



Integrating Data-Driven Analysis & Crowdsourced Community Input for Mobility Hub Site Selection

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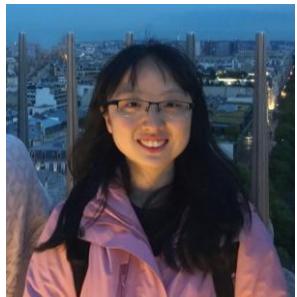


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- FDOT District Two (Janell Damato & Derek Dixon)
- FDOT District Four (Lisa Maack & Wibet Hay)



Presentation outline

- 1. Mobility hub definition and typology**
- 2. A novel method for mobility hub site selection**
- 3. Application of method in the City of Gainesville**
- 4. Validation and refinement of results through crowdsourced input**



1. Mobility hub definition and typology



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What is a mobility hub?



Figure. Cartoon mock-up of a mobility hub. Source: CoMoUK (2019)

1. Mobility hub definition and typology

- Supports the seamless integration of multiple transportation modes
- Includes amenities and services to facilitate multimodal travel
- Anchored by public transit systems





Adam Cohen • 1st

Senior Research Manager @ University of California, Berkeley | Innovative Mobility...
5d • Edited • 🌎

Question for the thought leaders on innovative mobility...

💡 Are we thinking too SMALL when it comes to intermodal passenger facilities?

💻 How do YOU define an intermodal passenger facility? Is it time for a taxonomy that defines what constitutes an intermodal passenger facility and how its similar and different from mobility hubs?

As transportation continues to evolve, it's time to rethink what qualifies as an "intermodal passenger facility." Should these hubs go beyond traditional modes like planes, buses, and trains to include:

- 🚗 Carsharing
- 🚲 Shared micromobility (bike and scooter sharing)
- 🚍 Microtransit
- 🚖 TNCs (Uber, Lyft) and Taxis
- 🚚 Courier network services
- 🤖 Shared AVs and other emerging modes?

- Given the growth of curbside pick-up and last-mile delivery services, is the legacy definition of "intermodal passenger" too rigid?

- Can they be digital? Imagine hubs that move virtually, adapting to demand like dynamic wayfinding, MaaS, travel hotspots, and traveler information systems, where the "station" is wherever you need it.

- Could they be staging areas for shared AVs, taxis, TNCs, and courier network services to become part of the intermodal mix?

- Do they need to be publicly owned? What if private companies owned/operated them—would that change the game?

- Could these facilities exist anywhere—urban, rural, suburban—or do certain preconditions (tech, infrastructure, etc.) need to exist first?

- What if intermodal passenger facilities weren't just transit connectors but lifestyle hubs—a blend of retail, art, charging stations, gyms, entertainment, and more?

- Do we need to tear down the walls of what we think intermodal hubs can be?

So I ask: What should REALLY define an intermodal passenger facility?

💥 Are we ready to rethink the future of mobility? Or are we too comfortable with the past?

1. Mobility hub definition and typology



MHs vs intermodal passenger facility

- MHs & new mobility (i.e., shared mobility, micromobility, and electric mobility)
- MHs & digital infrastructure (e.g., traveler information, mobility-as-a-service)
- Place-making function of MHs
- Different scales of MHs



Figure: Park and ride in Charleston. Source: CARTA, 2019

Typology of MHs

Neighborhood



Figure: Mobil.punkt Station in Bremen, DE. Source: Aono, 2019

District



Figure: Maverick Station in Boston, MA. Source: MTC, 2021

Regional



Figure: Stratford Station in London, UK. Source: Metrolinx 2011

1. Mobility hub definition and typology

Typology of MHs

Neighborhood

- **Minor** transit stations with **basic** modes and amenities
- Connect **residential** areas & **transit network**

District

- **Significant** transit stations with **several** modes & amenities
- Provide access to **key destinations**

Regional

- **Major** transport depots with **multiple** modes & amenities
- Facilitate **long distance** multimodal travel

Common Goals of MHs



Serve multimodal travel needs



Enhance first-/last-mile connectivity
and facilitate seamless transfers



Provide equitable accessibility for all



Bikeshare



Ridehall Pick-Up
& Drop-Off



Parklets, Public Art,
& Placemaking



Car Share



Electric Vehicle
Charging



Bike Parking



Transit



Branding



Information

A mobility hub may include these features
(Source: City of Boston)



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2. A novel method for mobility hub site selection



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A multi-criteria analytical framework for mobility hub location selection



A multi-criteria analytical framework for mobility hub location selection

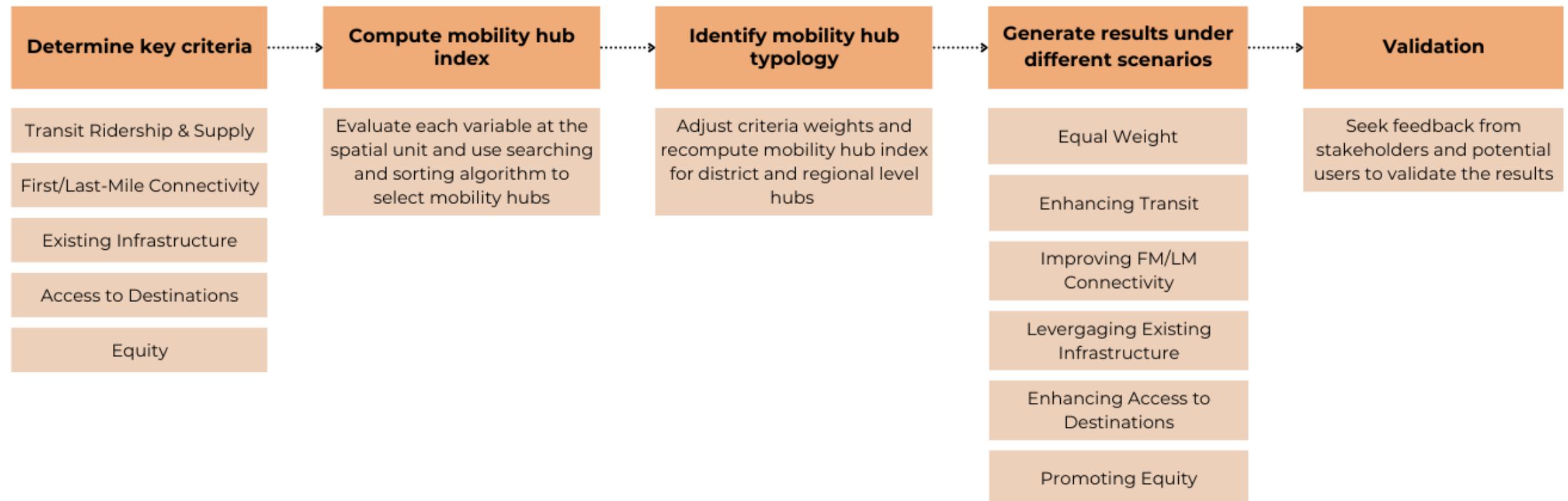


Figure: Overview of the proposed approach

Novelty of our proposed approach

- Unit of analysis**: Previous research usually focuses on areal units (e.g., Block groups), we focus on transit stops
- The existing method does not distinguish **MH typology** (neighborhood, district, regional)
- The consideration of **first-/last-mile connectivity and gaps**
- Use of (mostly) **publicly available** datasets
- Validation and refinement through **crowdsourced community input**

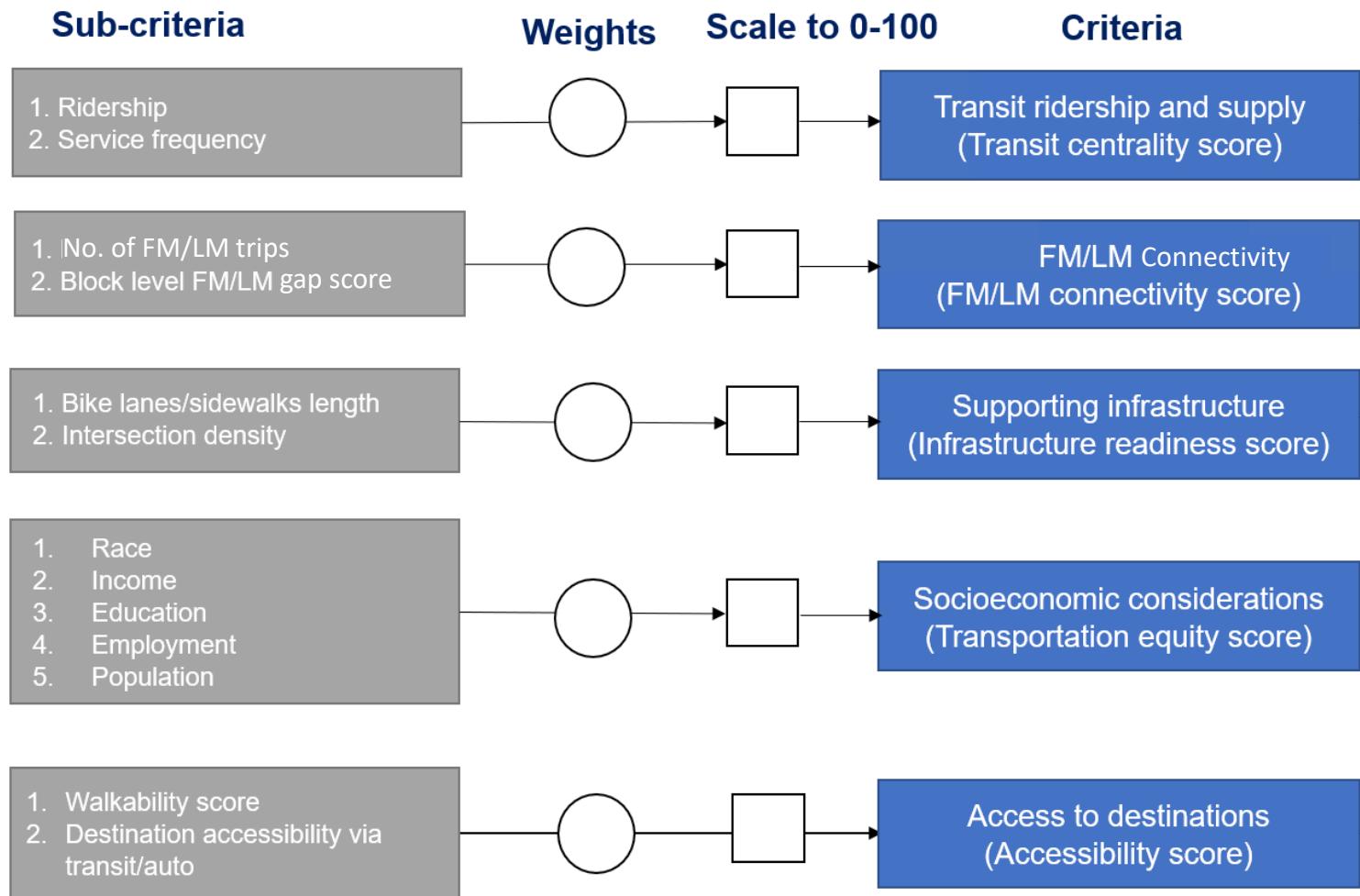
Unit of analysis: transit stop cluster

Use the DBSCAN clustering algorithm to group adjacent transit stops

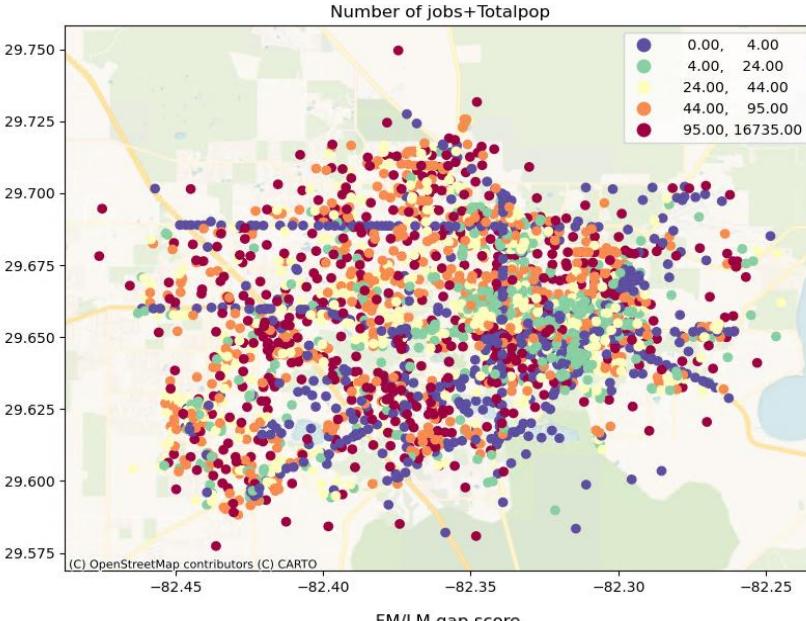
- search distance: 100 meters
- the maximum bus stop number of each cluster: 10



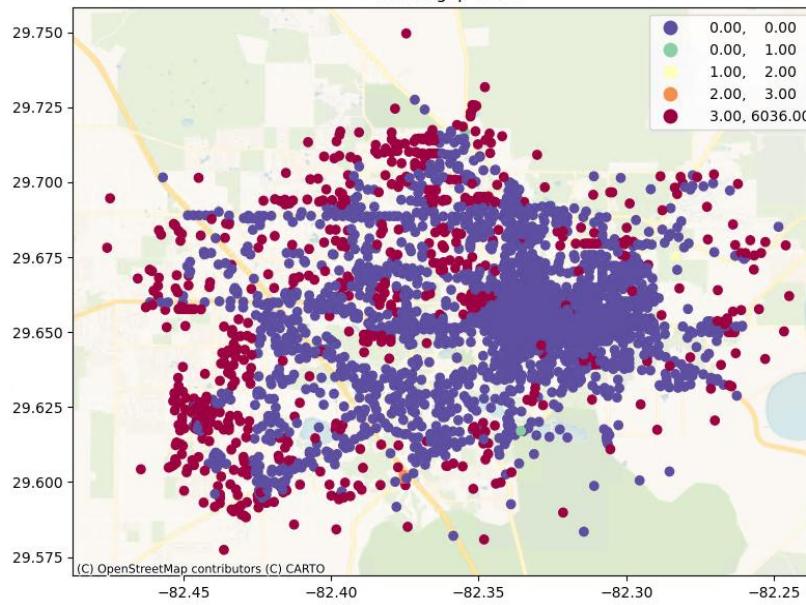
Computing the scores for each criterion



Block level FMLM gap score calculation

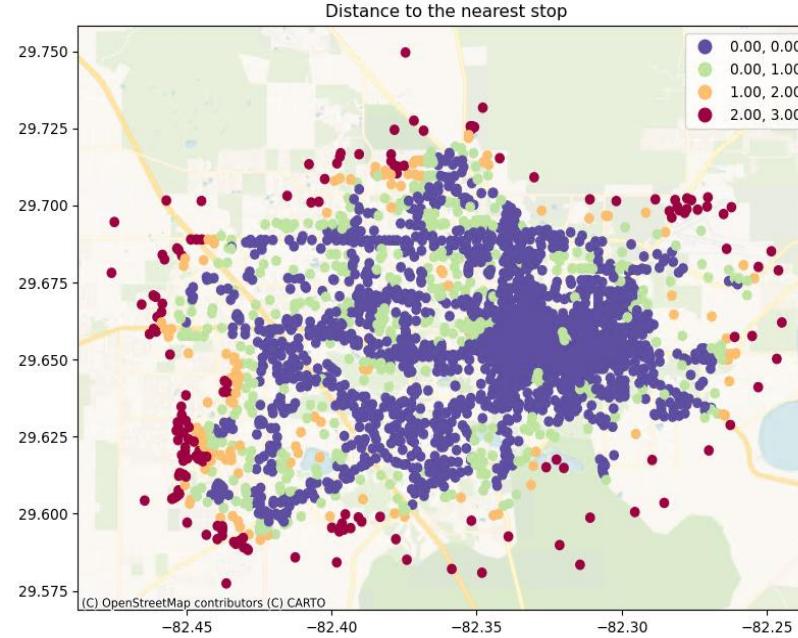


Step 1:
Calculate the number
of jobs + total
population in each
census block

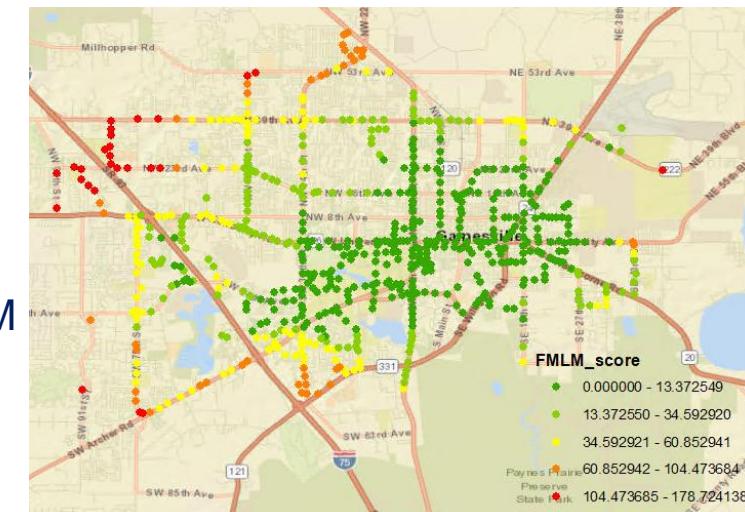


Step 3:
(number of jobs + total
population) * nearest
distance to get the FMLM
score at each census
block

hub site selection



Step 2:
Find the distance from
block centroid to the
nearest bus stop

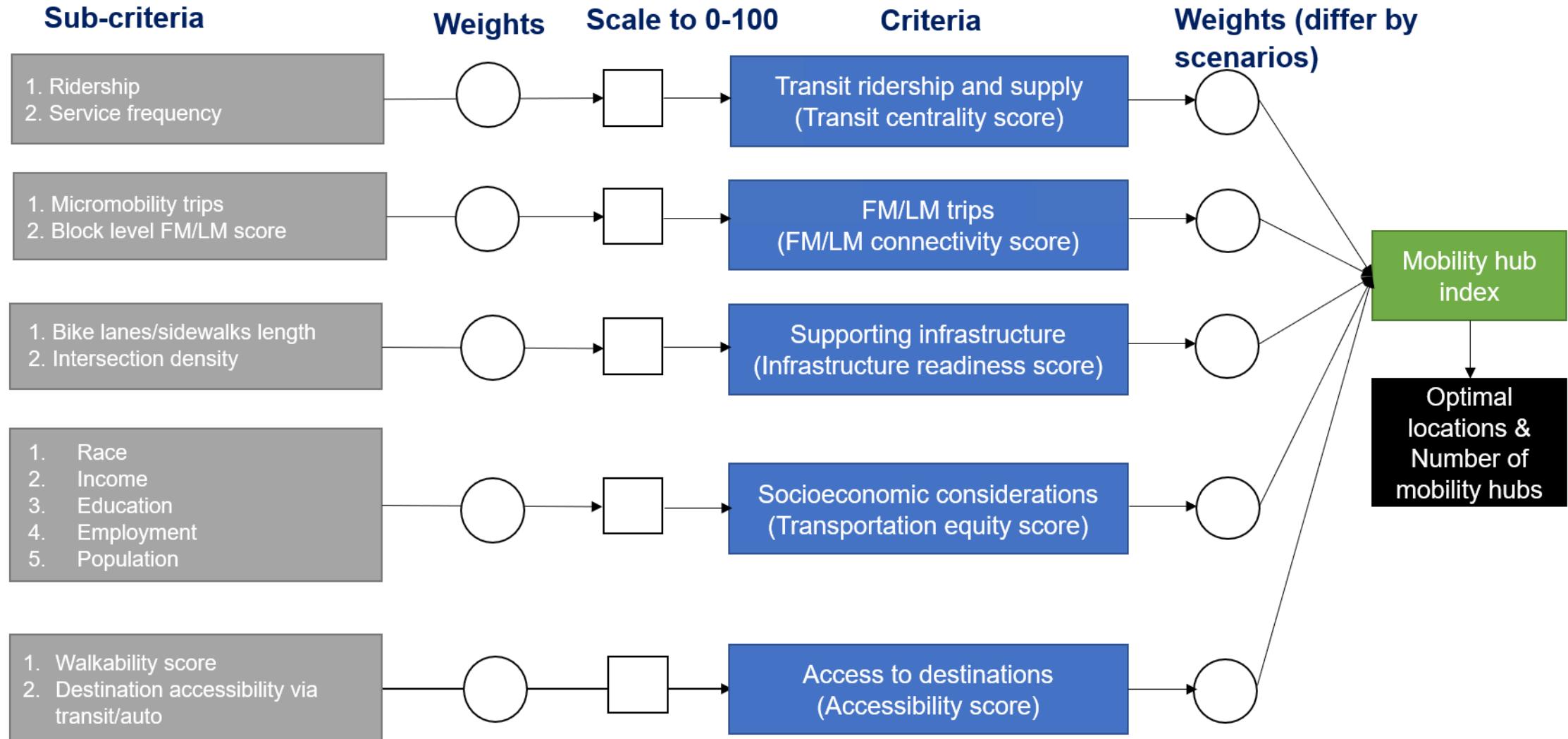


Step 4:
Aggregate the
average values to the
transit stop cluster



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Analytical steps for MH site selection

