NEW TOOLS FOR INCORPORATING ACTIVE MODES IN COMMUNITY AND TRANSPORTATION PLANNING

April 14, 2015

RENAISSANCE
PLANNING

A Workshop Based on NCHRP Report 770: Estimating Bicycling and Walking for Planning and Project Development

RENAISSANCE
PLANNING

WORKSHOP TEAM

Rich Kuzmyak: Principal, Renaissance Planning

- NCHRP 770 project manager
- Transportation/land use modeling research & applications

John Bowman, PhD: Consultant

- NCHRP 770 team – Seattle tour-based model with Mark Bradley
- Advanced travel demand modeling expert

Alex Bell: Transportation Planner, Renaissance Planning

- NCHRP 770 team – Arlington GIS accessibility model
- Urban planner and GIS applications specialist

Whit Blanton, FAICP: Vice President, Renaissance Planning

- Community planning, visioning
- Multimodal transportation planning

WORKSHOP PURPOSE AND OBJECTIVES

- Address importance of Community Design on Active Transportation
  - Walking
  - Biking
  - Transit
- What are most important elements to consider?
  - Transportation facilities
  - Land use/built environment
  - Trip type (work, non-work) and traveler
- Role of planning tools
  - Supporting unconventional decisions
  - Identifying most cost-effective strategies

WHAT IS HEALTHY COMMUNITY DESIGN?

When getting exercise is a normal, pleasurable and transparent part of daily life

WHAT FACTORS MAKE FOR HEALTHY COMMUNITY DESIGN?

- **Compact design**: densities that bring activities closer together
- **Mix of uses**: residential, employment, retail/service, recreation/green space
- **Pedestrian/bike friendly**:
  - Local street grid
  - Sidewalks & bike lanes/facilities
  - Safe, frequent crossings
  - Buildings fronting street instead of parking
- **Transit accessibility**:
  - High-level regional accessibility
  - Walk/bike access to stations
  - Concentrate activity near stations
- **Rescaled auto role**:
  - Smaller cross-sections
  - Lower speeds

WHAT HAPPENS WHEN THESE FACTORS ARE PRESENT?

- Households own fewer vehicles, make fewer auto trips, generate less VMT
- Shorter trips are more amenable to walking or biking
- Better access makes transit more desirable
- Travelers to such destinations less car dependent

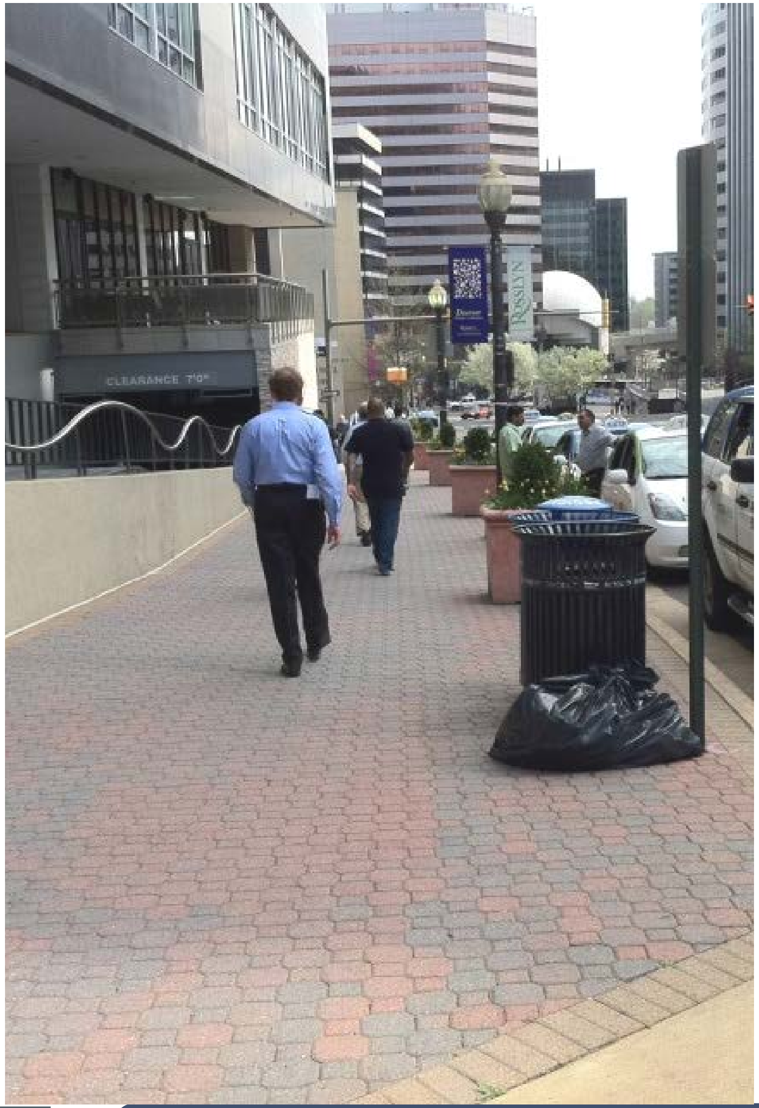
WHY AREN'T WE BUILDING MORE OF THESE COMMUNITIES?

Popularity HAS increased since 2000, but mainly redeveloping cities and inner suburbs:

- Transportation policy, planning and funding have long favored highway-based solutions
  - Auto perceived to be preferred mode, critical to the economy and residential preferences
  - Walking and biking not seen as "real modes"
- Local jurisdictions have planning and zoning authority
  - Citizens fear that density = traffic (perhaps crime?)
  - Traffic level of service ordinances restrict development intensity
  - NIMBY-ism dampens plans for local retail, affordable housing

WHY ARE TOOLS IMPORTANT?

- Difficult to argue for change without proof or compelling evidence
- Conventional transportation planning models (MPO zone-based) no help – too coarse for walk, bike, transit, land use
- Get maximum benefit from scarce resources – best bang per buck
- Need better medium for cooperative planning – diverse stakeholders have to come together



TODAY'S PROGRAM

- **Part 1: Introduction to NCHRP Report 770** (Rich Kuzmyak)
- **Part 2: Incorporating Walking and Biking in Advanced Travel Forecasting models** (John Bowman)
- **Part 3: GIS Multimodal Accessibility approach** (Alex Bell)
- **Part 4: Recent Examples** (Rich Kuzmyak)
- **Part 5: Incorporating Multimodal Accessibility into Planning and Programming** (Whit Blanton)

Part 1: Introduction to NCHRP Report 770

Rich Kuzmyak

1 NCHRP REPORT 770

Performed as NCHRP Project 08-78:

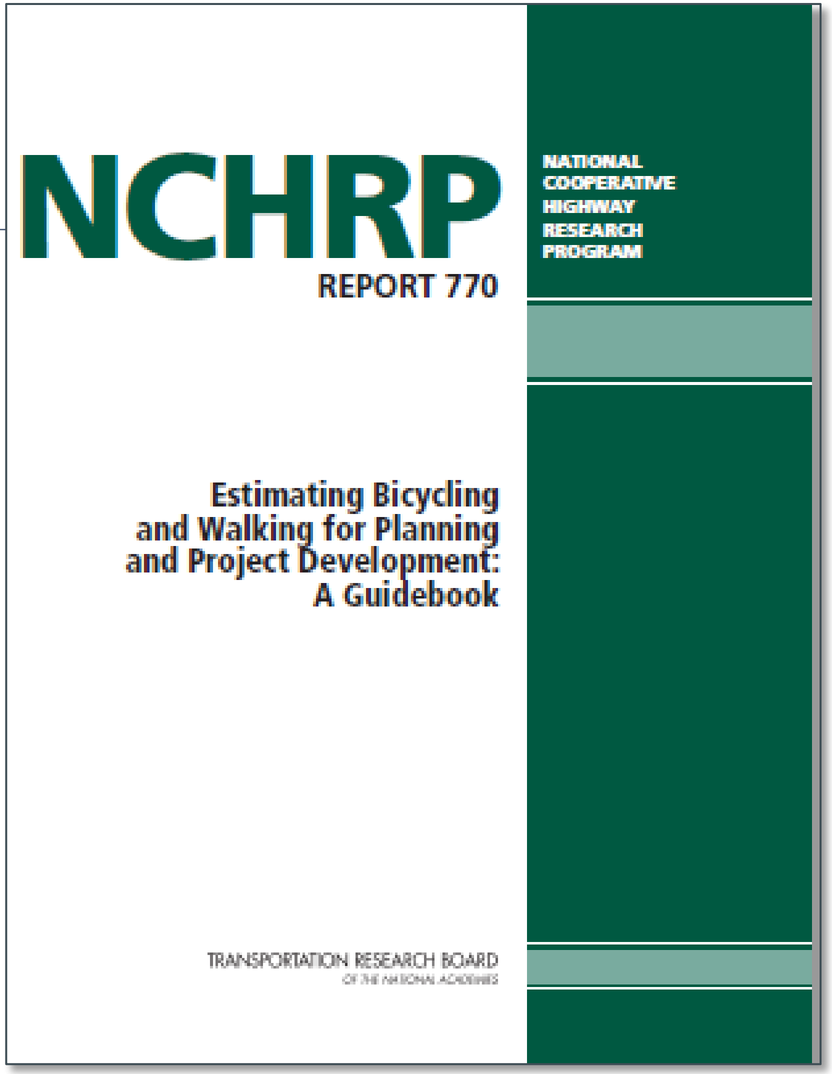
New tools for estimating walking and biking demand

Published as Report 770 (August 2014): A *Practitioner Guidebook*

Research Team:

- Renaissance Planning
- Fehr & Peers
- University of Texas Austin
- NuStats
- Specialist Consultants:

Mark Bradley -- John Bowman -- Keith Lawton -- Richard Pratt



PURPOSE OF NCHRP PROJECT 08-78

- Lack of robust planning tools for walk & bike
- Important planning questions unanswered:
  - What is the potential for walking and biking?
  - What is the relationship with land use/built environment?
  - How important are facilities?
  - How critical are land use and walkability to transit and TOD?
  - What impact on auto use & VMT?

