FTA

Ladders of Opportunity

*Connectivity Decisions Based on
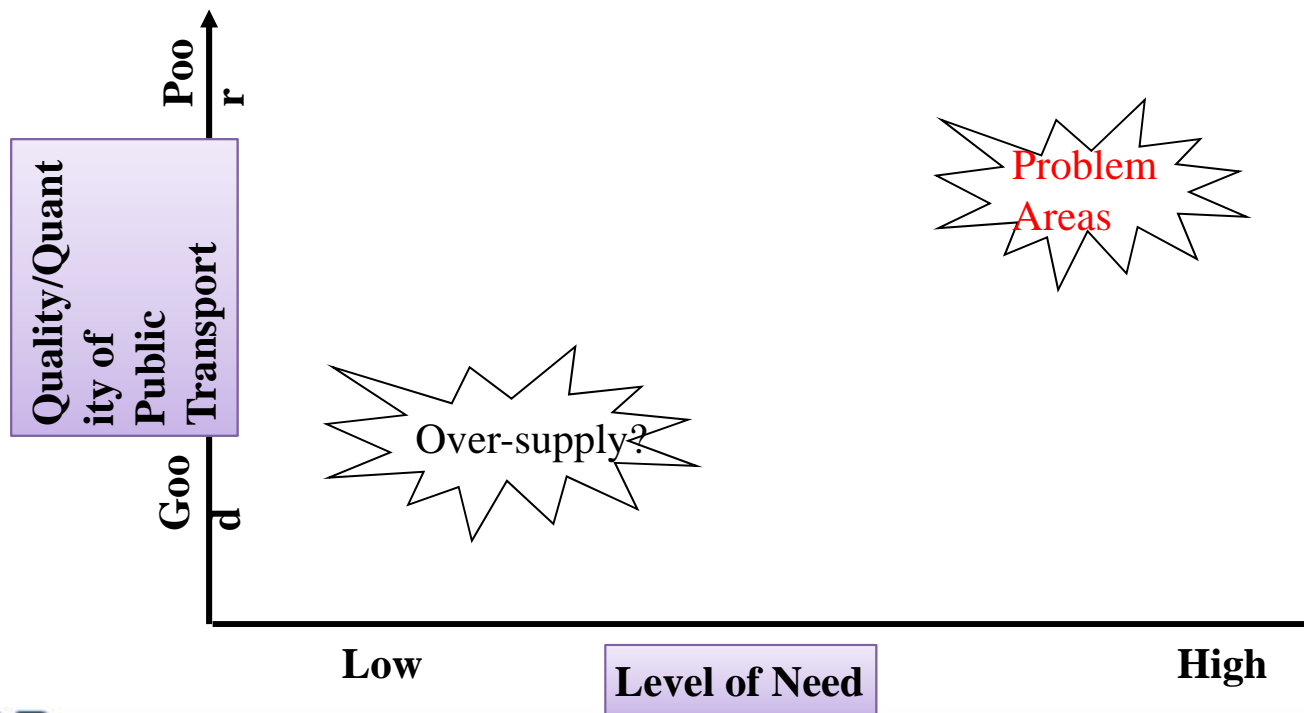Transportation Data*

Dwayne Weeks

and

Nazrul Islam

FTA, Office of Planning

U.S. Department of Transportation
Federal Transit Administration

Connectivity + Accessibility Measure

Quality/Quantity of Public Transport — Poor (top) / Good (bottom)

Level of Need — Low / High

Over-supply?

Problem Areas

Source - Public transport needs gap analysis by Graham Currie

Examples of Accessibility Measure

- ## Analytical Tool (Regional)

  1. Transit Service Provided vs Demand – DVRPC

  2. Minneapolis/St. Paul Route-level Analysis – Metro Transit

  3. Portland, OR Bike-Path Analysis – PSU Transportation Center

  4. Denver Regional Equity Atlas – DRCOG

- ## Analytical Tool (Nationwide)

  5. Accessibility Analysis Tool – Accessibility Observatory, UMN

  6. EPA's Smart Location Mapping – EPA Smart Growth

- ## Academic Literature

  7. Public Transit Needs Gap Analysis by Graham Currie

Steps in Accessibility Analysis

- **Origins**
  - Total Population
  - Low Income
  - Minority
  - Elderly
  - Persons with Disabilities
  - Transit Dependent

- **Destinations**
  - Employment Centers
  - Medical Facilities
  - Educational Institutions
  - Social Services

- **Services**
  - Public Transit
    - Local /Express Bus/BRT
    - Commuter Rail/Metro
  - Bike Network
  - Walk Network

- **Gaps**
  - Demand/Need
  - Supply (Quantity & Quality)
  - Gaps Analysis

- **Possible Solutions**

4

1. Delaware Valley Regional Planning Commission (DVRPC) Analysis

DVRPC Model

- 25 Counties
- 3,400 TAZs

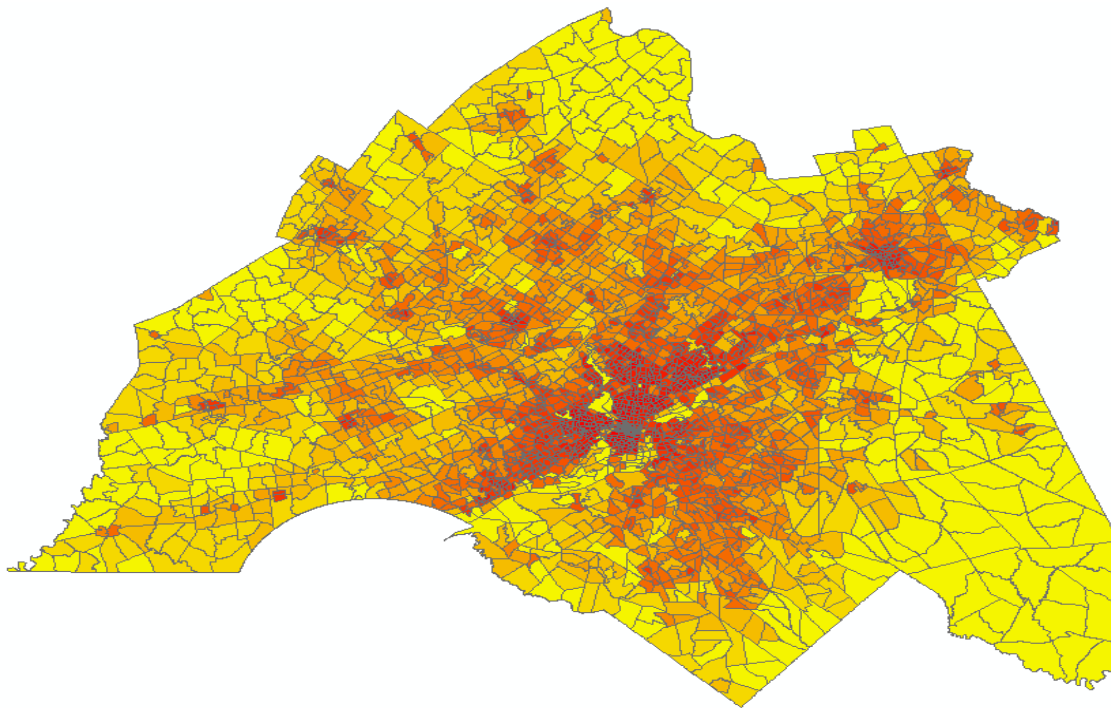**Data Source**

- GTFS
- OpenStreetMap (OSM)
- Regional Data

Steps in the Process

- Transit Demand Estimation
- Transit Supply Estimation
- Analysis
- Gaps Identification

Development of a Regional Forecasting Model Based on Google Transit Feed – Chritopher Puchalsky, et.al.
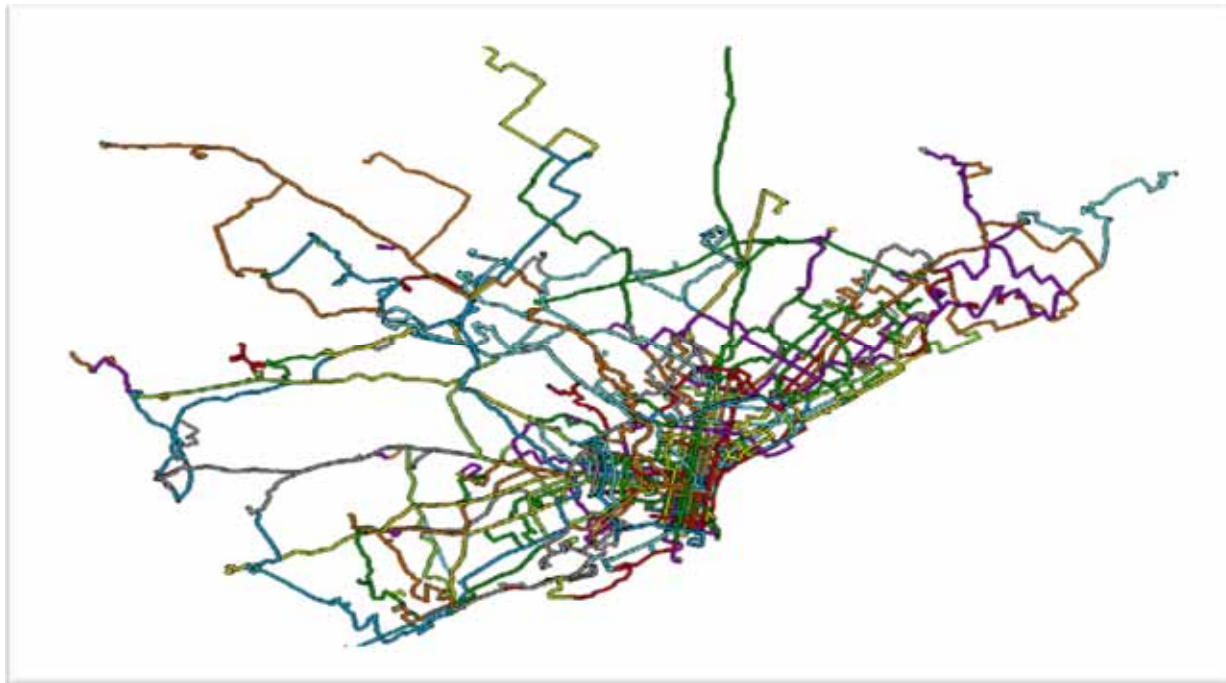
1. DVRPC Analysis (Cont…)
Transit Demand Scores

TAZ-level Transit Demand =

[0.4*(pop/acre)] +
[0.09*(jobs/acre)] +
[0.74*(0-car HH/acre)]

(Uses population density, job density, and density of 0-car households to assess likely transit demand)
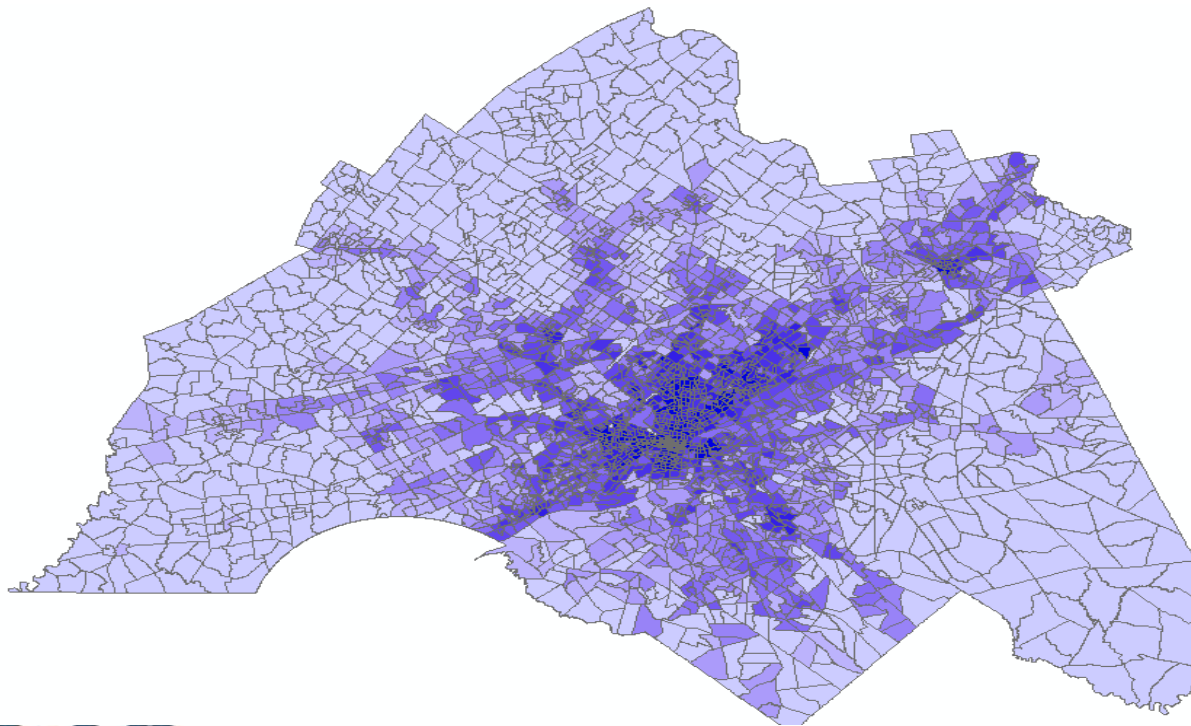
6

