

Evaluating Equity: A Method for Analyzing Transit Accessibility of Affordable Housing Units

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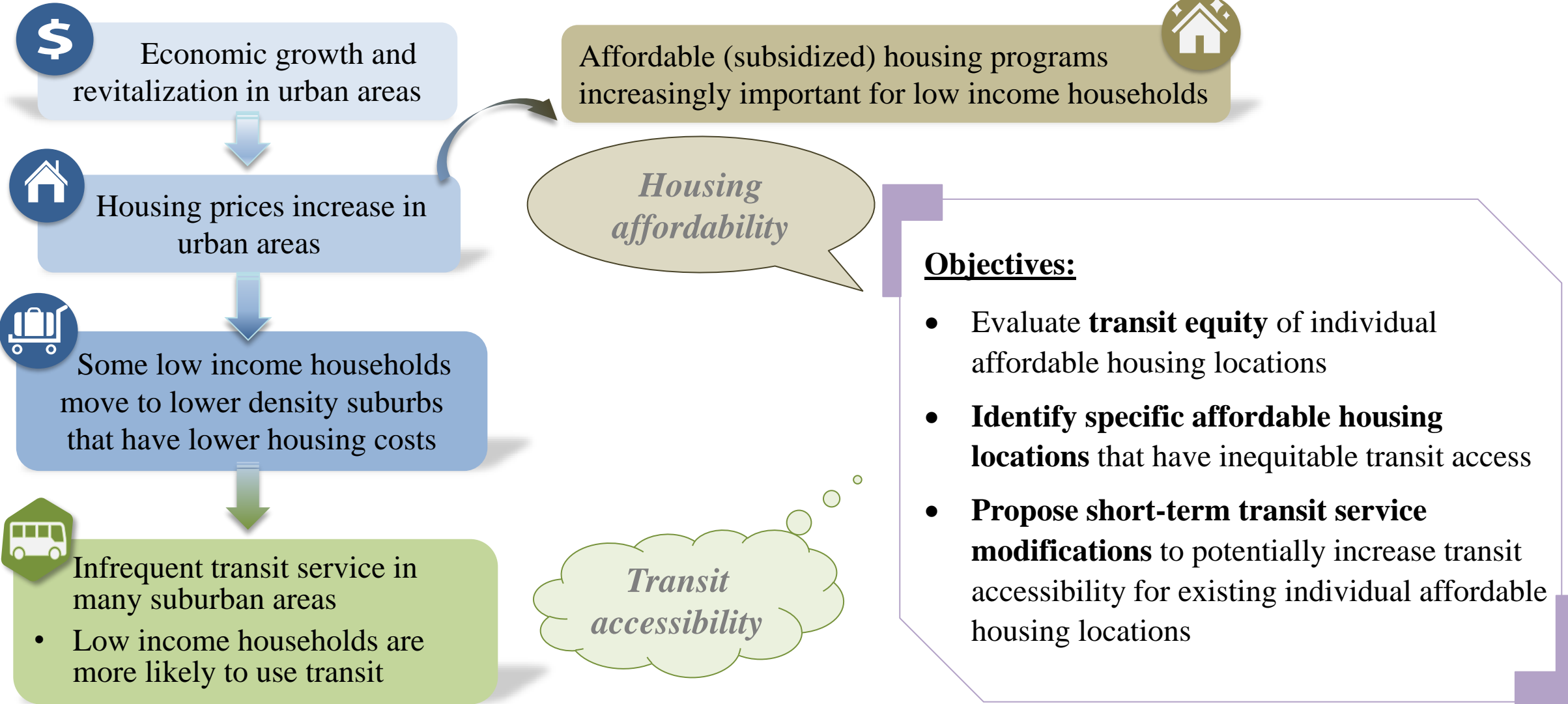
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Outline

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2. Data and Method
 - 1) *Step 1: Measure transit accessibility*
 - 2) *Step 2: Evaluate transit equity of individual affordable housing locations*
 - 3) *Step 3: Propose transit service modifications for affordable housing locations with a high inequity index*
3. Results
 - 1) *Discussion about Memphis*
 - 2) *A new case study in Nashville*
4. Limitations and Future Work

1

Introduction



1. Freeman, L. (2005). Displacement or succession? Residential mobility in gentrifying neighborhoods. *Urban Affairs Review*, 40(4), 463-491.

2. Giuliano G. (2005) Low Income, Public Transit, and Mobility. *Transportation Research Record*. 1927(1):63-70.

2.1

Data and method

Origins: *Affordable Housing locations (in 2022)*

- Low-Income Housing Tax Credit (LIHTC)
- Assisted Multifamily Housing (Multifamily)
- Public Housing (PH)

Transit network

GTFS in *February 2022*

Destinations: *job locations*

Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics dataset in *2018*

Step 1: Measure Transit Accessibility

Tool

QGIS & Conveyal

Method

Cumulative opportunity measure

Step 2: Evaluate Transit Equity of Individual Affordable Housing Locations

➤ Inequity Index:

$$\frac{\text{Housing units \%}}{\text{Accessible jobs within a given time threshold \%}}$$

Step 3: Propose Transit Service Modifications for Affordable Housing Locations with a High Inequity Index

Tool

QGIS
Conveyal

Method

1. Investigate the surrounding road network and nearby transportation services
2. Propose transit modification to improve transit accessibility
3. Evaluate transit accessibility before and after the transit modification

Links of affordable housing data (obtained from HUD):

LIHTC: <https://hudgis-hud.opendata.arcgis.com/datasets/HUD::low-income-housing-tax-credit-properties/about>

Multifamily: <https://hudgis-hud.opendata.arcgis.com/datasets/HUD::multifamily-properties-assisted/about>