RESEARCH FINDINGS

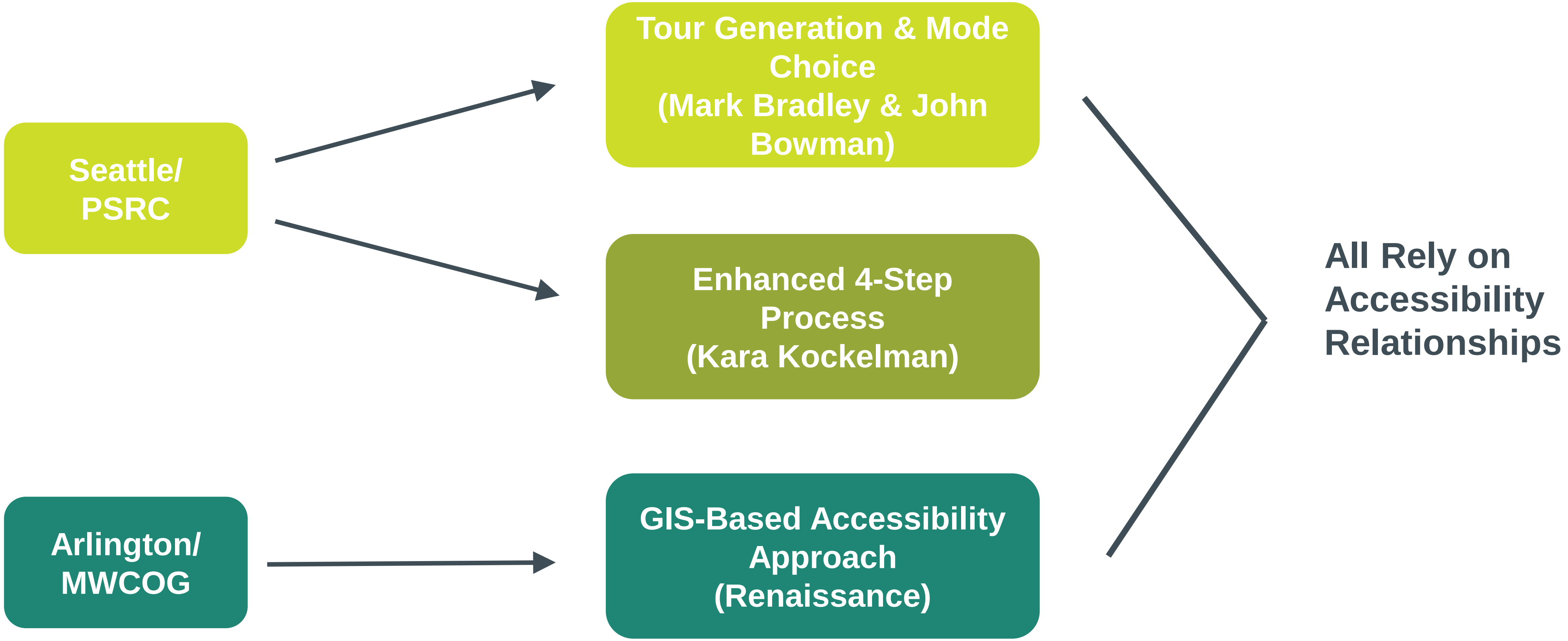
- Bicycle and Walk are different & must be treated separately:
  - *Different distances, facility needs, purposes, users*
  - Conventional models often group as “non-motorized”
- Data limited (both activity counts and travel behavior)
- Lots of “research” on factors – not so many complete tools
- Existing tools leave a major gap:
  - Regional forecasting models too coarse – everything critical happens within the zone!
  - Facility demand models (count-based regression models) not “choice based” -- *Can’t account for traveler, trip purpose, destination, etc.*

OUR RESPONSE

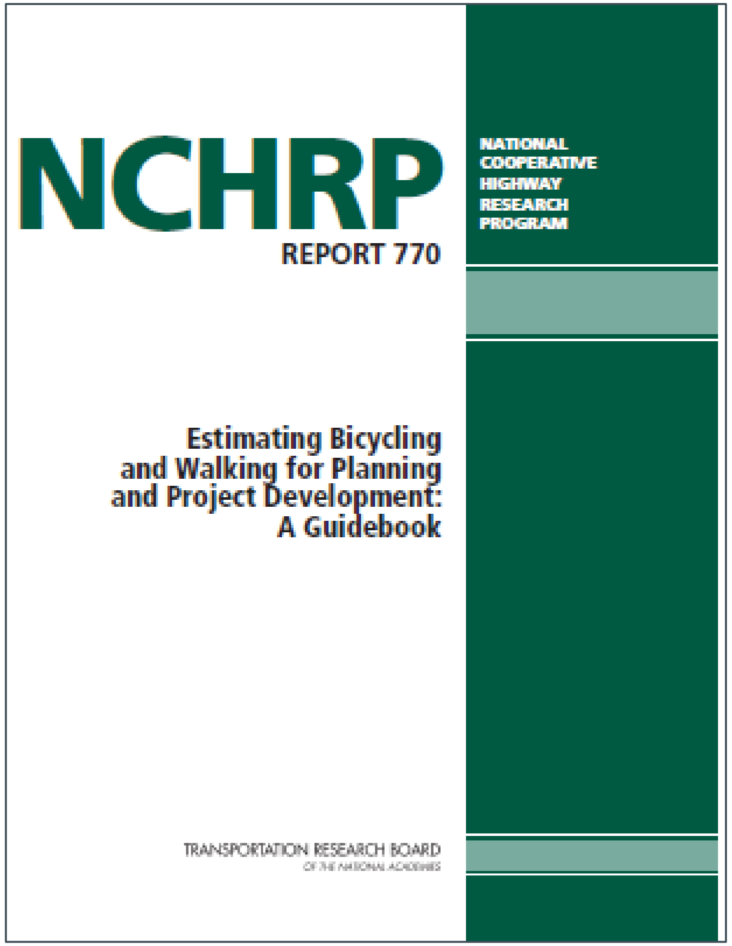
- Felt compelled to create a “behavioral” framework:
  - For what reason is the person traveling?
  - What are their travel options (mode, destination)?
  - What factors explain their choices?
  - How do those factors interact?

- Opted to perform original research
  - Great new travel surveys in Seattle (PSRC) and Washington DC (MWCOG)
  - Extensive GIS data on Land Use and Travel Networks
  - Look to “Accessibility” to define the relationships

NEW TOOLS FROM NCHRP 08-78

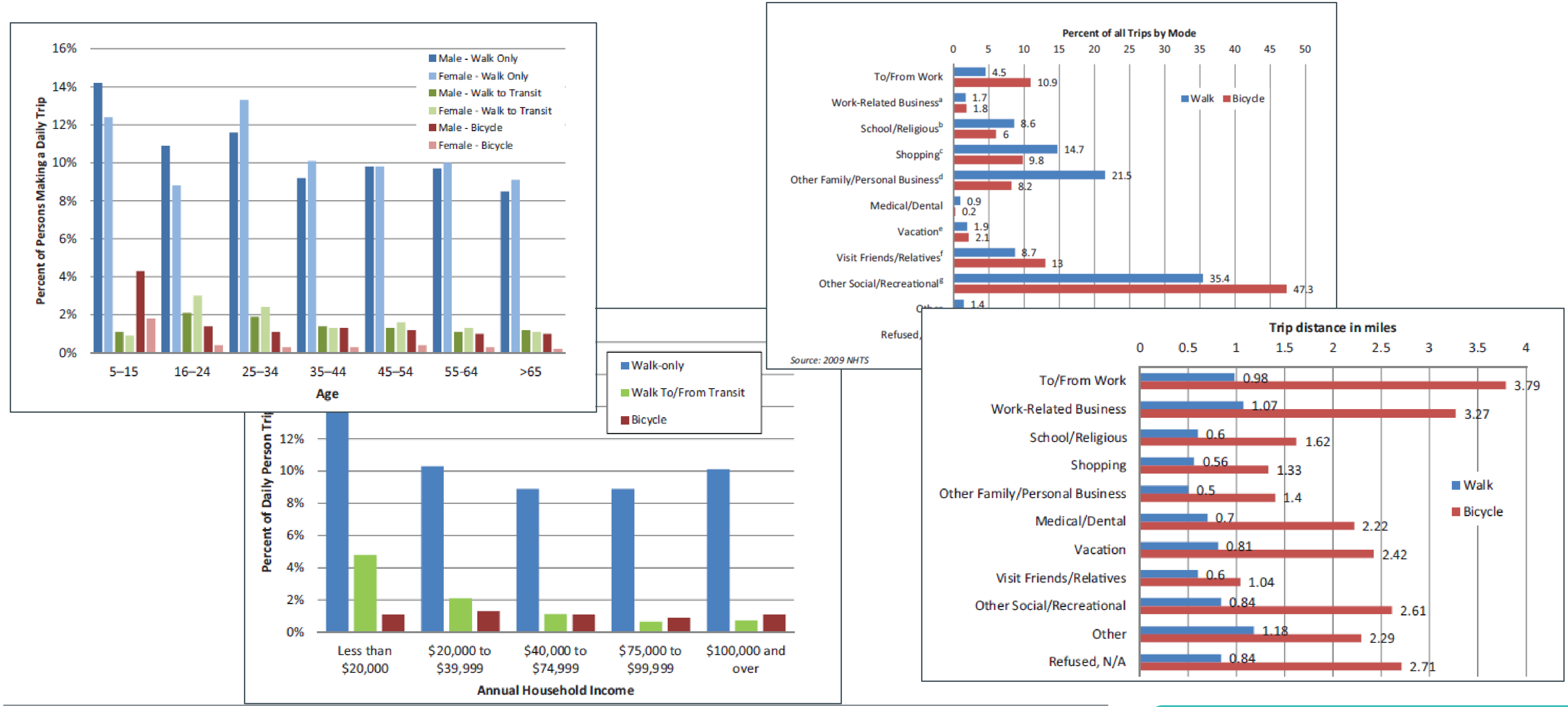


What’s In the Guidebook?