1. DVRPC Analysis (Cont…)
GTFS Network

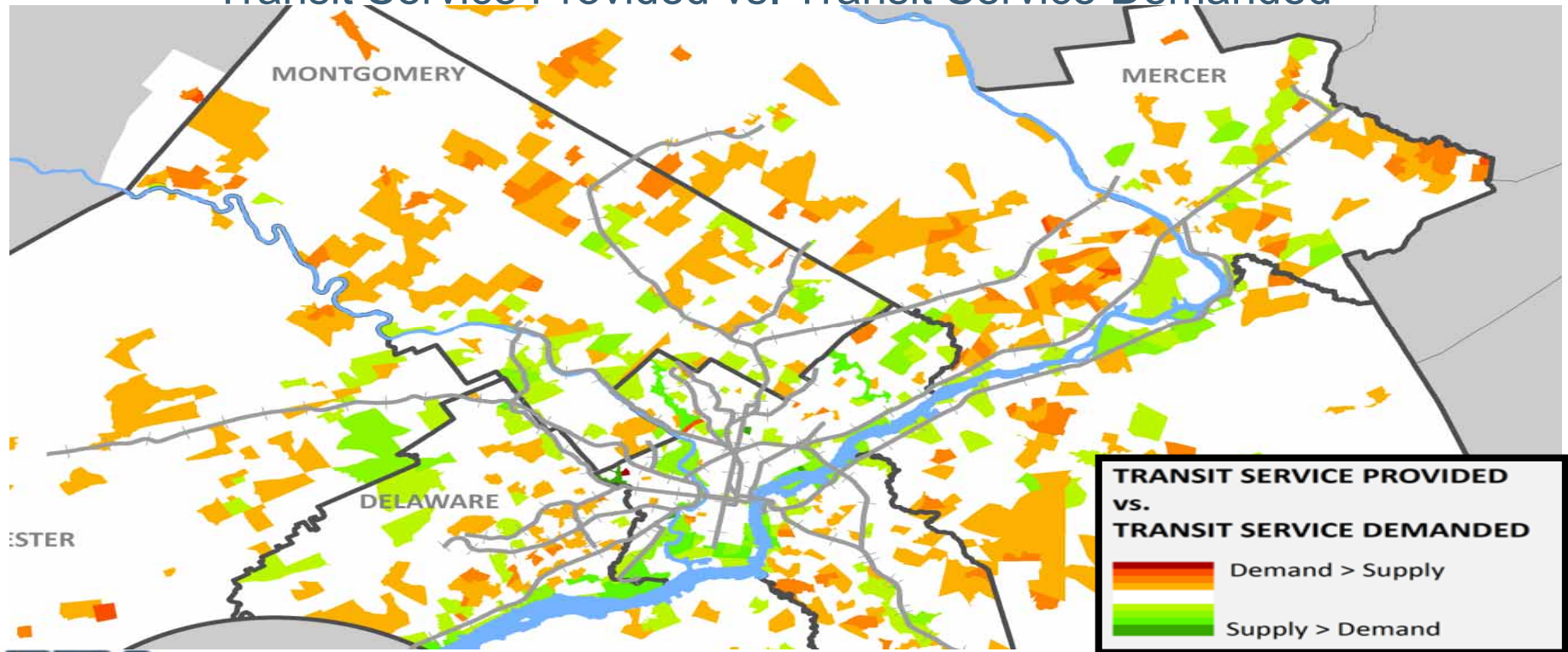# 1. DVRPC Analysis (Cont…)
Transit Supply Scores

TAZ-level Transit Supply =
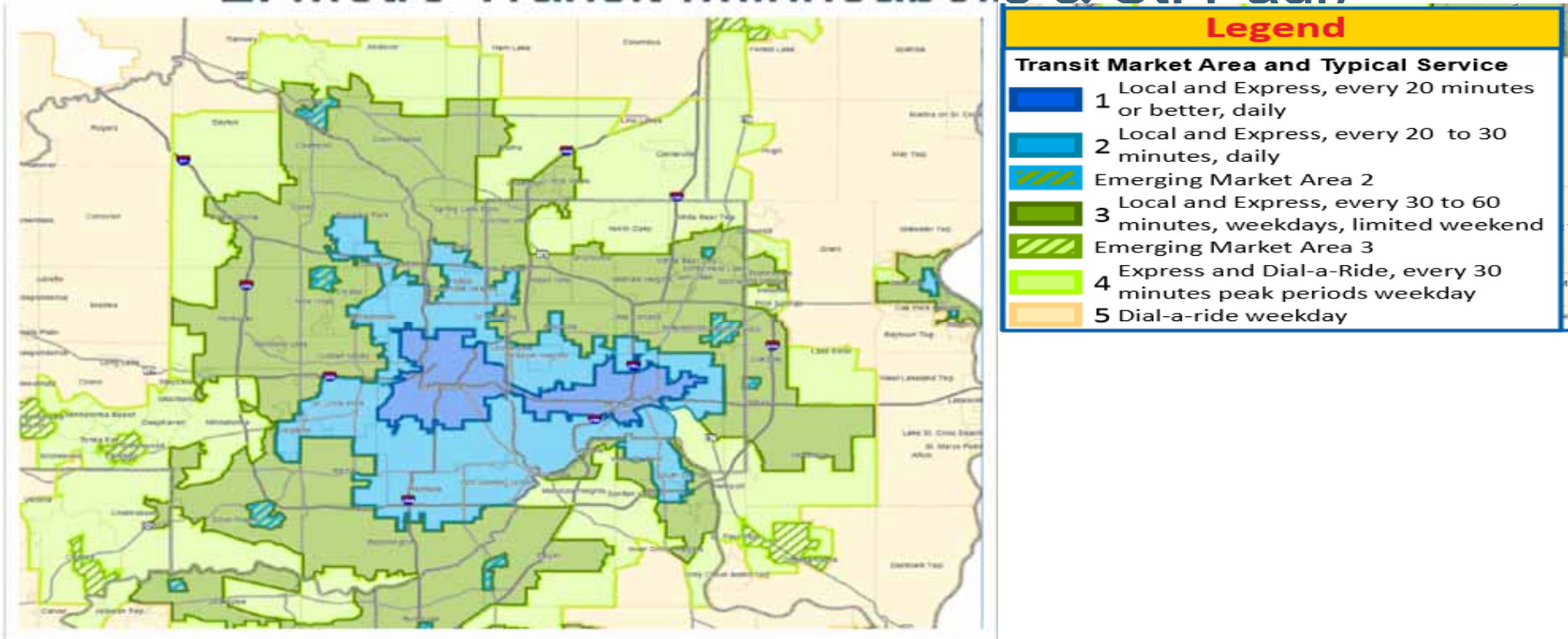24-hour transit vehicle departures by TAZ (from GTFS Data)

1. DVRPC Analysis (Cont…)
Transit Service Provided vs. Transit Service Demanded

2. Metro Transit (Minneapolis & St. Paul)

2. Metro Transit (Minneapolis & St. Paul)

Metro Transit Bus Service Improvement Plan.

=> **Productivity** (50%-existing population, existing employment, job concentration….)

=> **Social equity (**25%-low-wage jobs, service to low-income and minority population, disabled person, 0-car household**)**

=> **System connectivity** (25%-new population served, key destinations served, connecting routes, educational institutions, off-peak and span of service)

http://www.metrotransit.org/sip

2. Metro Transit (Cont…)

| Route Number	Route Type	Productivity			
		Population	Employment	Job Conc. Areas	PPISH
2	Urban Core	High	Medium	High	High
3	Urban Core	Medium	High	High	Medium
3	Urban Core	Medium	High	High	Low
3	Urban Core	Medium	Medium	Medium	High
4	Urban Core	High	Medium	Medium	High

Equity					
Sudsidy	Intersection Density	Low Wage Jobs	Low Income Pop.	Pop. People of Color	Disabled Pop.
High	High	Medium	High	High	Medium
High	High	High	High	Medium	Medium
Low	Medium	High	High	High	Medium
High	High	Medium	High	High	Medium
High	High	High	Medium	Low	Low

Connectivity						Overall Score
Car Availability	New Pop. Served	Key Destinations	Ed. Institutions	Connecting Routes	Off-Peak	
High	-	High	Medium	High	Medium	High
High	-	High	High	High	Medium	High
High	-	High	High	High	Medium	Medium
High	-	Medium	Low	High	Medium	High
Low	-	High	High	High	Medium	High

2. Metro Transit (Cont….)
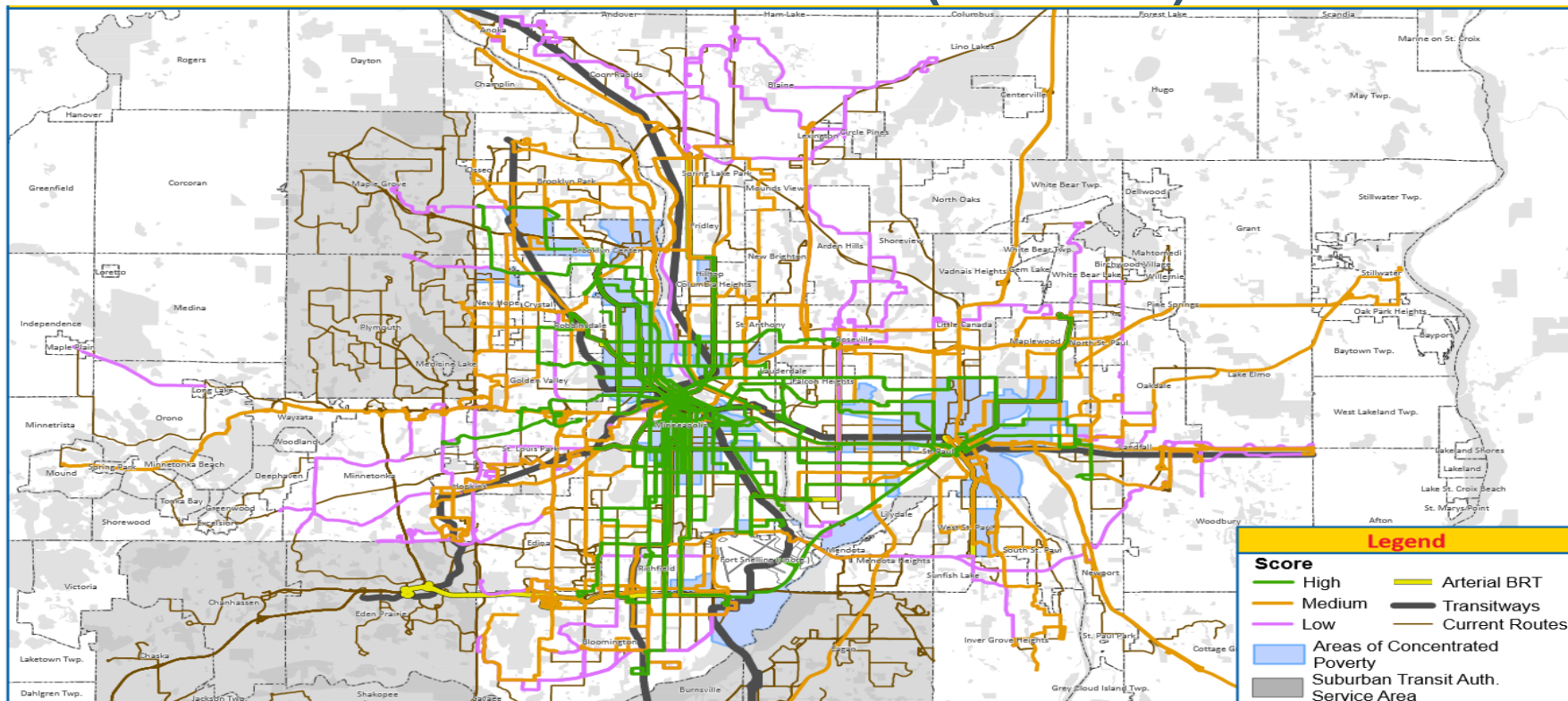
2. Metro Transit (Cont….)

3. Portland-Equity Analysis of Bicycle Plan

https://www.portlandoregon.gov/transportation/article/264747
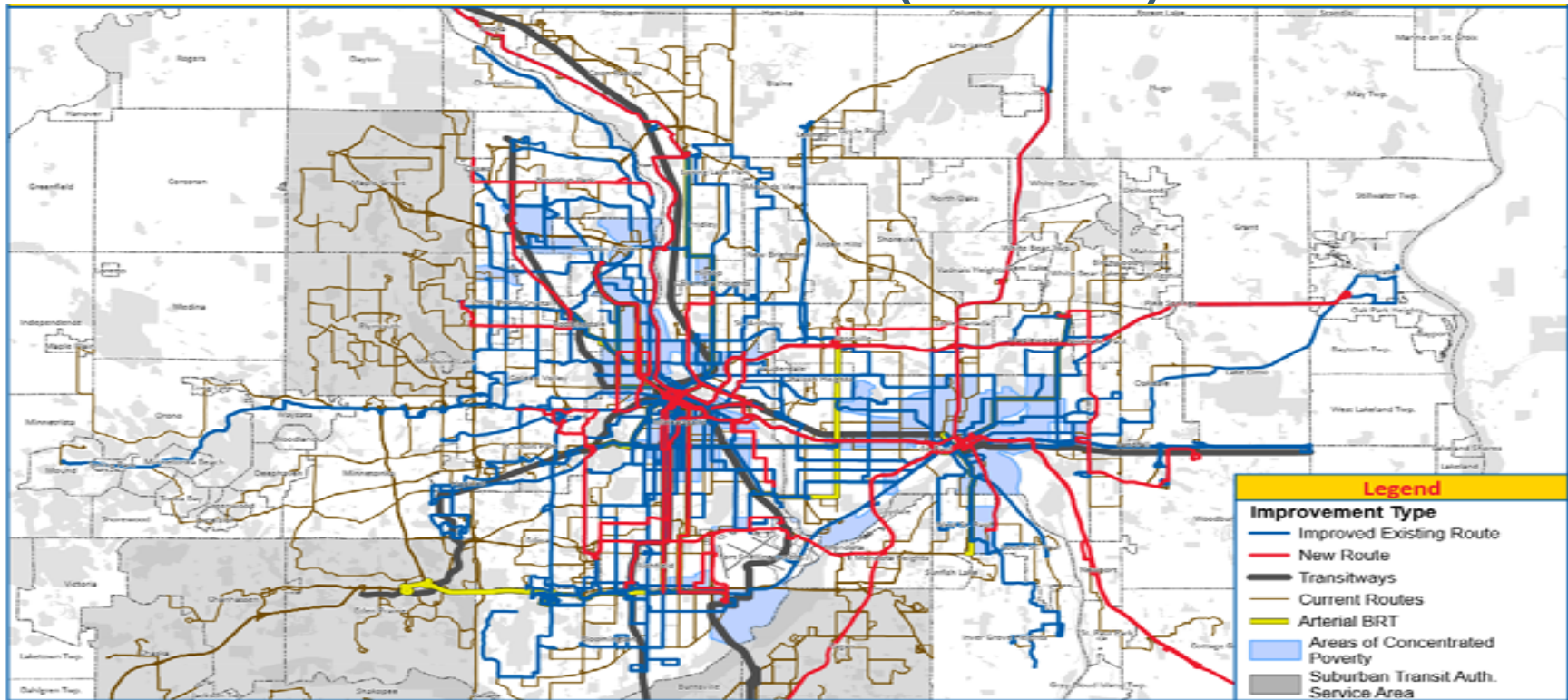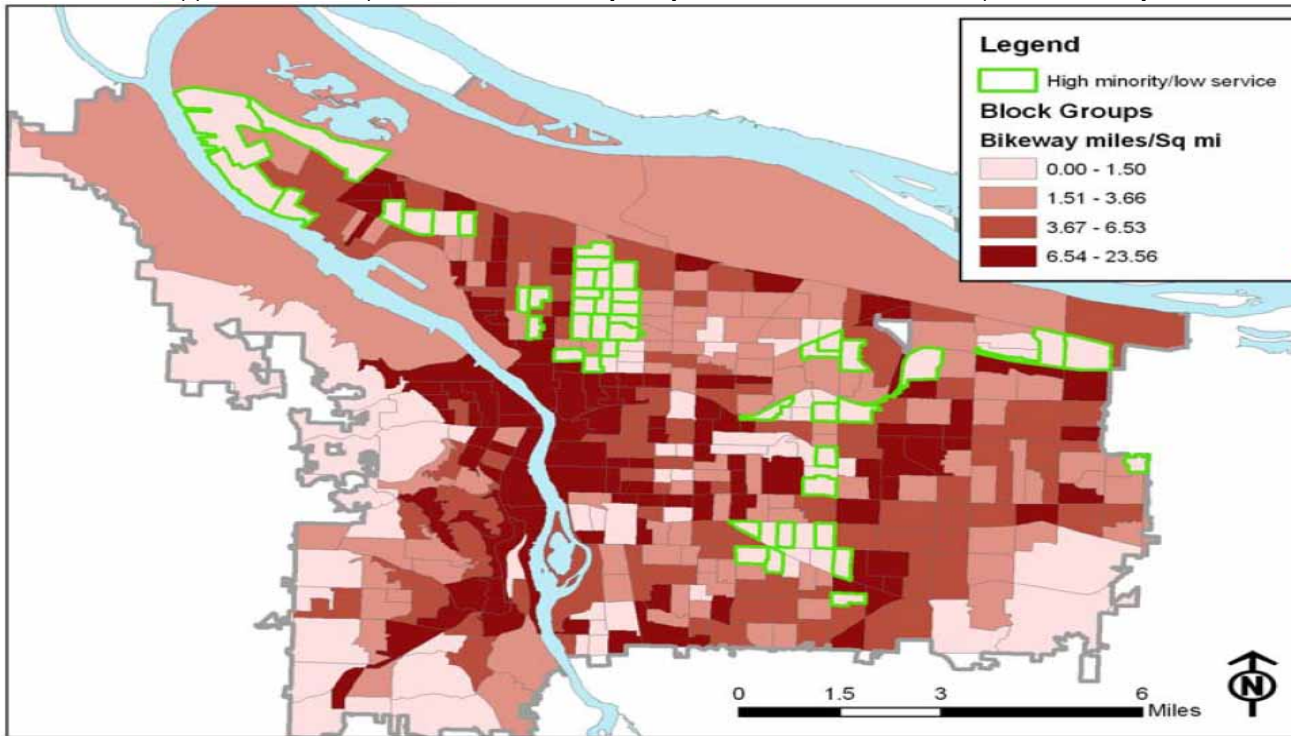
3. Portland-Equity Analysis (Cont..)