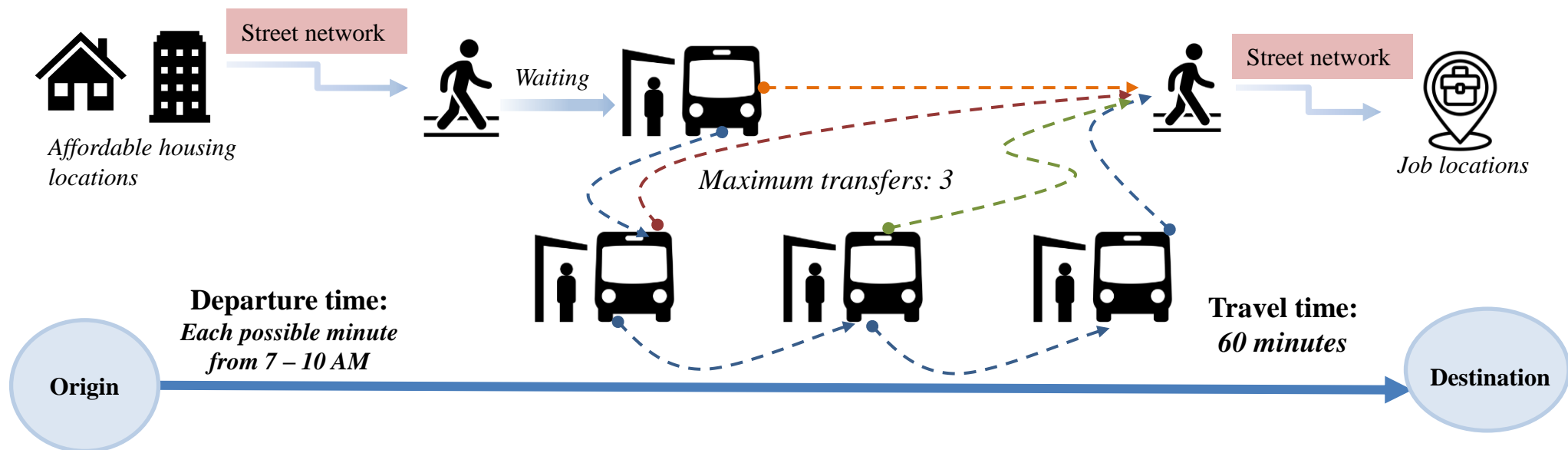
PH: <https://hudgis-hud.opendata.arcgis.com/datasets/HUD::public-housing-buildings/about>

Multifamily includes Section 8 Project Based Assistance, Section 202, and Section 811
HUD: The US Department of Housing and Urban Development

Analysis tool: <https://conveyal.com/>



➤ Step 1: Measure transit accessibility



➤ Step 2: Identify affordable housing units with limited transit accessibility:

- Higher inequity index means *higher demand (higher number of units) and lower supply (lower number of accessible jobs)*

➤ Step 3: Propose transit modifications in Conveyal software:

- Convert to frequency: Replace the scheduled trips for one or more existing trip patterns with frequency based timetables.
- Reroute: Detours, extensions, and curtailments to routes in existing travel patterns.
- Others...

3.1

Discussion about Memphis

1) Map of Regional Transit Accessibility and Location of Affordable Housing in Memphis

Affordable housing programs

LIHTC-Number of housing units

- 1 - 25
- 26 - 50
- 51 - 100
- 101 - 150
- 151 - 200
- 201 - 250
- 251 - 300
- >300

Multifamily-Number of housing units

- 1 - 25
- 26 - 50
- 51 - 100
- 101 - 150
- 151 - 200
- 201 - 250
- 251 - 300
- >300