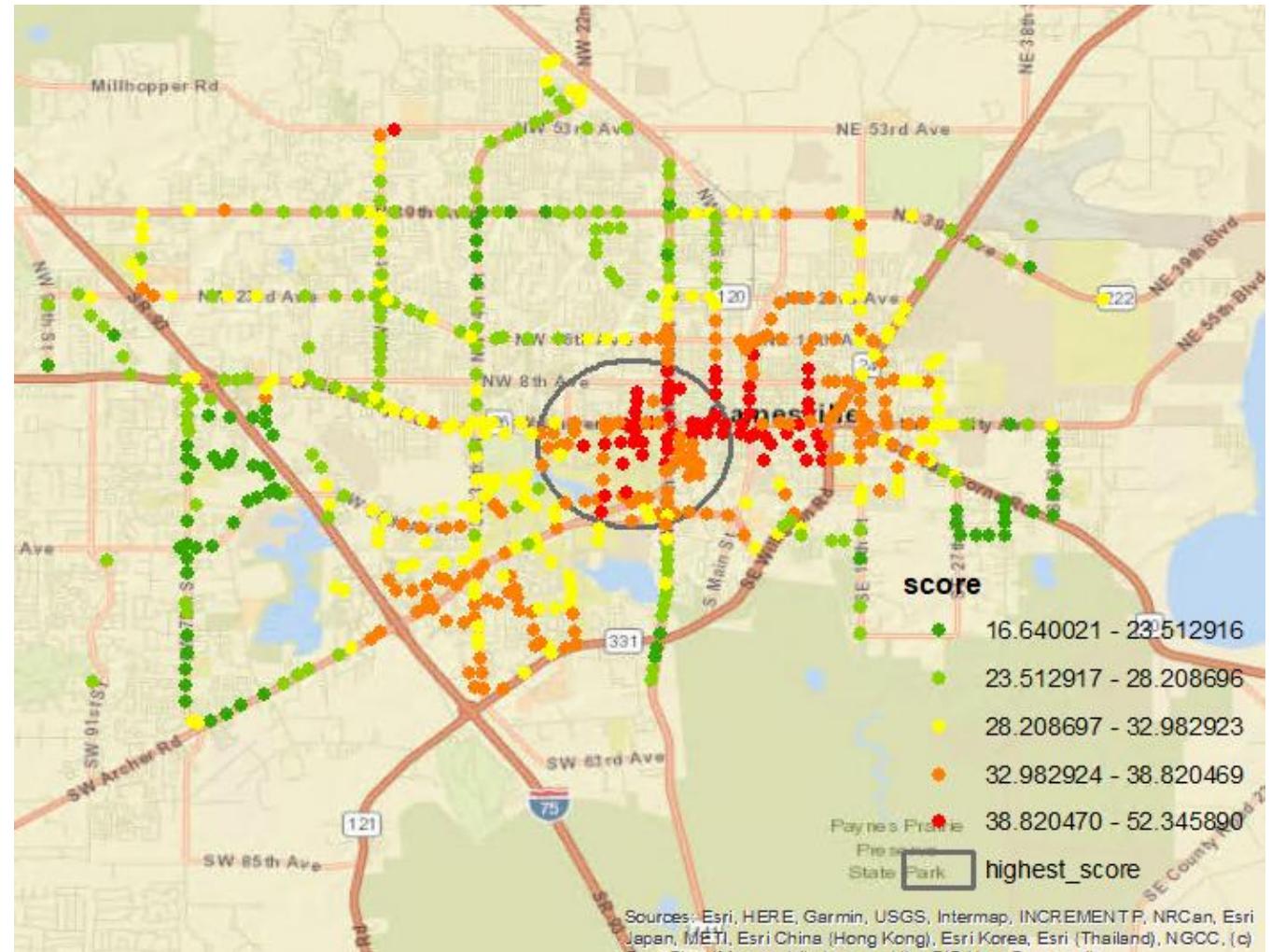
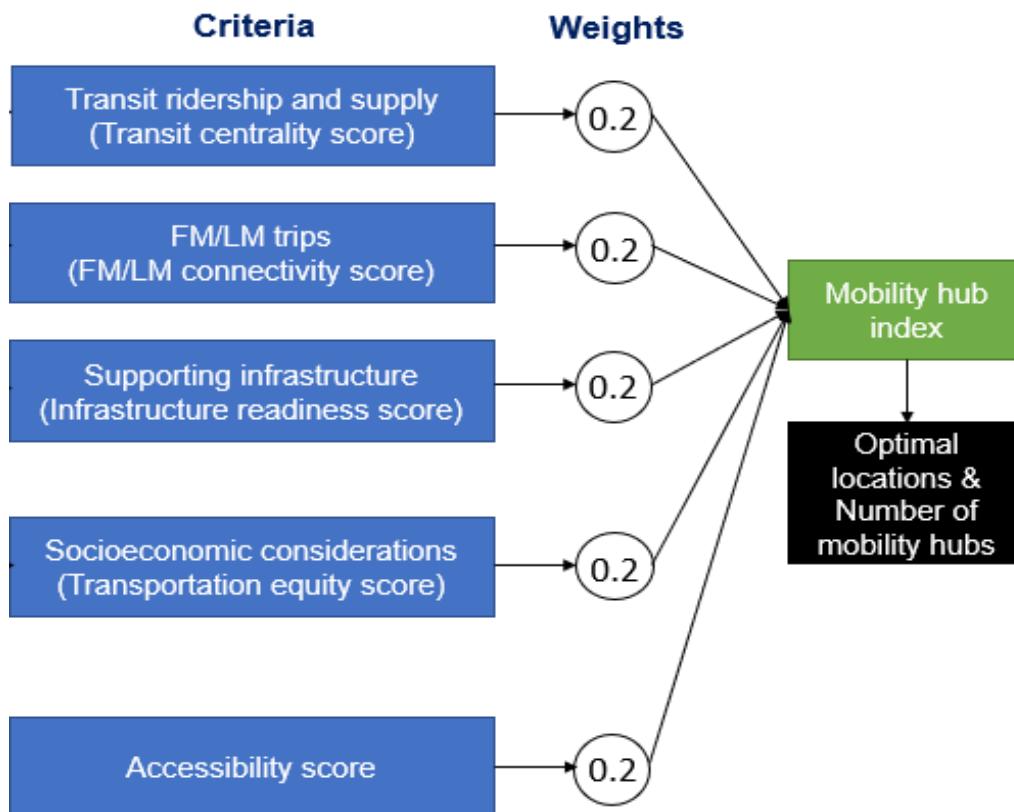


2. A novel method for mobility hub site selection

Planning scenarios and criterion weights

Planning scenario \ Criterion	Transit Ridership & Supply	FM/LM Connectivity	Infrastructure Readiness	Spatial Accessibility	Equity
Planning scenario					
Equal Weight	0.2	0.2	0.2	0.2	0.2
Promoting Equity	0.125	0.125	0.125	0.125	0.5
Enhancing Access	0.125	0.125	0.125	0.5	0.125
Leveraging Existing Infrastructure	0.125	0.125	0.5	0.125	0.125
Improving FM/LM Connectivity	0.125	0.5	0.125	0.125	0.125
Enhancing Transit	0.5	0.125	0.125	0.125	0.125

Computing MH index (equal weight scenario)



2. A novel method for mobility hub site selection



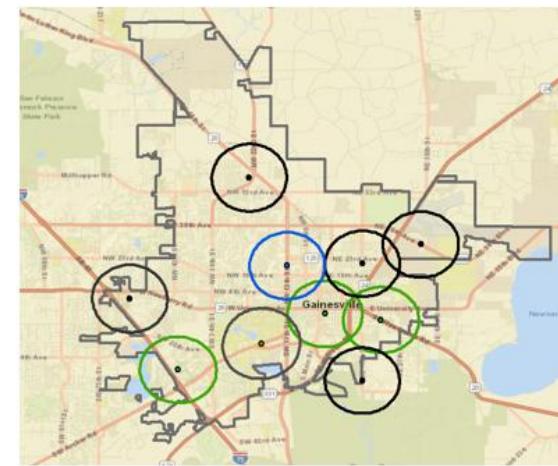
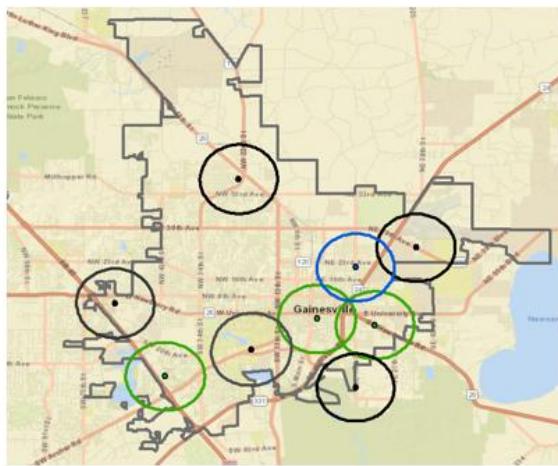
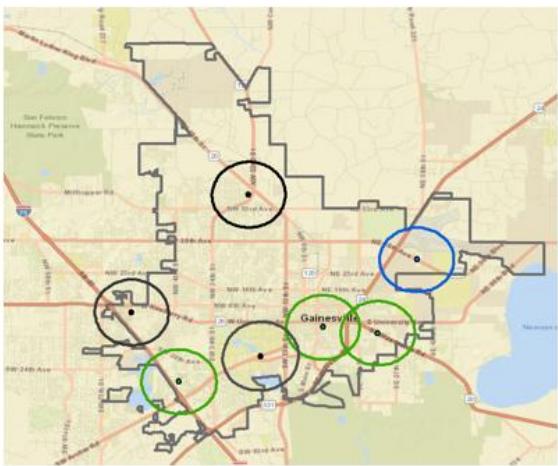
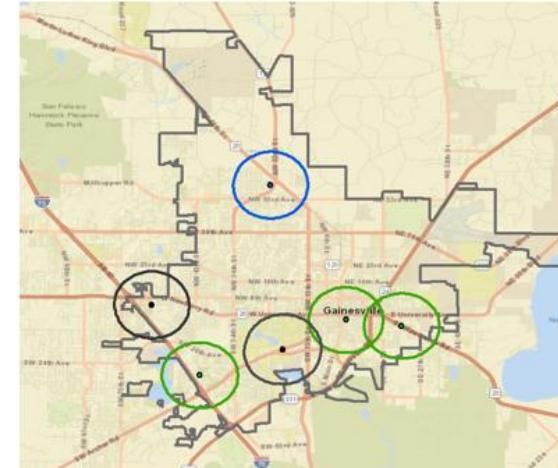
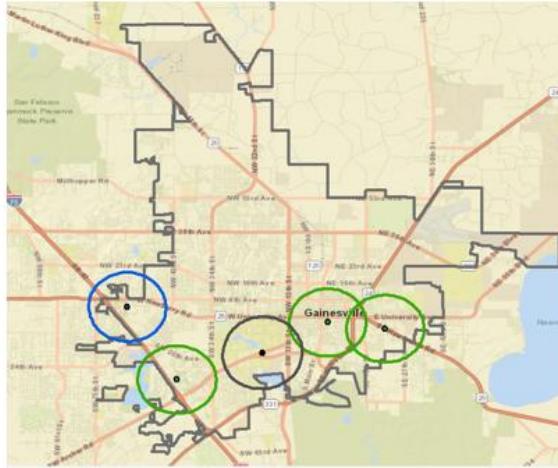
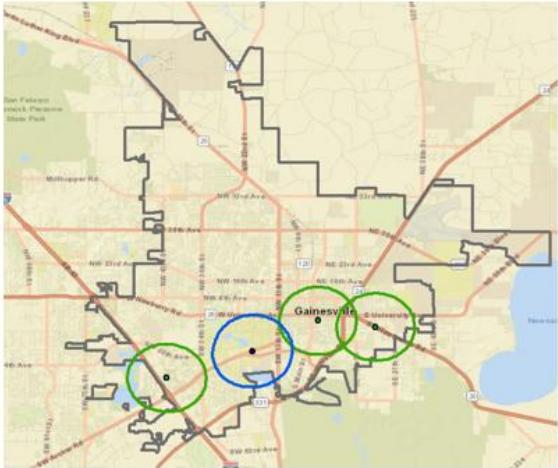
Algorithm for selecting a network of MHs

- **Step 1.** Select the existing (or planned) mobility hubs
- **Step 2.** Exclude all potential hubs within **X-mile** of the selected hubs from considerations
- **Step 3.** Select the hub with the highest mobility hub index as the next hub
- **Step 4.** Repeat steps 2 and 3 until the service coverage level reaches **Y%** or the total number of hubs reaches **N**

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Demonstration of the algorithm



2. A novel method for mobility hub site selection



3. Application of method in the City of Gainesville



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Criterion scores and MH index (equal weight)

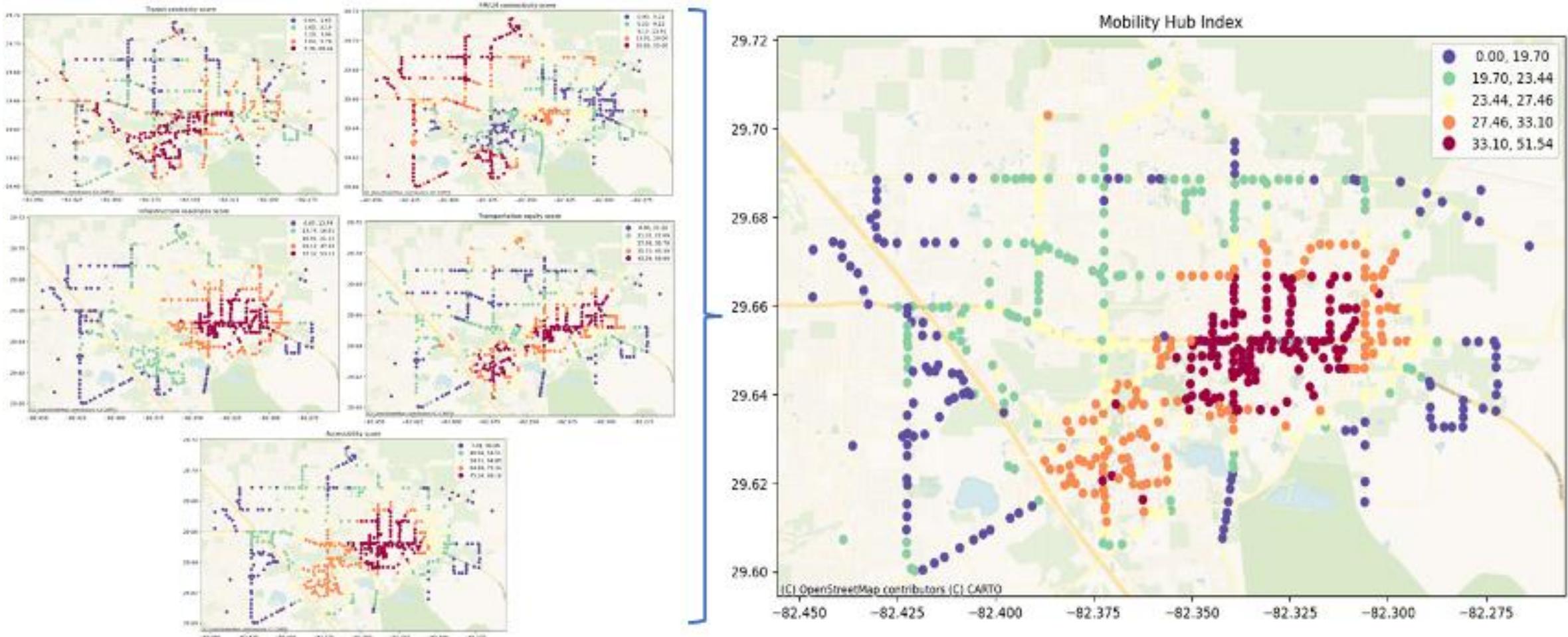
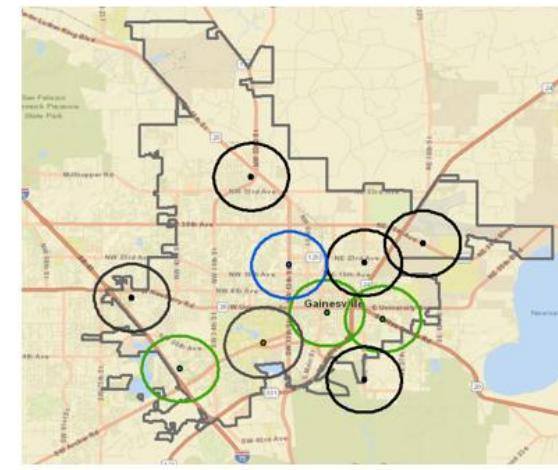
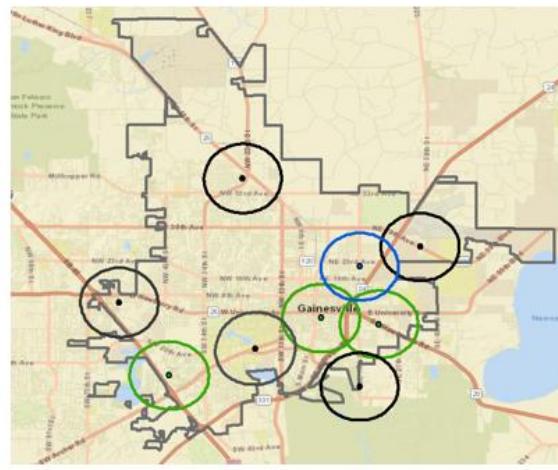
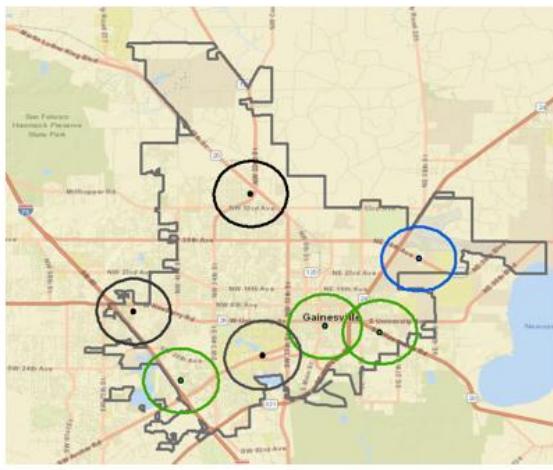
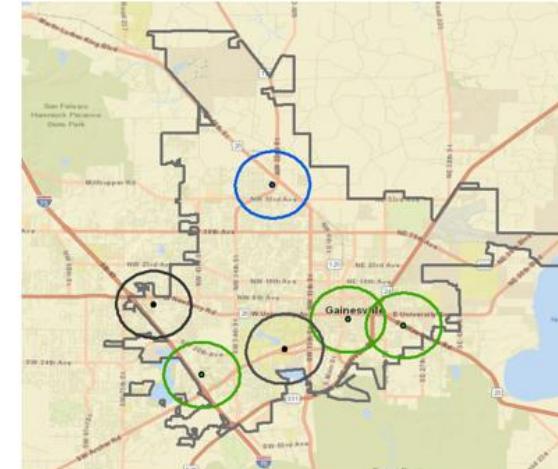
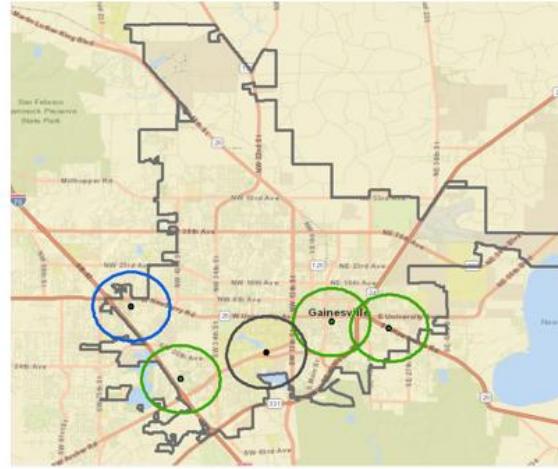
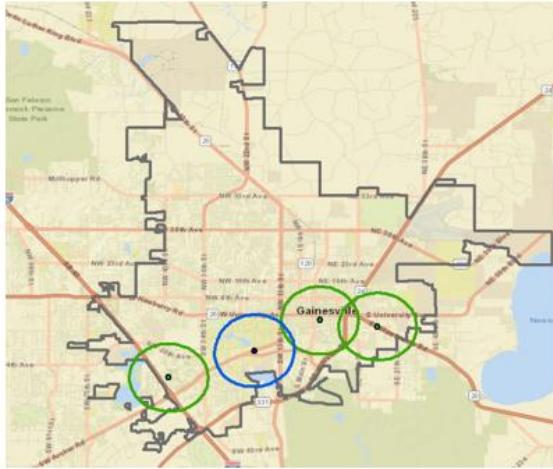


Figure: Maps displaying the score for each criterion and the overall MH score.