Where high poverty/low-income people live & bikeway miles/sq.mile
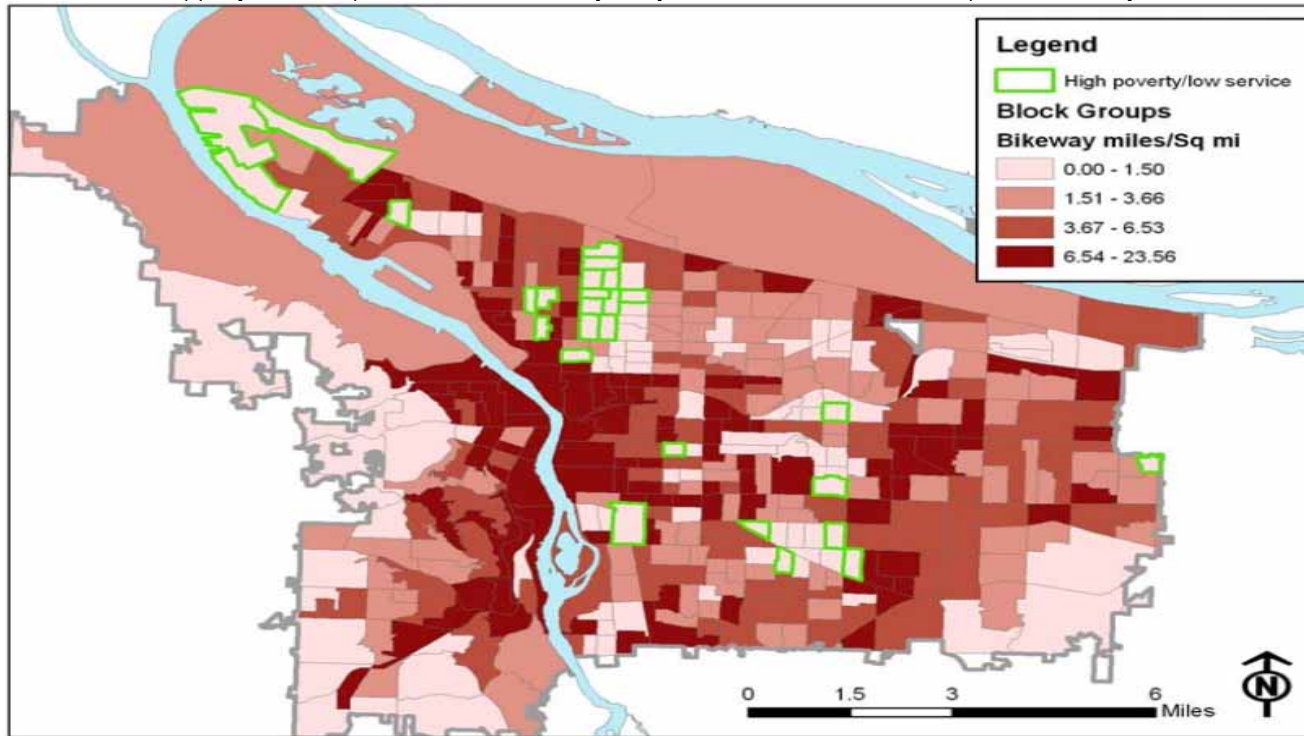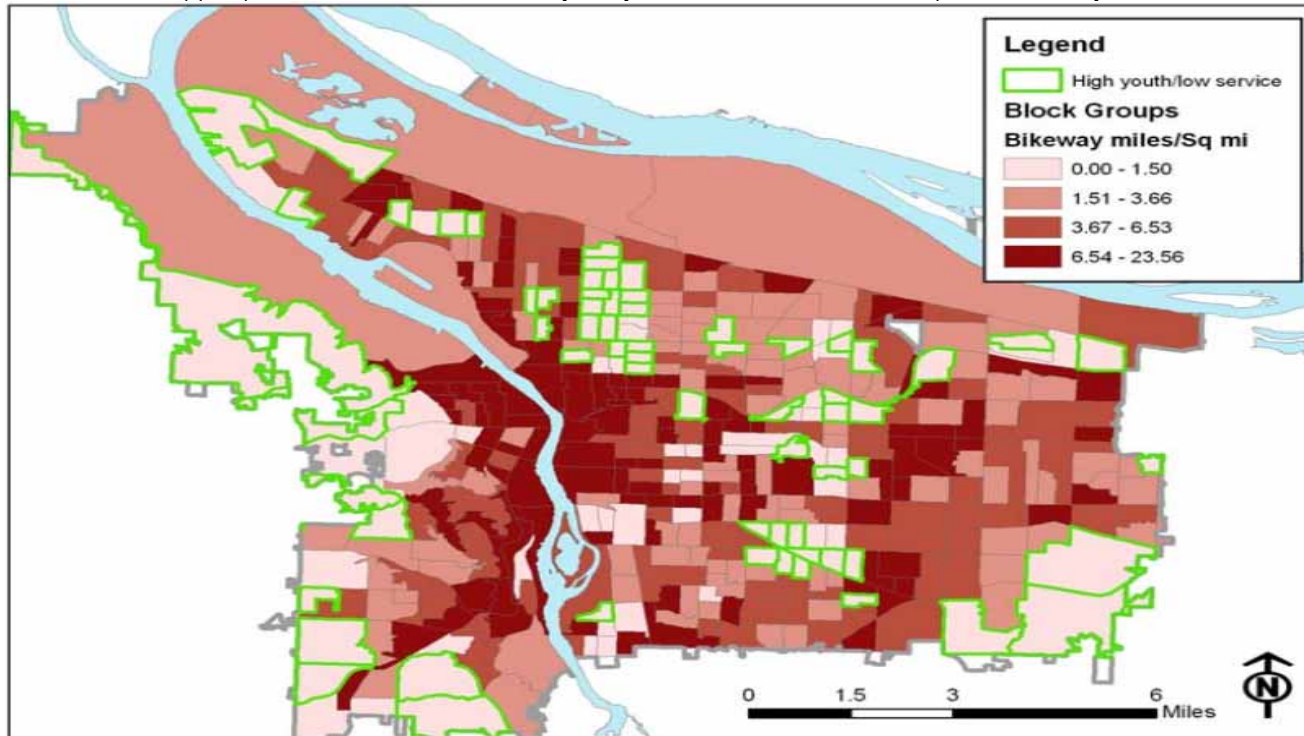
3. Portland-Equity Analysis (Cont..)

Where high minority/low-income people live & bikeway miles/sq.mile

3. Portland-Equity Analysis (Cont..)

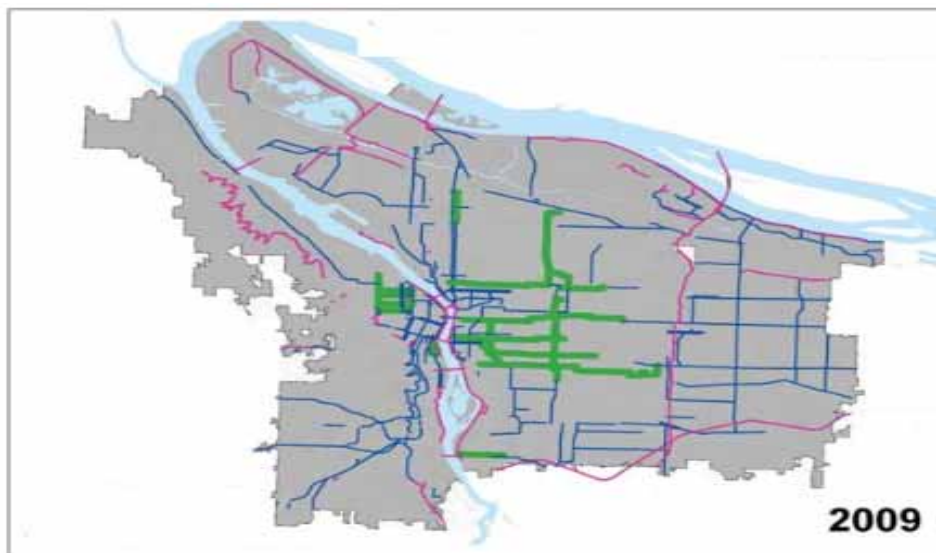Where high youth/low-income people live & bikeway miles/sq.mile

3. Portland-Equity Analysis (Cont..)

Where high elderly/low-income people live & bikeway miles/sq.mile

3. Portland-Equity Analysis of Bicycle Plan

Portland's Bikeway Network

LEGEND
- Off-Street Trails
- Greenways
- Separated In-Roadway
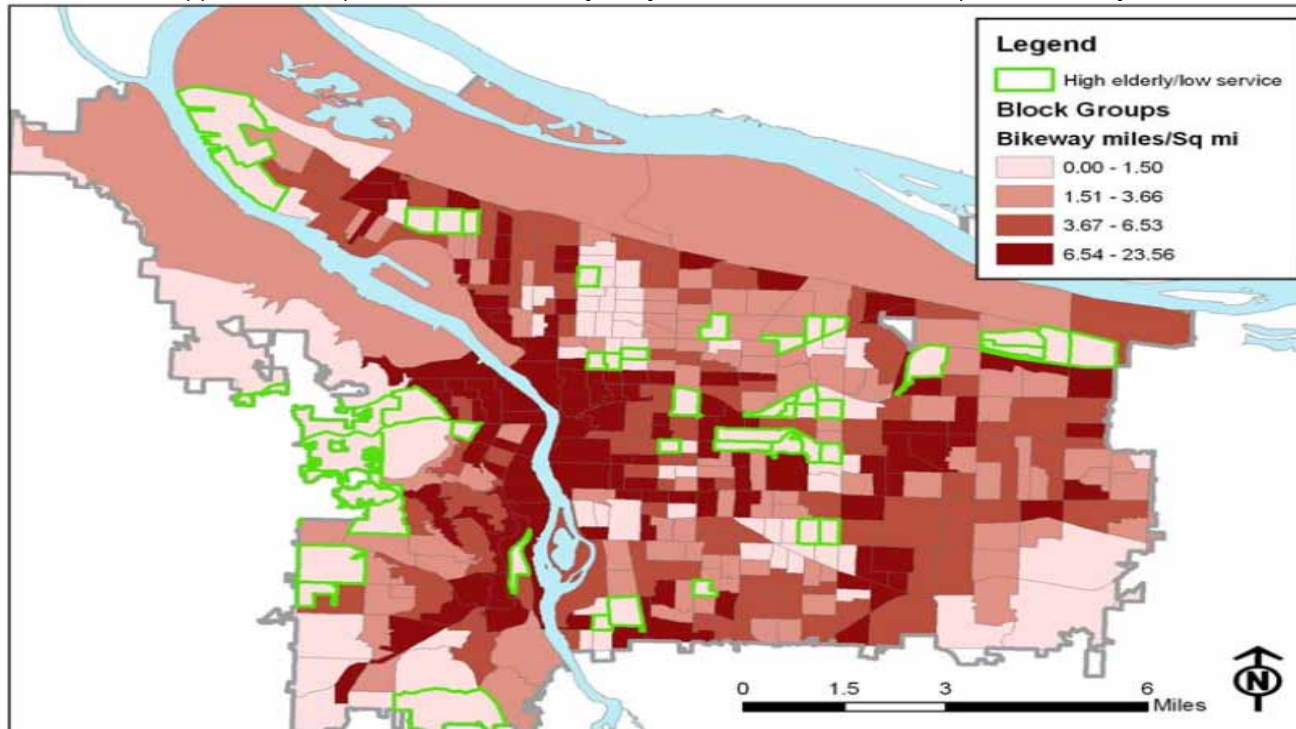
2009