- Orientation to Bike/Ped planning issues
- Summary facts on key relationships & factors
- Introduction to new tools
- Detailed guidance on selection and use
  - New study tools
  - Selected pre-existing tools
- CD-ROM with Appendix materials

"Fast Facts:" Who Walks or Bikes, How Far, for What Purposes?



NCHRP 770 Report Contents

Factors Affecting Walking and Biking

- Land Use
- Facilities
- Natural Environment
- Sociodemographic Factors
- Attitudes & Perceptions

Used to Structure Modeling Framework

Natural Environment	
WALKING	➢ Climate: Regions of the United States with extended hot and/or humid summers have walk rates less than half those in more temperate regions; however, this finding may be more associated with Sun Belt cities that are younger and have been shaped around the automobile (Pucher & Renne, 2003). ➢ Temperature: Extreme high temperatures are more of a deterrent than cold temperatures (Schneider, et al., 2009). ➢ Weather: Precipitation is more influential than temperature for walking (Schneider, et al., 2009). ➢ Precipitation: The potential for rain is more of a deterrent than the amount of rain itself (Nankervis, 1999). ➢ Darkness: A significant deterrent to walking, but less than with biking; more of an issue in crime-prone areas (Cervero and Duncan, 2003). ➢ Topography: Steep slopes are a deterrent to walking, though not as much for walking as for biking. Slope is more important as a factor for work-related trips than for discretionary (Cervero and Duncan, 2003).
BICYCLING	➢ Climate: Areas with cold winters may see a 50% reduction in bike activity levels; areas that are both cold and snowy may see an 80% decline. Effects of hot/humid climate not as well studied (Pratt, et al., 2012). ➢ Temperature: Ridership generally increases with temperatures up to 90^{o} F; effect of humidity believed important but not well studied (Lewin, 2011). ➢ Weather: Biggest impact of weather extremes is on recreational riders (Lewin, 2011). ➢ Precipitation: Precipitation is more influential than temperature for biking (Lewin, 2011). ➢ Darkness: Measured to be five times more important to cyclists than pedestrians (Cervero and Duncan, 2003). ➢ Topography: Hills and steep grades discourage bike use or choice of destination or route. Cyclists are more sensitive to steep grades than pedestrians. Experienced riders are more tolerant of grades (Cervero and Duncan, 2003).

Guide to Using the Tools

Tool Selection Keyed To:

- Planning application
- Geographic Scale
- Accuracy requirements
- Key variables
- Data resources
- Skill level

Which Tool To Use? Help Guides

Problem Application	Disaggregate Tour Based (Seattle)	GIS-Based Accessibility (Arlington)	Enhanced 4-Step (Seattle)	Portland Pedestrian Model	4-Step Walk Models (MoPeD)	4-Step Walk Models (PedContext)	Bicycle Route Choice	Direct Demand (St Monica)
Regional Plan Development	D	A	D	A	A	A	P	P
Scenario Planning / Visioning	D	D	A	A	A	A	P	P
Land Use / Smart Growth / TOD	D	D	D	A	A	A	P	P
Multimodal Corridor Studies	D	D	A	P	A	A	A	P
Traffic Impacts / Mitigation	A	A	A	P	A	A	P	P
Multimodal Accessibility & Equity	D	D	A	A	A	A	A	A
Local Comp or Master Plans	D	D	A	A	A	D	A	P
Site Planning & Traffic Impact Mitigation	D	D	A	A	D	A	A	P
Bicycle or Pedestrian Facility Planning	A[1]	A[1]	P	P	A	D	D	D
NMT Facility Prioritization	A[1]	A[1]	P	A	A	D	A	A
Intersection Activity Levels for Safety Analysis	A[1]	A[1]	N	P	A	D	A	D

NCHRP Report 770 Contents

Profile Sheet for Each Tool

Seattle Tour-Based Approach

Description:

This tool uses a highly disaggregated modeling approach – individual tour generation and mode choice at the parcel level – to account for the many factors that impact bicycle and pedestrian travel choice, particularly land use and network connectivity through measures of both local and regional accessibility. It may be applied back in tour-based form, or used in whole or part to enhance existing TB or trip based models, either through the full models, individual elasticities, or the provided custom spreadsheet.

Geographic Scale:

☑ Regional ☑ Corridor ☑ Subarea ☐ Project/Site ☐ Facility/Point

Planning Applications:

☑ Scenario Planning ☑ Smart Growth/TOD ☑ Transit ☑ Comp/Master Plans
☑ Traffic Impact Mitigation ☐ NMT Facility Planning ☐ Safety Analysis ☑ Equity

Forecasting Elements:

☐ Auto Ownership ☑ Trip Generation ☐ Distribution ☑ Mode Choice ☐ Assignment

Indicators and Metrics:

☑ Mode Shares ☑ Walk Trips ☑ Bike Trips ☑ Vehicle Trips ☑ Transit Trips
☑ VMT ☐ Walk Link Volumes ☐ Bike Link Volumes ☐ Intersection Volumes

Trip Purposes

☑ Work ☑ School ☑ Other ☑ Recreation ☑ Work based ☐ Non-home based

Model Relationships and Sensitivity:

Land Use:	☑ High	☐ Medium	☐ Low
Non-Motorized Network:	☑ High	☐ Medium	☐ Low
Accessibility:	☑ High	☐ Medium	☐ Low
Sociodemographics	☑ High	☐ Medium	☐ Low

Data Requirements:

☑ Travel Surveys ☑ Parcel Level Land Use ☑ Census Population & Employment
☑ All Streets Network in GIS format ☑ Walk Link Characteristics ☑ Bike Link Characteristics

☑ Transit Stop Locations ☑ Regional Model TAZ data & Skims (for accessibilities)

Tools & Expertise:

☑ Travel Modeling ☑ GIS Tools & Expertise ☑ Data Management

Assessment of Strengths and Weaknesses

Strengths

- Highly insightful into the choice of travel modes based on travelers' assessment of local and regional opportunities and benefits and traveler/household needs such as combining trips or chauffeuring passengers.
- Very directly deals with land use and network accessibility, at both the communitywide and regional level.
- Distinguishes between traveler choice of simple versus complex tours, which are predicated on local land use, and which have strong implications for mode choice for specific trip purposes: work, school, shop, work-based trips, other.
- Captures important physical attributes of bicycle or pedestrian networks that affect accessibility, such as directness and trip length, slope, presence of sidewalks and Class I and Class II bikeways, concentrations of population and employment.
- Accounts for traveler socio-economic factors such as family size, age, income

Weaknesses

- Complete replication of the methods would require substantial resources in terms of data availability, analytic expertise, software and potentially hardware investment, and consideration of budget and schedule issues. However, transfers and partial applications may be done with considerably less effort
- The best application works within a tour- or activity-based model environment, based on definitional issues distinguishing tours from trips; however, this problem can be overcome with some simplification of assumptions.
- Ideal application would require development and use of a synthetic population of individuals, since the models are most relevant when applied to individuals as opposed to households (important individual characteristics are lost) or zones (aggregation impacts accuracy)
- To obtain estimates of area-specific or facility specific use, requires additional tools for destination choice and route choice, and validation of the resulting estimates

Walk Through Application

Seattle Tour Generation & Mode Split Model

Likelihood of No More Tours	
Low income HH	0.225
High income HH	-0.2394
Age < 30	0.3345
Zero car HH	0.504
Origin entropy (buffer 1)	-0.757
Net interesection density (buffer 1)	-0.00367
CL I bike path fraction (buffer 2)	-1.821
CL II bike path fraction (buffer 2)	-1.387
Make a second tour (constant)	0.0027
Make a third tour (constant)	0.0027
Make a fourth tour (constant)	5.0