3. Application of method in the City of Gainesville



Network of MHs being identified (equal weight)



- Centroid of each circle is a MH
- Select a total of 12 mobility hubs

3. Application of method in the City of Gainesville



Determine the typology of MHs

Neighborhood MHs → district MH (district MH index) → regional MH (regional MH index)

Level	Neighbourhood	District	Regional
Mode to mobility hub	Walk/bike	Bike/car	car
Coverage Area	1 mile	3 miles	5 miles
Required number in Gainesville	12	4	1
Weights about sub criteria of accessibility	1. Destination accessibility via auto – 0 2. Destination accessibility via transit – 25% 3. walk score – 75%	1. Destination accessibility via auto – 20% 2. Destination accessibility via transit – 30% 3. walk score – 50%	1. Destination accessibility via auto – 33% 2. Destination accessibility via transit – 33% 3. walk score – 33%

8

3

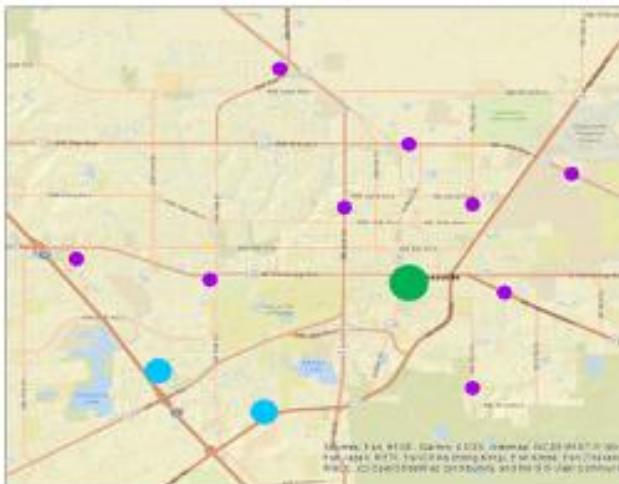
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MH networks under different planning scenarios

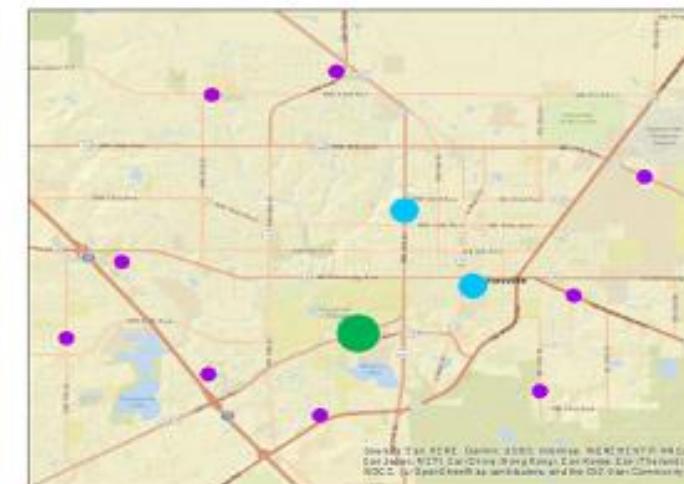
Applying equal weights



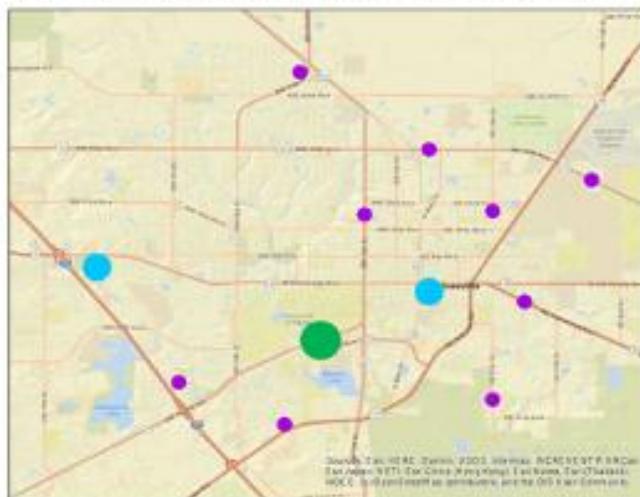
Enhancing public transit



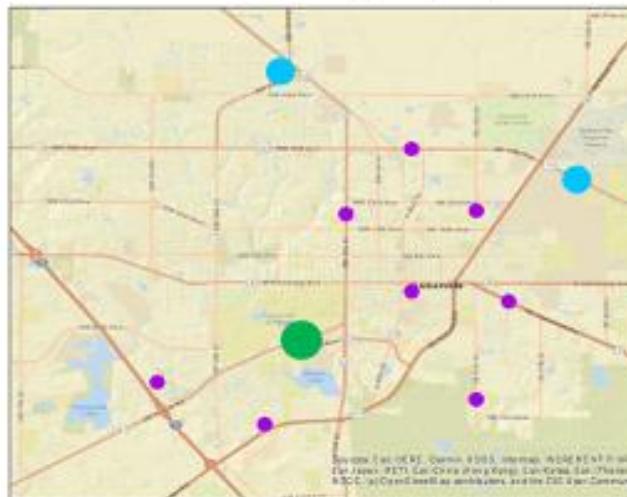
Enhancing first-/last-mile access



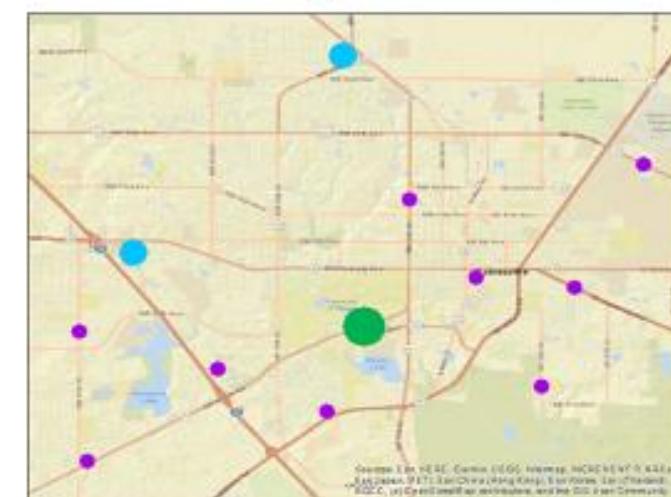
Leveraging existing infrastructure



Promoting equity



Enhancing accessibility



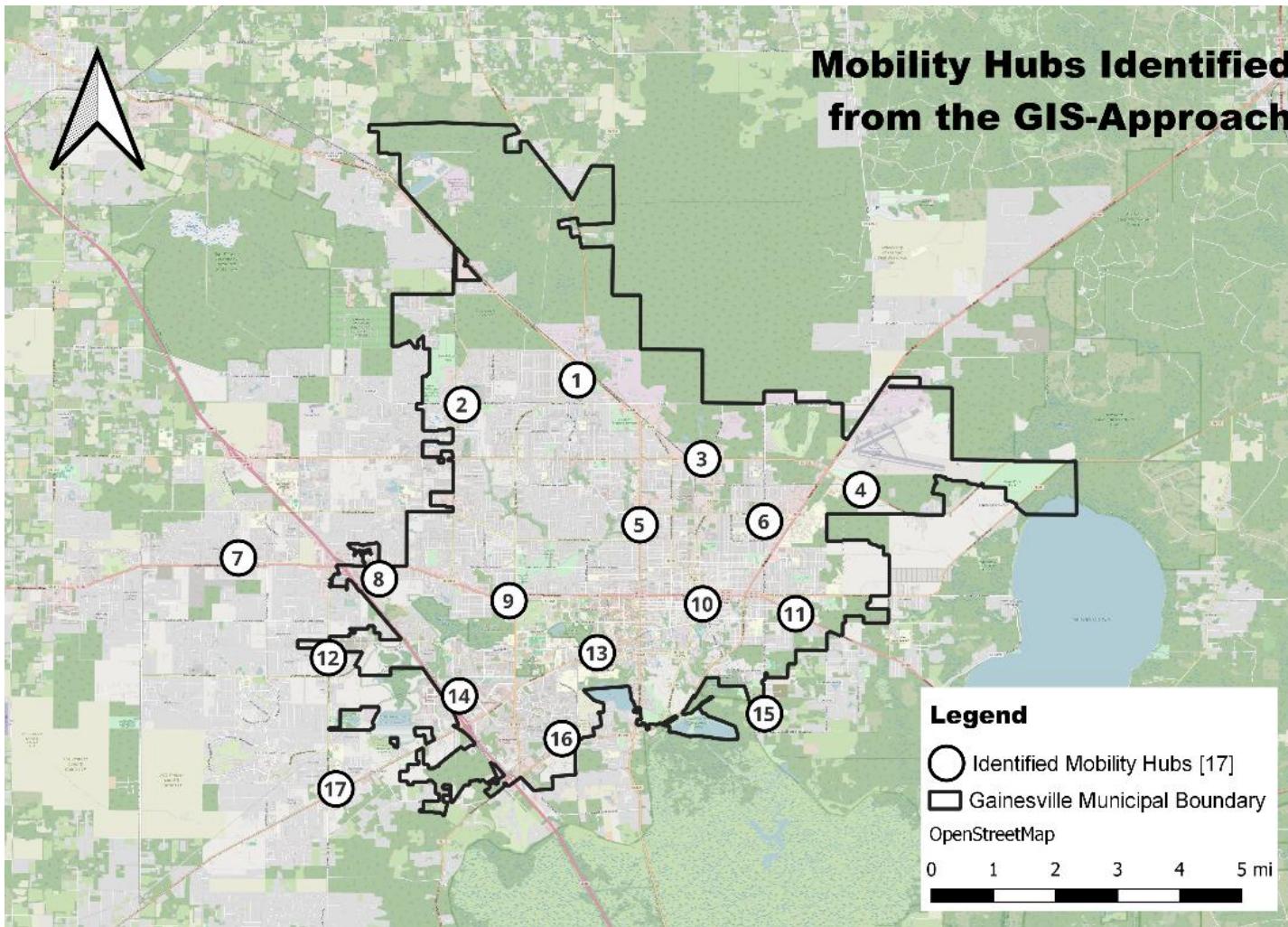
- Regional
- District
- Neighbourhood

3. Application of method in the City of Gainesville



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17 potential MH locations in City of Gainesville



3. Application of method in the City of Gainesville



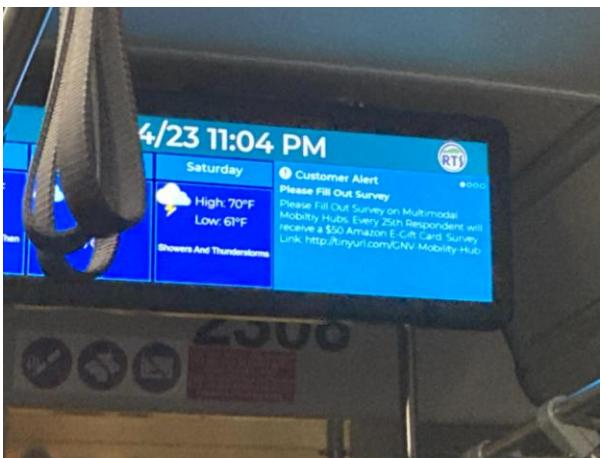
4. Validation and refinement of results through crowdsourced community input



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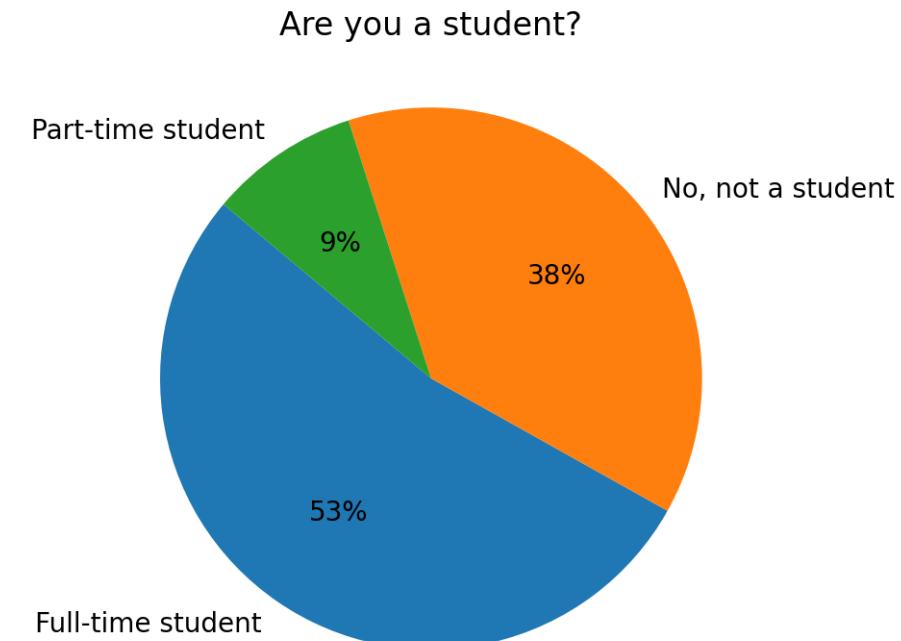
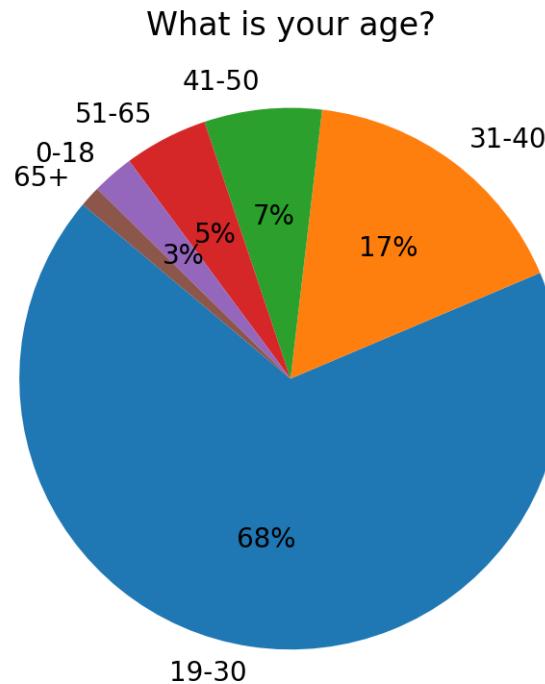
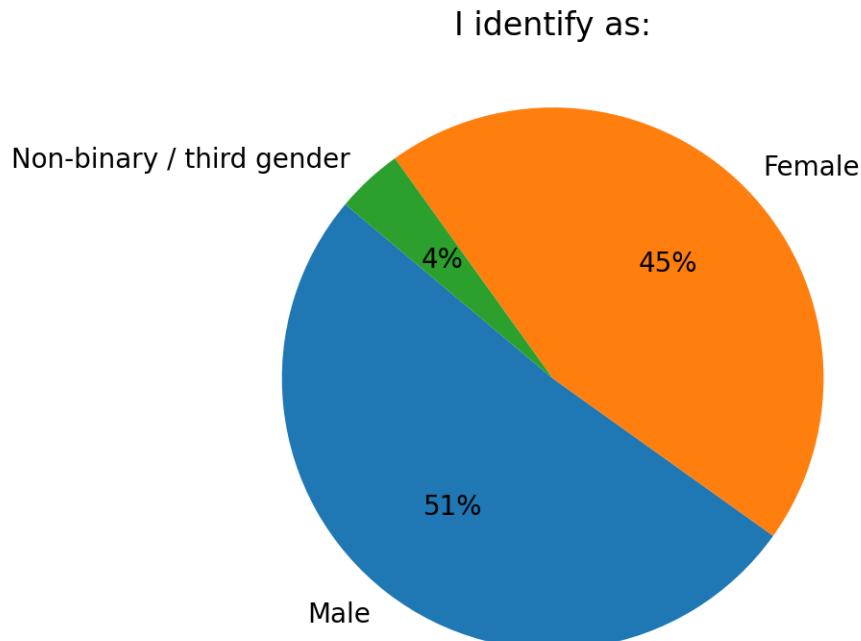
Participant recruitment methods

The screenshot shows the homepage of the City of Gainesville Department of Transportation (RTS) website. The header features the RTS logo and the text "City of Gainesville DEPARTMENT OF TRANSPORTATION". The navigation menu includes links for HOME, SCHEDULES, ADA, HOW TO RIDE RTS, ABOUT RTS, and CONTACT. A search bar and a language selection dropdown are also present. The main content area displays "Customer Service: (352) 334-2600" and a large graphic of a green alligator head with the word "SURVEY" overlaid. Text on the page encourages users to fill out a UF survey on multimodal mobility hubs, stating that every 25th respondent will receive a \$50 Amazon e-gift card. A "Take Survey Now" button is visible. To the right, a sidebar titled "RIDER ALERTS: News You Want" provides information about the "2024 Spring Arts Festival Bus Schedule" for Route 10, detailing service times and stops.



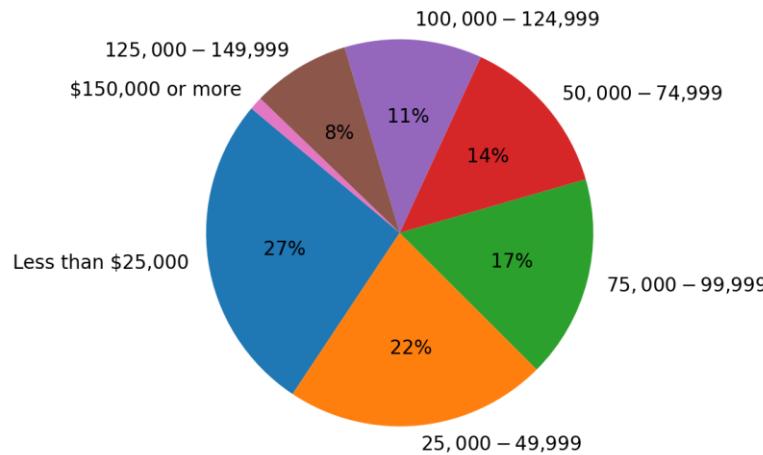
4. Validation and refinement of results through crowdsourced input

Respondents – age, gender, student

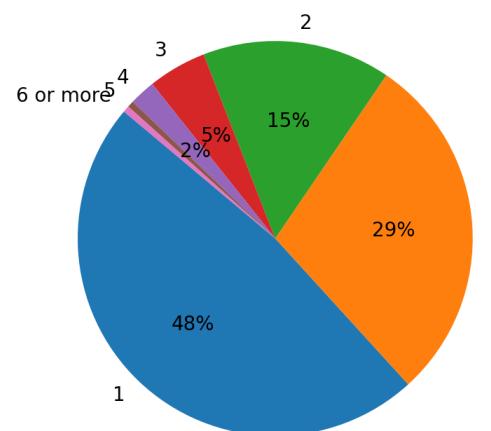


Respondents – income, vehicle ownership

Which category best represents your annual household income in the past year?