In Planning

283 Built Bikeway Miles in 2009

430 Existing, Funded and In-Planning Bikeway Miles

4. Denver Regional Equity Atlas

- Uses GTFS, ACS 2007-2011 and LEHD Data
- The users can create maps showing the region's major origins and destinations in relation to the current and future transit network.
- It generates reports on demographic and economic data.
- The Atlas emphasizes the accessibility to region's economically disadvantaged residents.
- The future transit network shows connection to jobs, healthcare providers, schools, grocery stores, parks and other essential destinations.

http://www.denverregionalequityatlas.org/
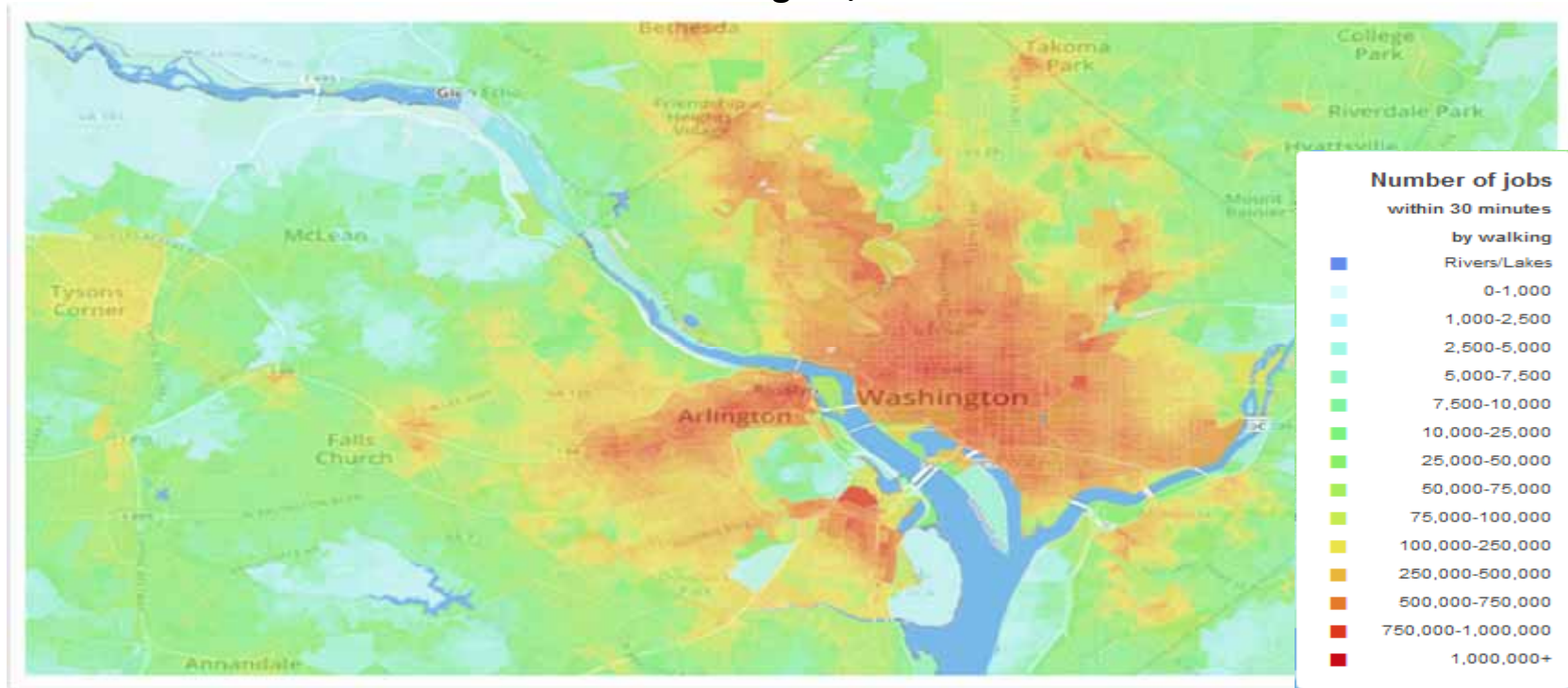
4. Denver Regional Equity Atlas(Cont…)

5. Accessibility Observatory - UMN Study

- Accessibility calculations are performed for every <u>block</u> in a given metropolitan area

- Pedestrian network from <u>OpenStreetMap</u>.org

- Transit Schedule – <u>GTFS</u>

- Labor and Employment - <u>LEHD</u>

- Travel time calculations performed by <u>OpenTripPlanner</u>.org using <u>access, transfer, wait and In-vehicle times</u>.

http://access.umn.edu/

5. Accessibility Observatory-UMN (Cont...)

Number of Jobs within 30 minutes – Washington, D.C.

Legend:
Number of jobs within 30 minutes by walking
- Rivers/Lakes
- 0-1,000
- 1,000-2,500
- 2,500-5,000
- 5,000-7,500
- 7,500-10,000
- 10,000-25,000
- 25,000-50,000
- 50,000-75,000
- 75,000-100,000
- 100,000-250,000
- 250,000-500,000
- 500,000-750,000
- 750,000-1,000,000
- 1,000,000+

6. EPA's Smart Location Mapping

- EPA's Smart Location Database (SLD) is a nationwide geographic data resource for measuring location efficiency of various places.

- Data sources used to develop SLD:
  - TIGER
  - 2010 Census; ACS; LEHD
  - HERE
  - Protected Areas Database of the United States (PAD-US)
  - TOD Database
  - GTFS

- It includes more than 90 attributes – residential and employment density, land use diversity, access to destinations, and distance to transit.

- SLD can be downloaded for the entire nation or for a single state, metro region, or locality.

http://www.epa.gov/smartgrowth/smartlocationdatabase.htm#SLD

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6. EPA's Smart Location Mapping(Cont..)

⊞ ☐! Housing units per acre
⊞ ☐ People per acre
⊞ ☐ Jobs per acre
⊞ ☐ Activity density (housing + jobs per acre)
⊞ ☐ Jobs per household
⊞ ☐ Workers per job equilibrium index
⊞ ☐ Land use diversity
⊞ ☐ Total road network density
⊞ ☐! High-speed road network density
⊞ ☐! Street intersection density
⊞ ☐! Distance to transit (meters)
⊞ ☐ Percentage of jobs within 0.25 miles of fixed-guideway transit
⊞ ☐ Percentage of jobs within 0.5 miles of fixed-guideway transit
⊞ ☐! Transit service frequency

⊞ ☐! Jobs within a 45 min. transit ride (weighted)
⊞ ☐! Jobs within a 45 min. drive (weighted)
⊞ ☐! Working-age population within a 45 min. transit ride (weighted)
⊞ ☐! Working-age population within a 45 min. drive (weighted)
⊞ ☐! Accessibility index - Transit to jobs
⊞ ☐ Accessibility index - Auto to jobs
⊞ ☐ Accessibility Index - Transit to working-age population
⊞ ☐! Accessibility Index - Auto to working-age population
⊞ ☐! Total employment
⊞ ☐ Low income workers (home location)
⊞ ☐ Low income workers (workplace location)
⊞ ☐! Percent low income workers (home location)
⊞ ☐! Percent low income workers (workplace location)
⊞ ☐! Zero car households

6. EPA's Smart Location Mapping(Cont..)
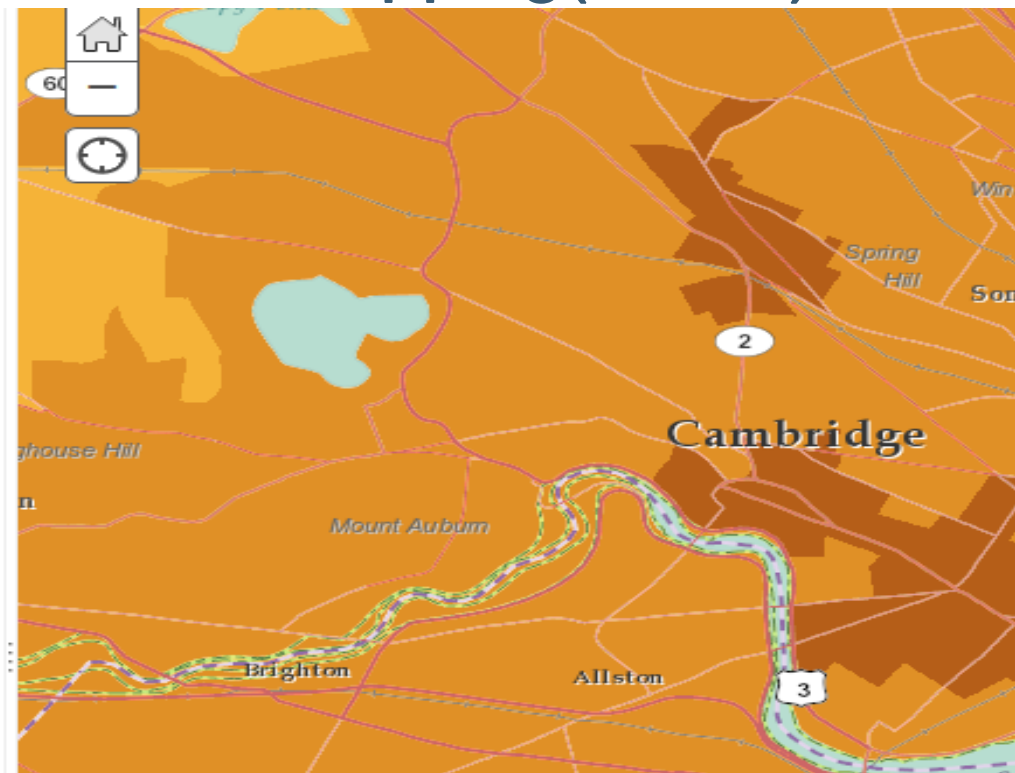
7. Transit Needs Gap Analysis

This paper presents an approaches that measure the geographical distribution of transport needs and compares this with the distribution of public transport service availability/quality

Graham Currie

Monash University, Australia

TRR#1895, 2004

7. Transit Needs Gap Analysis(Cont..)

Need Indicator – Person Type
▶ Adults without cars
▶ Persons Aged 60+
▶ Adults on Low Income
▶ Adults in the Labor Force
▶ Students
▶ Persons on Disability Pensions

Trip Purpose Destinations Used
▶ CBD – Hobart CBD
▶ Pools – public swimming pools
▶ Shops – major groups of shops
▶ Universities – major tertiary education facilities
▶ Sports – key recreational sporting facilities
▶ Pharmacy – chemists
▶ Regional – larger regional shopping centers
▶ Employers – larger scale employers main location
▶ Schools – major primary and secondary schools
▶ Hospitals – major clinics and hospital sites
▶ Food Stores – convenience shopping/ local stores
▶ Cinema – movie houses
▶ Child Care – site for a child care center or crèche
▶ Doctors – individual surgeries or clinics

7. Transit Needs Gap Analysis(Cont..)

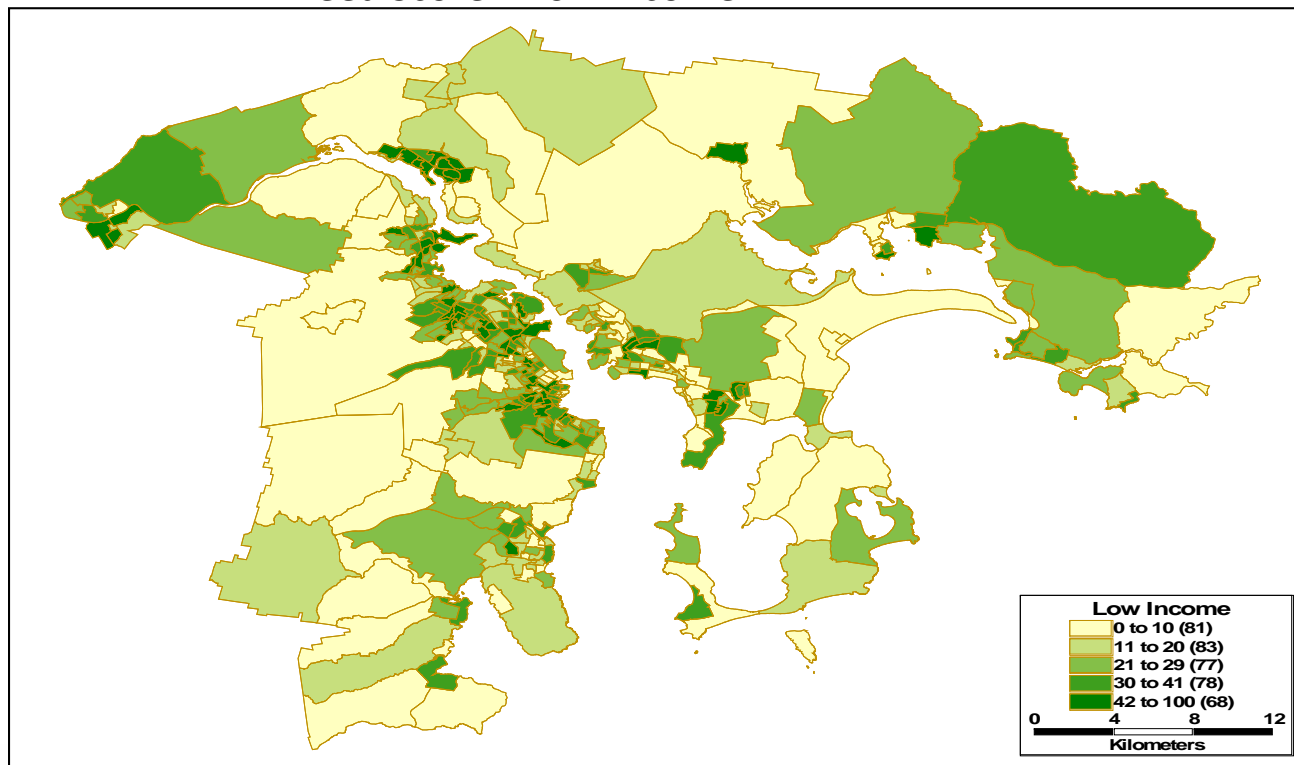| Supply Modeling	Element of Travel	Assumptions

▸ TransCAD Modelling System
 	
▸ Each Route coded for 5 time periods:
  – A.M. peak
  – Interpeak
  – Evening
  – Saturday
  – Sunday
	Walk Access/ Egress Time	• Measured between residential zone centroid and stop or from a stop to the facility destination.
		• Walking is made along the streets of Hobart rather than as the crow flies
		• A walking speed of 4.32 kph is used. A weighting of 2 was applied to walking time to model passenger perceptions of walk quality

	Fare	• Based on an analysis of revenue and boarding data from the Hobart ticketing system. Included an average fare for travel between zones including higher fares for Hobart coaches routes and also consideration of concession fares for particular passenger groups
	Wait Time	• Based on half the effective headway of routes operating between on and off stops. Headways based on an analysis of bus schedules. • A weighting of 2.0 was applied to wait time to model passenger perceptions of waiting.
	Value of Time	• Time was valued at $8.69/hour (or 14.48c per minute) based on values used elsewhere in the transit planning industry
	Transfer Time	• A transfer penalty of 20 minutes was added to the time of those transferring between bus routes

7. Transit Needs Gap Analysis(Cont..)

⇒ **Transit Service =** Calculated generalized costs by area to each of the 14 trip purposes, considering walk time, fare, wait time, value of time and transfer time.