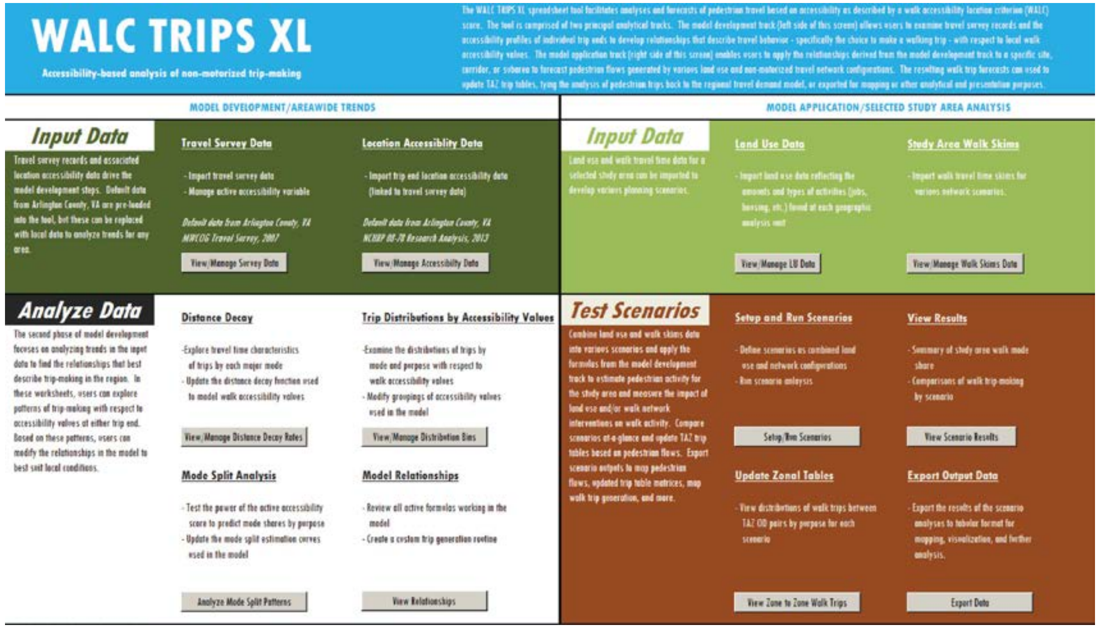
(if coefficient is positive (+), increases in that variable discourage additional travel)

Likelihood of Complex Tour	
Origin composite logsum	
Origin mixed use entropy	0.182
Full-time worker	
Part-time worker	-0.965

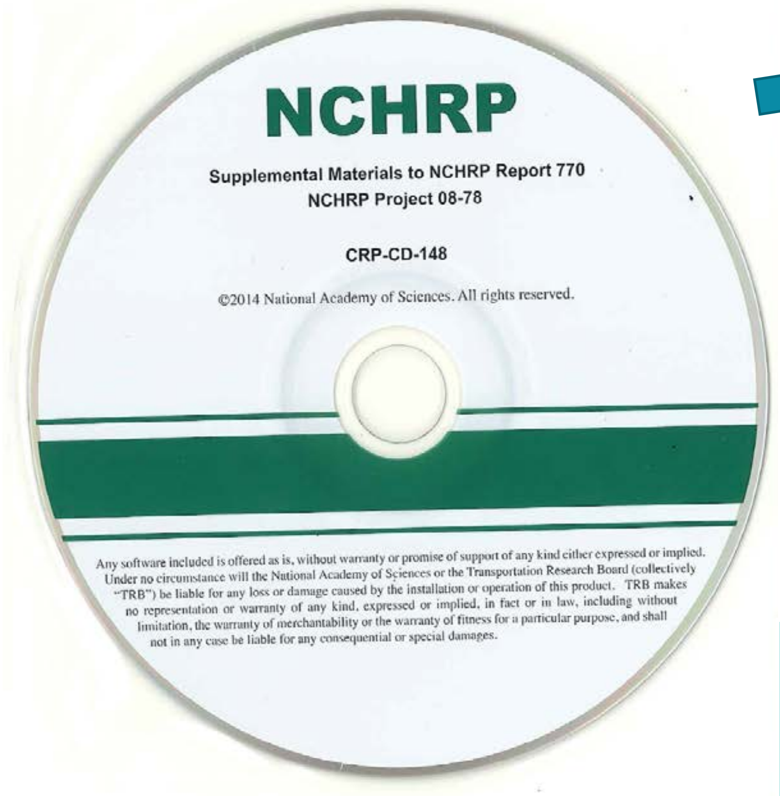
Tour Purpose	Work (W)	School (S)	Escort	Pers Business	Shopping	Meal	Social-Recreat
Constant	-4.91	-20.0	-7.17	-5.57	-9.67	-5.31	-10.25
Buffer 2 Activity (purpose specific)							
Purpose-specific logsum					0.3735	0.141	0.319
Complex tour interaction constant	-0.994		-0.595	-1.649	-1.241	-2.58	-2.955
Full time worker							
Part time worker						-1.081	-2.0

	Home-Based Work				Home-Based School				Home-Based Social/Rec				Home-Based Other				Work-Based			
	Walk	Bike	Transit	Auto	Walk	Bike	Transit	Auto	Walk	Bike	Transit	Auto	Walk	Bike	Transit	Auto	Walk	Bike	Transit	Auto
Constant	-7.31	-3.61	-3.78		-3.82	-7.69	-2.94		-2.92	-4.84	-5.78		-3.03	-6	-8.5		-3.49	-3.49	-0.986	
Income < $25k			0.379		1.14		2.38						-0.647		0.813					
Income > $100k	-0.546				-0.42								-0.256		-1.81					
Male	0.337	0.676			0.32	0.711				1.96				0.72						
Age <35		-1.38							-0.412		1.25		-0.26							
Age > 50		-0.833								-0.991	2.17		-0.486	-0.338						
Zero car HH				-4.69				-5				-3.09				-3.6				
Adults > Cars				-1.21				-1.16				-0.799				-0.417				
Buffer 1 attractions for purpose	0.403				0.423				0.262				0.36							
Buffer 2 attractions for purpose						0.22														
Mode/destination logsum with zero cars	0.245					0.289			0.0922						0.355		0.699			
Mode/destination logsum with full car own				0.154								0.0944				0.04				
Buffer 1 household density													0.00026							
Buffer 1 net intersection density	0.0043		0.00007								0.00048		0.0101		0.00014					
Buffer 2 net intersection density		0.0087												0.0127						
Buffer 1 average fraction rise									-29.2				-35.5							
Buffer 2 average fraction rise		-62.6				-31.4								-92.5						
Buffer 2 fraction Class 1 bike path		2.4				3.15														
Buffer 1 percent no sidewalk	-1.04						-1.38		-0.769		-2.96		-1.12				-1.6		-3.89	
Buffer 1 transit stops			0.737				0.291				0.121				0.296				0.312	
Buffer 1 mixed use index			0.716						0.454						1.36		0.791		0.559	
Walked to work																				
Bike to work																		2		
Transit to work																			0.574	
Car to work																				1.67
Tour Complexity	-1.45	-1.08	-0.781		-2.21	-2.18	-0.314		-1.33	-0.628	0.693		-1.3	-1.59	-0.361		-1.61	-2	-0.677	