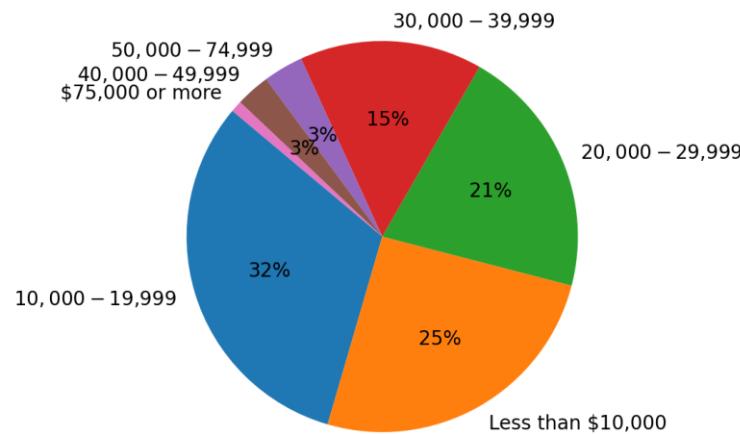


How many motor vehicles are there in your household?

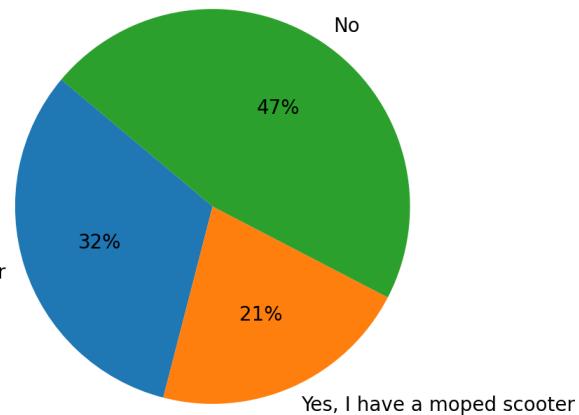


- Non-students

Which category best represents your annual living expenditure in the past year?



Do you have a personal vehicle to use in Gainesville?



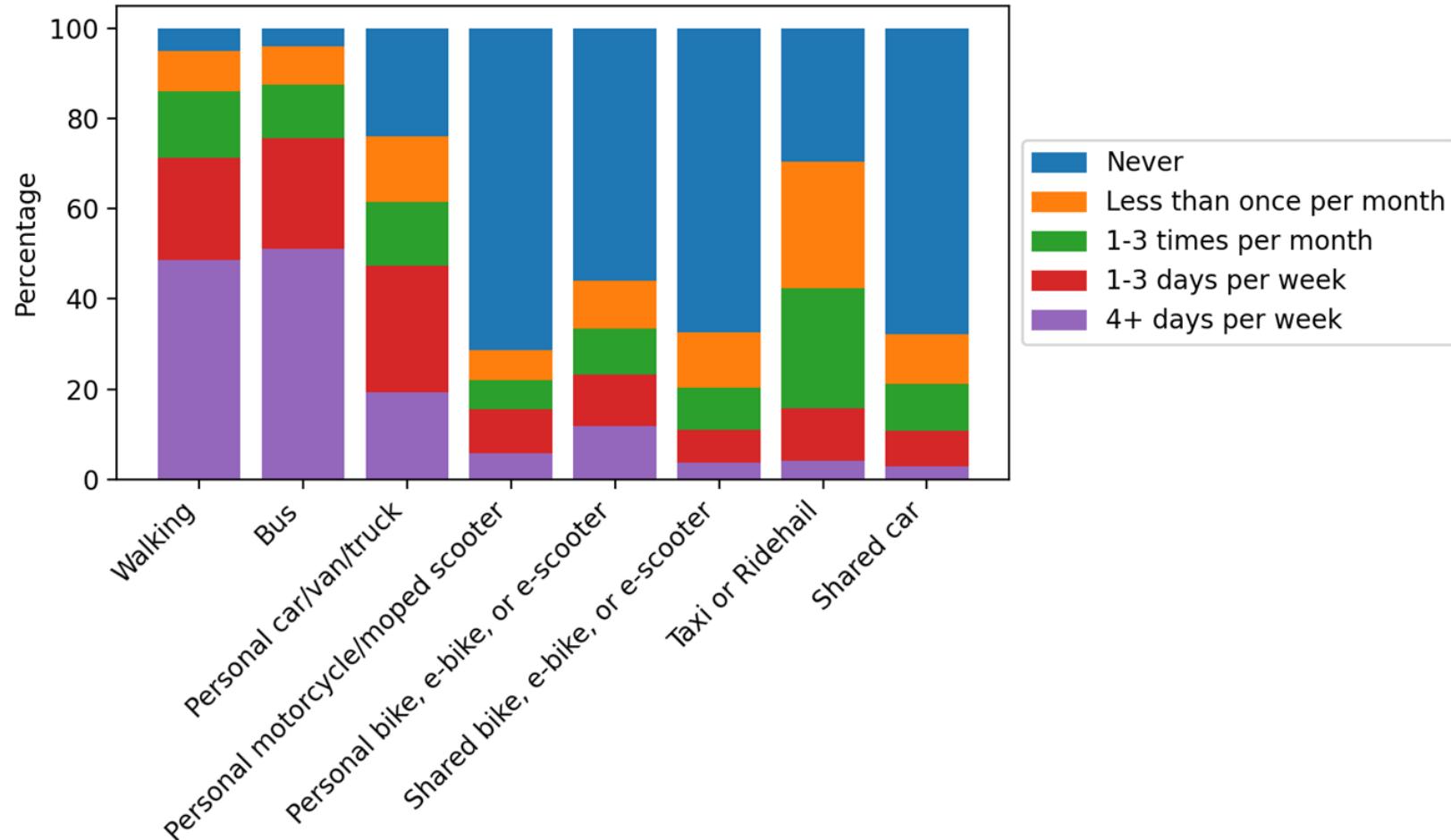
- Students (full-time)

4. Validation and refinement of results through crowdsourced input



Current travel behavior - modes

Q3 How often do you typically travel using each of the following modes of transportation?



- >50% use bus more than 4 days per week.
- ~40% are micromobility users and ~30% are shared micromobility users

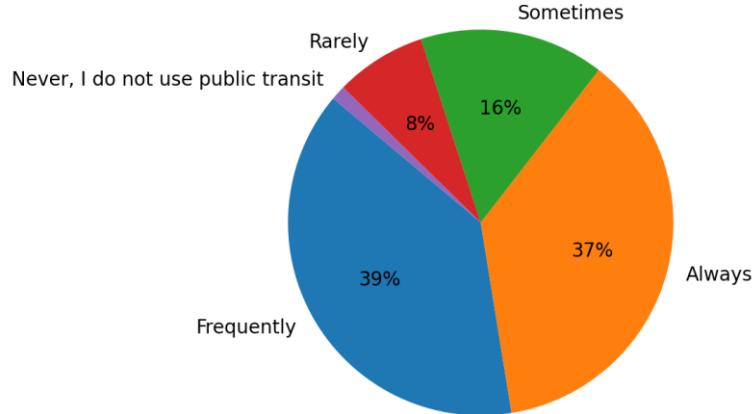
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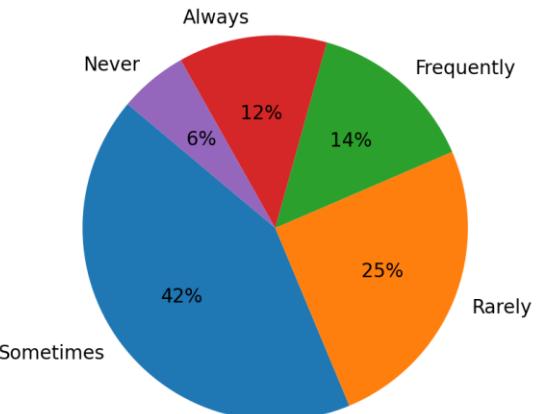
Current travel behavior - transit

Q4, Q5, Q6. Mode choice regarding public transit & the first-/last-mile problem

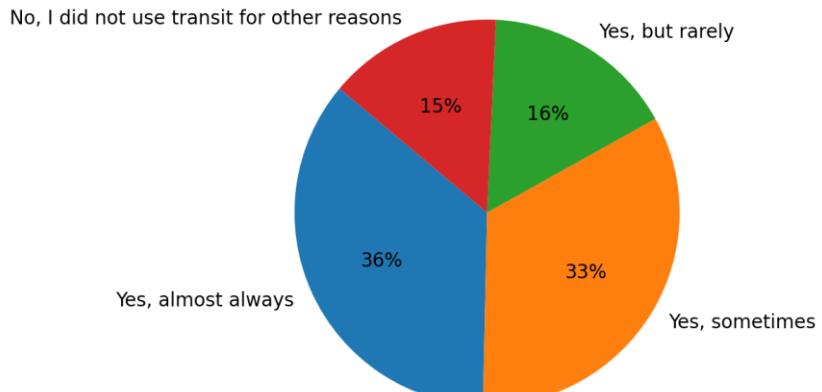
When you travel, how often is public transit an option that you consider (regardless of which travel mode you end up using)?



How often have you considered taking public transit but then used a different travel mode instead?



When ended up using a different travel mode, was the distance to the nearest stop an important factor in your decisions?



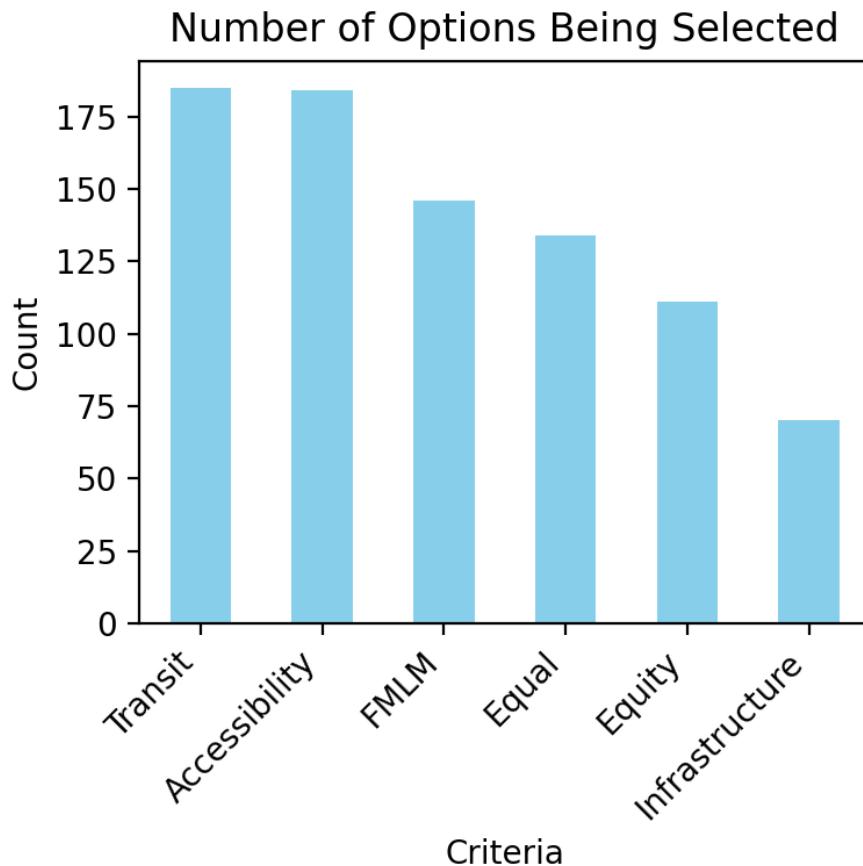
- Over 75% frequently consider using transit for travel
- Over 50% often ended up using other modes
- Over 75% thinks distance to stop influenced their decision

4. Validation and refinement of results through crowdsourced input



Mobility hub – which criteria to prioritize

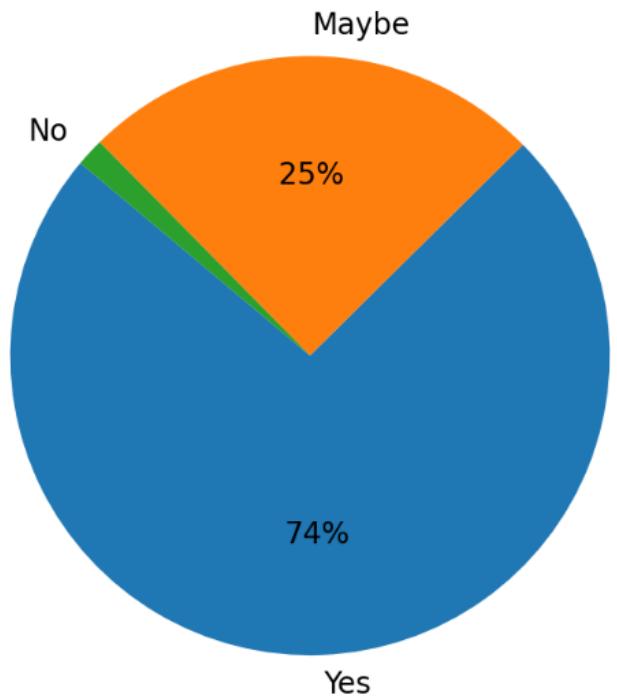
Q21 Where do you think mobility hubs should be built at? Please select two of the six options.



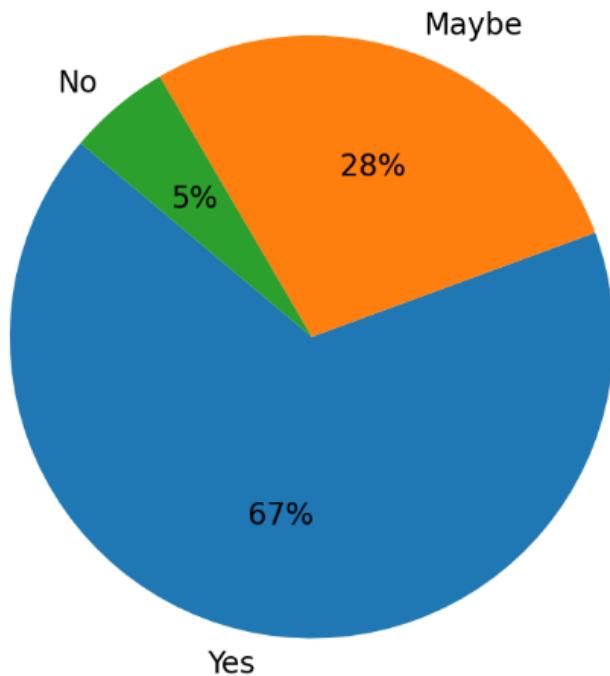
- **Transit**: Prioritize transit stops with the highest number of riders
- **FMLM**: Prioritize transit stops where many transit riders need to travel long distances to their destinations
- **Equity**: Prioritize transit stops located in underserved neighborhoods
- **Accessibility**: Prioritize transit stops where riders can access the most destinations
- **Infrastructure**: Prioritize transit stops connected by high-quality pedestrian and bicyclist infrastructure
- **Equal**: All of the above factors should be considered equally

Intention to use MHs

Would you use mobility hubs when they become available in Gainesville?

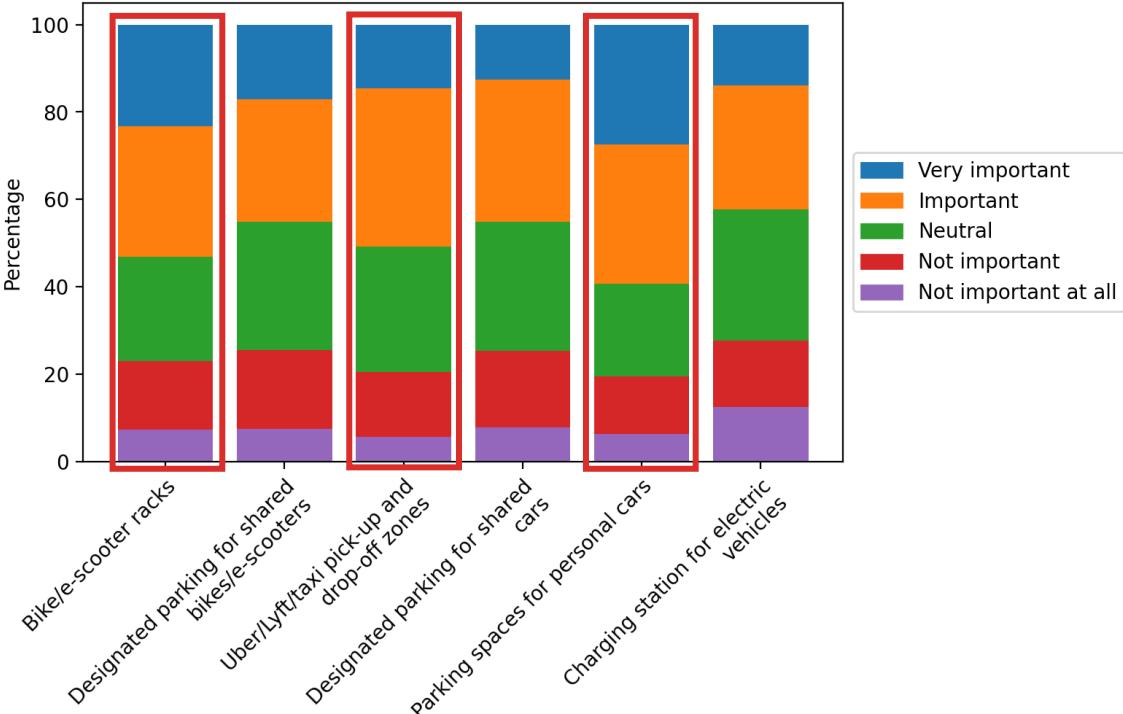


Would the availability of mobility hubs make you use public transit more?

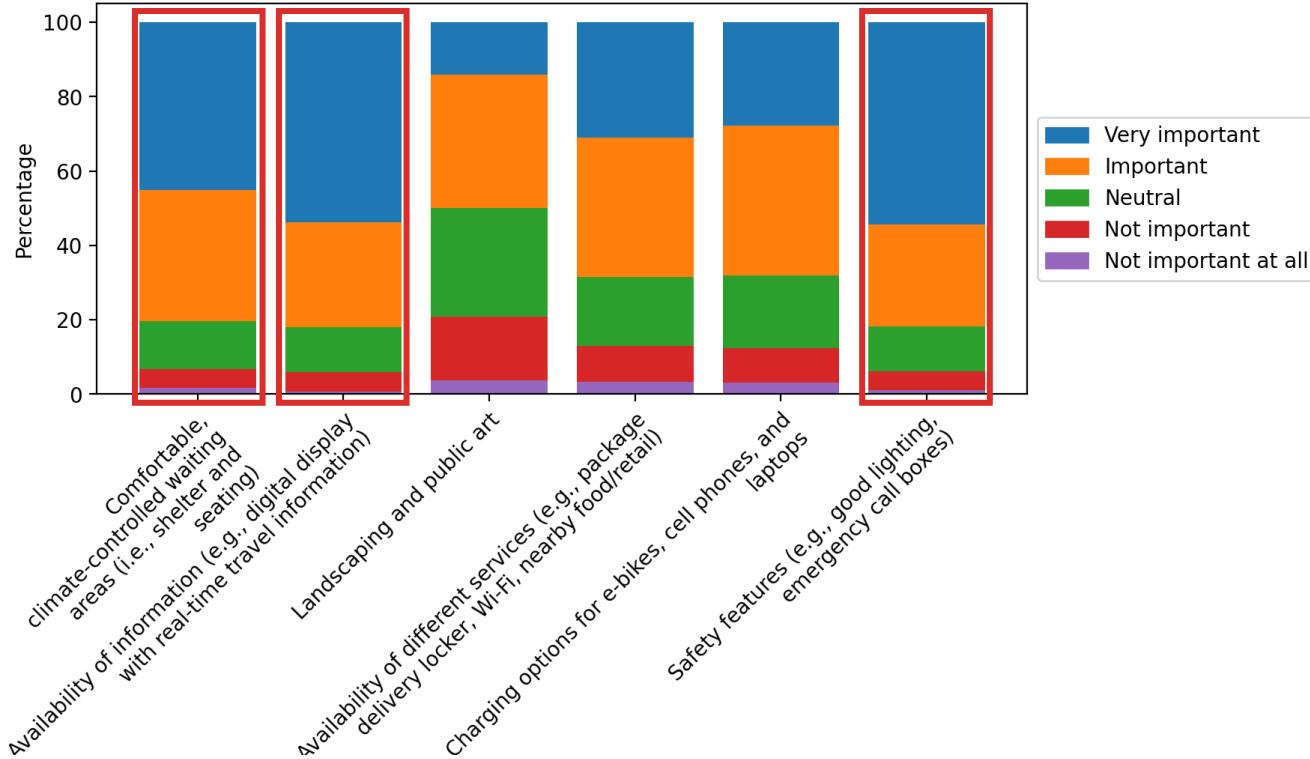


Important MH features and amenities

Please indicate how important each of the following mobility hub features are to you.