⇒ **Transit Needs =** (0.22*adults without cars) +(0.17*Accessibility) +(0.16*Persons aged over 60 years) +(0.14*Persons on a disability pension) +(0.11*Adults on a low income) +(0.10*Adults not in the labor force) +(0.10*Students)

7. Transit Needs Gap Analysis(Cont..)

Need Score – Low Income

Low Income
- 0 to 10 (81)
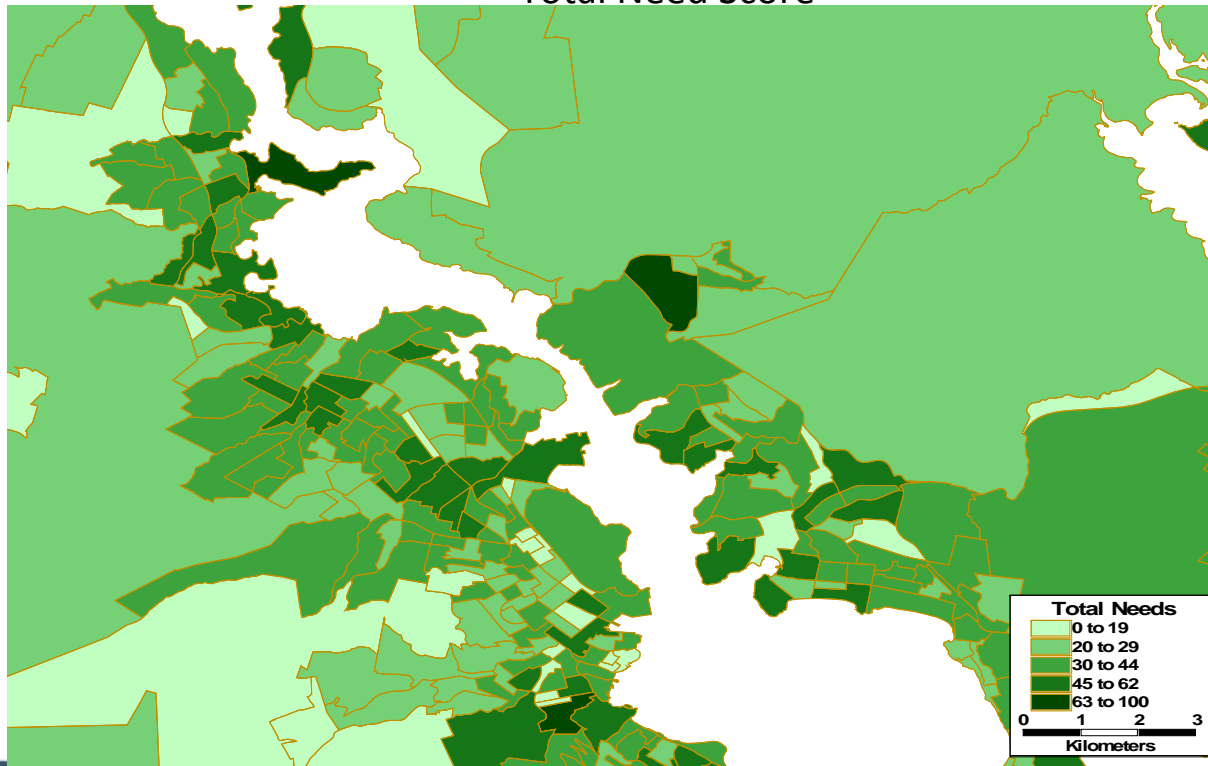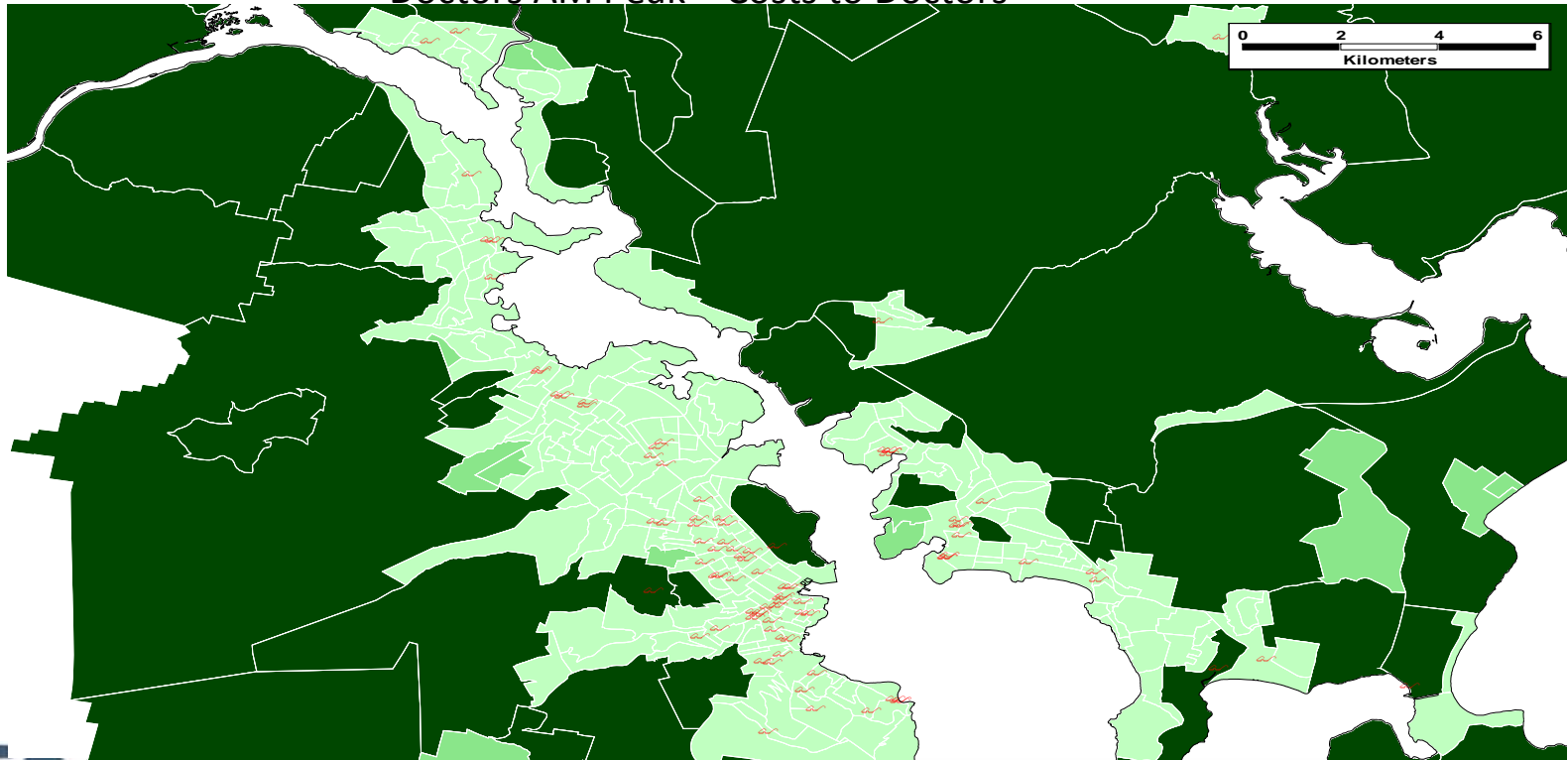- 11 to 20 (83)
- 21 to 29 (77)
- 30 to 41 (78)
- 42 to 100 (68)

0   4   8   12
Kilometers

7. Transit Needs Gap Analysis(Cont..)

Need Score – Age 60+

Aged (60+)
- 0 to 11 (84)
- 12 to 18 (86)
- 19 to 23 (66)
- 24 to 32 (75)
- 33 to 100 (76)

0   4   8   12
Kilometers
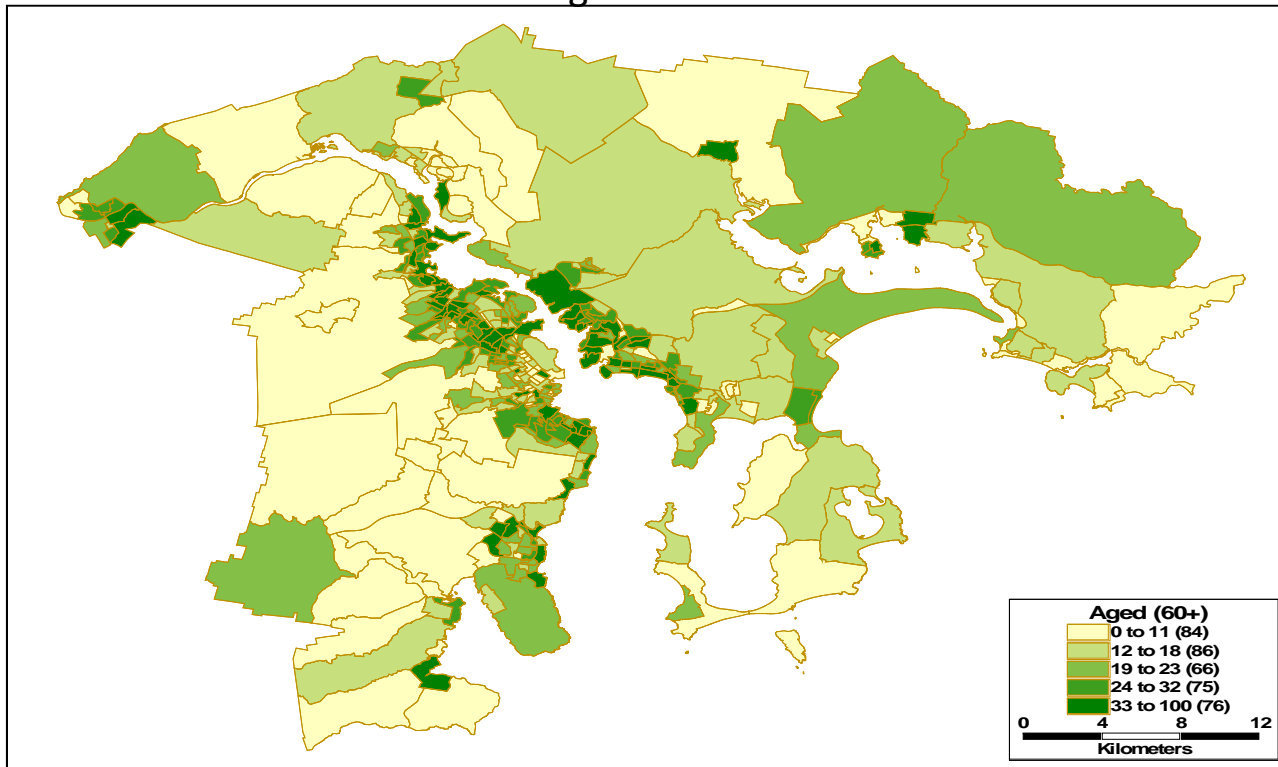
7. Transit Needs Gap Analysis(Cont..)

Total Need Score

Transit Needs =
(0.22*adults without cars)
+(0.17*Accessibility)
+(0.16*Persons aged over
60 years) +(0.14*Persons
on a disability pension)
+(0.11*Adults on a low
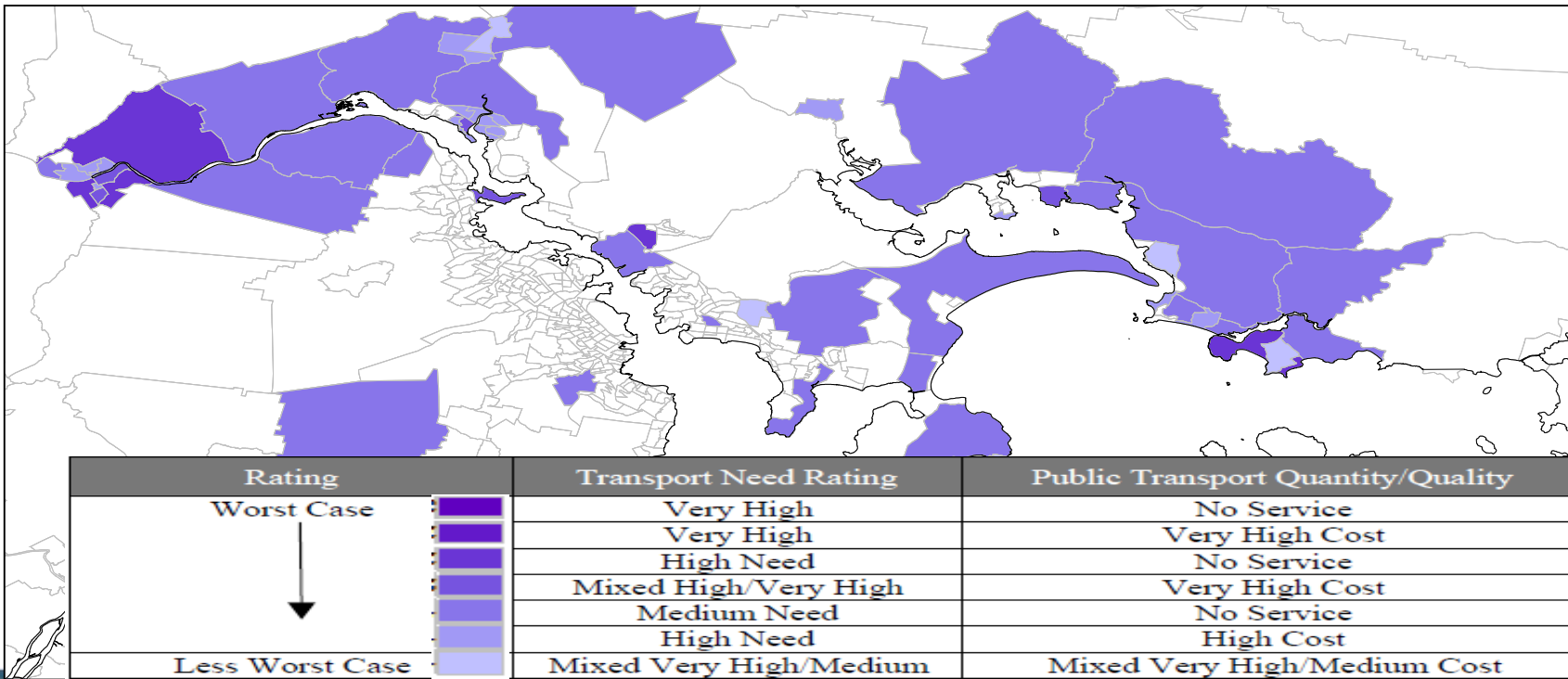income)
+(0.10*Adults not in the
labor force)
+(0.10*Students)