Arlington GIS Accessibility Model

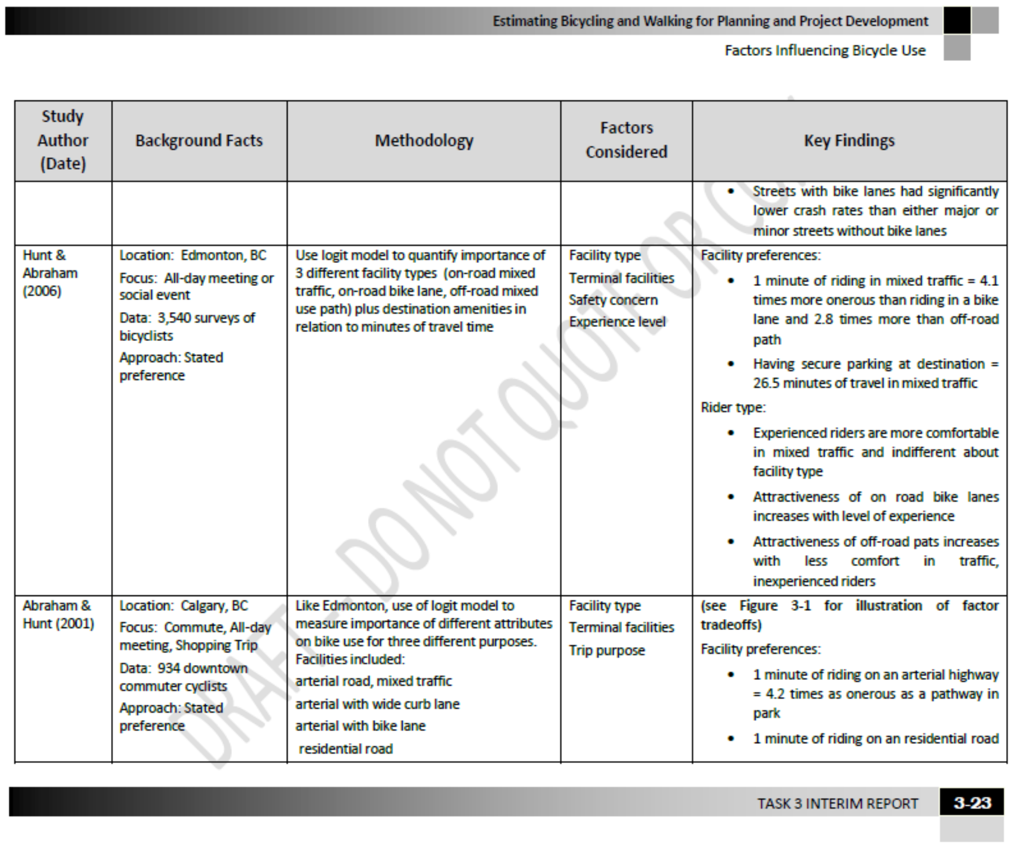


Accompanying CD-ROM



Spreadsheet Versions of New Models

Extensive research findings from unpublished Interim Report



Estimating Bicycling and Walking for Planning and Project Development

Factors Influencing Bicycle Use

Study Author (Date)	Background Facts	Methodology	Factors Considered	Key Findings
				• Streets with bike lanes had significantly lower crash rates than either major or minor streets without bike lanes
Hunt & Abraham (2006)	Location: Edmonton, BC Focus: All-day meeting or social event Data: 3,540 surveys of bicyclists Approach: Stated preference	Use logit model to quantify importance of 3 different facility types (on-road mixed traffic, on-road bike lane, off-road mixed use path) plus destination amenities in relation to minutes of travel time	Facility type Terminal facilities Safety concern Experience level	Facility preferences: • 1 minute of riding in mixed traffic = 4.1 times more onerous than riding in a bike lane and 2.8 times more than off-road path • Having secure parking at destination = 26.5 minutes of travel in mixed traffic Rider type: • Experienced riders are more comfortable in mixed traffic and indifferent about facility type • Attractiveness of on road bike lanes increases with level of experience • Attractiveness of off-road pats increases with less comfort in traffic, inexperienced riders
Abraham & Hunt (2001)	Location: Calgary, BC Focus: Commute, All-day meeting, Shopping Trip Data: 934 downtown commuter cyclists Approach: Stated preference	Like Edmonton, use of logit model to measure importance of different attributes on bike use for three different purposes. Facilities included: arterial road, mixed traffic arterial with wide curb lane arterial with bike lane residential road	Facility type Terminal facilities Trip purpose	(see Figure 3-1 for illustration of factor tradeoffs) Facility preferences: • 1 minute of riding on an arterial highway = 4.2 times as onerous as a pathway in park • 1 minute of riding on an residential road

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TASK 3 INTERIM REPORT 3-23

Part 2: Improving the treatment of walking and bicycling in advanced travel forecasting models

John Bowman, PhD – Bowman Research & Consulting

Mark Bradley -- Resource Systems Group

Research focus

In ***conventional zone-based regional models***, most walk and bike trips are intra-zonal or between adjacent zones >>> ***very little relevant information to predict choices***

Two main directions

Create *detailed* ***small-area models*** using map-based/ GIS framework

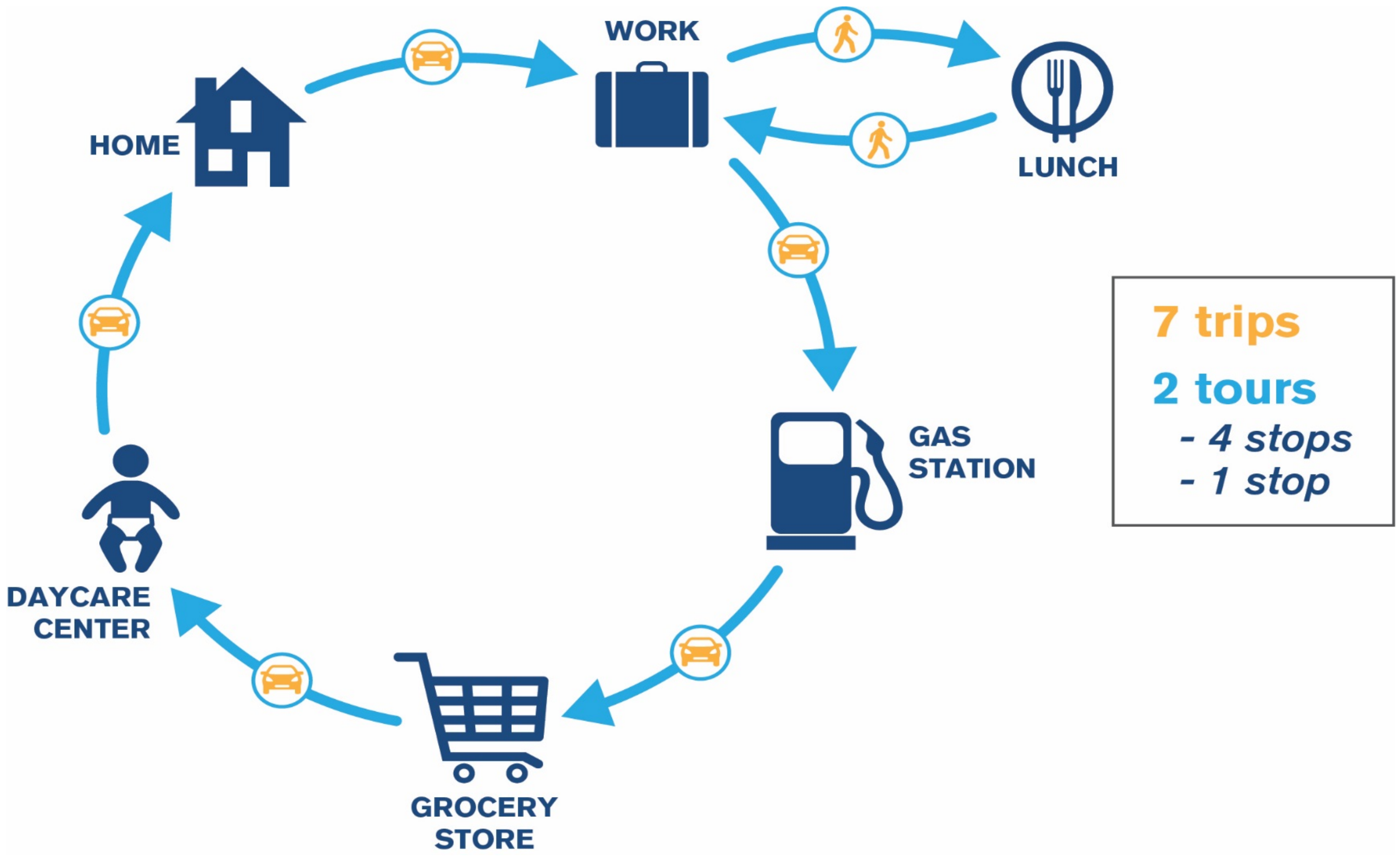
Add more detail and data in ***advanced regional forecasting models***

Why use an advanced regional model to estimate walking and bicycling?

- It is desirable to include walking and bicycling projects and policies in the regional plan.
  - Access to federal and state funding
  - Growing recognition of value of health benefits
- Advanced activity-based (AB) models can include the detail needed for active transport modes within a region-wide analysis tool

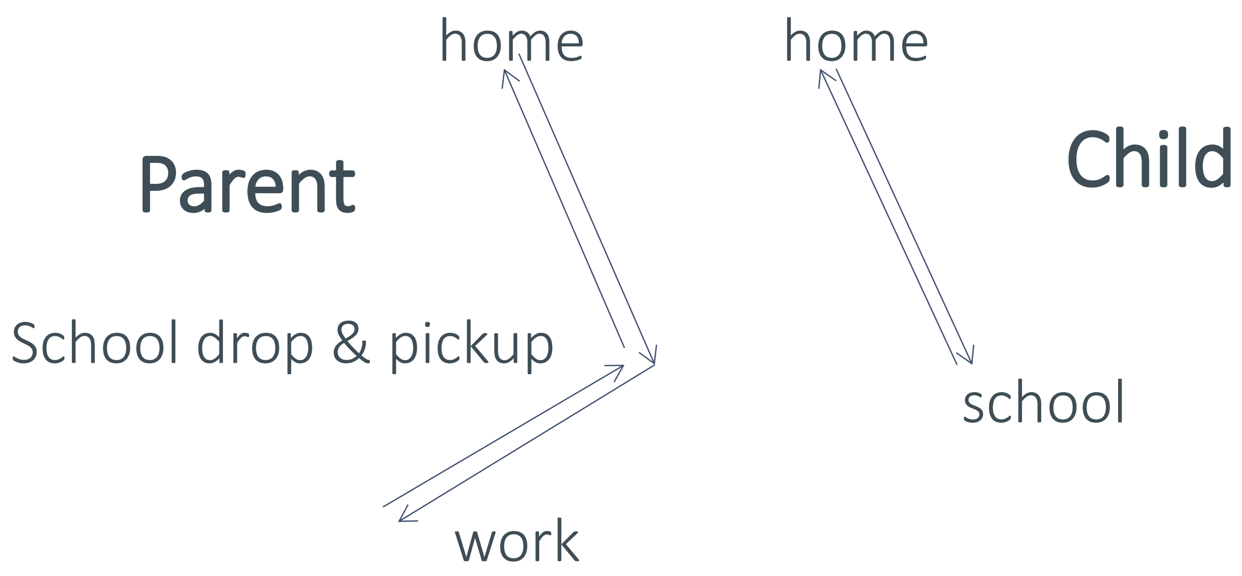
Why use an advanced regional model to estimate walking and bicycling?

AB models simulate a day of activity and travel for each person, taking into consideration travel conditions along the way for all modes.



Why use an advanced regional model to estimate walking and bicycling?

They can also model interactive effects of household members:



AB model results are useful for analysis of health effects

- For each trip of each person:
  - Miles and minutes by walk and bike

- Can be summarized many ways:
  - Age, income, purpose, geographic subarea, etc.

But it is hard to include bicycling and walking in regional models. Why?

- Because the devil is in the details of the route, and including those details requires a lot of data!
  - Is there an intersection that feels too dangerous for me to cross?
  - Is there a stretch of road that feels too dangerous to walk or bike along?
  - Is there a hill that is too steep to climb?
  - Is there a convenient and secure place to park my bicycle?

