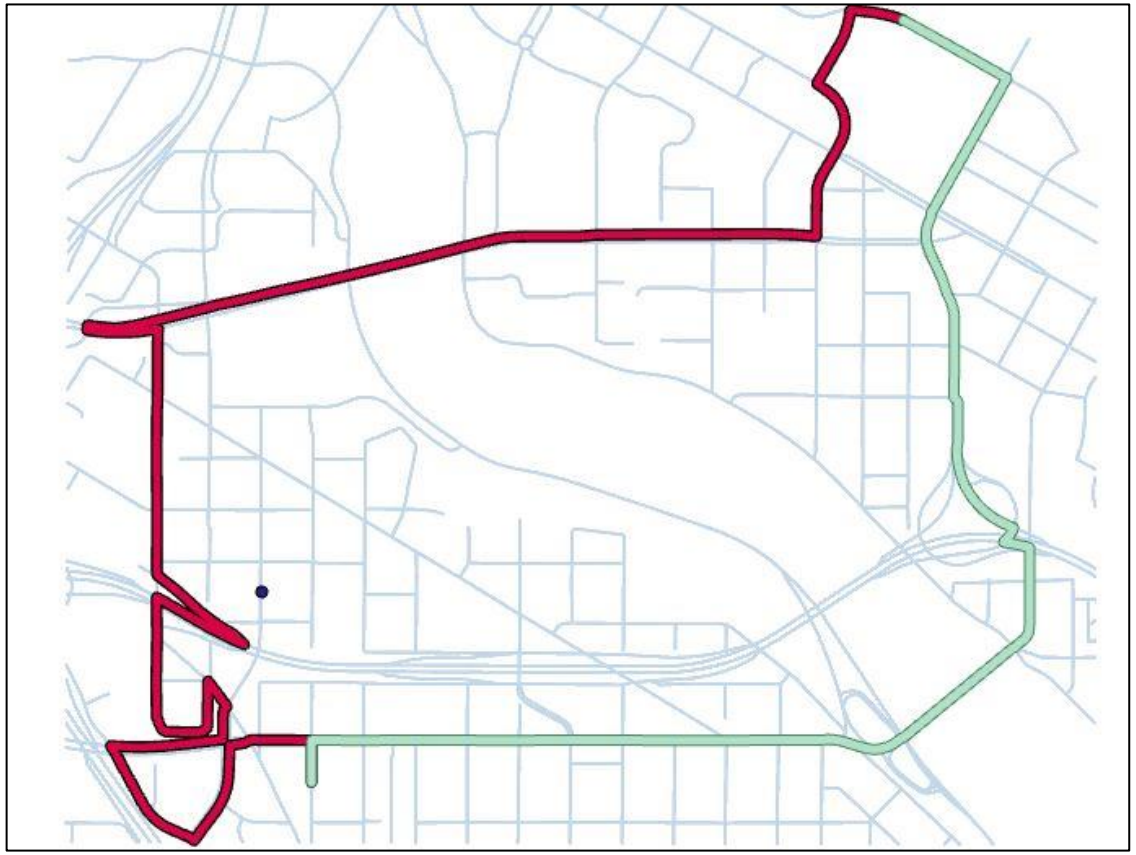
- Clipped roads file > Network Dataset
- Create travel mode with ‘Energy’ as impedance = (user value for distance)*(distance) + (user value for slope)*(slope).
- Add two restrictions
- Create blank class and
- Ask for addresses, translate to UTM
- Build network
- Router returns route situation. Create service area maps
- Delete temporary layers
- For each change in cost ratio, edit the cost under the network properties, click ok, and then rebuild the network.