Total Needs
0 to 19
20 to 29
30 to 44
45 to 62
63 to 100

0   1   2   3
Kilometers

7. Transit Needs Gap Analysis(Cont..)
Doctors AM Peak – Costs to Doctors

7. Transit Needs Gap Analysis(Cont..)
AM Peak High Priority Need Gaps

Rating	Transport Need Rating	Public Transport Quantity/Quality
Worst Case	Very High	No Service
	Very High	Very High Cost
	High Need	No Service
	Mixed High/Very High	Very High Cost
	Medium Need	No Service
	High Need	High Cost
Less Worst Case	Mixed Very High/Medium	Mixed Very High/Medium Cost

Data for Connectivity + Accessibility Analysis

- Census
  - TIGER/Line; Census 2010; American Community Survey; Longitudinal Employment-Household Dynamics (LEHD)
- Local Data
  - Household Survey; Employment Data
- HERE Data
- EPA Smart Location Database
- Protected Area Database of US (PAD-US)
- TOD Database
- General Transit Feed Specification (GTFS)
- OpenStreetMap
- Local Transit network
- Google Places
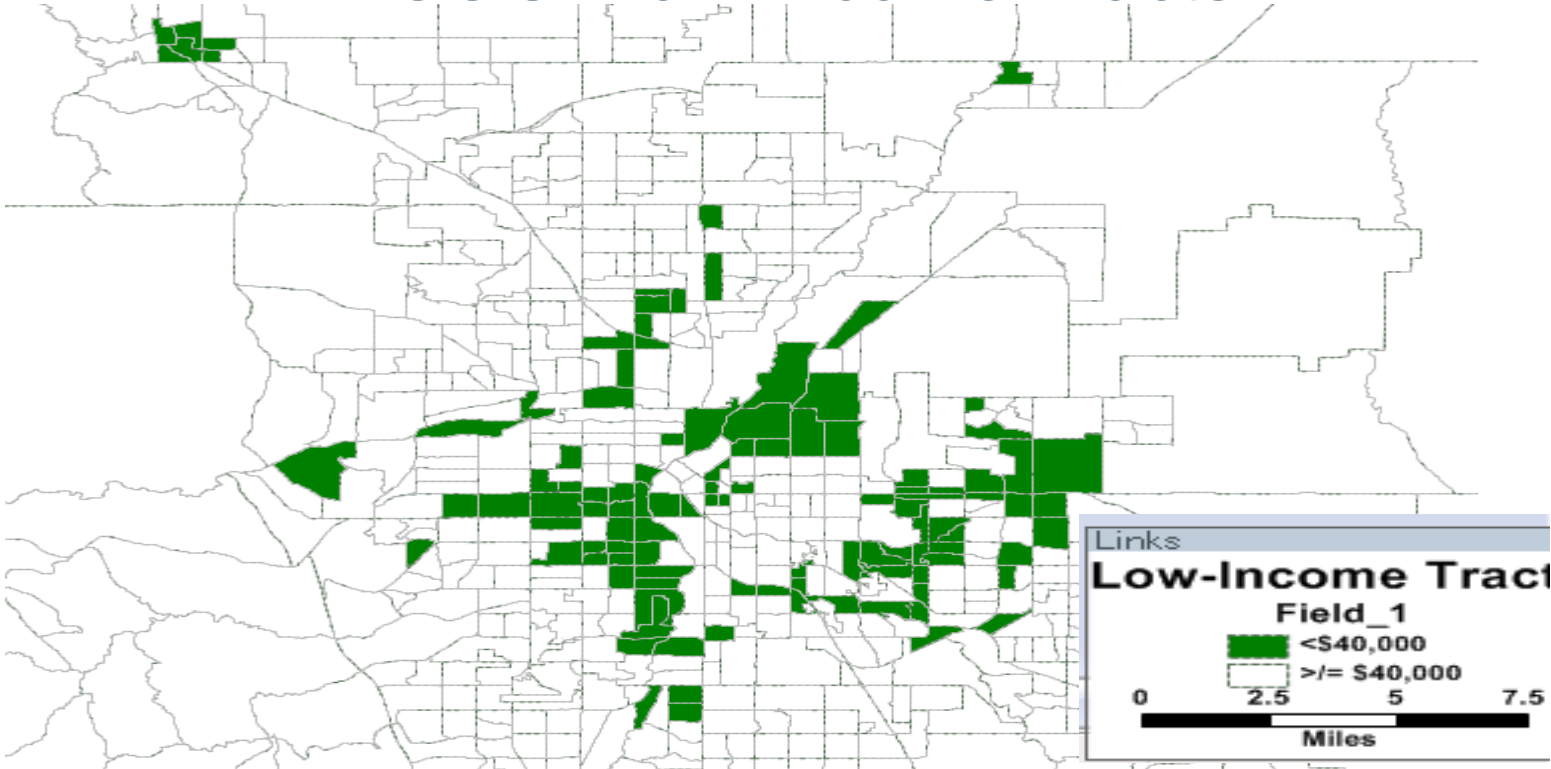
Federal Transit
Administration

www.fta.dot.gov

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Denver Regional Council Of Governments (DRCOG) Analysis

Analysis Using Denver Area Data

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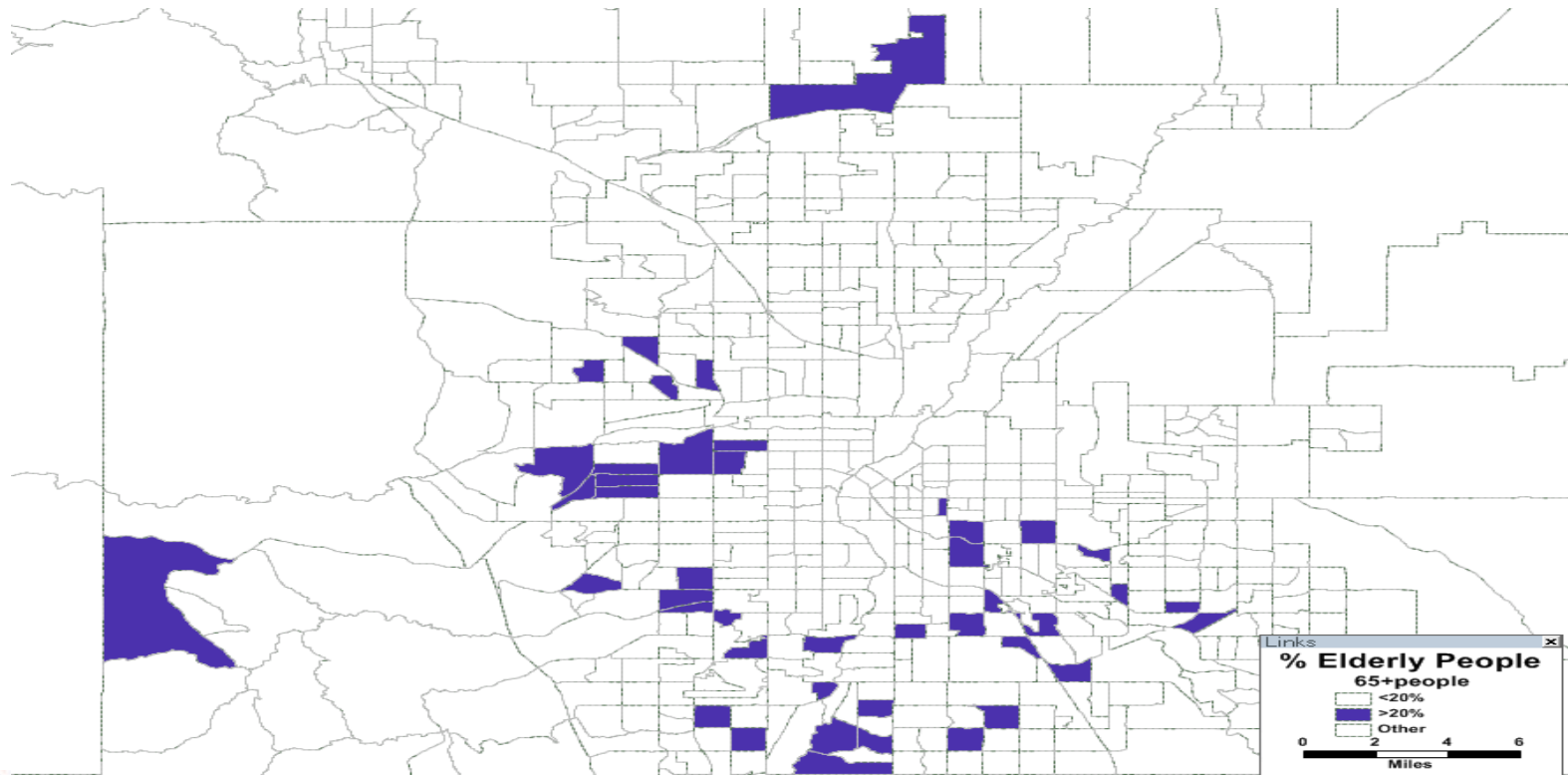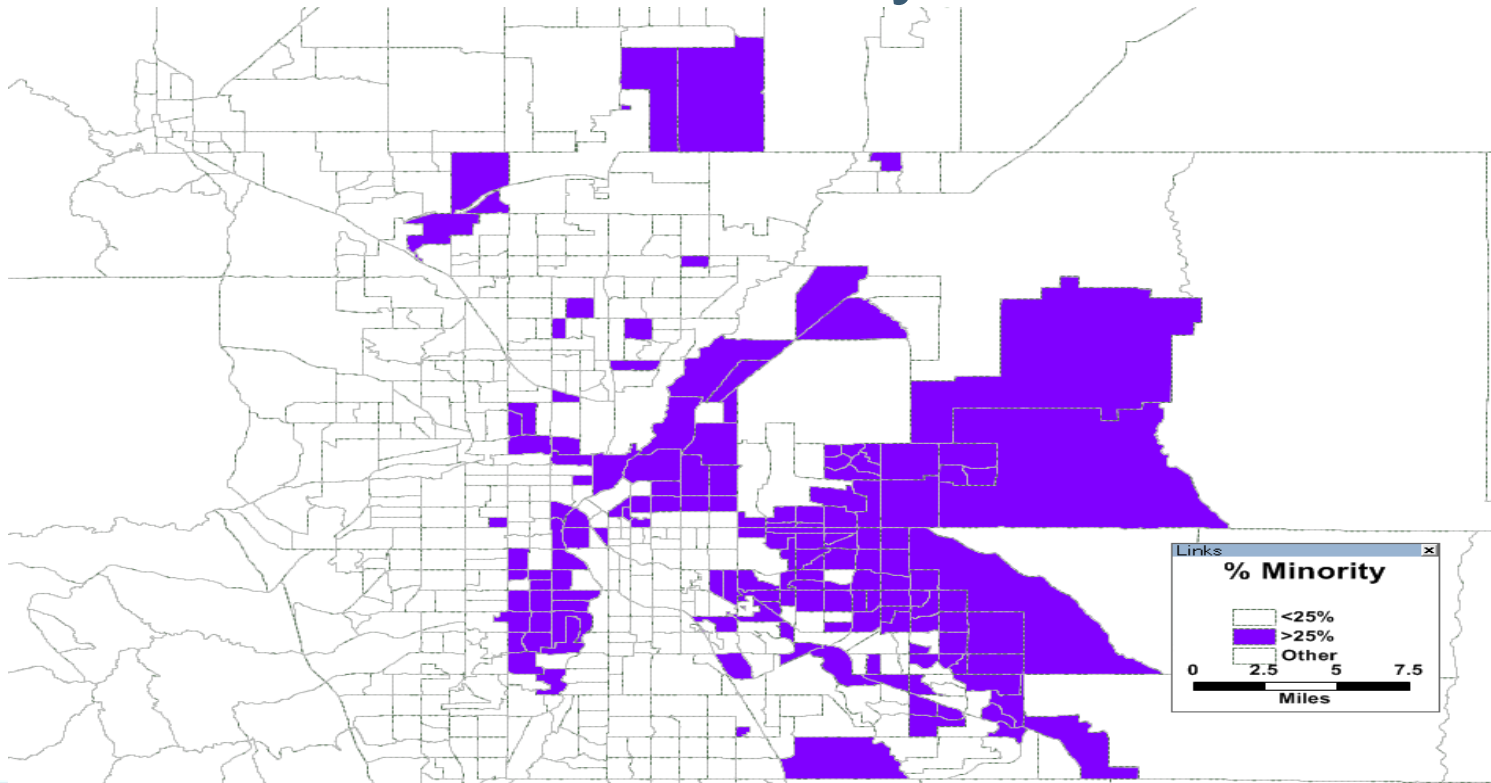
DRCOG: Low-Income Tracts