Seattle Tour Generation and Mode Choice Model

NCHRP 08-78 Project

Seattle—estimated **tour generation and mode choice models** to test variables explaining propensity for walk and bike trips

Seattle Objectives

- Establish relationships between bicycle and pedestrian demand and….

Infrastructure

  - Provision of bike paths and lanes
  - Provision of sidewalks
  - Street network connectivity
  - Other aspects of routes (grade, traffic flow, etc.)

Urban design

  - Density of housing and employment
  - Variety of land uses (mixed use entropy)
  - Provision / location of transit stops
  - Local versus regional accessibility

- Using methods that can be applied in an operational regional model

Seattle methods rely on detailed data

- Model estimation with ***parcel-level data***
- Distances from an ***all-streets network***
- ***Distance-decay buffers*** to measure nature of neighborhood surrounding each parcel (e.g. elevation gain, transit stops, bike lanes)
- Use of detailed ***sidewalk data*** for each side of street
  - Presence of sidewalk (full, partial, none)
  - Speed limit (proxy for pedestrian safety risk)
- Use of detailed ***bike network data***, with paths based on San Francisco bike route choice model

Bike path attributes(for each origin-destination pair)

- Attributes averaged across multiple potential paths, weighted by path selection probability:
  - Path ***distance***
  - Fraction of distance on ***Class 1 bike path***
  - Fraction of distance on ***Class 2 bike lane***
  - Fraction of distance ***wrong-way*** on one-way links
  - Fraction ***elevation gain*** along the path
  - Number of ***turns*** per mile
  - A ***"logsum"*** (inclusive value) across paths/attributes

- Four ***market segments***: male / female x work / non-work

Model estimation

- Models estimated
  - Tour generation and trip chaining
  - Tour mode choice
    - Using separate bike path attributes
    - Using bike path logsum
- Behavior data: PSRC 2006 household travel survey
- Estimation tool: DaySim software that PSRC uses for their AB model

Tour generation and complexity model results

- Short distance buffer effects are very strong: People who live very near attractions tend to make more tours for those purposes
- Longer-distance accessibility measures also important for most purposes
- People who live in areas that are more amenable to walk, bike and transit tend to make more tours, but those tours tend to have fewer stops per tour
  - Higher presence of Class 1 bike paths
  - Smaller elevation gain along streets
  - Shorter distance to transit stops

Mode choice model results

- Estimated effects are generally in the expected directions, but without much statistical precision or significance.
- They are feasible for use in advanced regional or local forecasting models, but there is still room for improvement.
  - This has also been an issue with modeling auto vs. transit mode choice > Reaching “consensus” has required decades of survey-based modeling research.
  - For walk and bike demand, there are similar challenges…

Data challenges

- ***Collinearity***: Detailed spatial data on land use and infra-structure tends to shows high correlation across different variables (e.g. sidewalks and employment).
- ***Mutual causality***: Cities often put sidewalks where people are already walking, and bike lanes where people are already cycling.
- ***Self-selection***: People who walk and/or bike tend to relocate to walkable/bikeable areas.
- ***Scarcity***: A lack of systematic count data for calibration and validation.

Nevertheless, some regions are actively incorporating active transport modes into advanced AB models

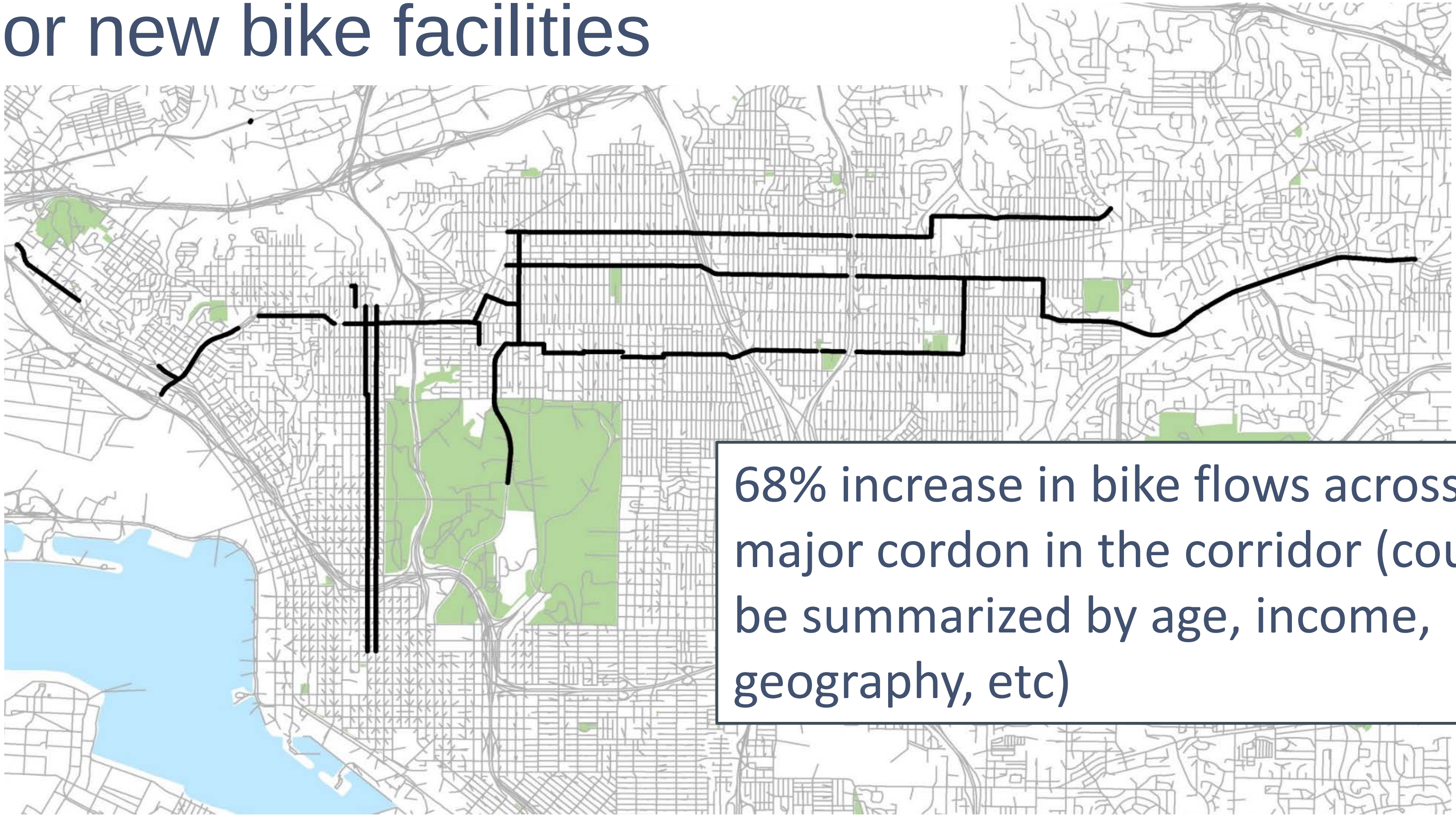
- **San Diego**—incorporated **bicycle route choice and walk generalized cost** into an operational AB model, using techniques similar to those employed in our research project (RSG, Jeff Hood, PB)
- **Copenhagen**—explicitly representing **bicycle and walk access to public transport** in an operational AB model
- Other regions—Sacramento, San Francisco, Philadelphia, Portland, Nashville (and probably others)

San Diego AB model enhancements

- Already had an AB model with 33k microzones (typically Census blocks)
- Added:
  - Detailed bike network attributes
  - Bike route choice model
    - Provides inclusive logsum and estimates bike link flows
  - Mode choice model
    - Bike mode affected by route choice logsum
    - Walk mode affected by distance and elevation gain
  - Other models affected by mode choice logsum

Applications in Other Areas

San Diego AB model sensitivity test: Uptown corridor new bike facilities

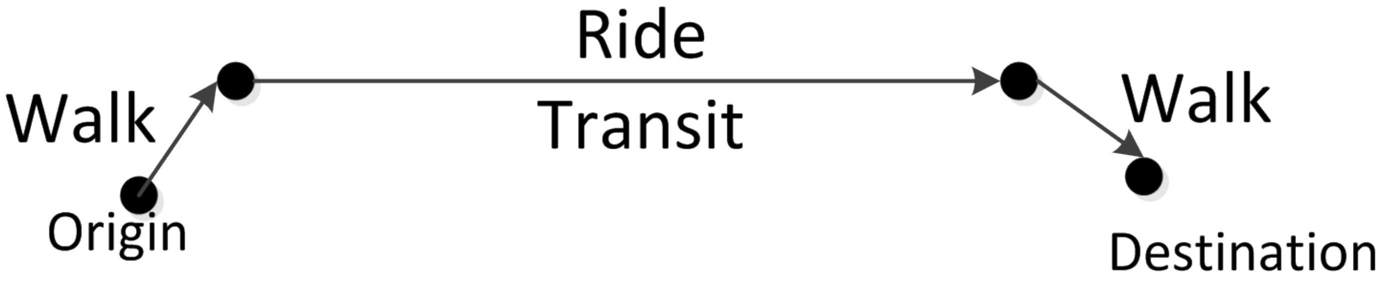


68% increase in bike flows across a major cordon in the corridor (could be summarized by age, income, geography, etc)