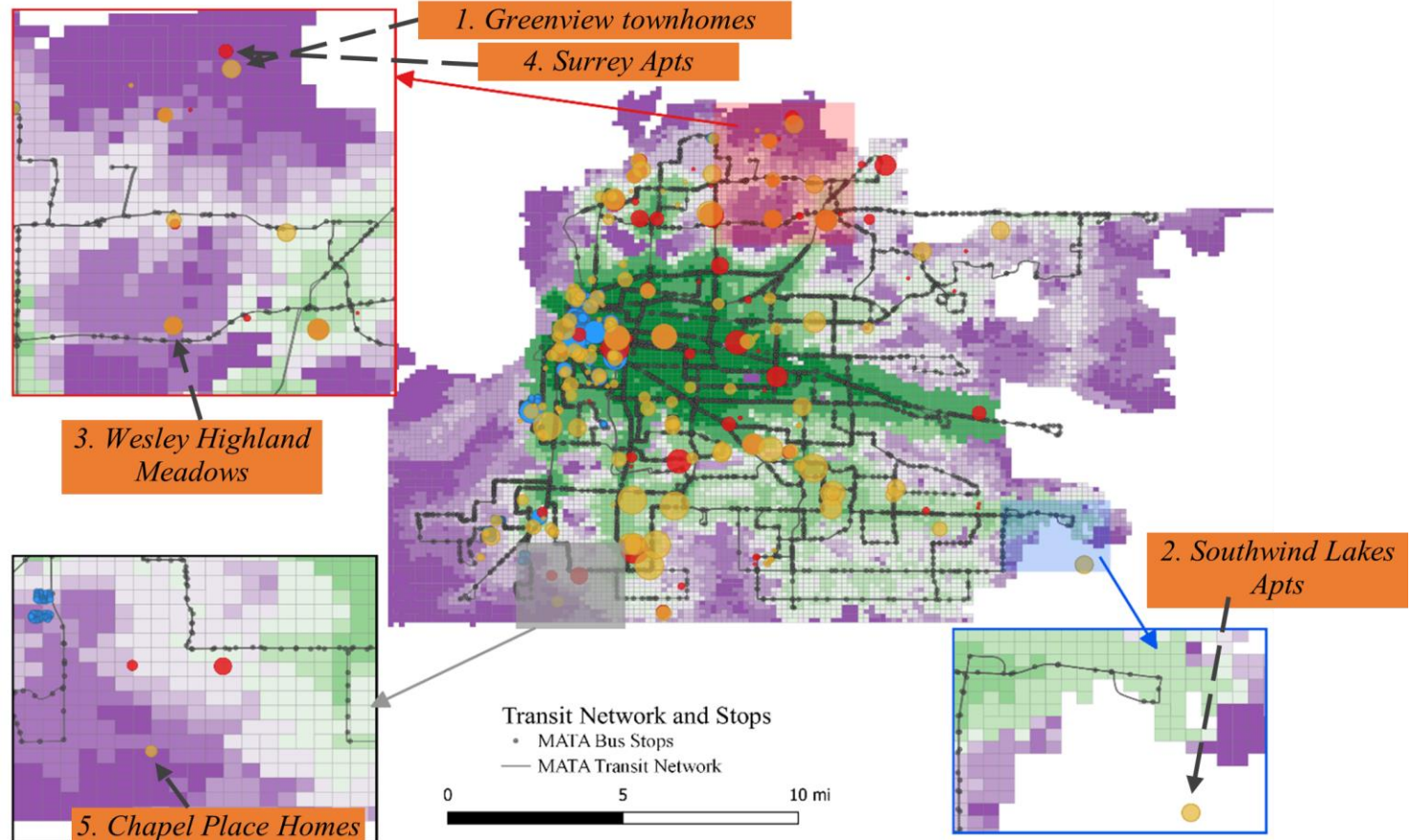
PH-Number of housing units

- 1 - 5
- 6 - 10
- 11-100 (small complex)
- >100 (big complex)

Regional transit accessibility (2022)

Number of transit-accessible jobs within 60 minutes

- 0 - 151
- 151 - 488
- 488 - 1561
- 1561 - 3715
- 3715 - 8063
- 8063 - 15193
- 15193 - 25900
- 25900 - 50987
- 50987 - 109617
- 109617 - 178637



Case 3 was selected affordable housing for proposing transit improvements; more detail on the next slide.

3.1

Discussion about Memphis

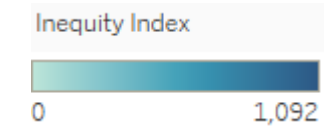
2) Sort affordable housing by the value of inequity index

- Top 14 low-access affordable housing in Memphis

	Project	Program	City Memphis
Case 1	GREENVIEW TOWNHOMES	LIHTC	1,092 158 94
Case 2	SOUTHWIND LAKES APTS PHASE I	LIHTC	1,057 200 123
Case 3	WESLEY HIGHLAND MEADOWS	LIHTC	963 200 135
		Multi-family	958 199 135
Case 4	SURREY APARTMENTS I		709 108 99
		Multi-family	
Case 5	CHAPEL PLACE HOMES	LIHTC	331 87 171
	TANGLEWOOD APTS (MEMPHIS)	LIHTC	135 198 953

Inequity index
Number of units
Transit access

Project	Program	City Memphis
		97
NORTHSIDE MANOR APTS	LIHTC	150 1,001
RIDGEMONT TERRACE APTS	LIHTC	97 150 1,007
Todd Creek Apartments	Multi-family	90 150 1,081
KEYSTONE LANDING APARTMENTS	Multi-family	85 131 1,007
LAKEVIEW MANOR APTS	LIHTC	67 152 1,474
LAKEVIEW LANDING	PH	61 152 1,617
COUNTRYSIDE NORTH APTS	LIHTC	61 152 1,621
THE VILLAGES AT CYPRESSWOOD	PH	60 116 1,257



3.1

Discussion about Memphis

3) Propose transit modifications for affordable housing with low-transit accessibility:

- **Case 3:**

- Wesley Highland Meadows
- Address: 3517 Andy Way Lane
- # units: 200
- # accessible jobs: 135

Transit distribution:

- Route 40 Stage:
 - 6 am – 10 pm | 1.5-hour frequency
 - 2 trip patterns

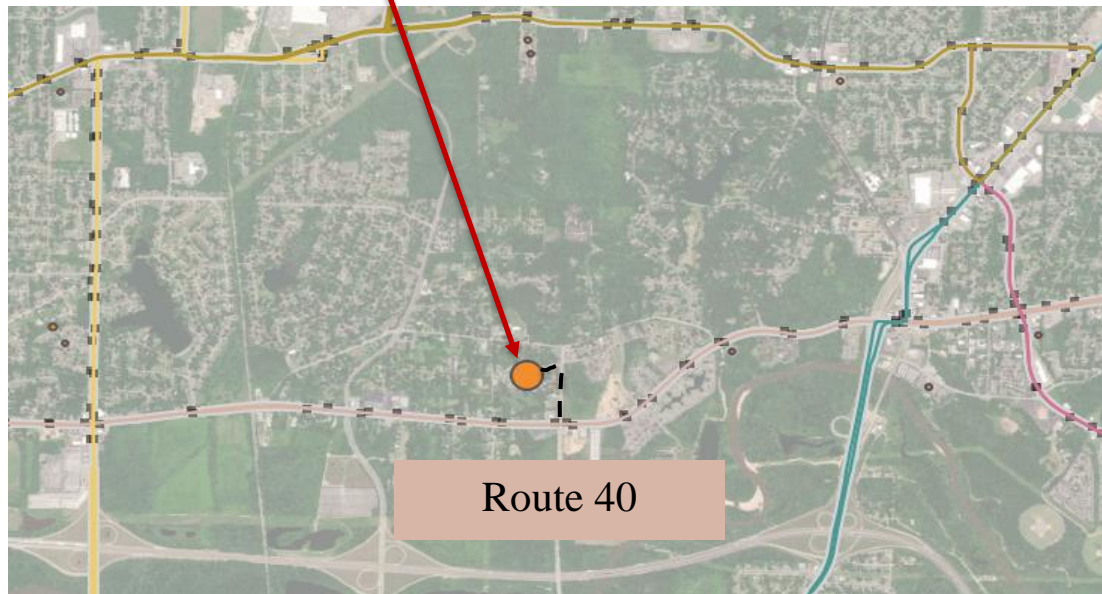
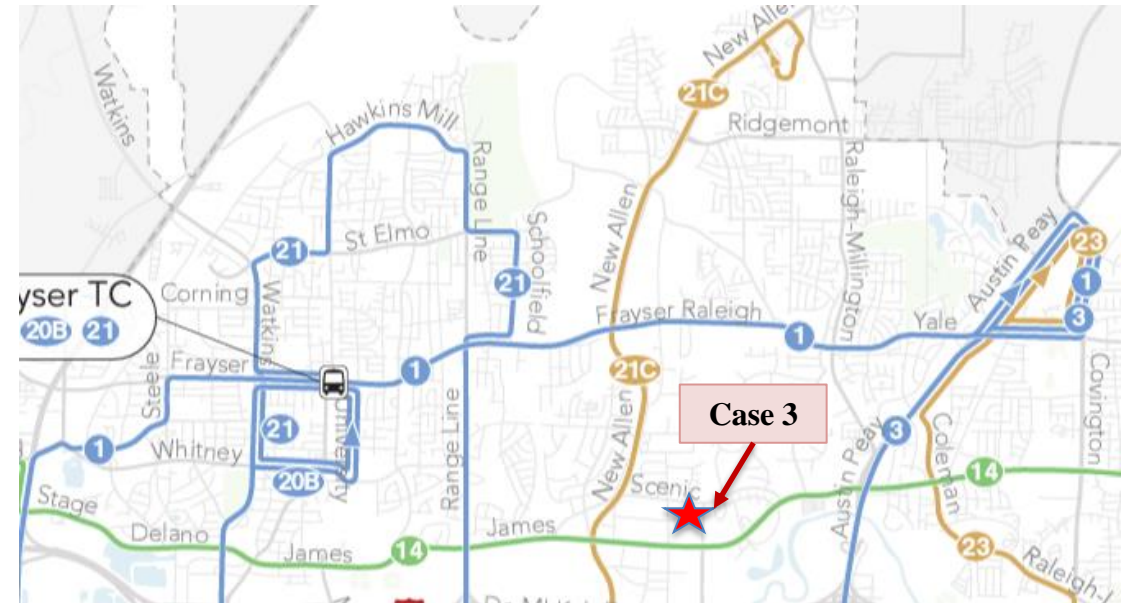


Figure: Satellite view of Wesley Highland Meadows, the surrounding road and the transit network

- **Draft recommended network from Transit Vision Memphis:**

- Cancel the Route 40
- Add a new route 14 with a similar shape of route 40
- Route 14: 60-minutes frequency



Transit modification:

- Possibly increase frequency in AM-peak hours (from 90 minutes to 60 minutes)

3.1

Discussion about Memphis

3) Propose transit modifications for affordable housing with low-transit accessibility:

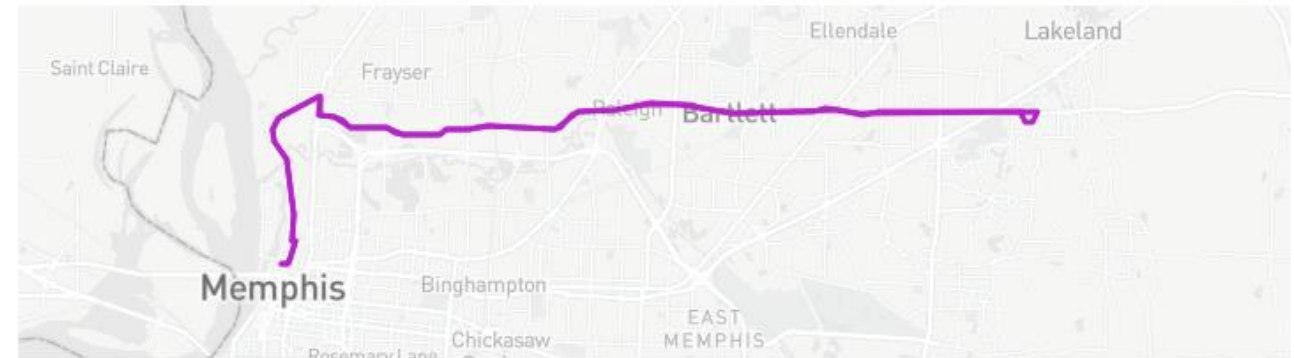


Figure 1: Departure time and count of trips for trip patterns of MATA transit route 40

Increase frequency for #40

(1 / 1) Adjust frequency

Route: 40 STAGE



All existing trips are removed.

New frequencies

Name	Direction	Start time	End time	Frequency	Days of service	Number of trips	Length
Frequency Entry - from downtown	0	06:15	10:45	60	Mo Tu We Th Fr Sa Su	4	33.6 km (20.9 mi)
Frequency Entry - to downtown	1	07:44	10:44	60	Mo Tu We Th Fr Sa Su	3	35.3 km (21.9 mi)

Figure 2: Adjusted AM-peak frequency for MATA transit route 40

*We only consider trip patterns on weekdays

3.1

Discussion about Memphis

4) Evaluate transit modifications in Conveyal:

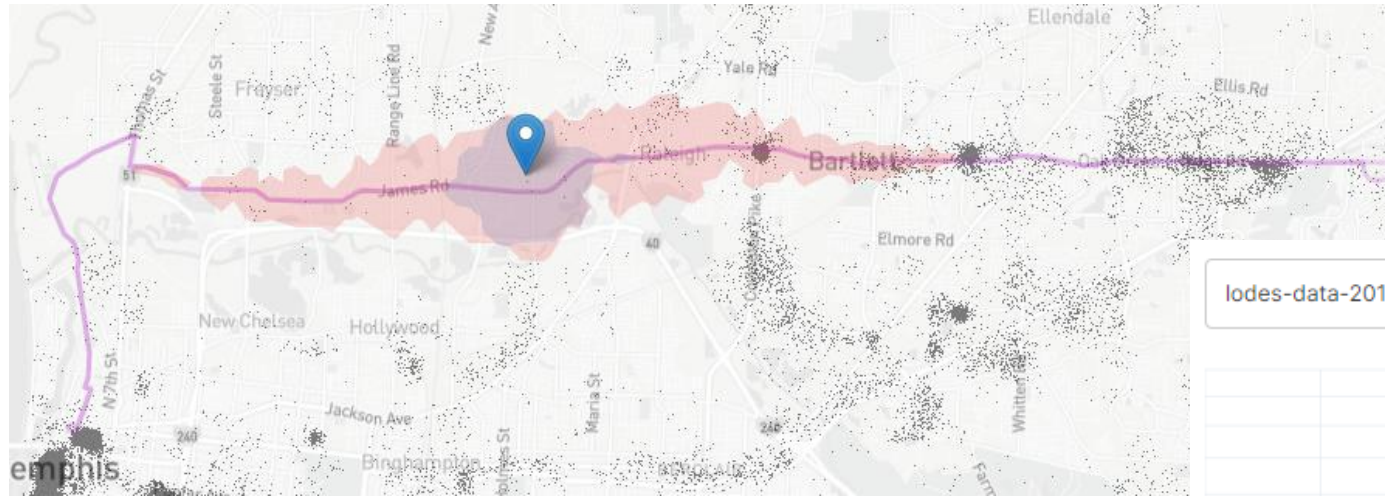


Figure 1: Overlapping isochrones before and after modifying MATA transit route 40 for Wesley Highland Meadows

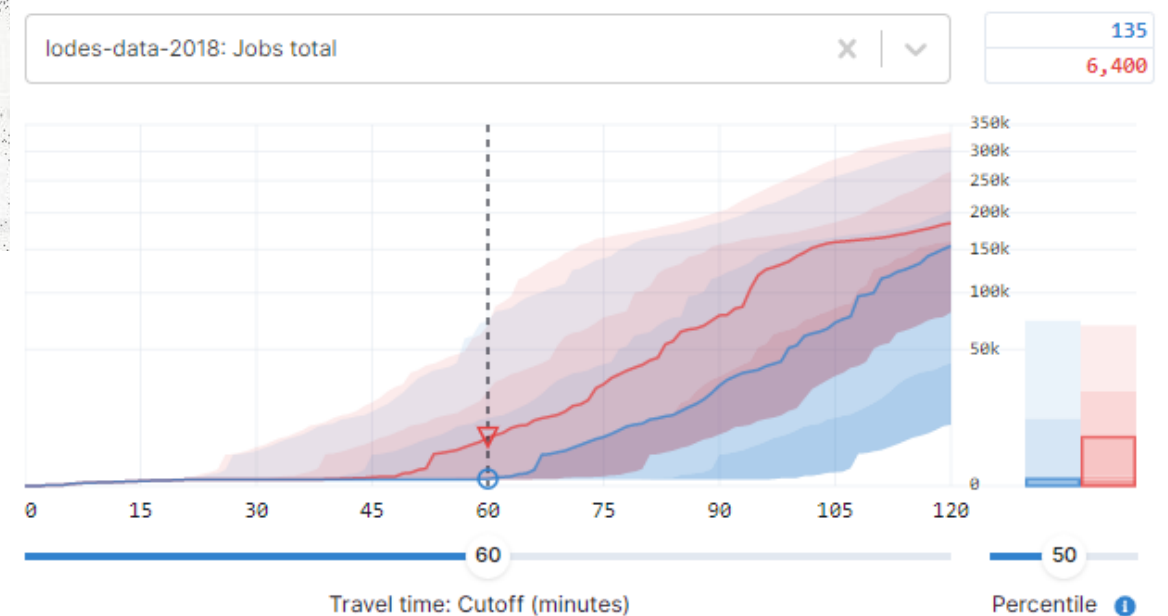


Figure 2: Charts of transit accessibility results before and after modifying MATA transit route 40 Wesley Highland Meadows

3.2

A new case study in Nashville

1) Map of Regional Transit Accessibility and Location of Affordable Housing in Nashville