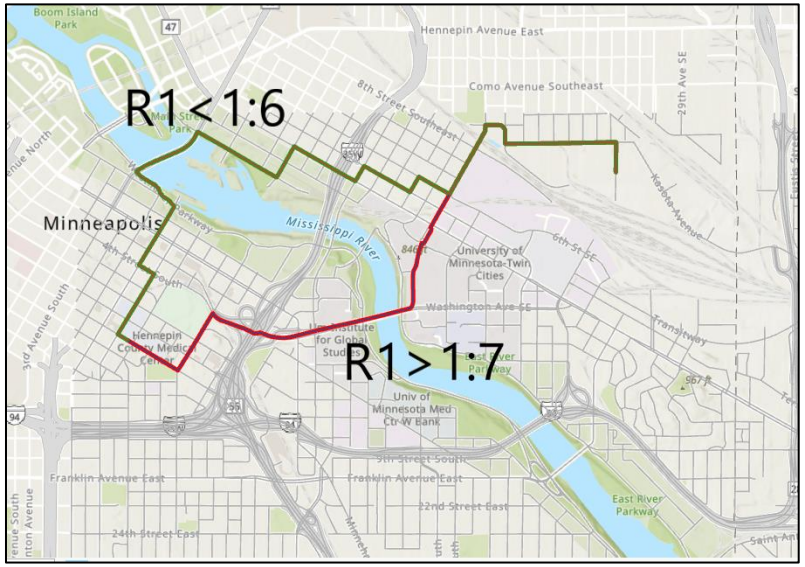
Results

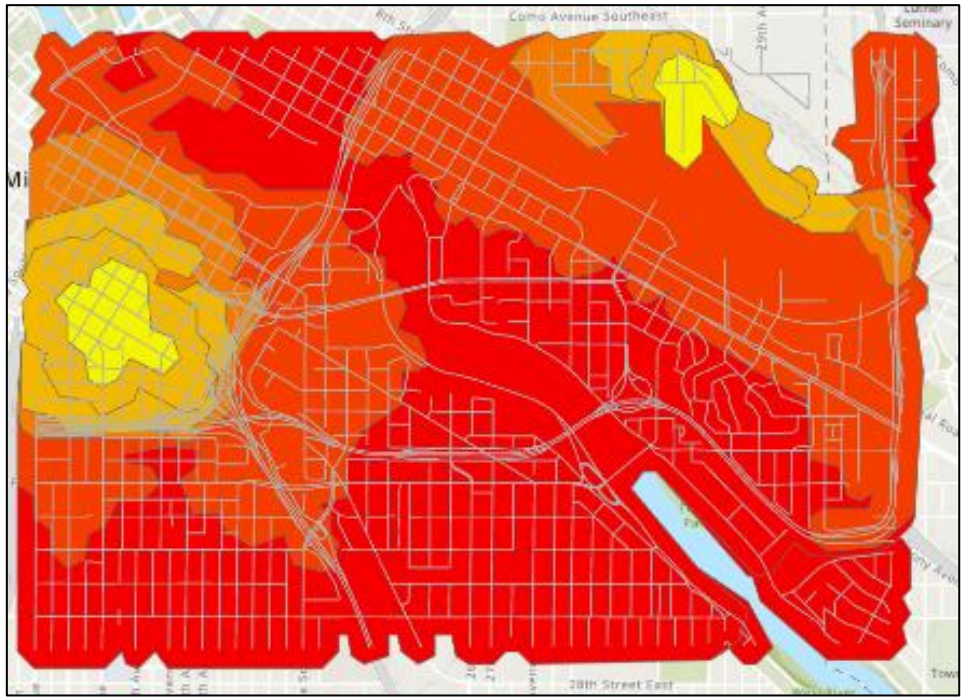
Green one: 1*[Distance]+1*[Slope]

Red route is: [Distance]+[Slope]