Please indicate how important each of the following mobility hub amenities are to you.



- Parking spaces for private cars
- Micromobility parking
- Rideshare pickup/drop-off zones

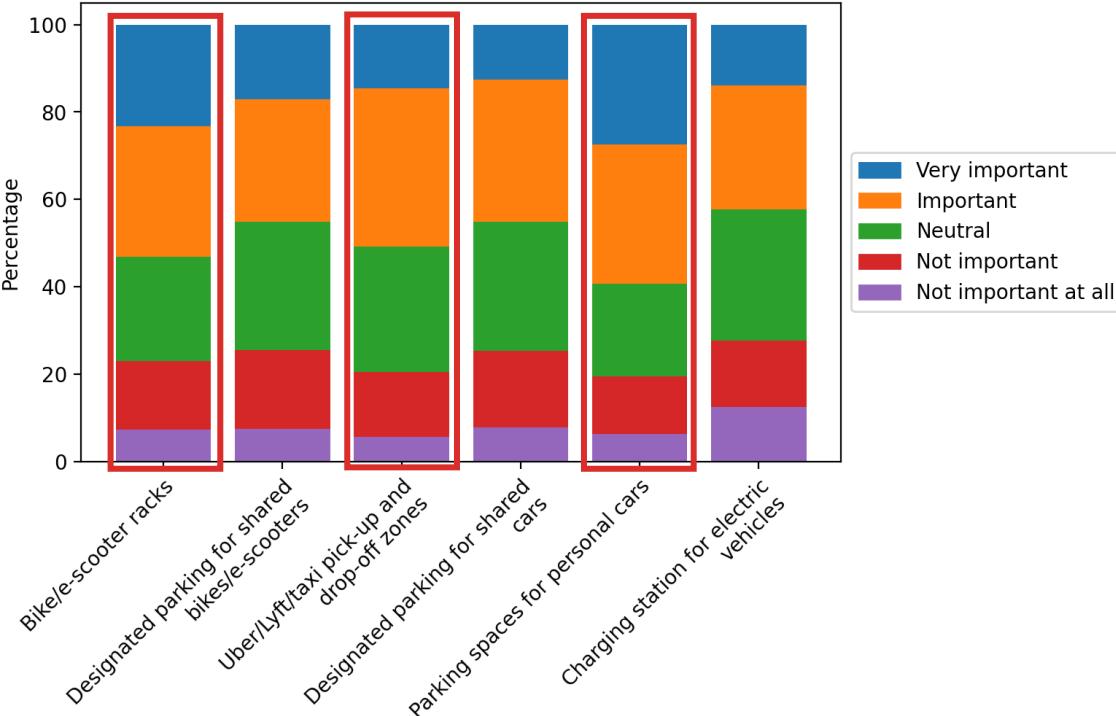
- Traveler information
- Safety features (lighting, 911 kiosk)
- Shelter and seating

4. Validation and refinement of results through crowdsourced input



Important MH features and amenities

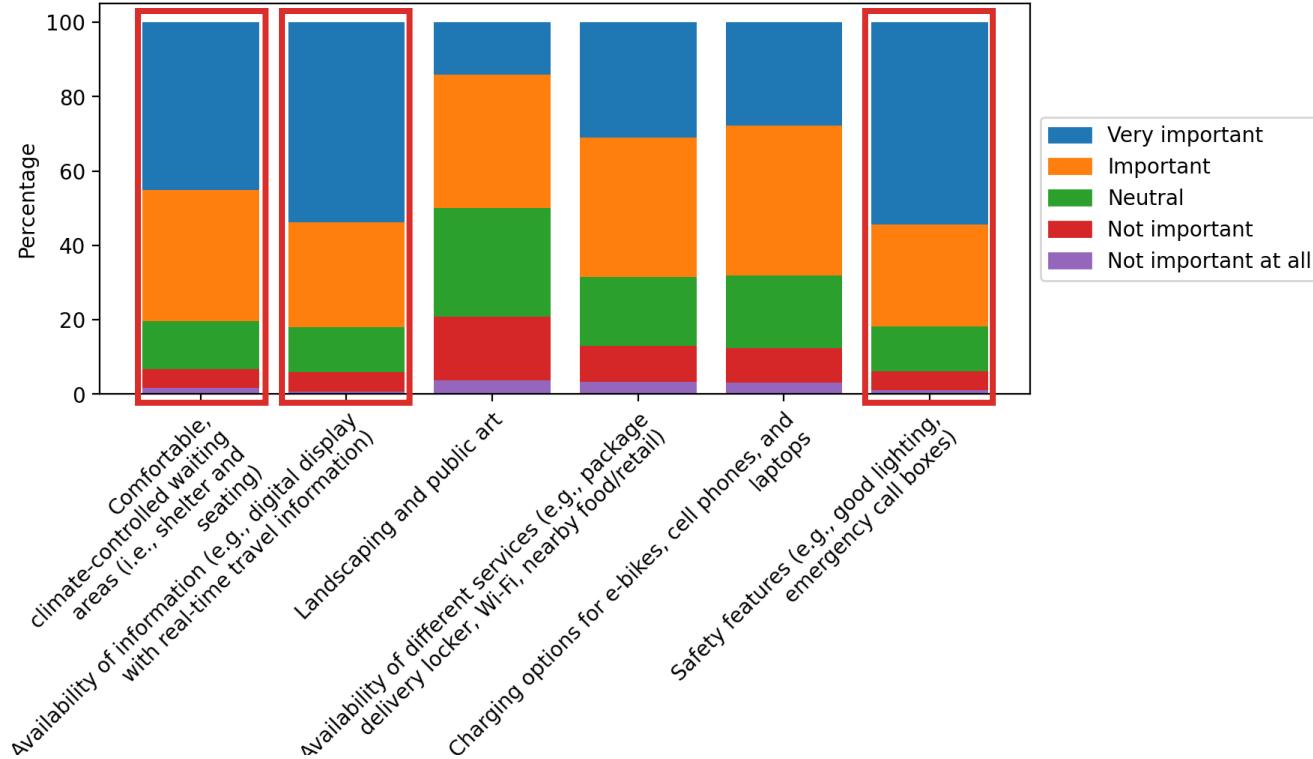
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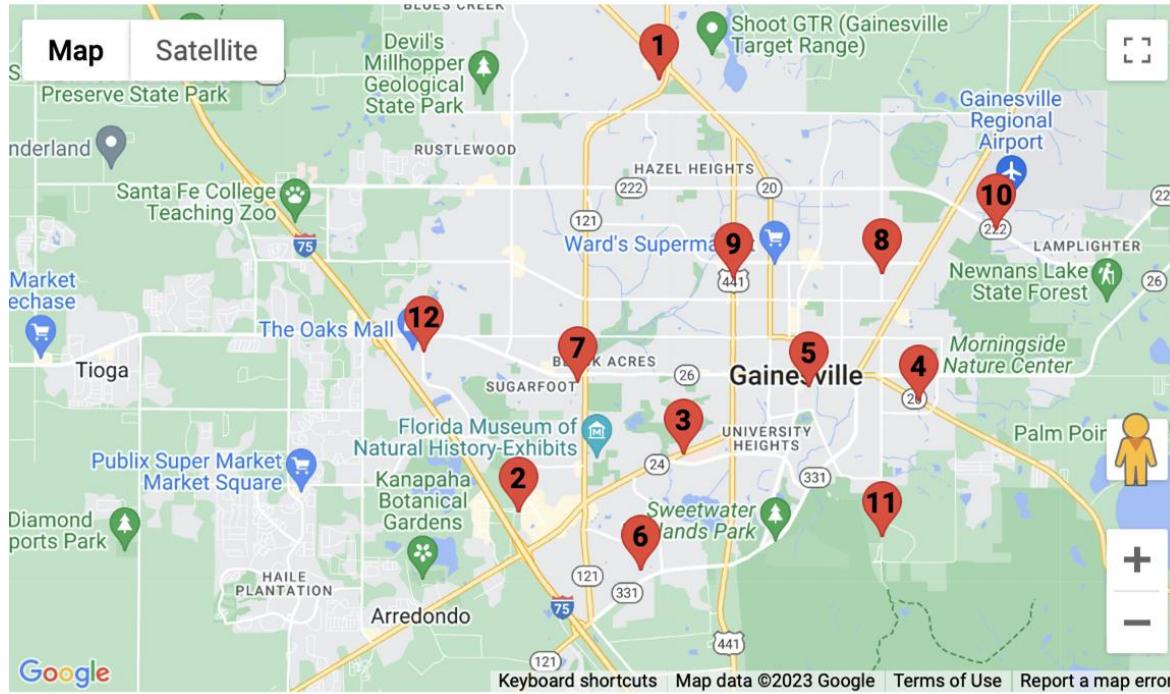


- Traveler information
- Safety features (lighting, 911 kiosk)
- Shelter and seating

4. Validation and refinement of results through crowdsourced input

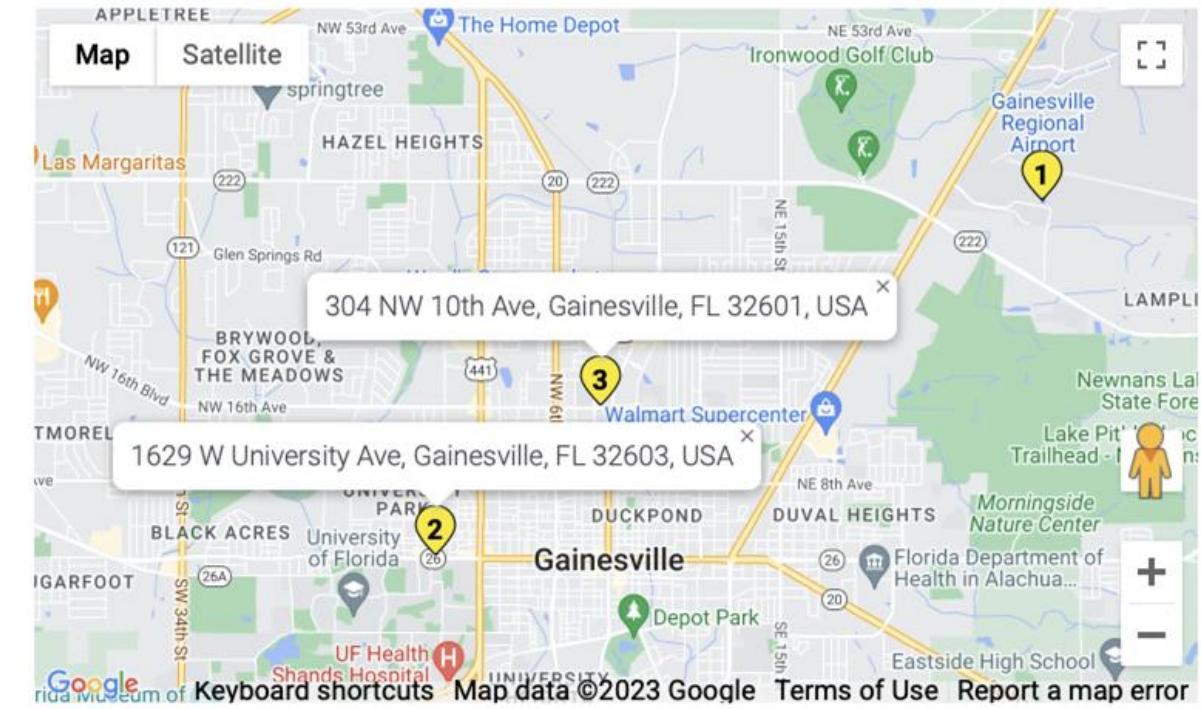


Crowdsourcing via interactive mapping



Are you likely to use any of the mobility hubs displayed in the map?

- Yes, I would use at least one of the mobility hubs pictured
- No, I would not use any of the mobility hubs pictured



Location 1: Gainesville Regional Airport, Northeast 39th Av

Location 2: 1629 W University Ave, Gainesville, FL 32603,

Location 3: 304 NW 10th Ave, Gainesville, FL 32601, USA

Now imagine that the city has created a mobility hub development plan by prioritizing transit stops located in underserved neighborhoods.

On the map displayed here, the blue pins indicate locations for potential mobility hubs.

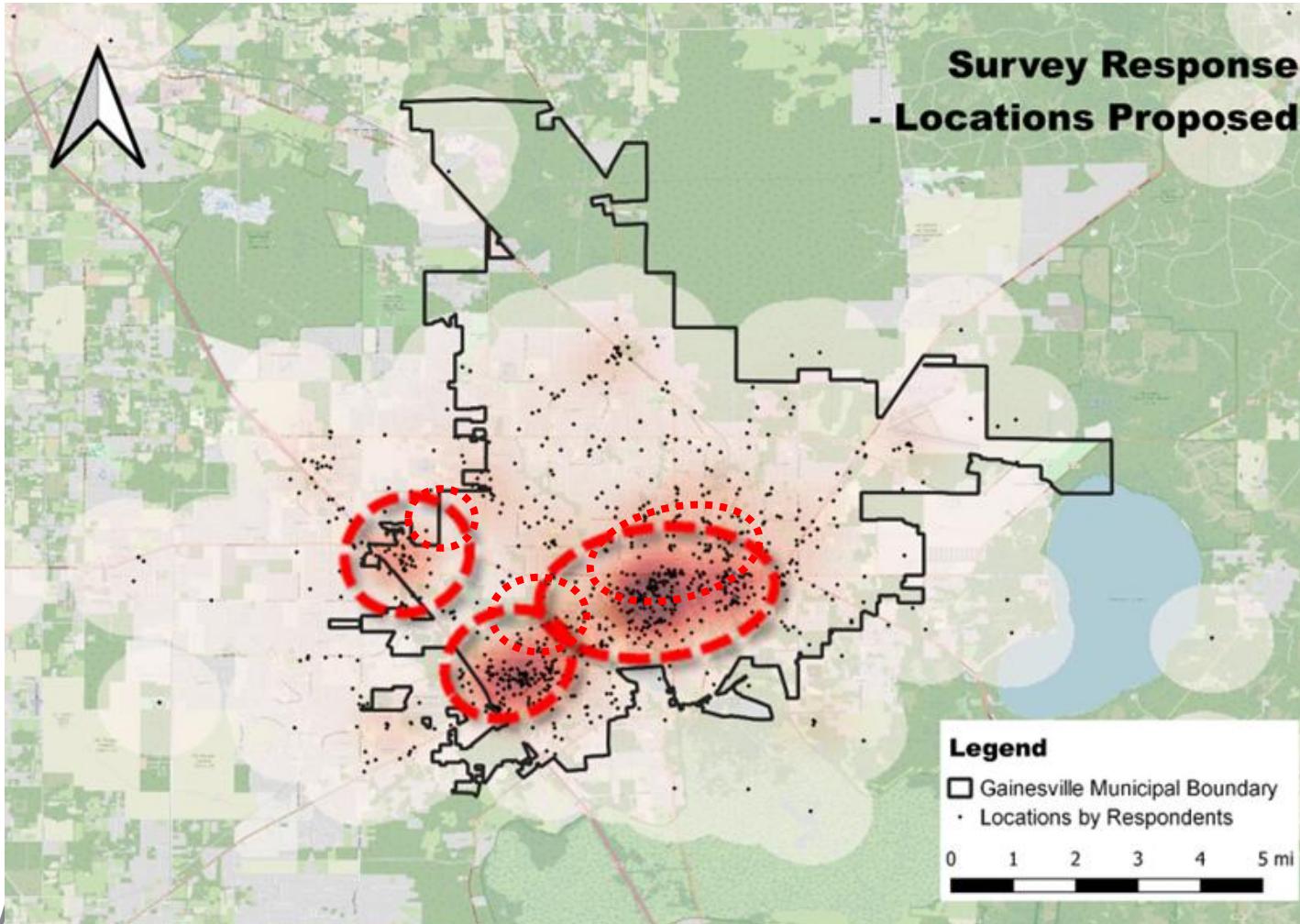


Are you likely to use any of the mobility hubs indicated in the map?

- Yes, I would use at least one of the mobility hubs shown
- No, I would not use any of the mobility hubs shown

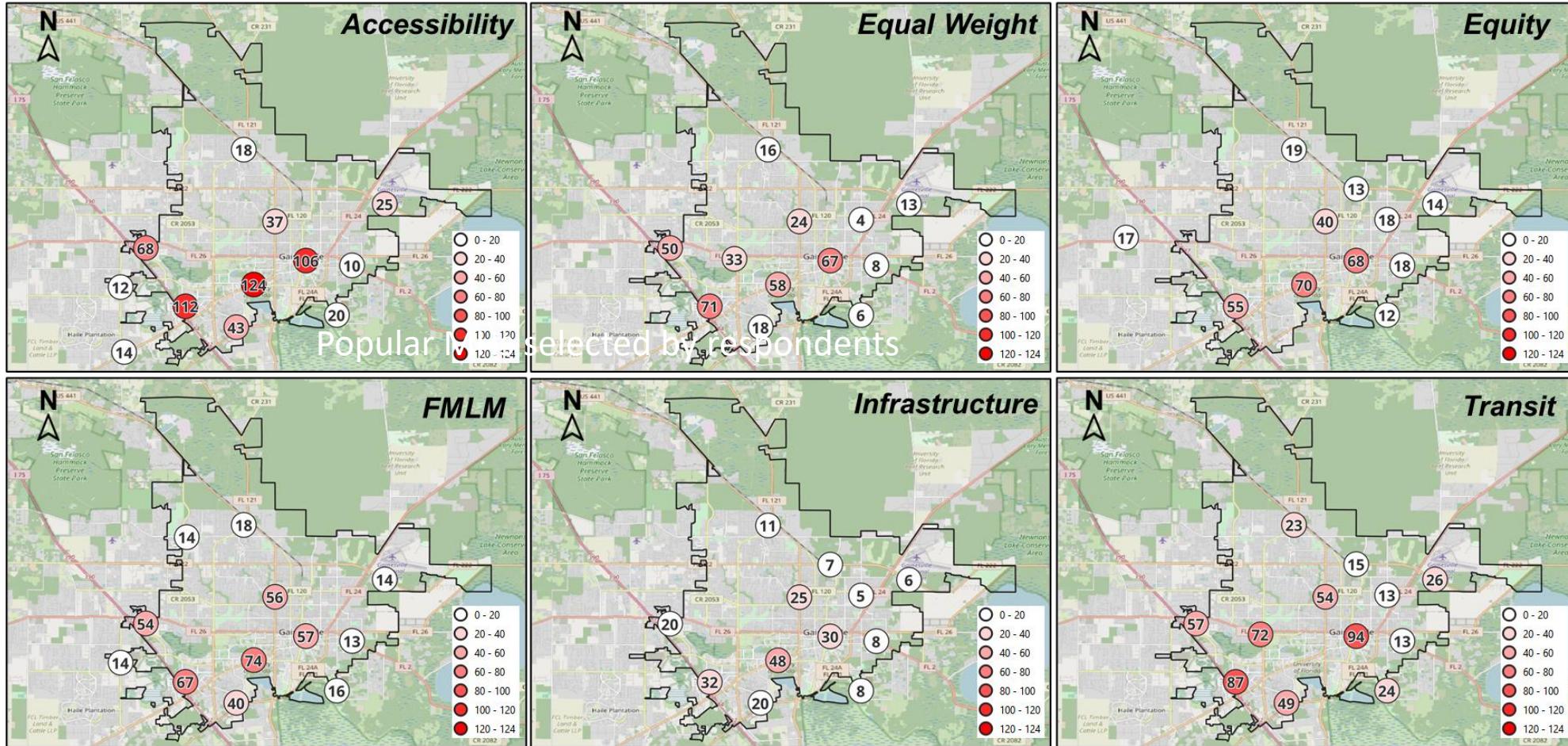
MH locations proposed by respondents

Q22 Imagine that you could build a mobility hub anywhere in Gainesville. Click on the map to indicate the locations that you feel make the most sense for developing a mobility hub. Please select up to three locations.