Affordable housing programs

LIHTC-Number of housing units

- 1 - 25
- 26 - 50
- 51 - 100
- 101 - 150
- 151 - 200
- 201 - 250
- 251 - 300

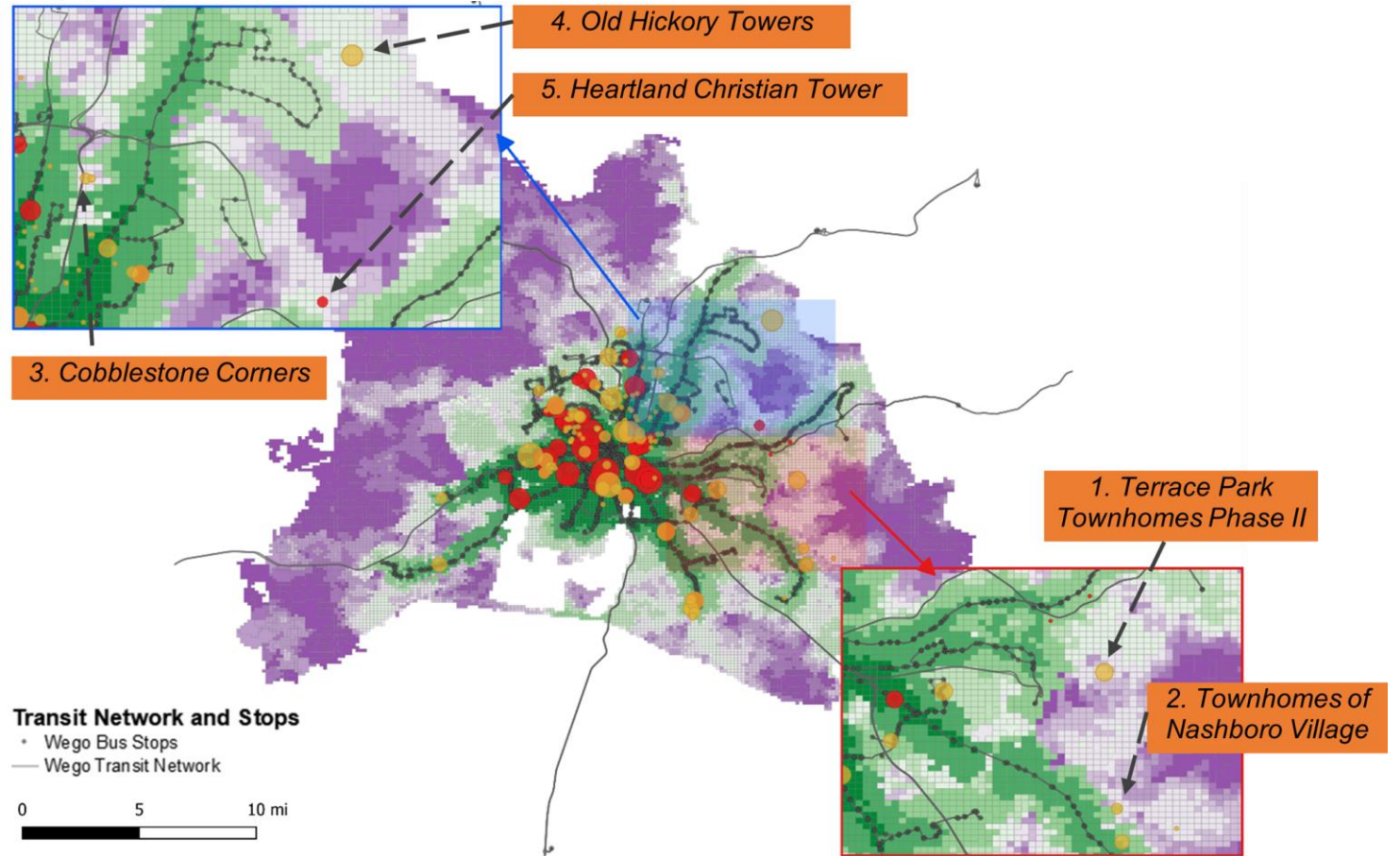
Multifamily-Number of housing units

- 1 - 25
- 26 - 50
- 51 - 100
- 101 - 150
- 151 - 200
- 201 - 250
- 251 - 300
- >300

Regional transit accessibility (2022)

Nashville

- 0 - 11
- 11 - 31
- 31 - 77
- 77 - 157
- 157 - 368
- 368 - 1125
- 1125 - 13757
- 13757 - 78070
- 78070 - 182627
- 182627 - 393986



3.2

A new case study in Nashville

2) Sort affordable housing by the value of inequity index

- Top 15 low-access affordable housing in Nashville

	Project	Program	City Nashville	
Case 1	TERRACE PARK TOWNHOMES PHASE II	LIHTC	1,496 172 258	Inequity index Number of units Transit access
Case 2	TOWNHOMES OF NASHBORO VILLAGE	LIHTC	819 73 200	
Case 3	COBBLESTONE CORNERS	LIHTC	680 96 317	
Case 4	OLD HICKORY TOWERS	LIHTC	577 216 840	
Case 5	HEARTLAND CHRISTIAN TOWER	Multifamily	396 57 323	
Case 6	ELLINGTON VIEW APTS	LIHTC	345 32 208	

Project	Program	City Nashville
KNOLLCREST APARTMENTS	Multifamily	32 197 13,806
LAUREN COURT DUPLEX	LIHTC	18 2 254
VALLEY BROOK TOWNHOUSES PHASE II	LIHTC	17 140 18,924
BILTMORE PLACE APARTMENTS	LIHTC	15 176 25,517
PARKWOOD VILLA APTS	LIHTC	15 153 22,859
HAYNES GARDEN APTS	Multifamily	14 208 34,214
VALLEY BROOK TOWNHOMES I	LIHTC	13 108 18,924
SOUTHSIDE I	LIHTC	11 85 148,450
TRINITY HILLS APTS	LIHTC	9 100 24,796

3) Propose transit modifications for affordable housing with low-transit accessibility:

Case 1:

- Terrace Park Townhomes Phase II
- Address: 3110 Elm Hill Pike, Nashville TN 37214
- # units: 172
- # accessible jobs: 258