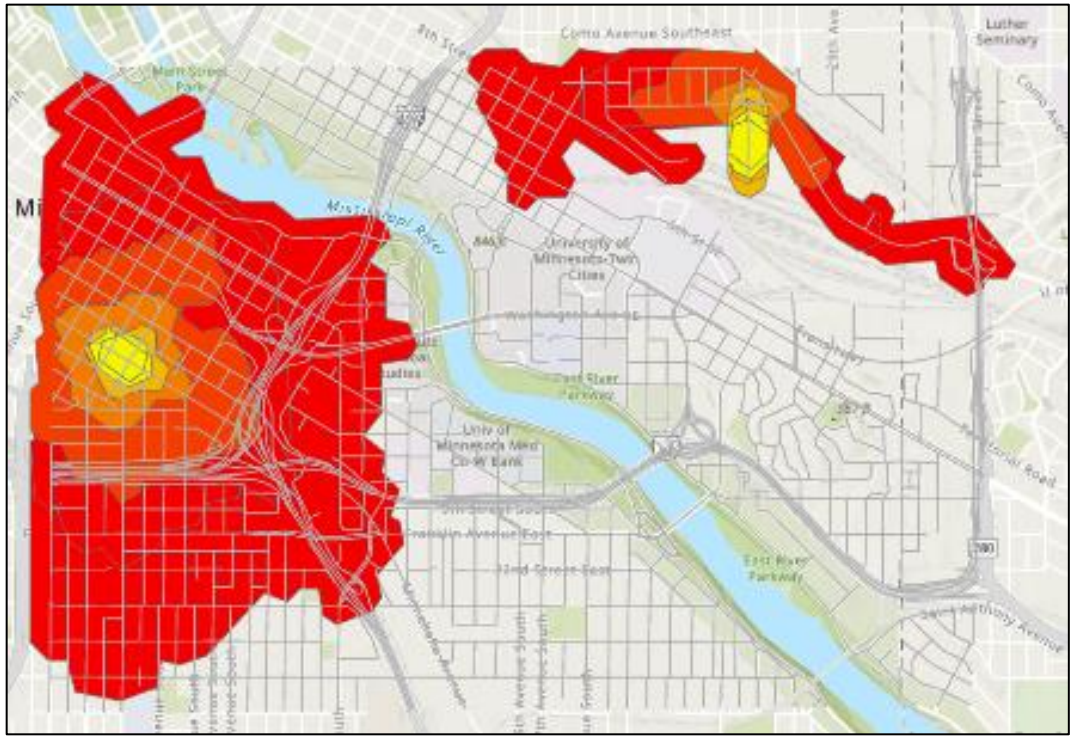


Results: R1



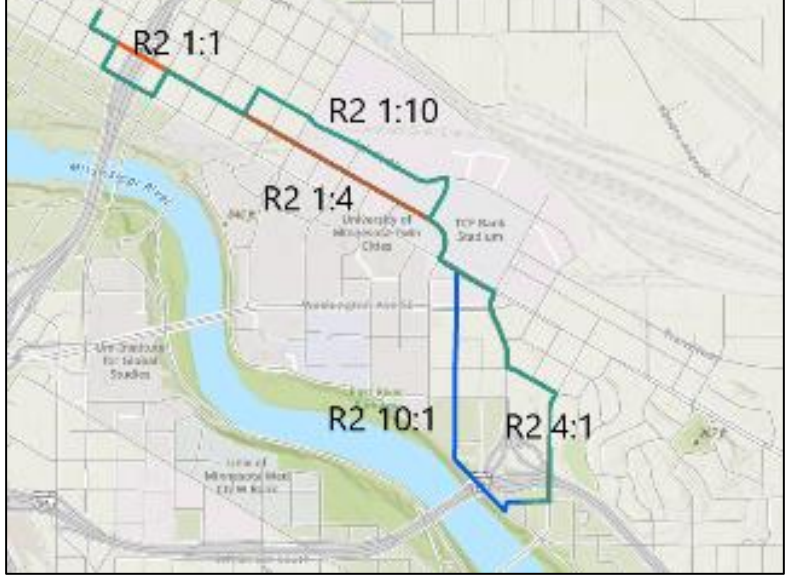


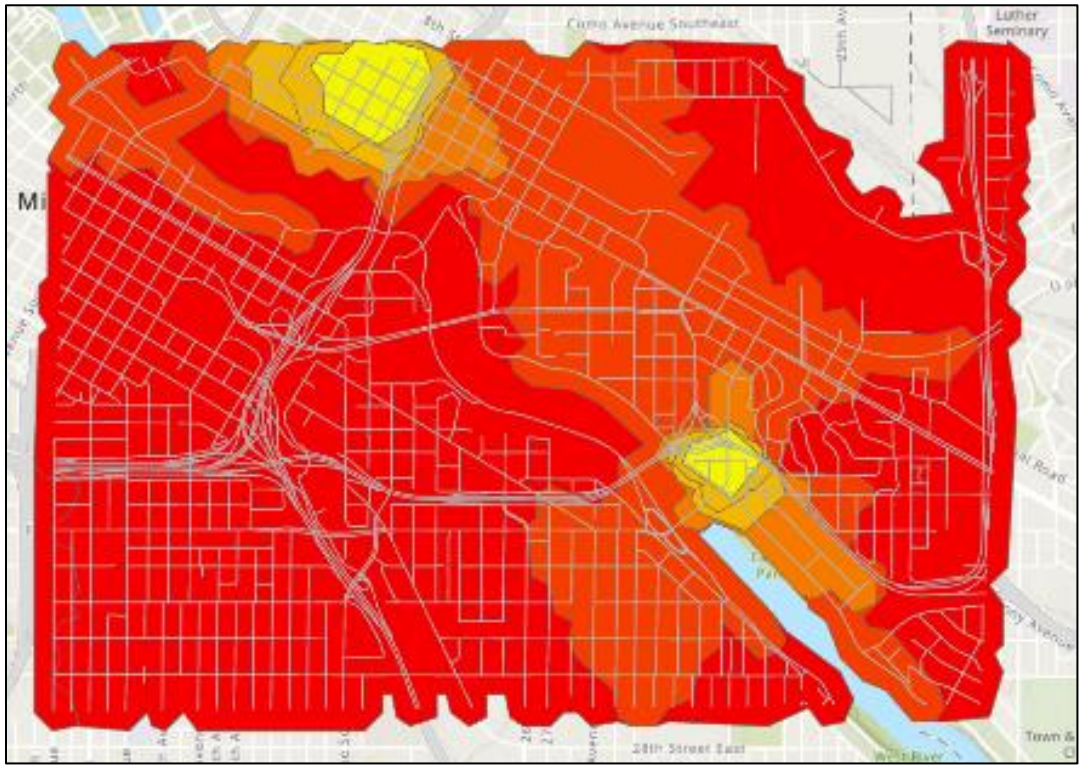
Service Area 1:40



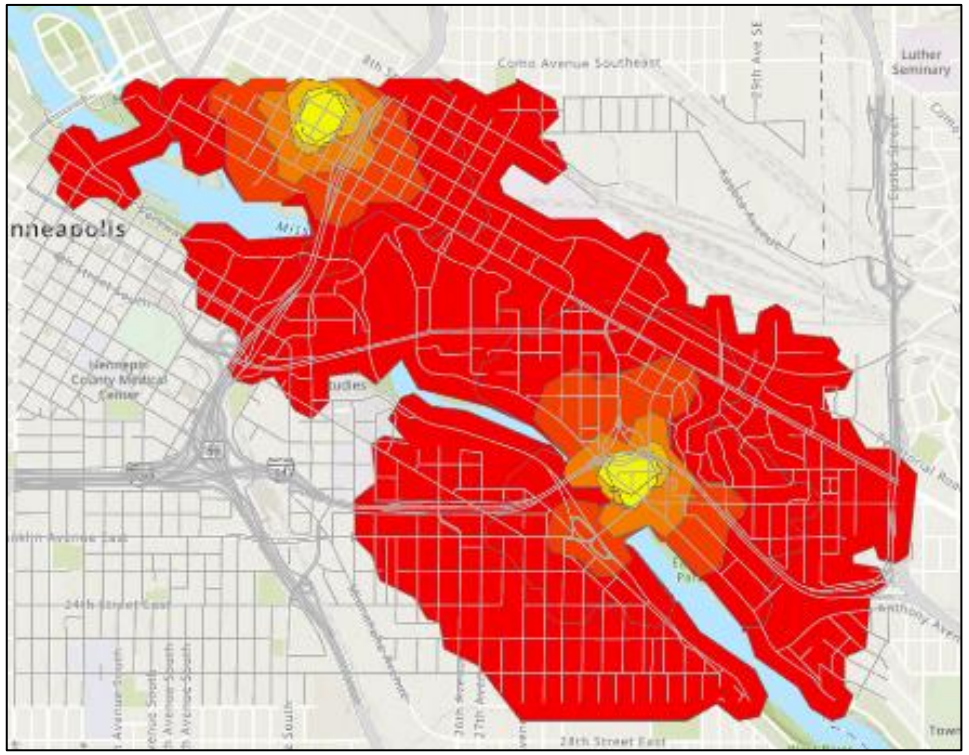
Service Area 40:1

Results: R2



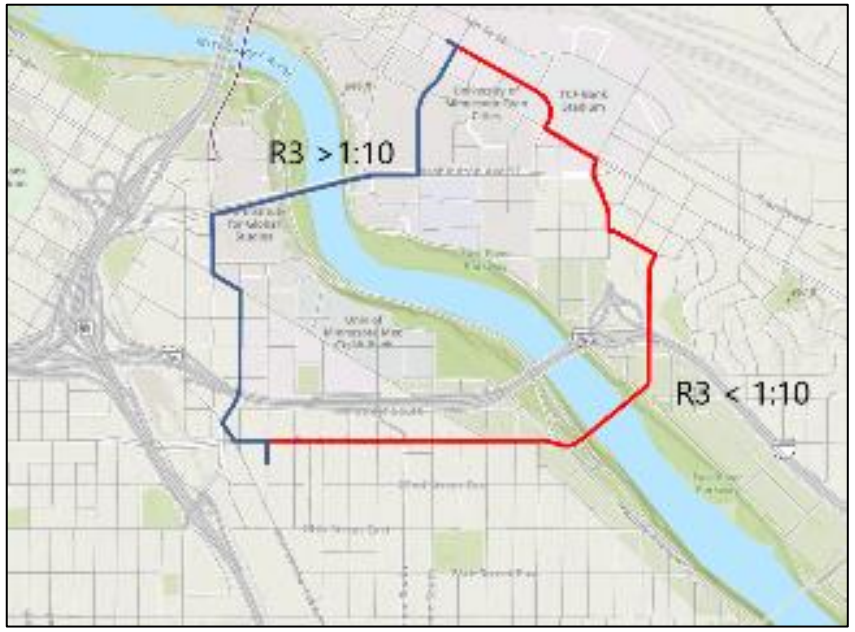


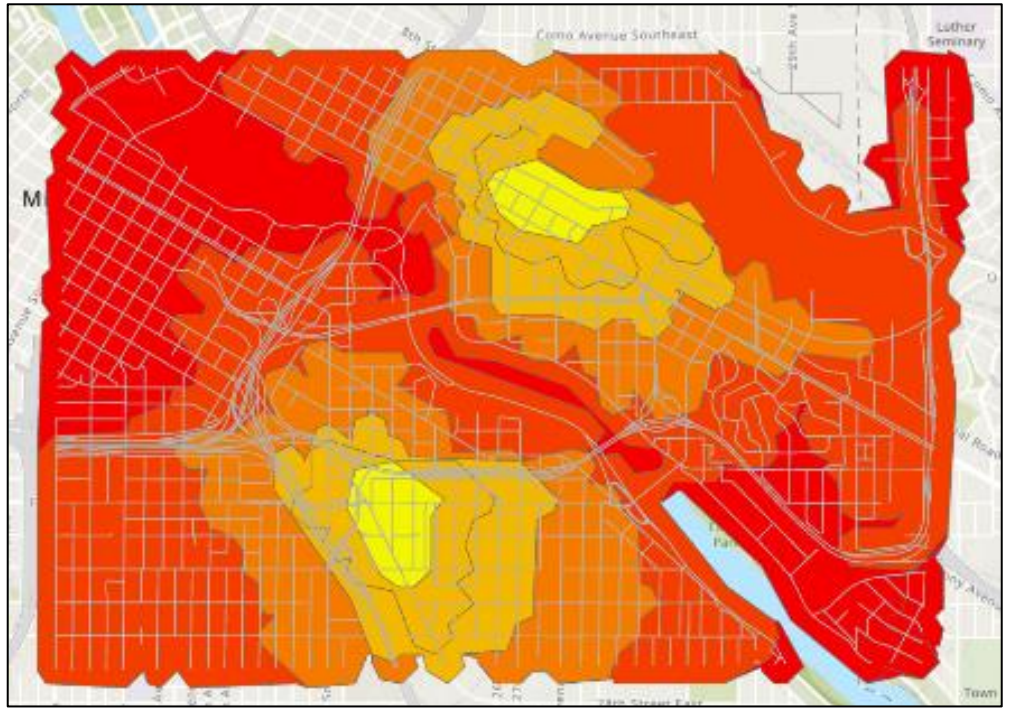
Service Area 1:40



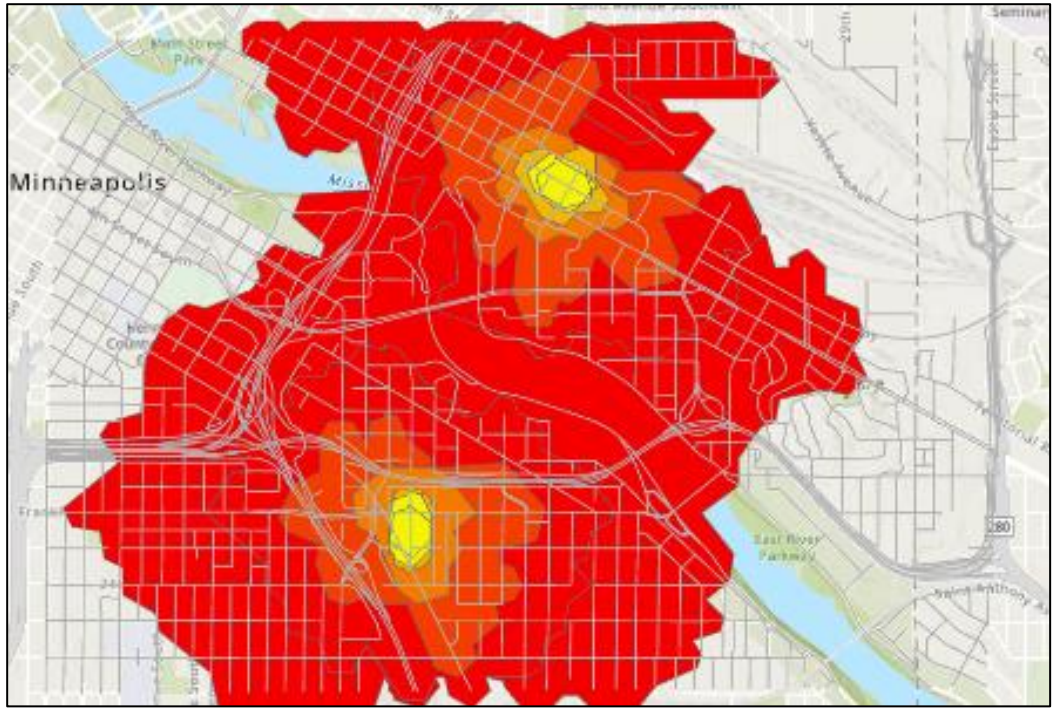