- Inside municipal boundary:
 - UF Campus and Downtown
 - Butler Plaza
 - Oaks Mall
- Also, some outside municipal boundary

Popular MHs selected by respondents



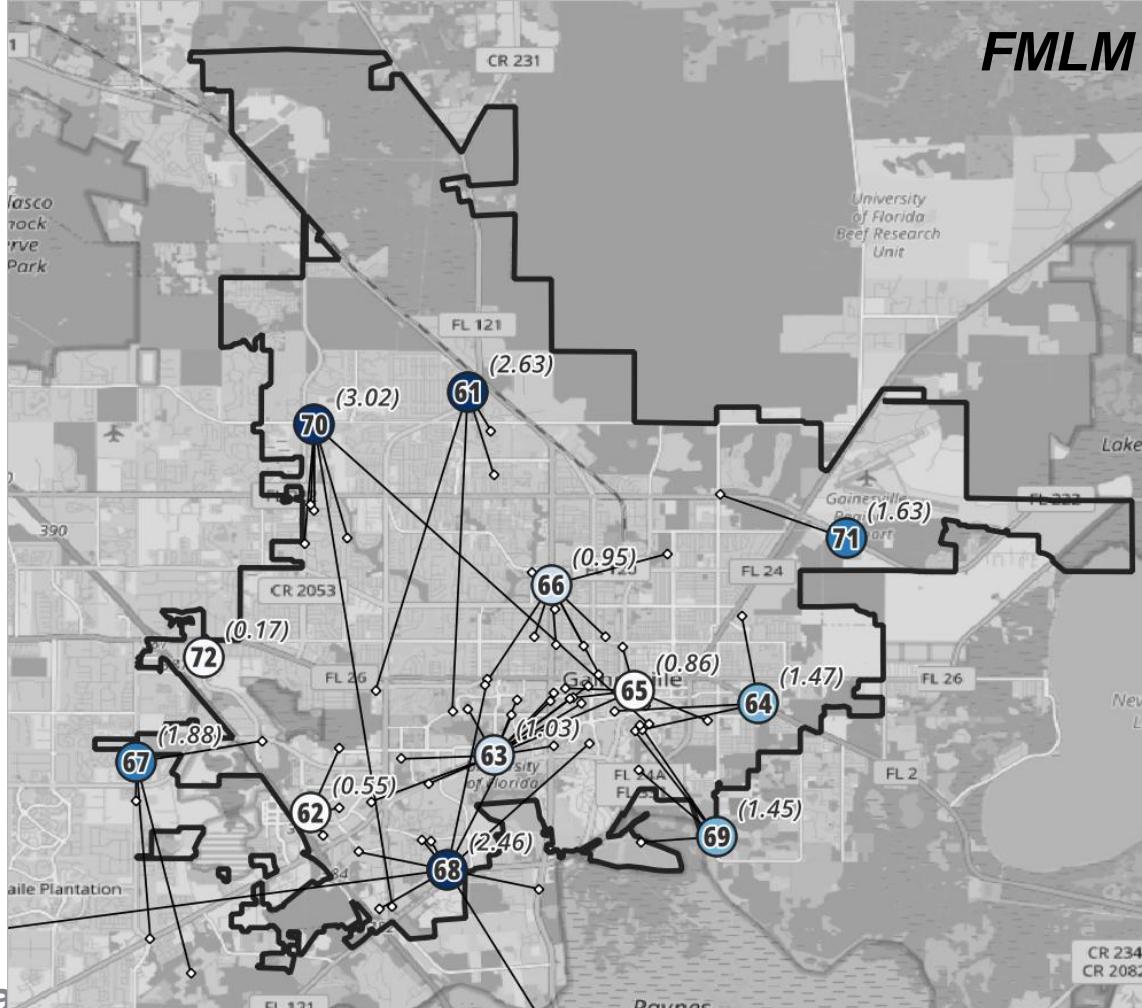
4. Validation and refinement of results through crowdsourced input



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Movement of MHs suggested by respondents

Click on the hubs that you feel are in inconvenient or undesirable locations. For each selected hub, if you believe there is a more suitable location nearby, drag the yellow pin to move it to that position.

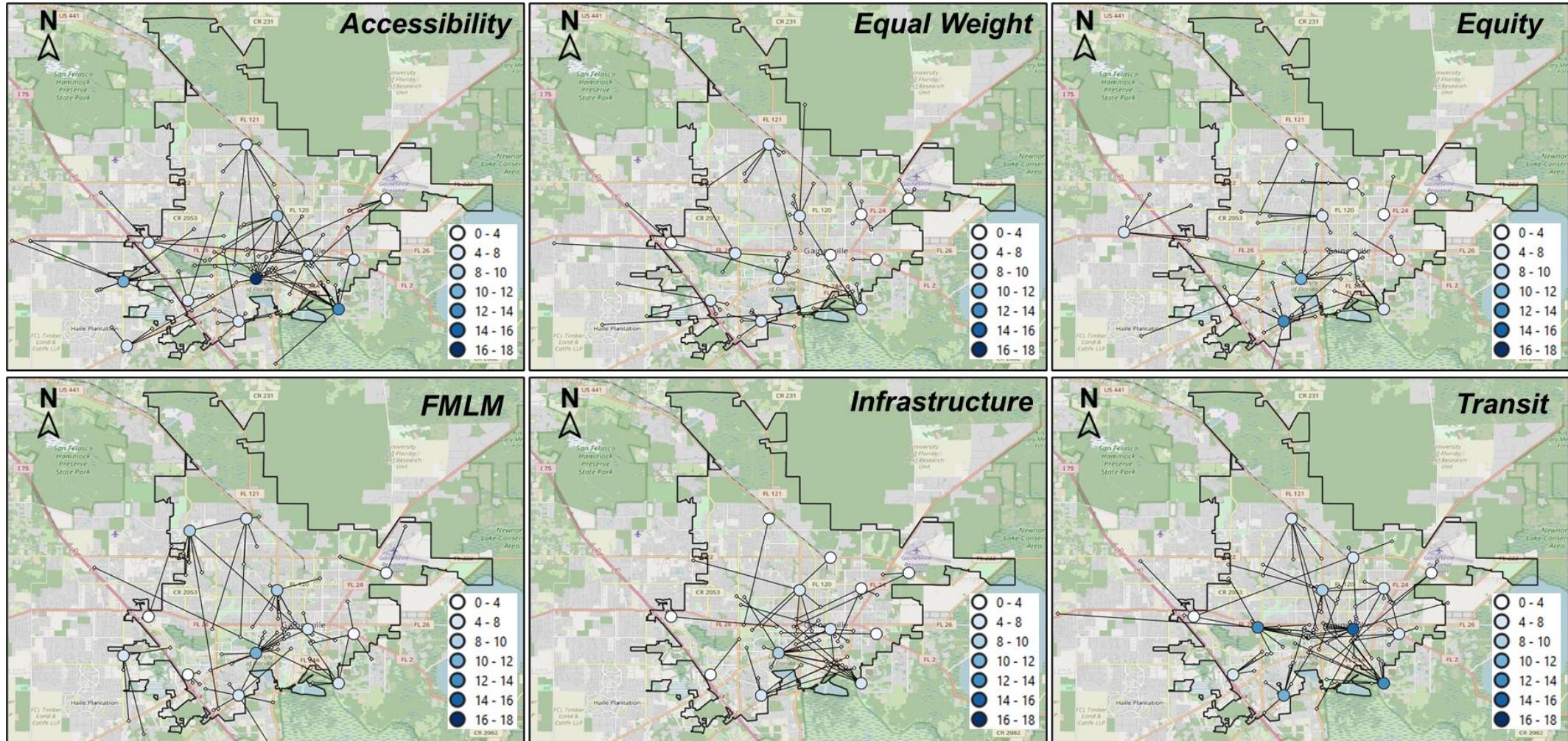


(Average distance of suggested movement)

- **Suggestions:**
 - 61: closer to housing and supermarket and food
 - 62: closer to museum, Archer
 - 63: cheaper, more convenient, closer to apartments
 - 64: closer to supermarket
 - 65: closer to bus transfer station, apartment
 - 66: consider east side working class
 - 67: consider county library
 - 68: facilitate park and ride for out-of-town traveler, apartment for students
 - 69: cheaper
 - 70: densier area, couch station, library, Thorne brook
 - 71: main stores
 - 72: ocatin



Movement of MHs suggested by respondents



4. Validation and refinement of results through crowdsourced input

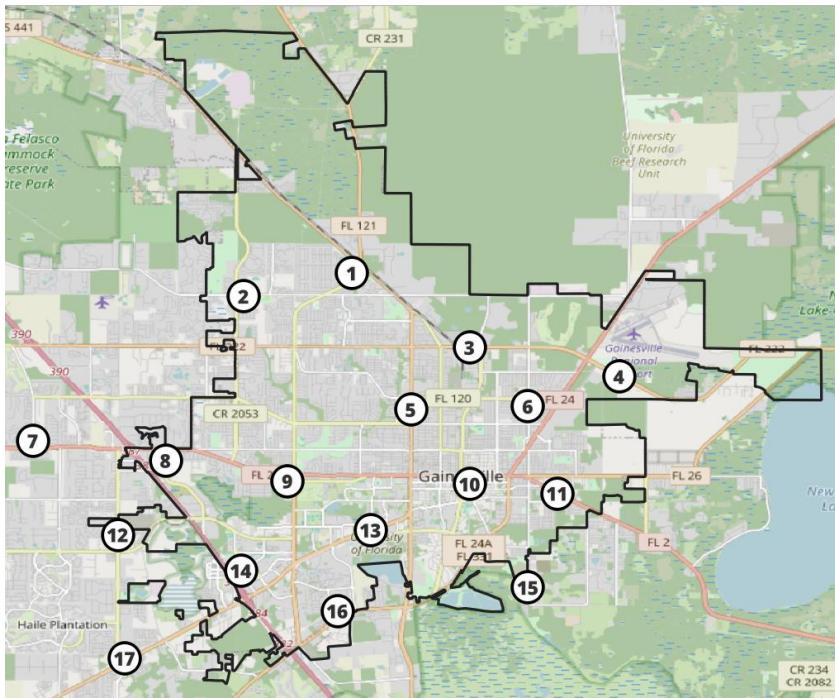


Summary of results

Summary Table :

17 potential sites

- # times identified in GIS
- Survey responses (selected/moved)



4. Validation and refinement of results through crowdsourced input

MH #	Nearest bus stop	Number of times being identified as a hub across planning scenarios			Survey responses		
		Neigh- borhood	District	Regional	Freq. selected as a desirable site	Freq. being moved	Avg. moved dist. (mi)
1	North Walmart Supercenter	2	4	0	105	26	2.14
2	NW 31 st Terrace @ Nearside NW 53 rd Ave	1	0	0	14	10	2.19
3	Southeast Car Agency	3	0	0	35	9	1.78
4	Alachua County Jail	3	3	0	98	8	1.91
5	Gainesville High School	4	2	0	236	46	1.43
6	NE 15 th St @ NE 20 th Place	4	0	0	40	15	1.20
7	Westside Baptist Church	1	0	0	17	5	1.89
8	Oaks Mall @ NW 62 nd St	1	4	0	249	10	2.67

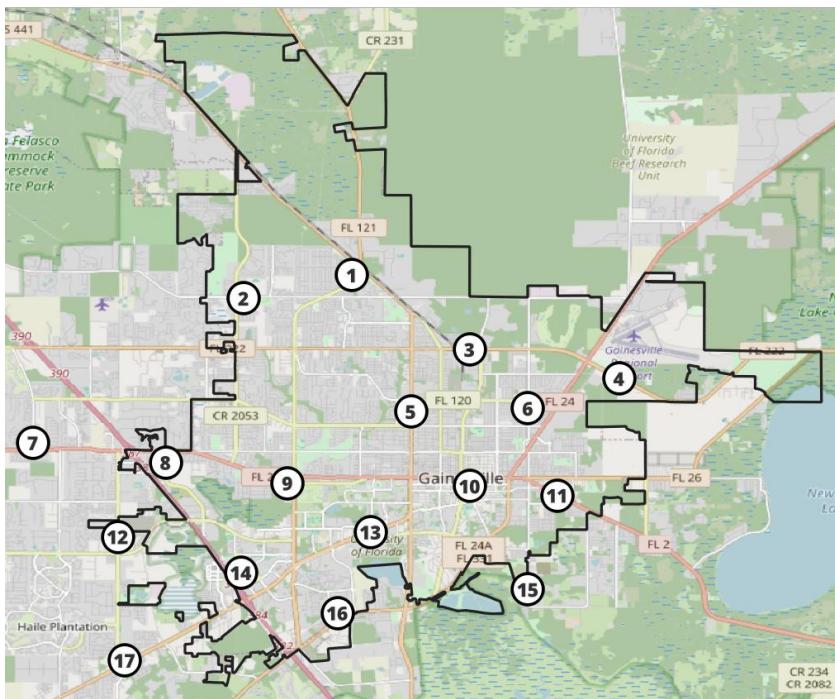


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MH #	Nearest bus stop	Number of times being identified as a hub across planning scenarios			Survey responses		
		Neigh- borhood	District	Regional	Freq. selected as a desirable site	Freq. being moved	Avg. moved dist. (mi)
9	The Wynwood Apartments	2	0	0	105	18	1.76
10	Rosa Park Downtown Station	3	2	1	422	41	0.93
11	SE Hawthorne Rd @ SE 21st St Eastbound	5	1	0	70	12	1.42
12	Sunrise Subdivision	2	0	0	26	16	1.77
13	Shands Hospital	0	0	5	374	57	1.16
14	Butler Plaza Transfer Station	5	1	0	424	20	1.15
15	Prairie Elementary School	6	0	0	86	50	1.96
16	Westbound SW 40th Place @ NW 26th Terrace	5	1	0	170	54	1.37
17	Publix @ Tower Square on SW 75th Street	1	0	0	14	5	1.89

4. Validation and refinement of results through crowdsourced input



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Recommendations of MH development in GNV

Regional-level Hubs:

- *Shands Hospital (#13)*

District-level Hubs:

- *Butler Plaza Transfer Station (#14)*
- *Rosa Park Transfer Station (#10)*
- *Oaks Mall (#8)*

Neighborhood-level Hubs:

- *Gainesville High School (#5)*
- *Westbound SW 40th Place @ NW 26th Terrace (#16)*
- *North Walmart Supercenter (#1)*

- *Alachua County Jail (#4)*

- *Wynwood Apartments (#9)*

Additional Neighborhood Hubs:

- *NW 31st Terrace @ Nearside NW 53rd Ave (#2)*
- *Southeast Car Agency (#3)*
- *NE 15th St @ NE 20th Place (#6)*
- *Westside Baptist Church (#7)*
- *SE Hawthorne Rd @ SE 21st St Eastbound (#11)*
- *Sunrise Subdivision (#12)*
- *Prairie Elementary School (#15)*
- *Publix @ Tower Square on SW 75th Street (#17)*

Key takeaways

- Identifying mobility hubs under various planning scenarios using a data-driven approach
- Crowdsourced community inputs confirm the validity of our approach and offer additional insights
- Our approach can be easily used by U.S. cities and agencies



To learn more...

- Project website: https://jacobyano.github.io/MobilityHubs_FullPost/
- ArcGIS storymap:
<https://storymaps.arcgis.com/stories/9c56b17d9587428b8b4e323979576c67>
- Tools and code: <https://github.com/jacobyano/Just-and-Green-Transportatiion-Lab/tree/main/Florida%20Mobility%20Hubs>



Questions or Comments?

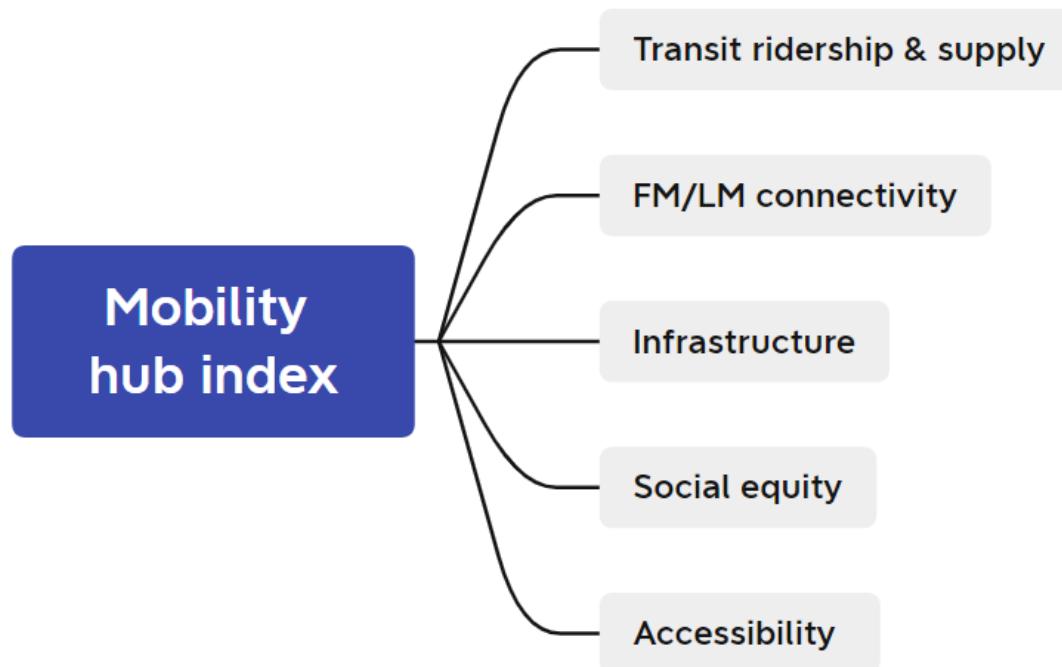
Xiang (Jacob) Yan
xiangyan@ufl.edu



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Project Objectives

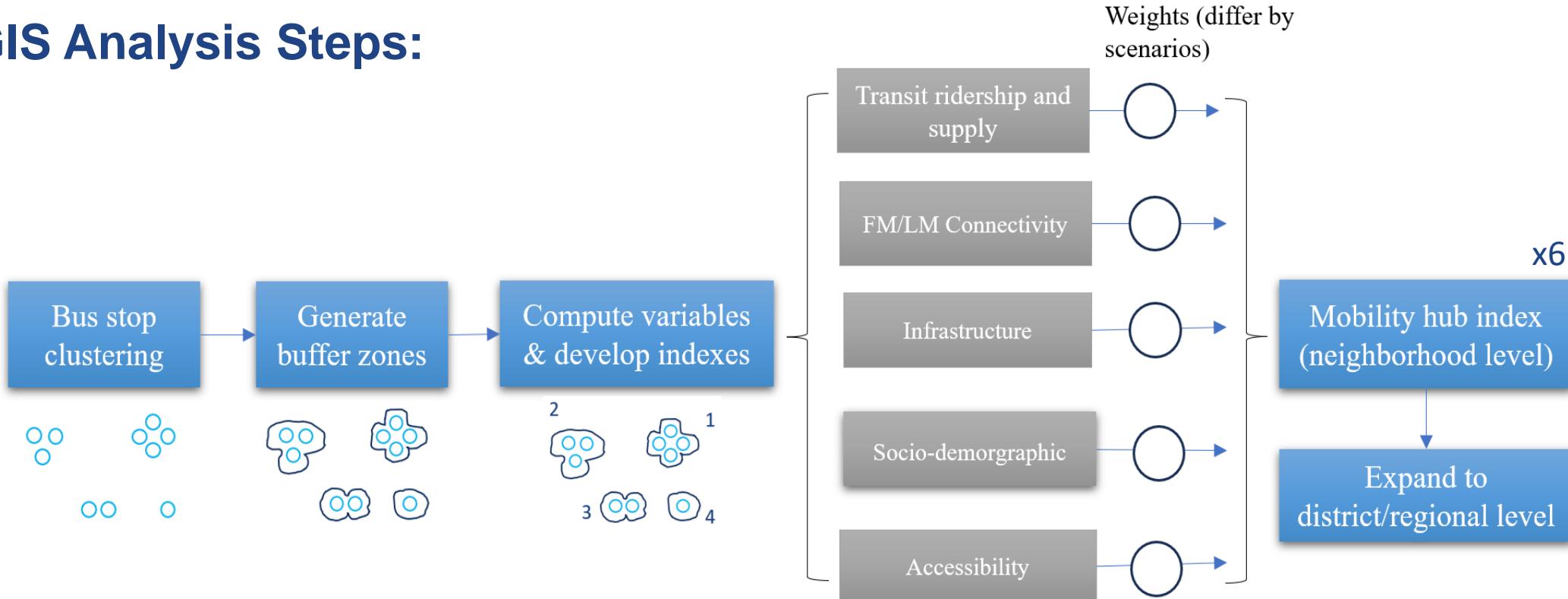
To develop a GIS-based analytical framework for Florida agencies to decide the optimal locations of mobility hubs