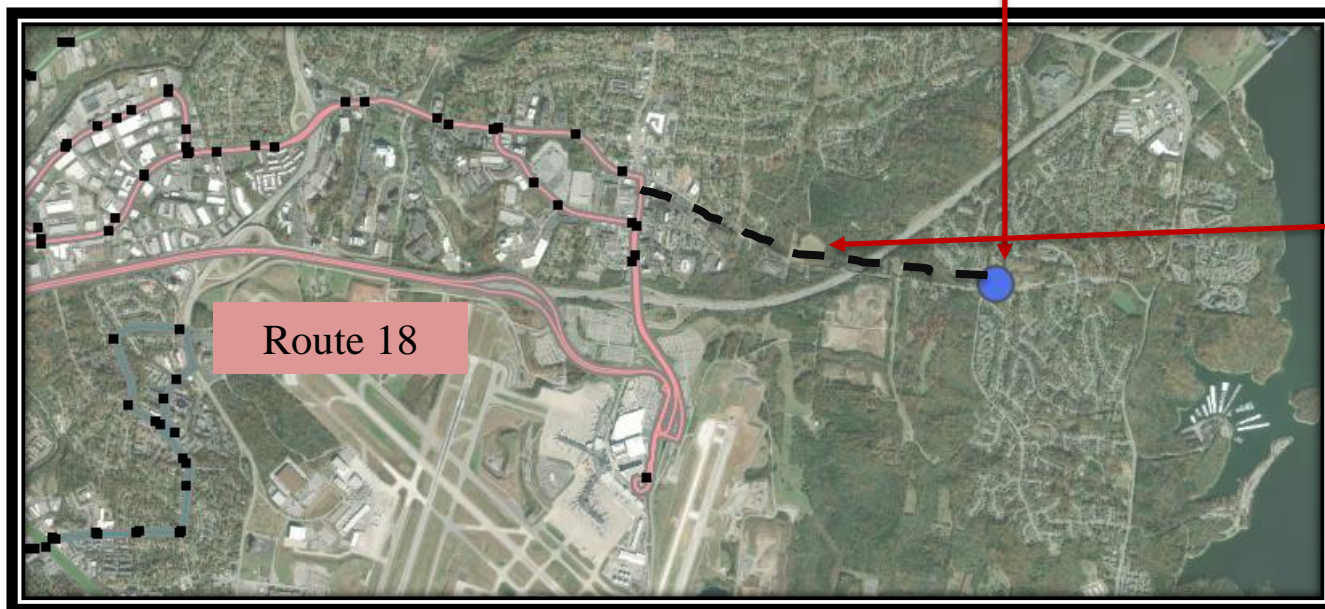


Figure: Satellite view of Terrace Park Townhomes Phase II and the surrounding road and transit network

Transit distribution:

- Route 18 (*Downtown – airport*):
 - 5 am – 12 am | about 45 minutes frequency during AM peak
 - 6 trip patterns

Network distribution:

- The nearest bus stop:
 - Elm Hill Pike & Nelson Pl WB
 - 1.7 mile
 - 4 minutes driving | 34 minutes walking
- Roadway to the nearest bus stop:
 - Elm Hill Pike
 - Two-lane, two-way roadway with two solid yellow lines
 - Speed limit of 40 mph

Transit modification:

- Possibly extend route 18 to make it pass through affordable housing units.

3.2

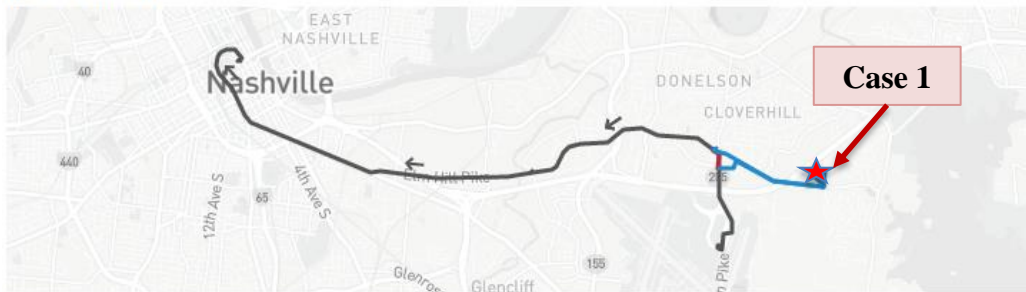
A new case study in Nashville

Modification in Conveyal:

- Select two patterns:
 - Trip #16563, and trip #16566
- Route geometry
- Average speed: 50 km/h
- Default dwell time: 1 minute per stop
- Total added travel time: 10 minutes

Case 1: Reroute #18 to downtown
Route: 18 AIRPORT

(1 / 2) Reroute

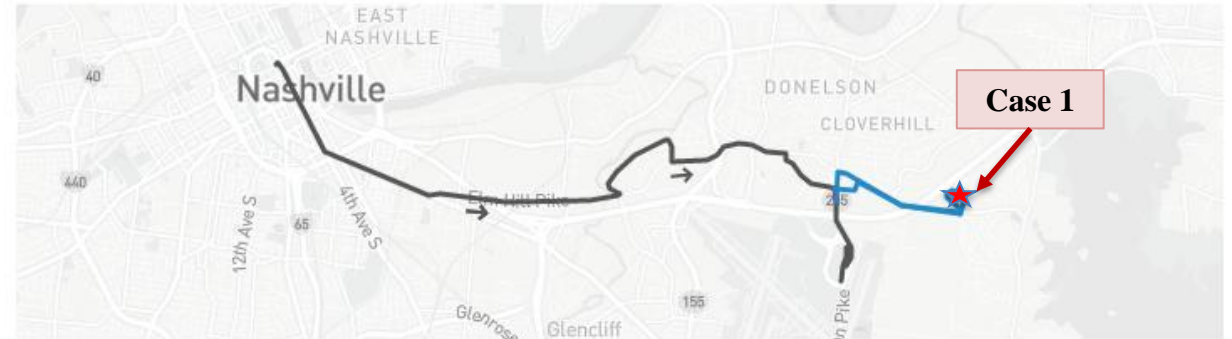


Pattern	36 stops from NASHVILLE INTERNATIONAL AIRPORT to CENTRAL 4TH AVE - BAY 13 via ELM HILL PIKE & AIR LANE DR WB (15 trips)
Original length	16.1 km (10 mi)
New length	21.9 km (13.6 mi)
New segment length	6.3 km (3.9 mi)
Change in length	5.8 km (3.6 mi)
Average speed (along added segments)	50 km/h (31.1 mph)
Dwell time (added segments)	60
Stops removed	0
Stops added	2

Figure 1: Modification summary for WeGo transit trip patterns 16566

Case 1: Reroute #18 to airport
Route: 18 AIRPORT

(2 / 2) Reroute



Pattern	36 stops from CENTRAL 4TH AVE - BAY 13 to NASHVILLE INTERNATIONAL AIRPORT via ACORN DR & ELM HILL PK SB (2 trips)
Original length	15.7 km (9.7 mi)
New length	22.1 km (13.7 mi)
New segment length	6.7 km (4.2 mi)
Change in length	6.4 km (4 mi)
Average speed (along added segments)	50 km/h (31.1 mph)
Dwell time (added segments)	60
Stops removed	0
Stops added	2