Links
Low-Income Tract
Field_1

■ <$40,000
□ >/= $40,000

0   2.5   5   7.5
Miles

DRCOG: 0-Car Household Tracts

Links ✕
Low-Income Tracts
% no-car HH
☐ < 10% 0-Car HH
■ > 10% 0-Car HH
☐ Other

0   2.5   5   7.5
Miles

DRCOG: Elderly Population Tracts

Links

% Elderly People
65+people

- <20%
- >20%
- Other

0   2   4   6
Miles

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42
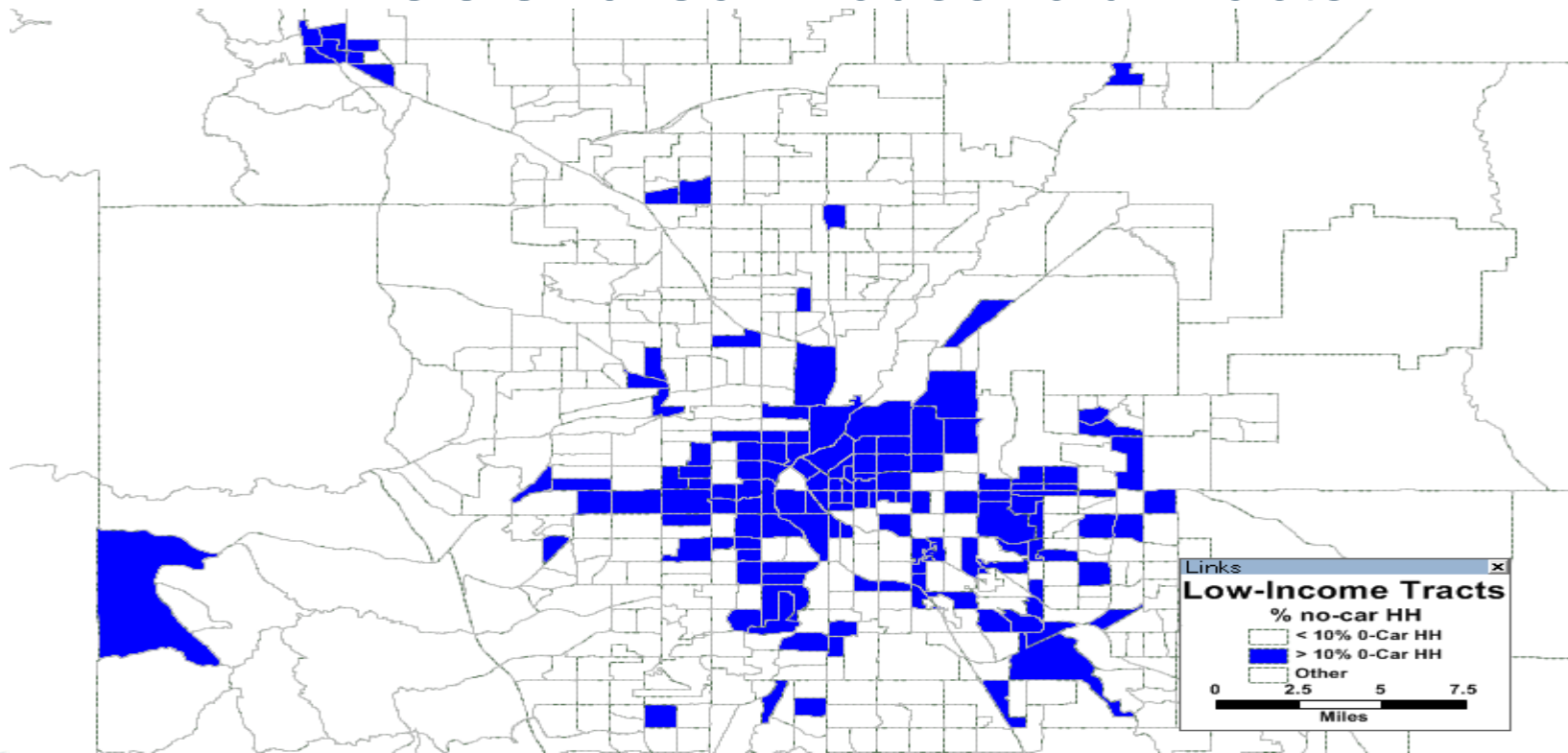
DRCOG: Minority Tracts

DRCOG: Transit Work Trips Share
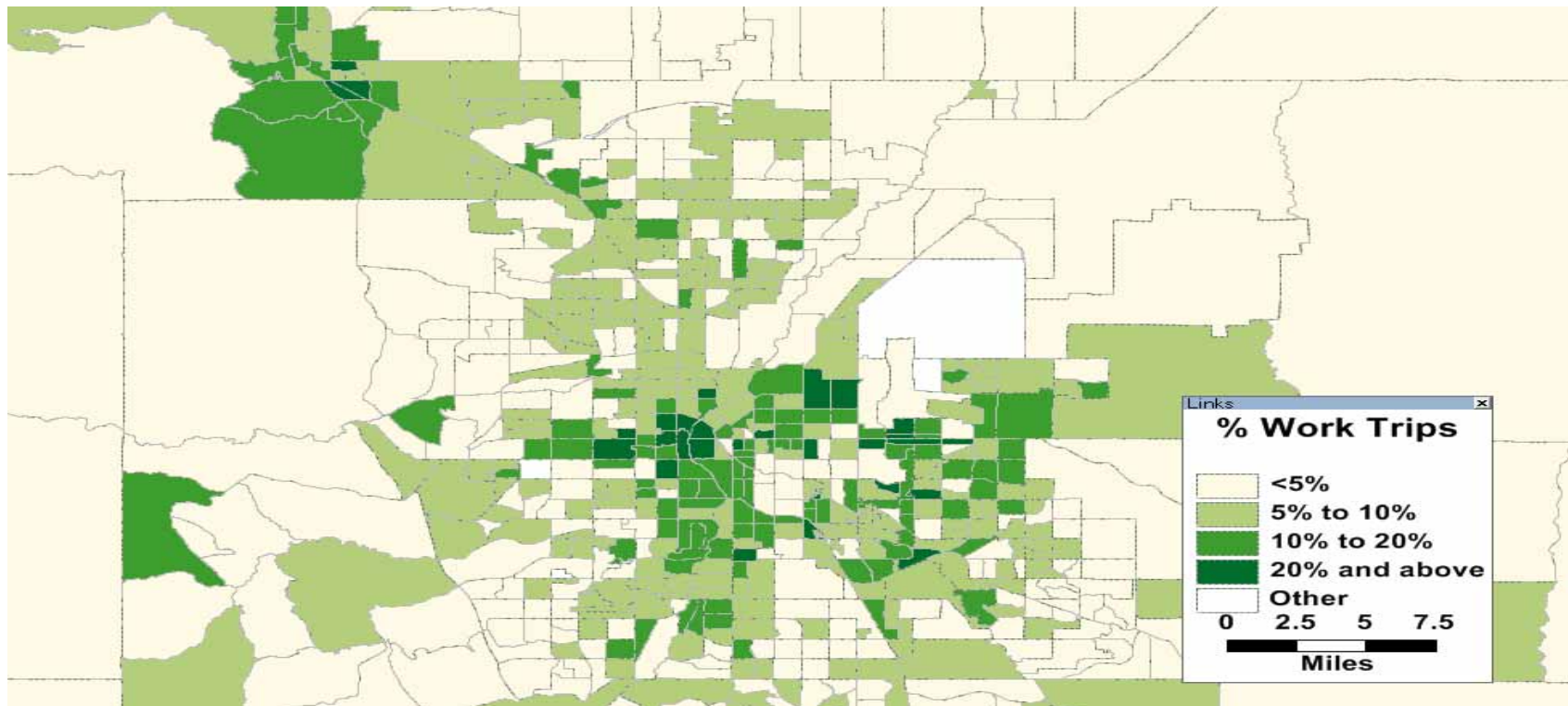
DRCOG: Jobs per Square Mile

Map of geoid
F1
- 0 to 377
- 378 to 1007
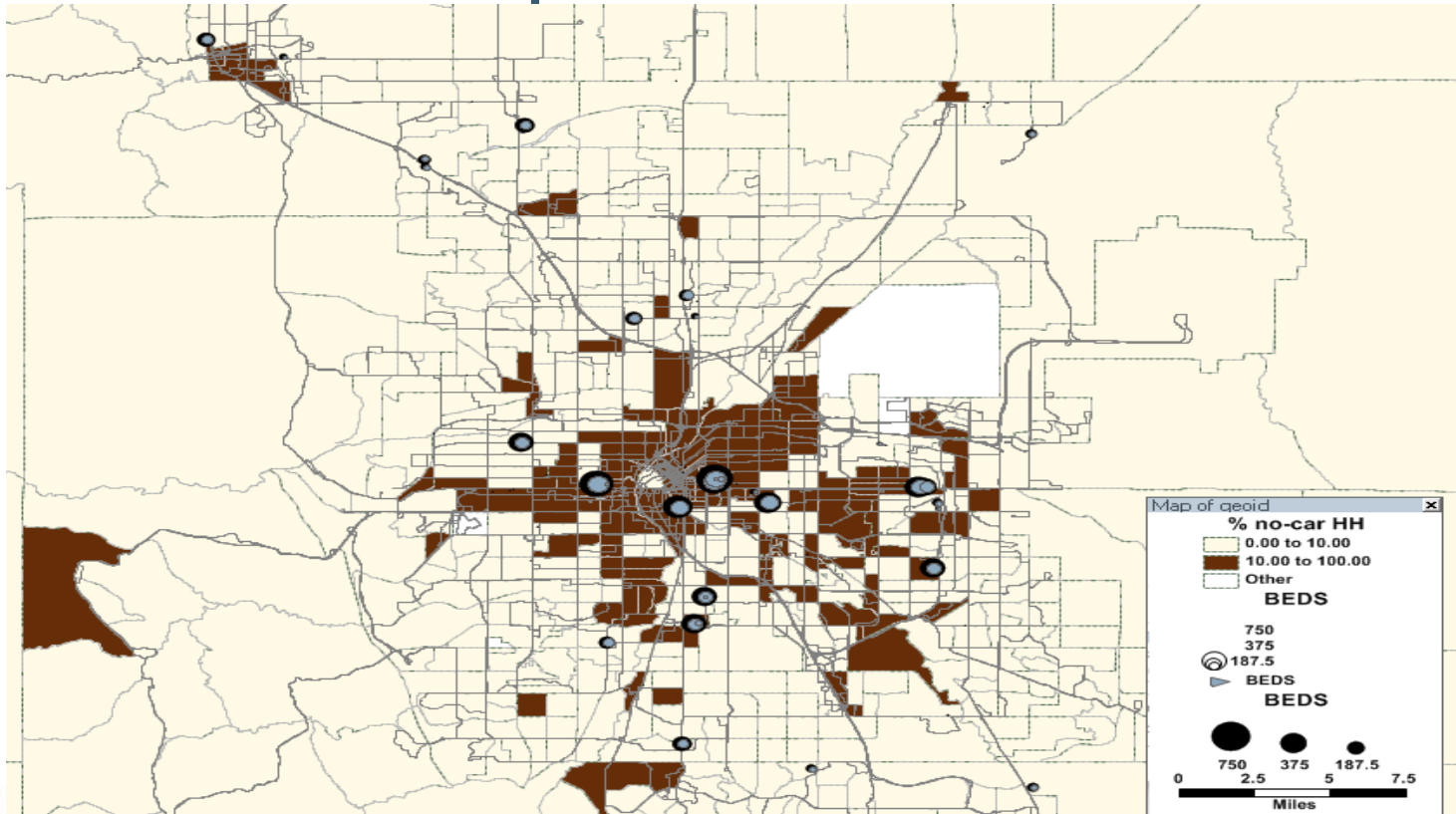- 1008 to 2041
- 2042 to 130874

0 3 6 9
Miles

DRCOG: Hospital Beds
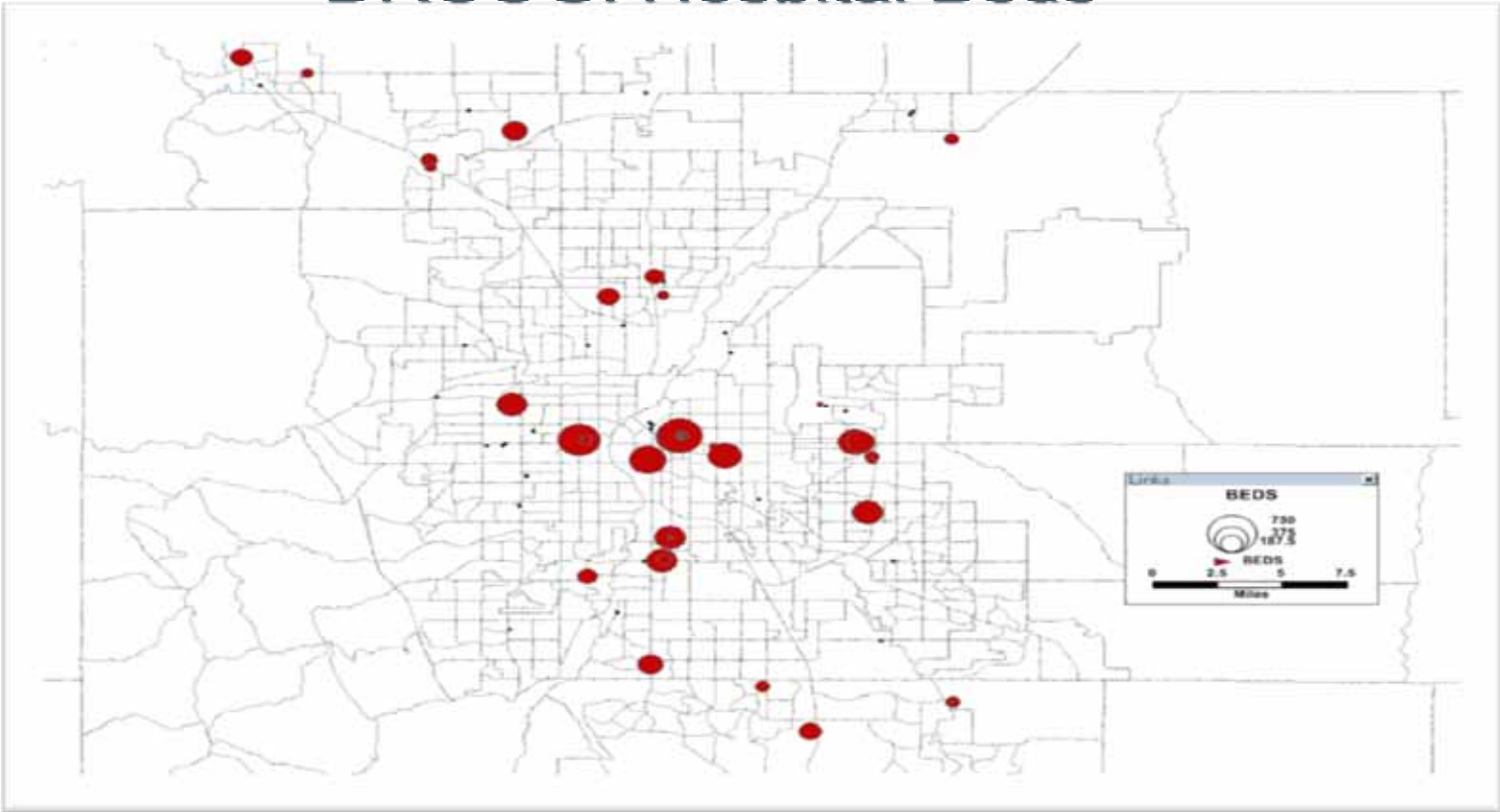
DRCOG: Hospitals + Elderly Population
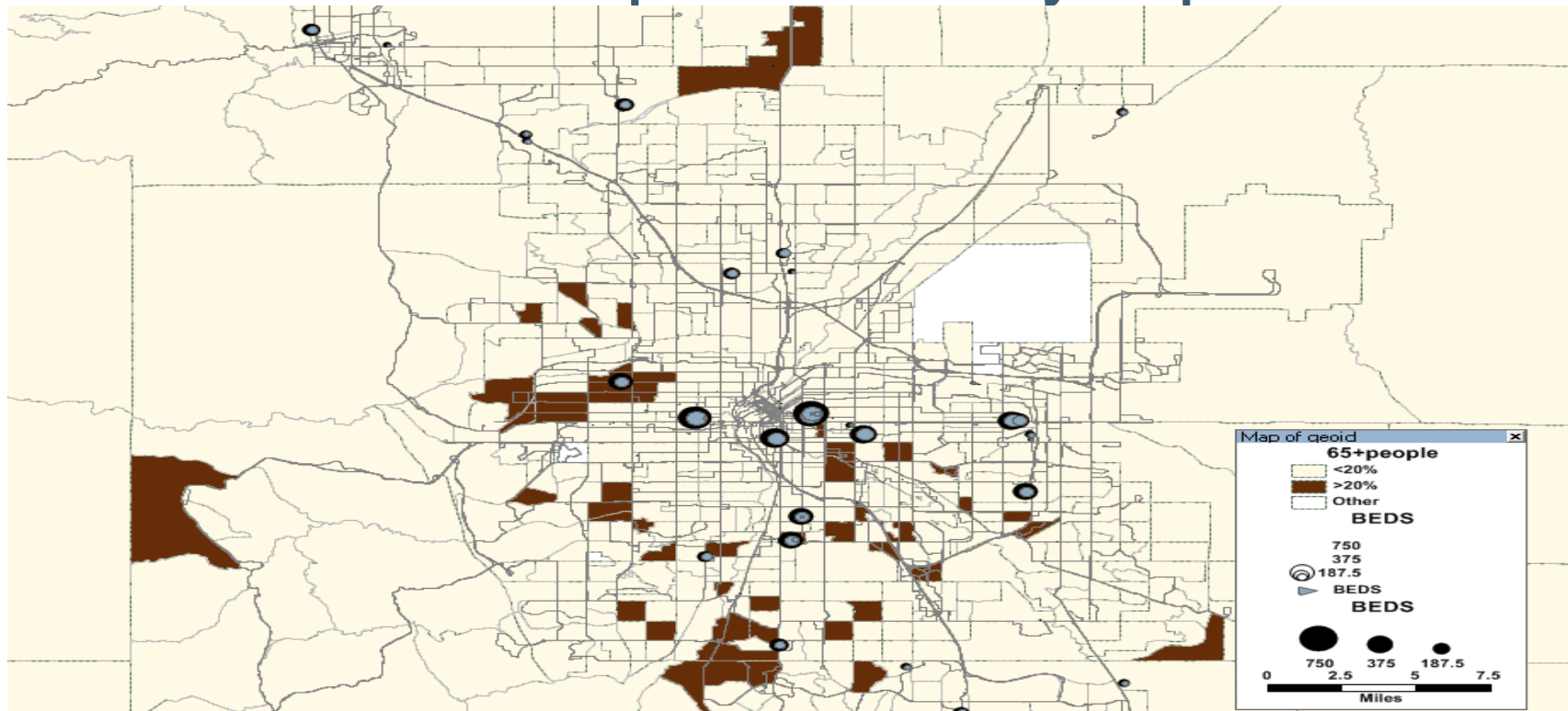
DRCOG: Hospitals + 0-Car Household