Applications in Other Areas

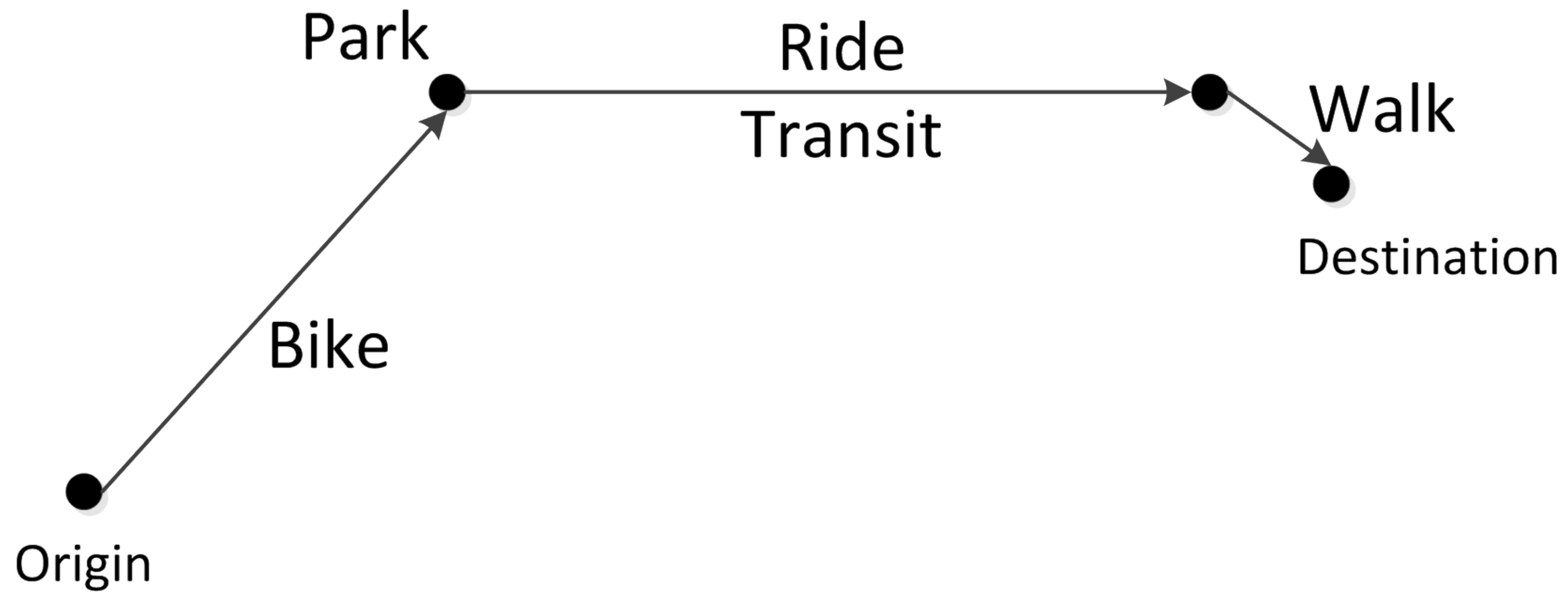
Copenhagen AB model includes transit access and egress:

walk-ride-walk



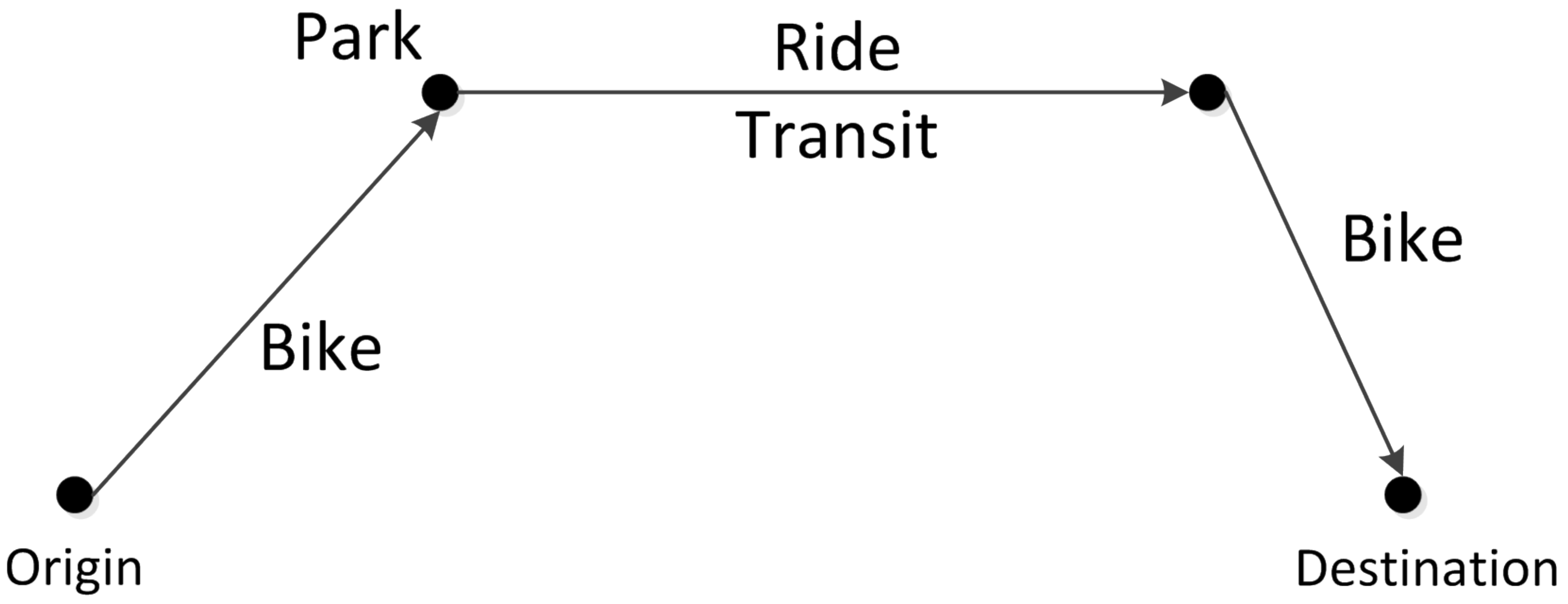
Applications in Other Areas

bike-park-ride-walk



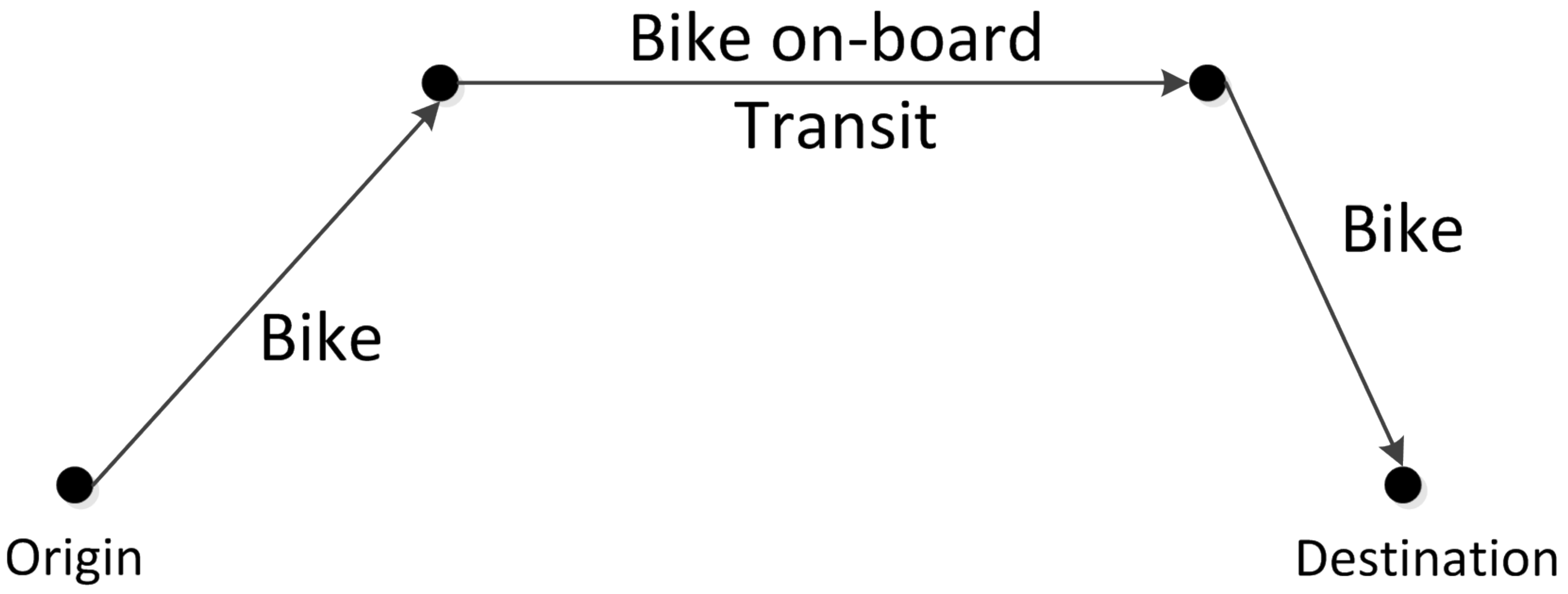
Applications in Other Areas

bike-park-ride-bike



Applications in Other Areas

bike-on-board



Copenhagen AB model enhancements

- Models these transit submodes explicitly
  - Including choice of access and egress stations
- Detailed spatial resolution
  - 10k microzones
  - Detailed bicycle-specific and walk-specific networks
  - Station-to-station transit assignment
- Uses data on bike parking at stations
  - Capacity, security, price, distance to platform
- Uses data on availability of bike-on-board
- Model predicts how changes in these factors affect bicycle and transit usage.