Five criteria in deciding mobility hubs

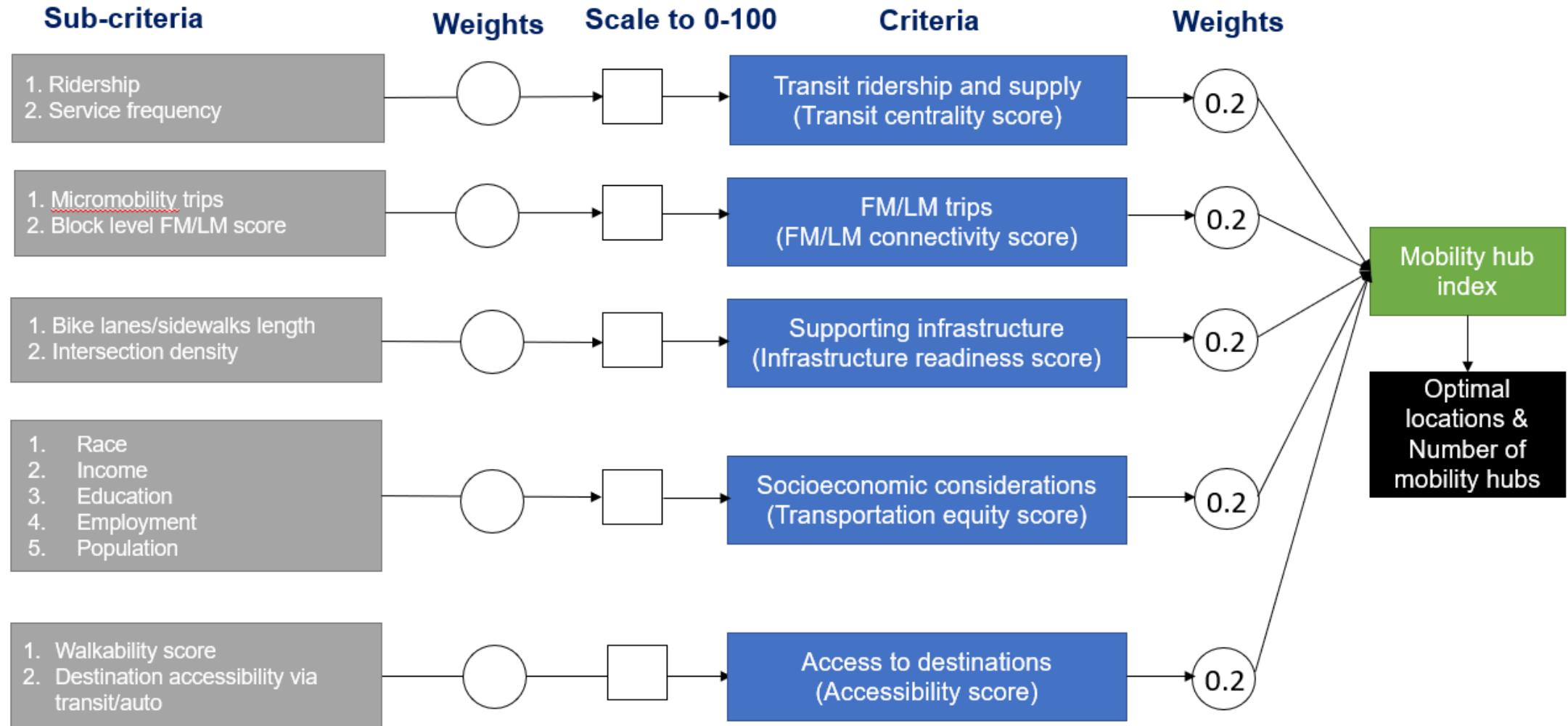
Synthesize GIS Analysis and Survey Results

GIS Analysis Steps:



1. Mobility hub tool

Weights will change
based on scenarios



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weights assigned under different scenarios

Criteria (score)	accessibility	transit supply	equity	infrastructure	FMLM	weights_equal
Transit Centrality Score	0.125	0.5	0.125	0.125	0.125	0.2
First/last mile Connectivity Score	0.125	0.125	0.125	0.125	0.5	0.2
Infrastructure Readiness Score	0.125	0.125	0.125	0.5	0.125	0.2
Socio-demographic equity Score	0.125	0.125	0.5	0.125	0.125	0.2
Accessibility Score	0.5	0.125	0.125	0.125	0.125	0.2



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How to choose multiple mobility hubs?

- 1. Select the existing (or planned) mobility hubs
- 2. Exclude all potential hubs within X-mile of the selected hubs from considerations
- 3. Select the hub with the highest mobility hub index as the next hub
- 4. Repeat steps 2 and 3 until the service coverage is a certain level or the total number of hubs reaches N

comparison of mobility hubs at different scale

Level	Neighbourhood	District	Regional
Mode to mobility hub	Walk/bike	Bike/car	car
Coverage Area	1 mile	3 miles	5 miles
Required number in Gainesville	12	4	1
Weights about sub criteria of accessibility	<ol style="list-style-type: none">1. Destination accessibility via auto – 02. Destination accessibility via transit – 25%3. walk score – 75%	<ol style="list-style-type: none">1. Destination accessibility via auto – 20%2. Destination accessibility via transit – 30%3. walk score – 50%	<ol style="list-style-type: none">1. Destination accessibility via auto – 33%2. Destination accessibility via transit – 33%3. walk score – 33%

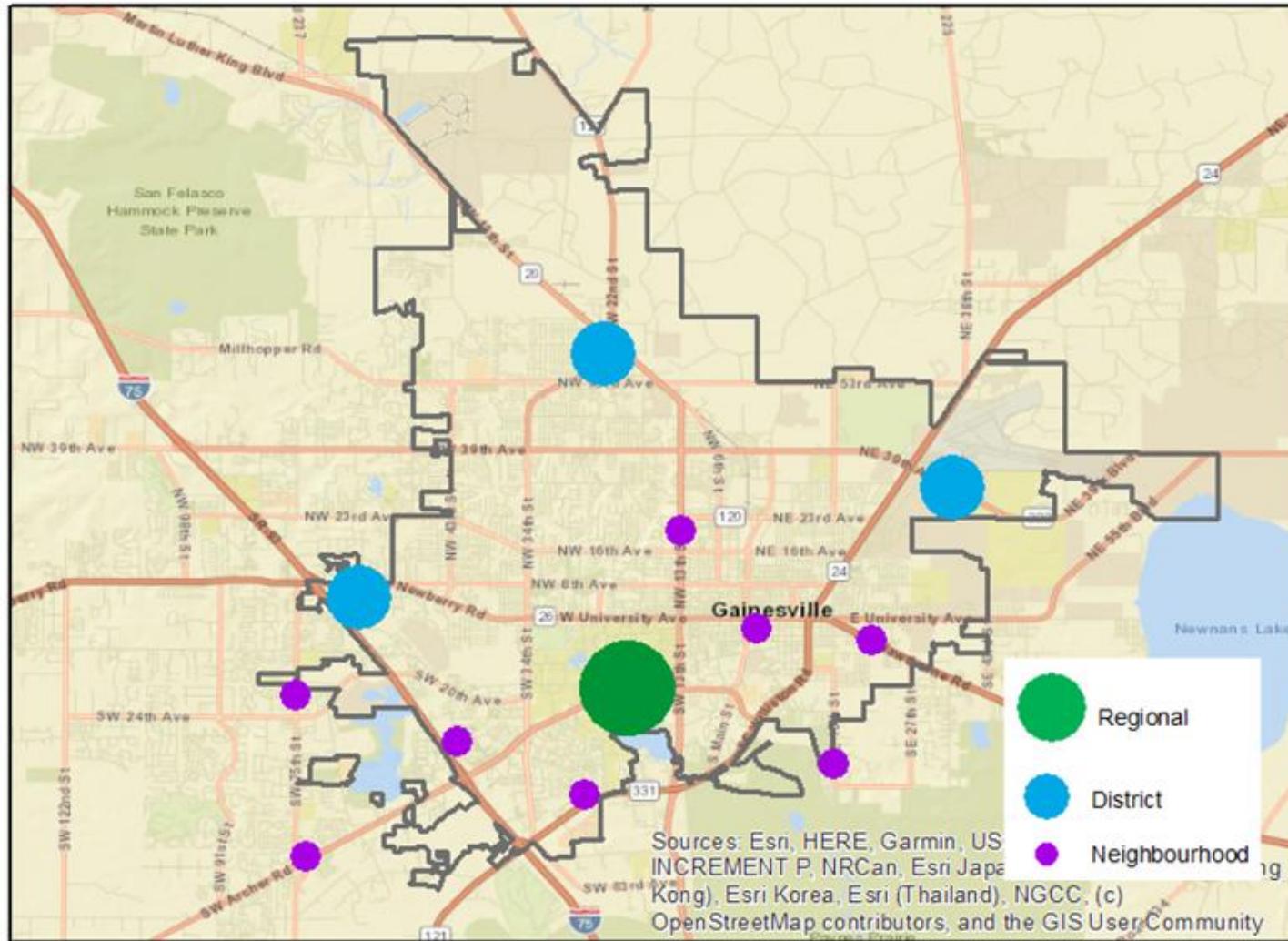
8

3

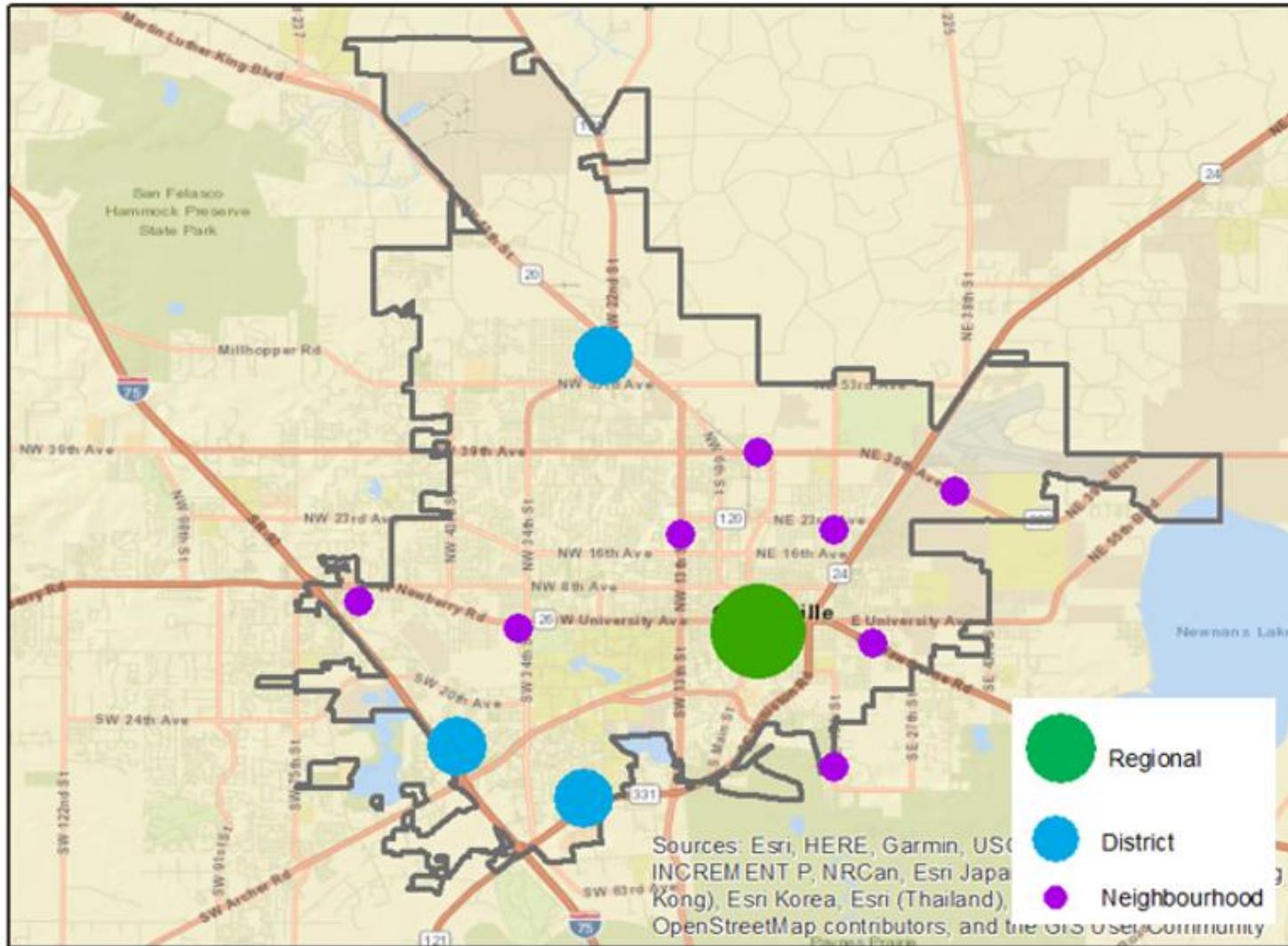
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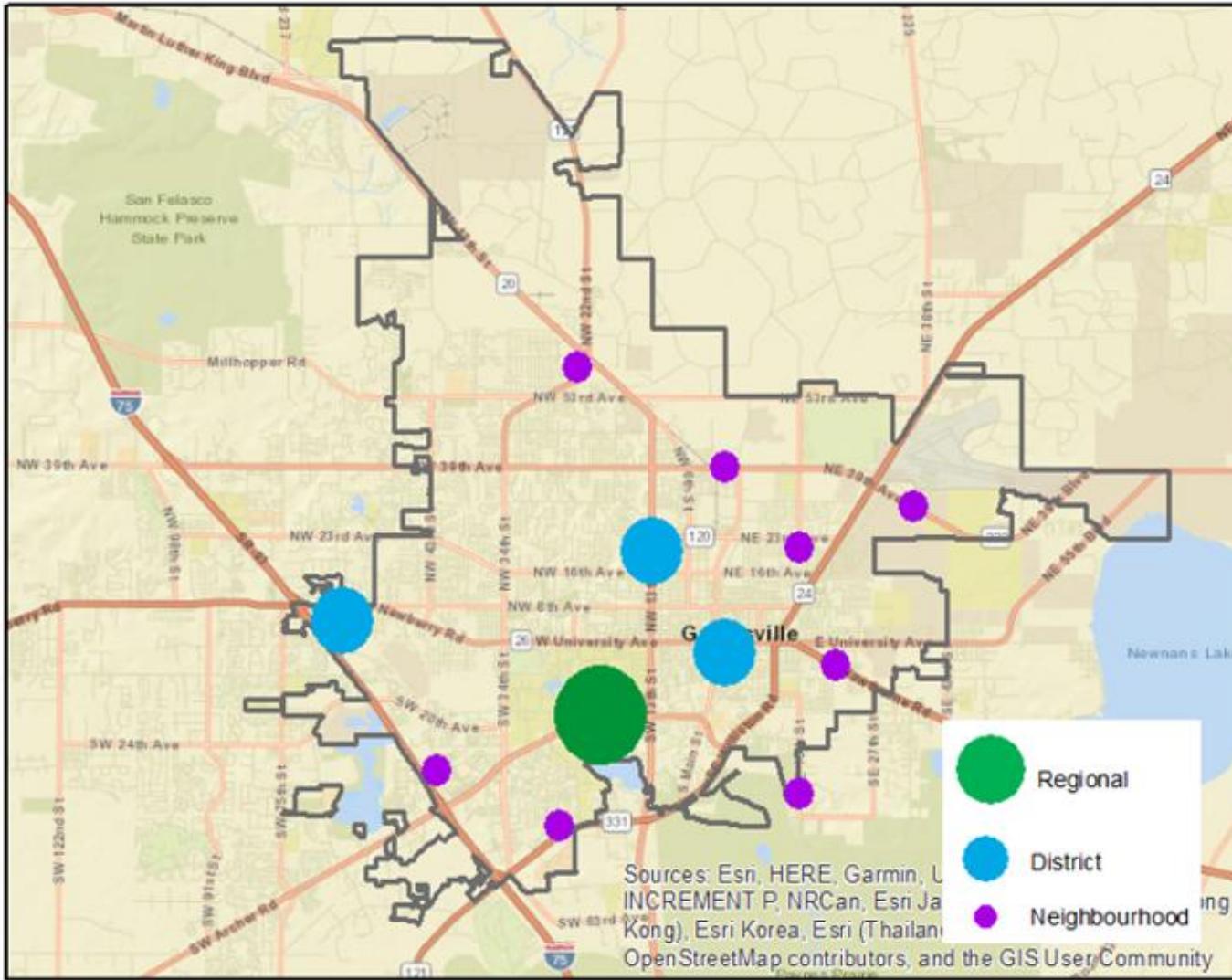
GNV results: equal weights scenario