DRCOG: Schools + School-Age Population

School-Age Population in Census Tracts
- 0000 - 600
- 600 - 1000
- 1000 - 1500
- 1500 - 2300
- 2300 - 5000
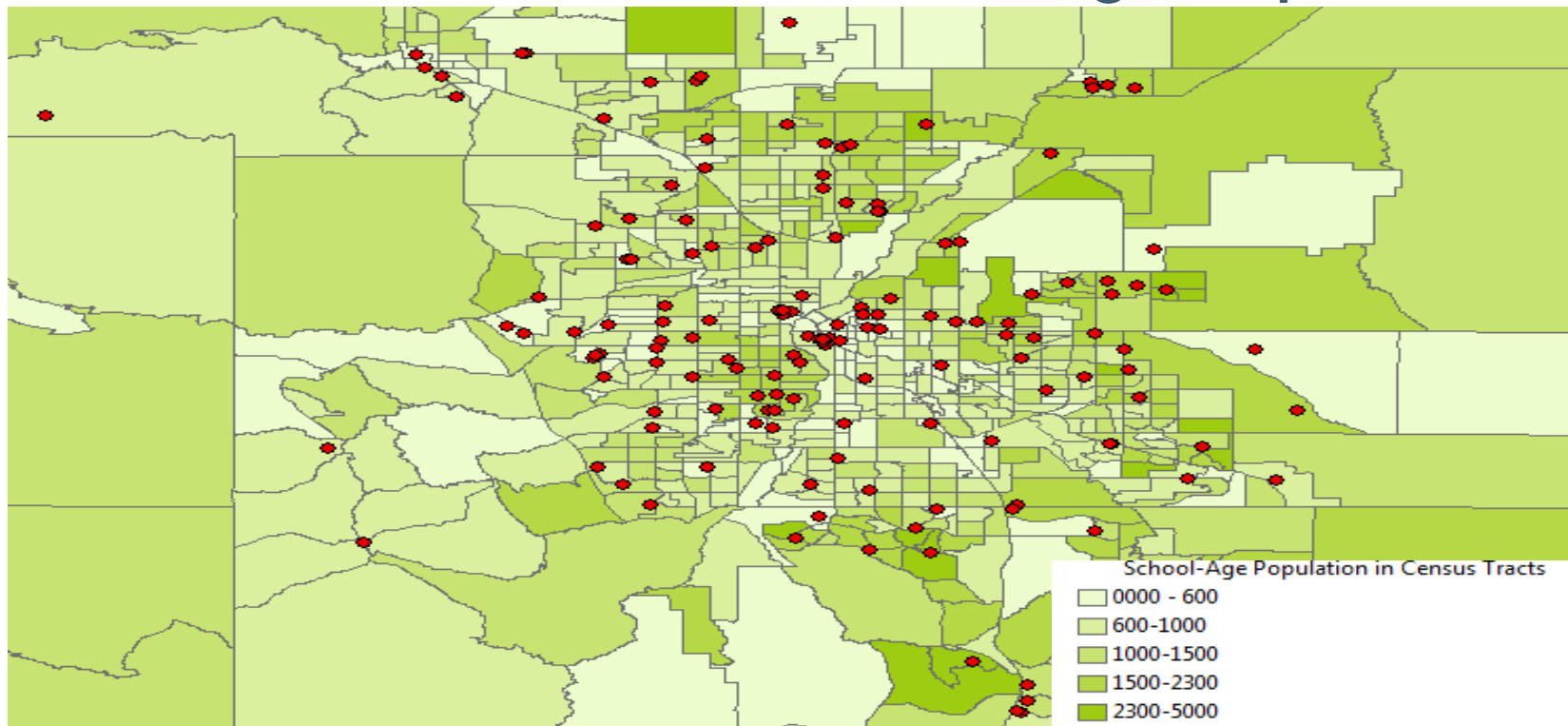
DRCOG: GTFS Network
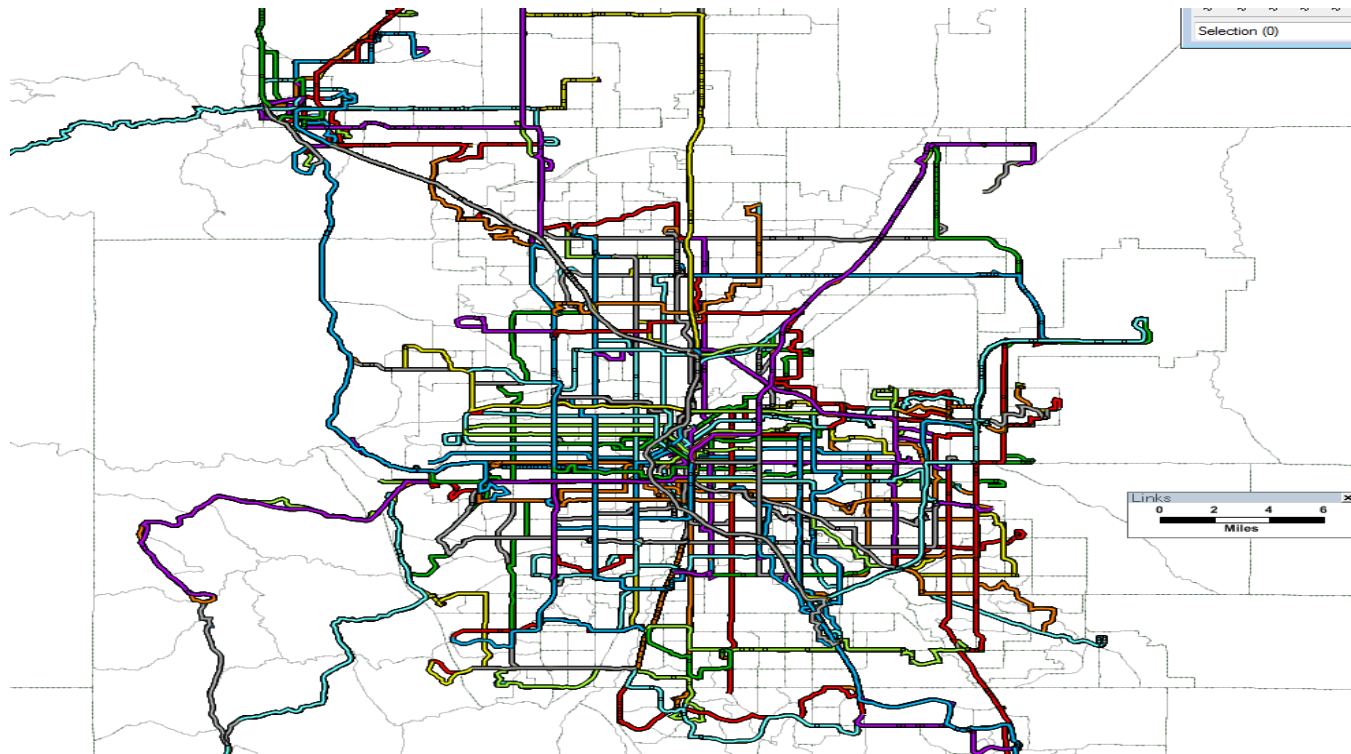
DRCOG: 0-Car Household + Transit Stops
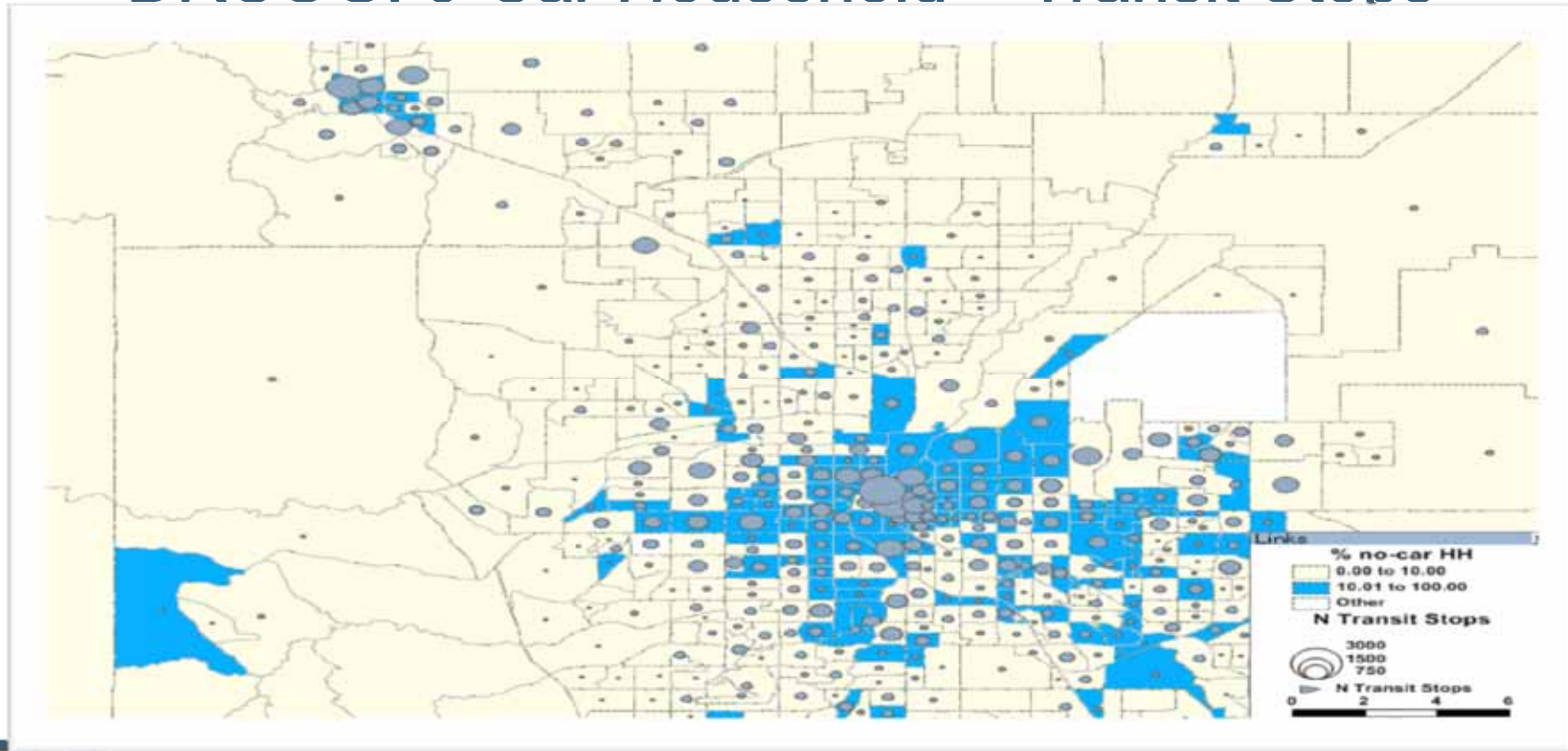
DRCOG: Elderly Population + Transit Stops