Service Area 40:1

Results: R3



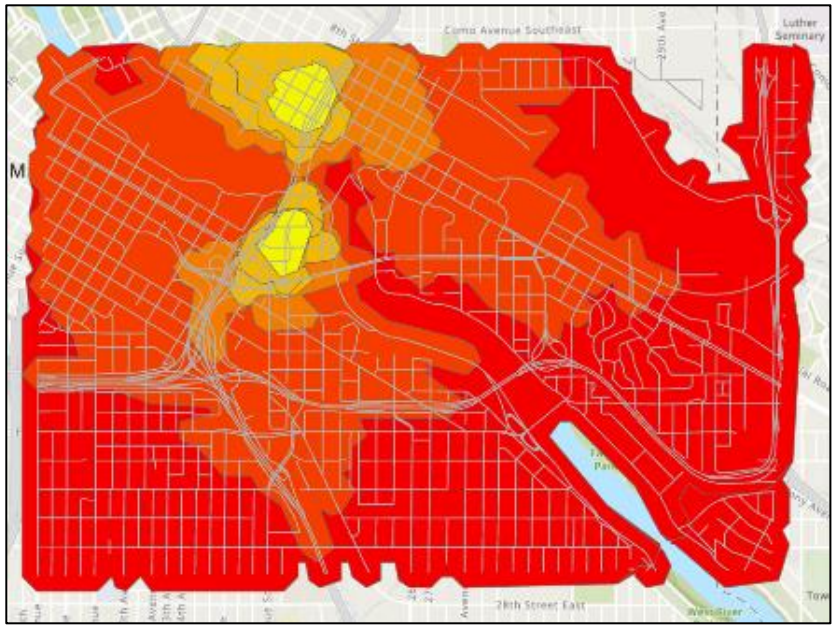


Service Area 1:40

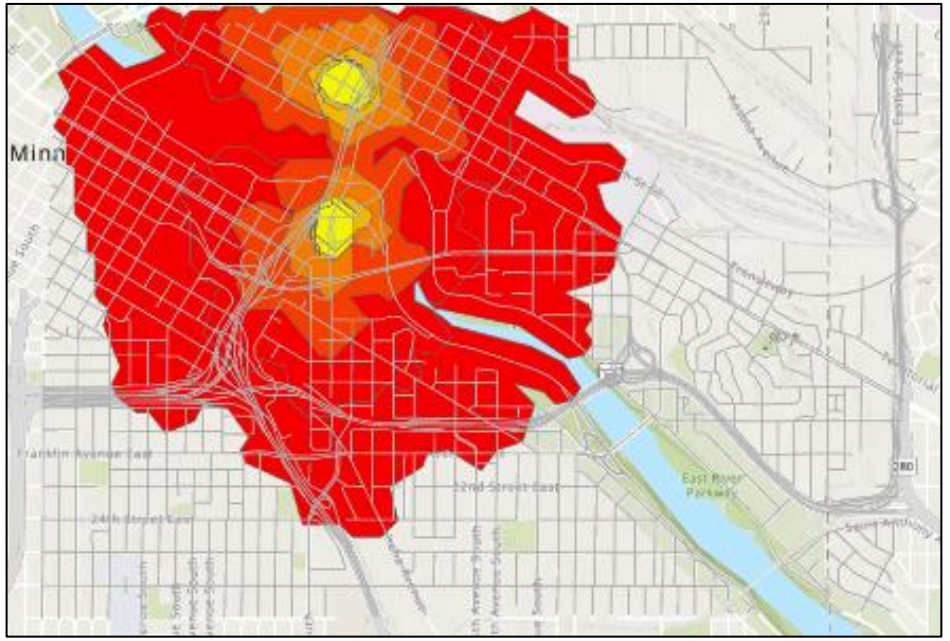


Service Area 40:1

Results: R4

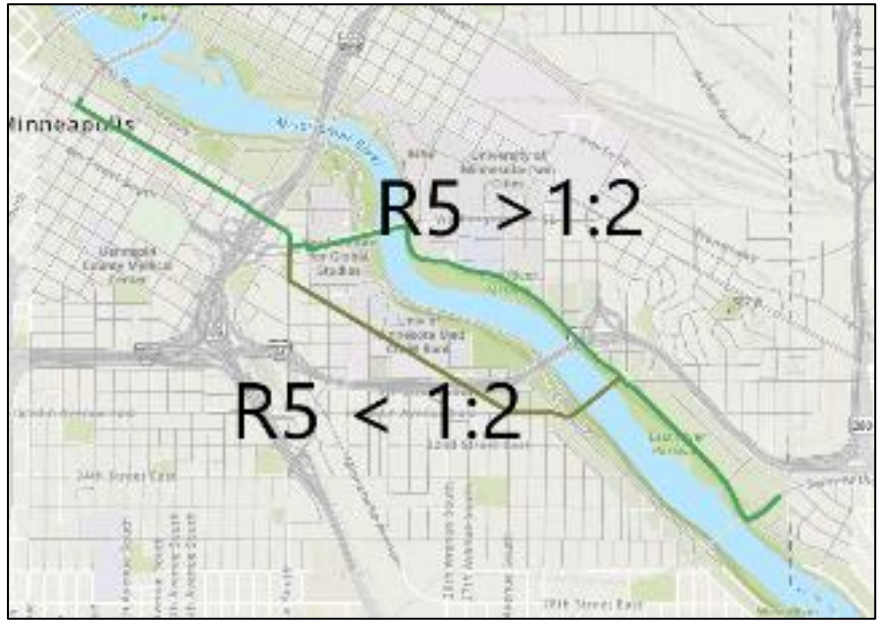


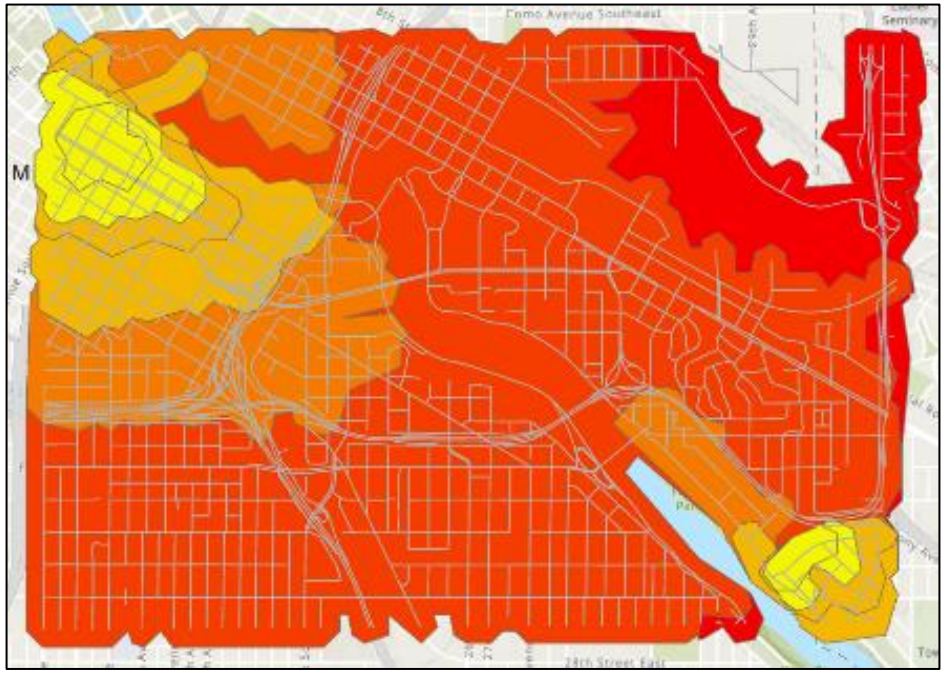
Service Area 1:40



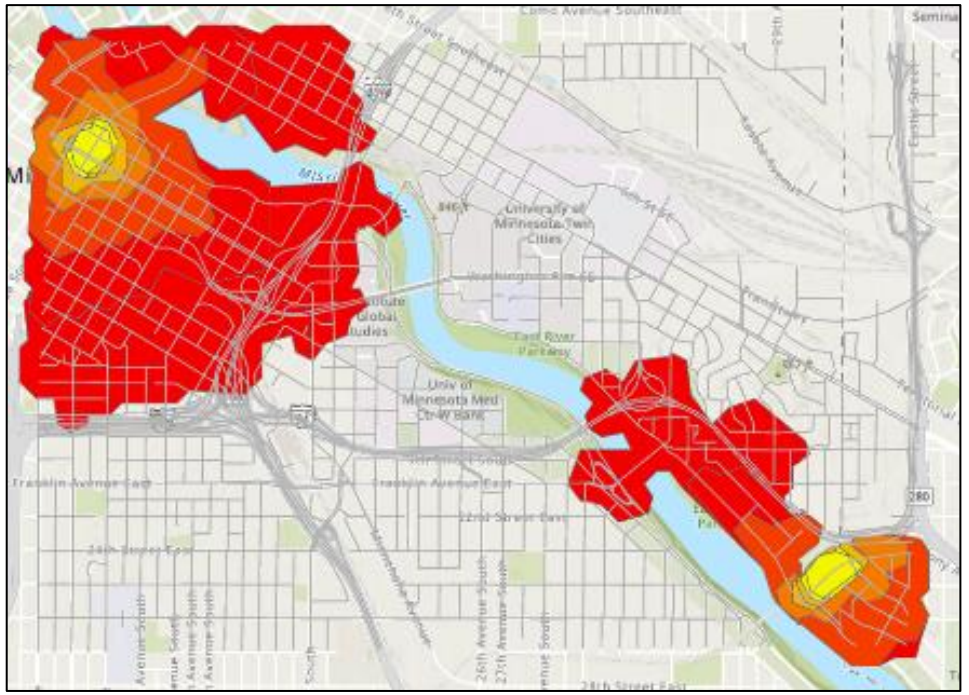
Service Area 40:1

Results: R5





Service Area 1:40



Service Area 40:1

Discussion: Observations

‘Tipping point’ - specific ratio between two main routes

Cost Surfaces

Constant on the distance and slope terms not additive

Better decision: eliminate the odd outliers

Discussion: Project Challenges

Python ArcPy network handling

Accurate slope measure/estimate

Merging LAS and DEM data

Overall Improvements: Significant

Takes variables into account.

- Standardizing and weighting values
- Better bridge data
- The additional cost surface result
- Neater and automated. Route solver
- The addition of addresses

Overall Improvements

Passes Least Energy Path Heuristics: best route

Pedestrian Feasibility: path is walkable

Entry and UI: accepts and provides accessible format

Remaining Problems

Highway data proxy vs. sidewalks.

Slope Equation

Local program

Future Directions

Primitive compared to the directive at UWS

The University of Minnesota contains efficient paths that are not considered

No equation can be translated directly to exhaustion

Might provide user the base information on distance and slope and allow them to evaluate best route, while being given some routes ideal for various criteria.

This semester project was primarily meant as a learning experience, and in that sense, it accomplished its goals.

- Familiarity with network GIS
- Parallel tools in different programs.
- Strong automated route models still have annoying weaknesses.
- Writing/troubleshooting code: improved skills

Citations

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