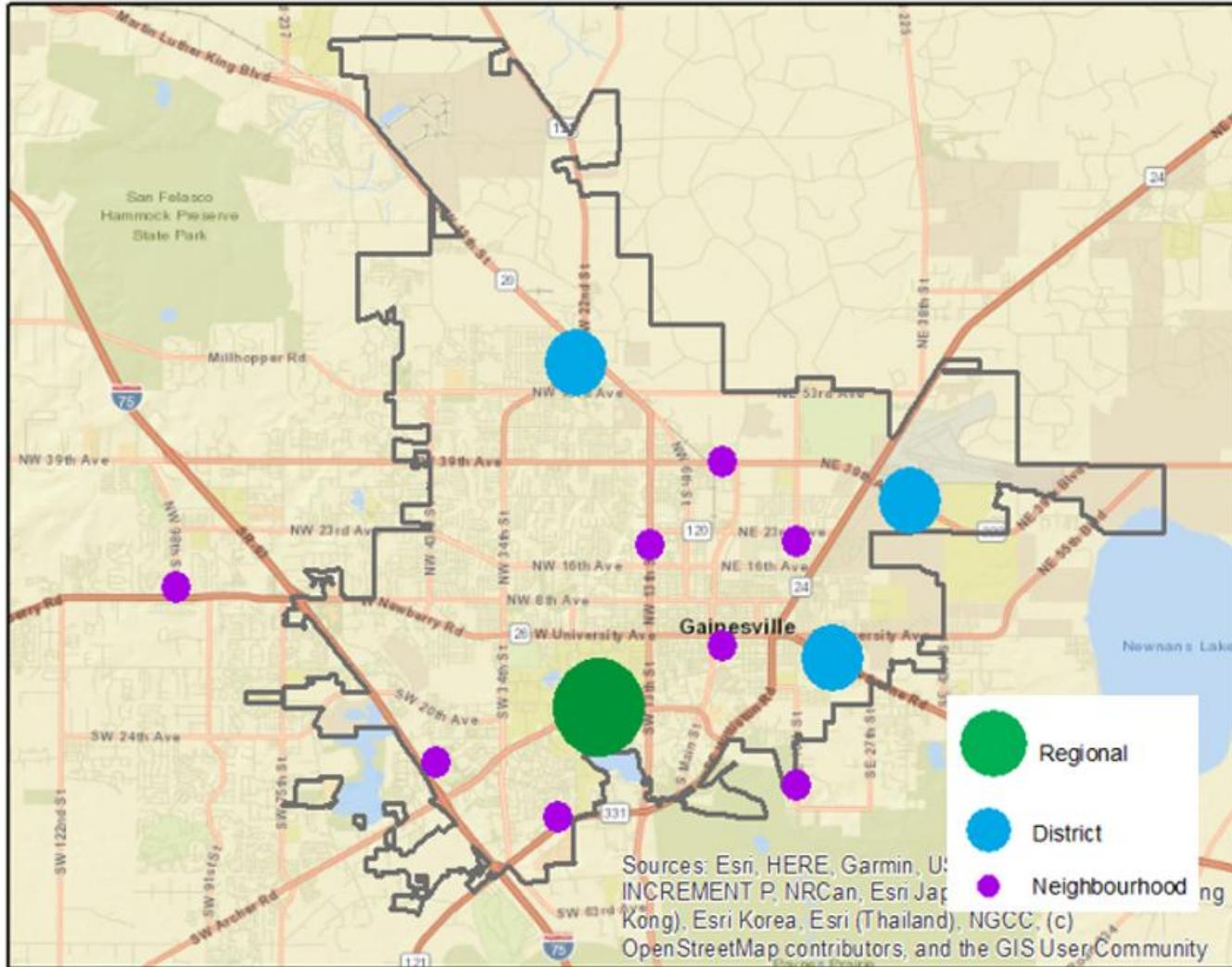
GNV results: Enhancing transit supply



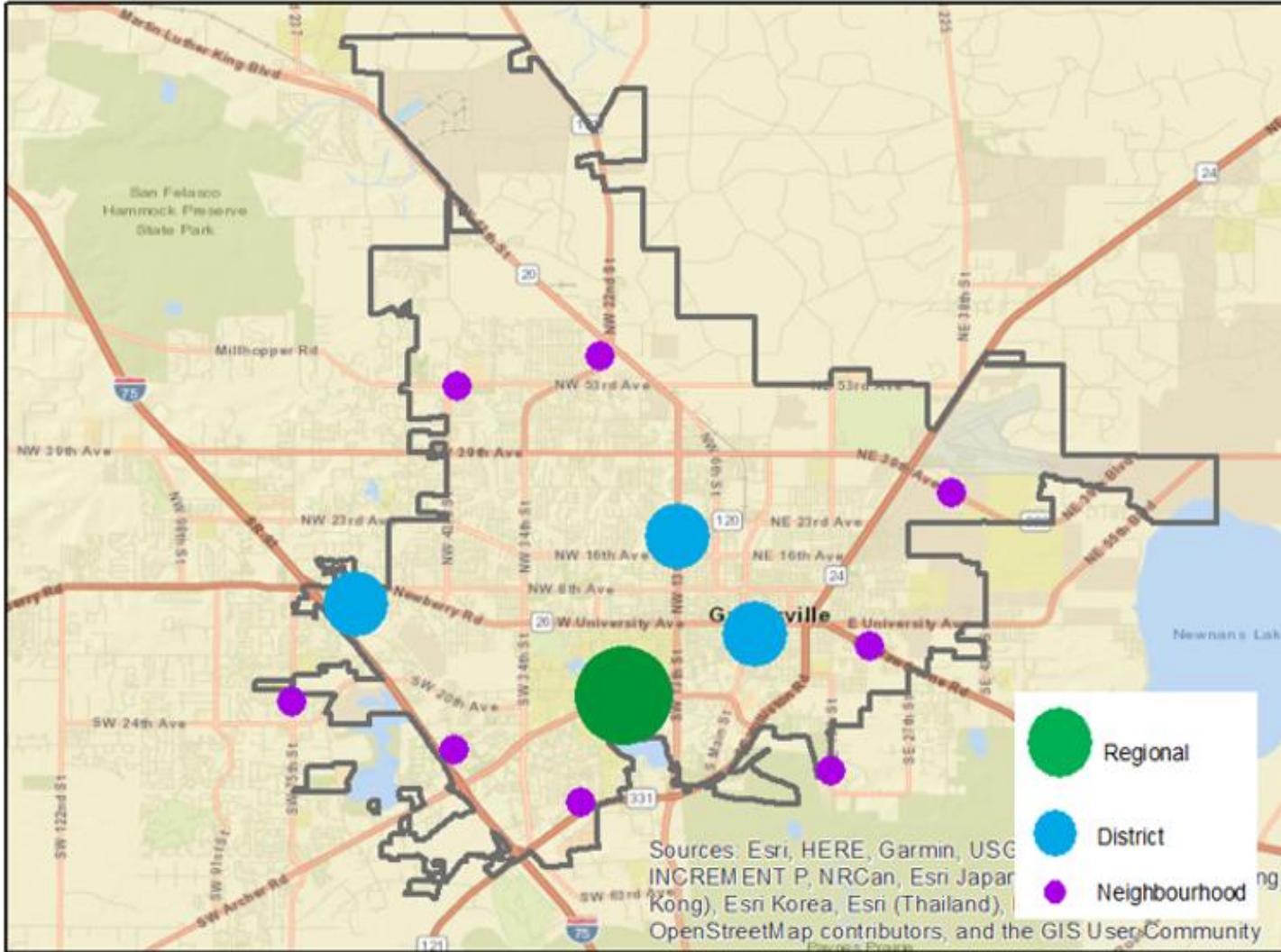
GNV results: Leveraging existing road infrastructure



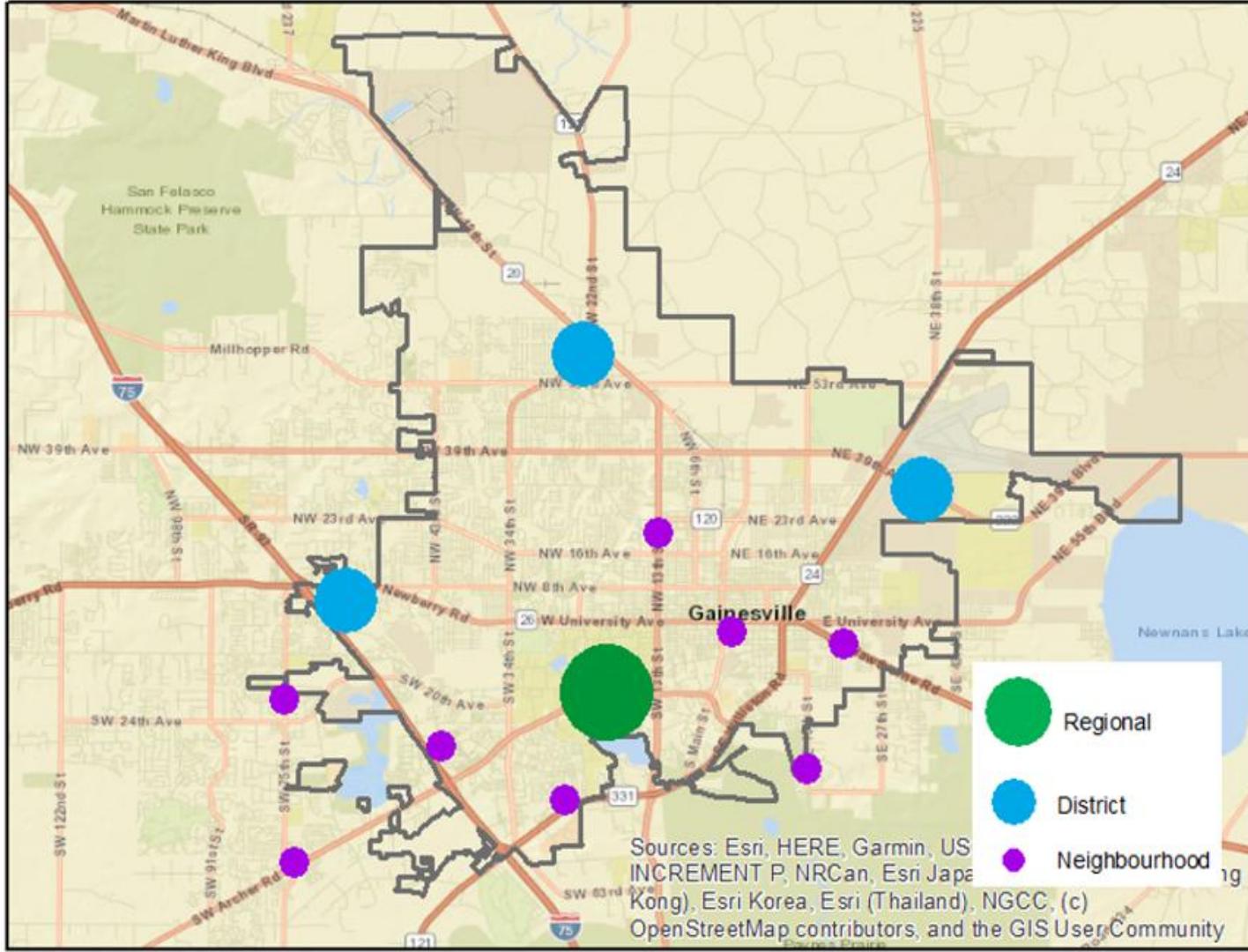
GNV results: Promoting socioeconomic equity



GNV results: Enhancing FMLM access

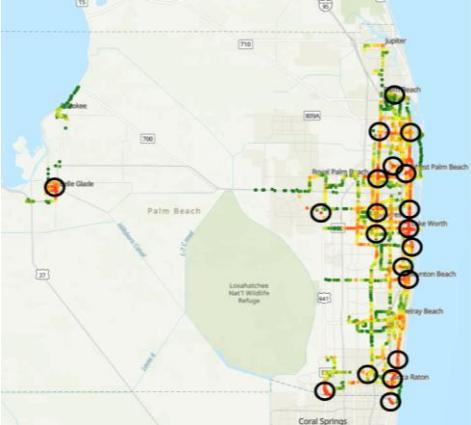


GNV results: Enhancing accessibility

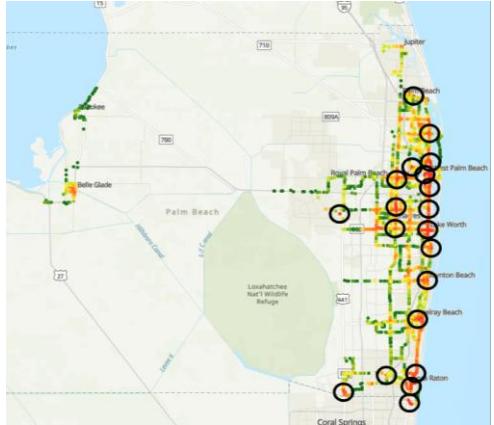


Palm Beach County (20)

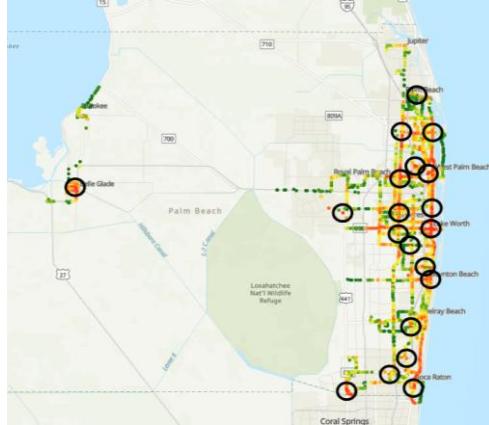
Equal weight



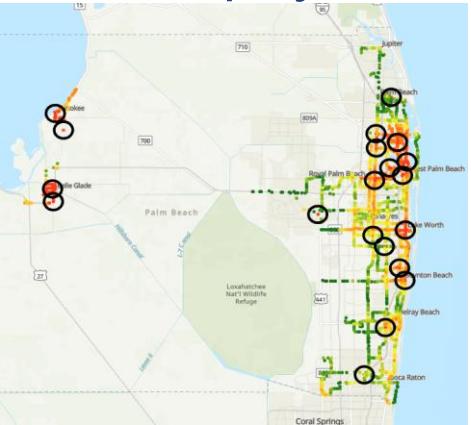
Accessibility



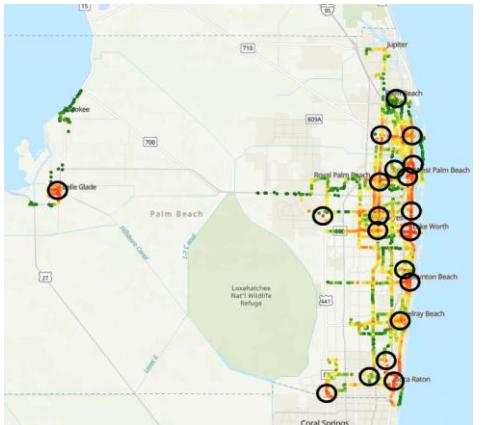
Transit



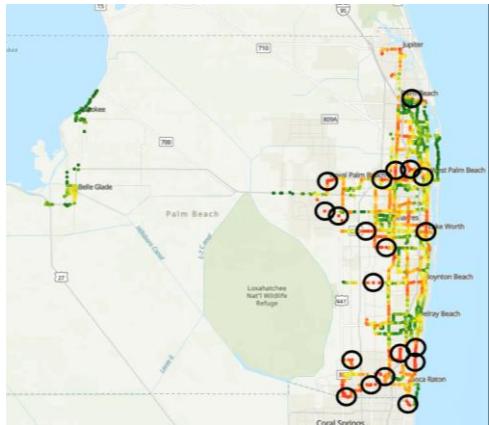
Equity



Infrastructure



FMLM



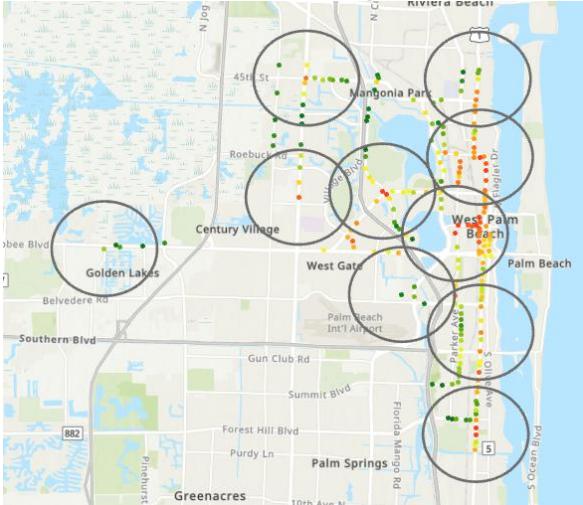
3. Application of method in the City of Gainesville



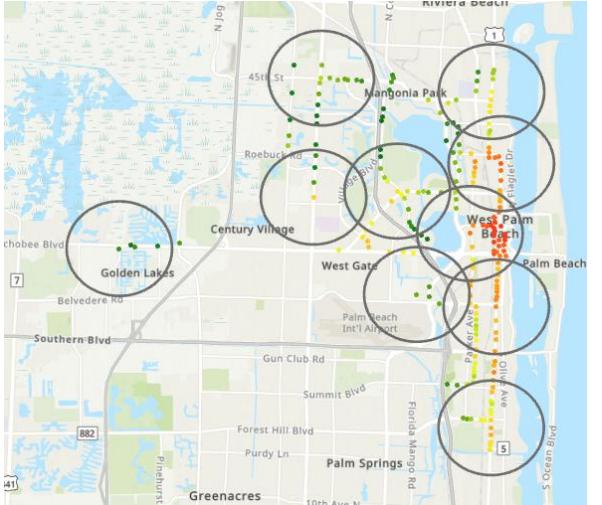
West Palm Beach (Set to select 20, selected 10)



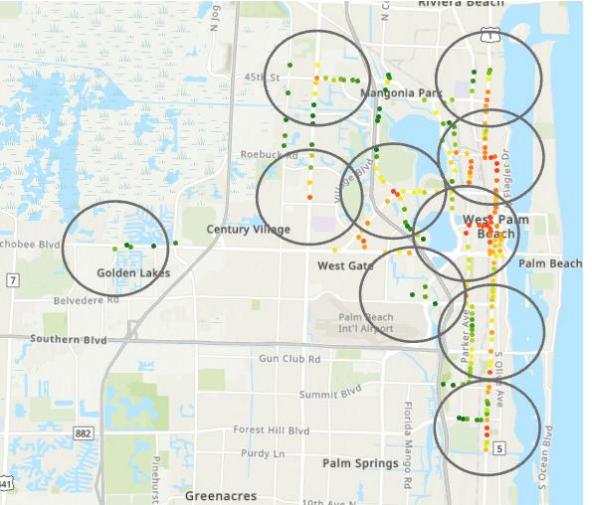
Equal weight



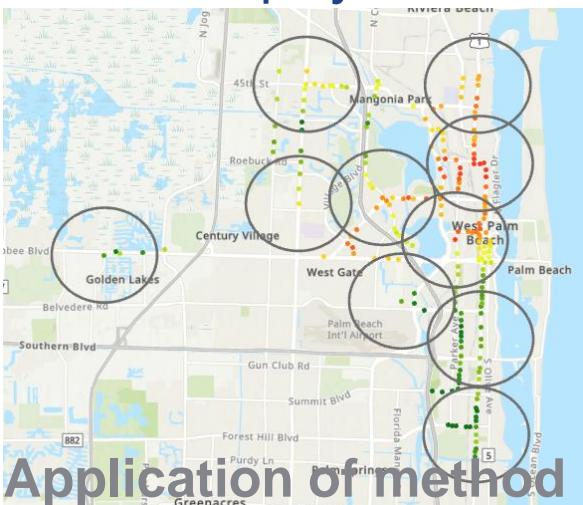
Accessibility



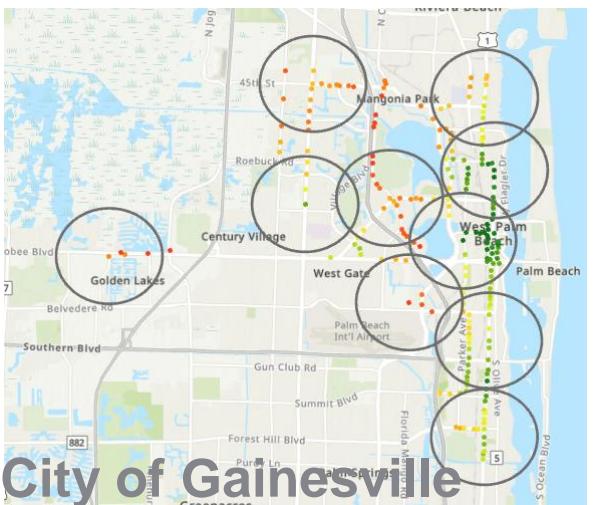
Transit



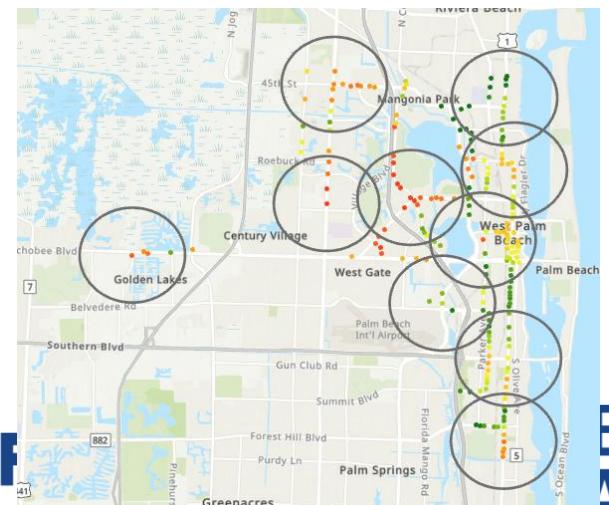
Equity



Infrastructure



FMLM



3. Application of method in the City of Gainesville

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