Figure 2: Modification summary for WeGo transit trip patterns 16563

3.2

A new case study in Nashville

4) Evaluate transit modifications in Conveyal:

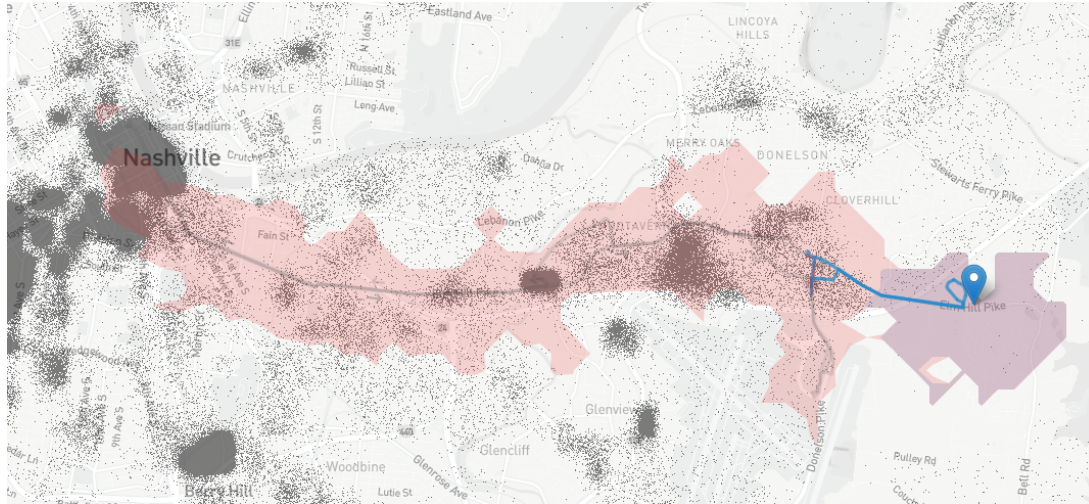


Figure 1: Overlapping isochrones before and after modifying WeGo transit route 18 for Terrace Park Townhomes Phase II

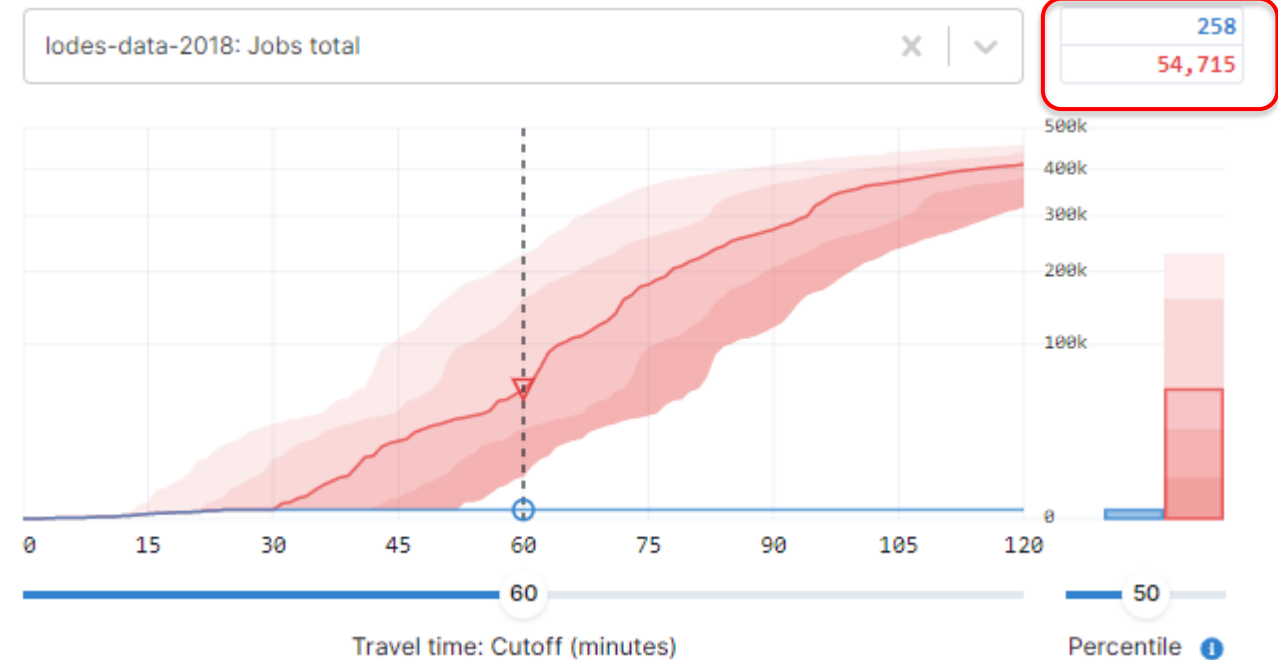


Figure 2: Charts of transit accessibility results before and after modifying WeGo transit route 18 for Terrace Park Townhomes Phase II

Cost assessment is required for future research!

Limitations and future work

Limitations

Future work

**Cost
assessment!**

1. Only consider transit accessibility to jobs

①

1. Measure transit access to other essential services, such as grocery stores, healthcare facilities, schools etc..

2. Transit travel time threshold was set to 60 minutes in this study

②

2. Transit travel time threshold should be adjusted considering typical transit travel time in specific areas

3. The evaluation only considered changes in transit accessibility to specific affordable housing locations

③

3. Analyze the impact of transit service changes on all nearby affordable housing locations

4. Only accessibility levels of fixed transit routes were measured

④

4. Measure accessibility of demand-response transportation services

Questions and comments?

Thanks!

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