Summary point 1

It is desirable to use activity-based regional models to predict how projects and policies will affect the amount of bicycling and walking:

- They simulate a day of activity and travel for each person, taking into consideration travel conditions along the way for all modes
- This provides a framework for representing the effects of projects and policies
  - Route connectivity for entire journeys
  - Protected bike lanes
  - Pedestrian zones
  - Transit access policies
- They provide key outcomes for assessing health benefits of regional policies

Summary point 2

There are big challenges:

- It requires detailed data on infrastructure
- It is difficult to extract good information on behavior from existing survey and count data

Summary point 3

The projects in Seattle, San Diego and Copenhagen are demonstrating specific ways of making these improvements:

- Bicycle route choice and walk generalized cost
- Bicycle and walk access to public transport

Acknowledgments

- Seattle (data):
  - Stefan Coe and others (PSRC)
  - Jeff Frkonja and others (RSG)
  - Orion Greene and others (U. Washington)
- San Diego
  - Jeff Hood (Hood Consulting)
  - Wu Sun and others (SANDAG)
  - Joe Castiglione and others (RSG)
  - Joel Freedman and others (PB)
- Copenhagen
  - Goran Vuk (Danish Road Directorate)
  - Christian Overgård Hansen (Danish Technical Univ.)

Part 3: Arlington GIS Accessibility Approach

Alex Bell

DISCUSSION OUTLINE

1. CORE CONCEPTS OF ACCESSIBILITY
2. TOOLS AND DATA RESOURCES
3. INTERPRETING OUTPUTS
4. NCHRP 770 SPREADSHEET TOOL (WALC TRIPS XL)
5. EXAMPLE APPLICATION

1 CORE CONCEPTS OF ACCESSIBILITY

A SIMPLE AND POWERFUL PREMISE

- Accessibility is a direct measure of a fundamental question:

  “WHAT OPPORTUNITES ARE AVAILABLE TO ME?”

- As accessibility increases, so too do opportunities
- Accessibility increases through improvements to activity patterns and transportation networks

*In short, the more **activities** I can reach by walking, the more likely I am to walk. The network’s job is to connect me to those activities **directly** and **safely**.*

Accessibility as a Framework

$$\text{ACCESSIBILITY} = \frac{\text{Land Use}}{\text{Transportation Network}}$$

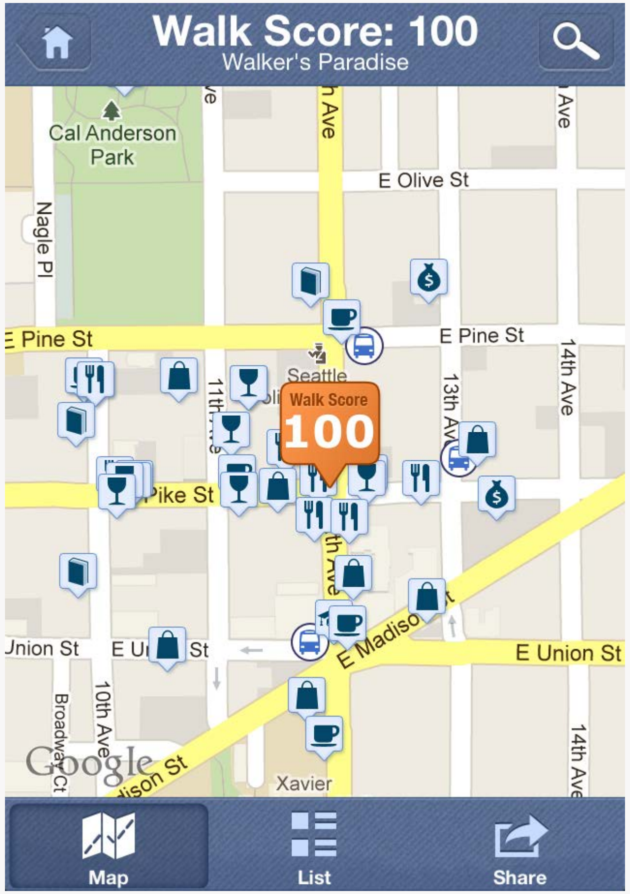
Opportunities (→ Land Use)
- Number
- Variety
- Proximity

Travel Time (→ Transportation Network)
- Connectivity
- Directness
- Safety

2 TOOLS AND DATA RESOURCES

GIS ACCESSIBILITY MODEL

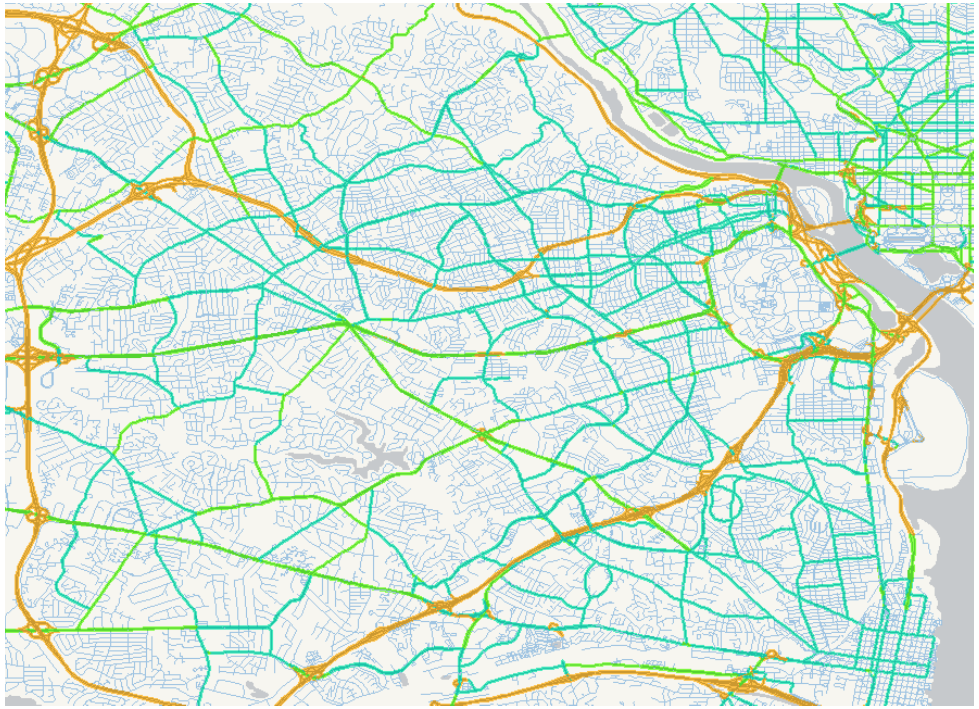
- Wanted a menu of tools for different situations
- Liked idea of "Walk Score" – try to operationalize
- Had access to great resources:
    - Recent travel survey (MWCOG)
    - Great GIS data on employment (Dun and Bradstreet, InfoUSA)
    - Support of MWCOG and Arlington County



DATA NEEDS

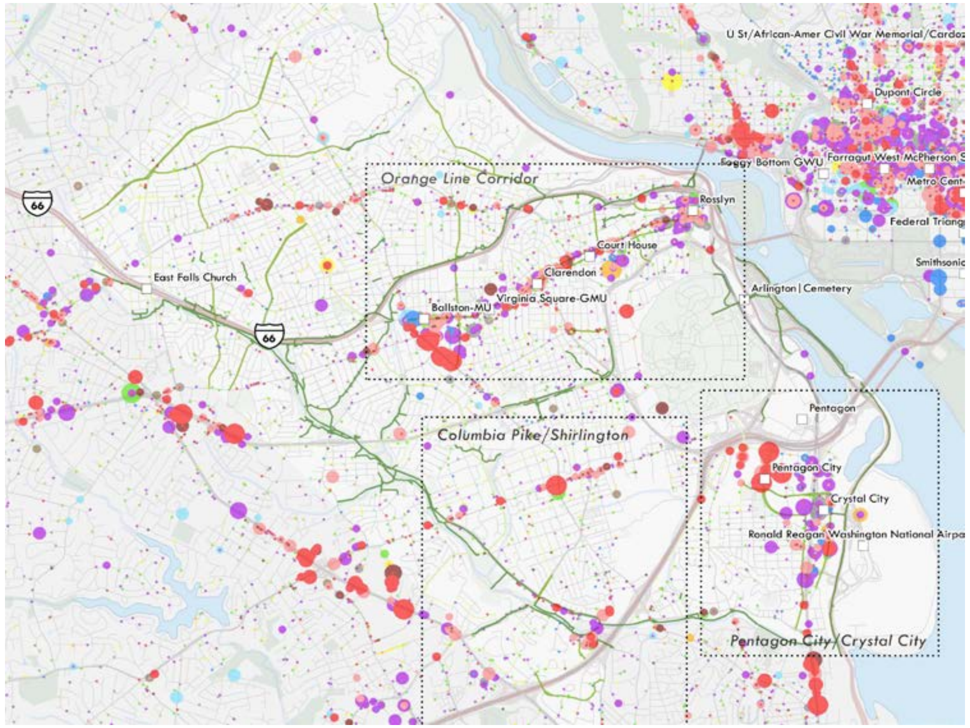
GIS RESOURCES

Transportation connections



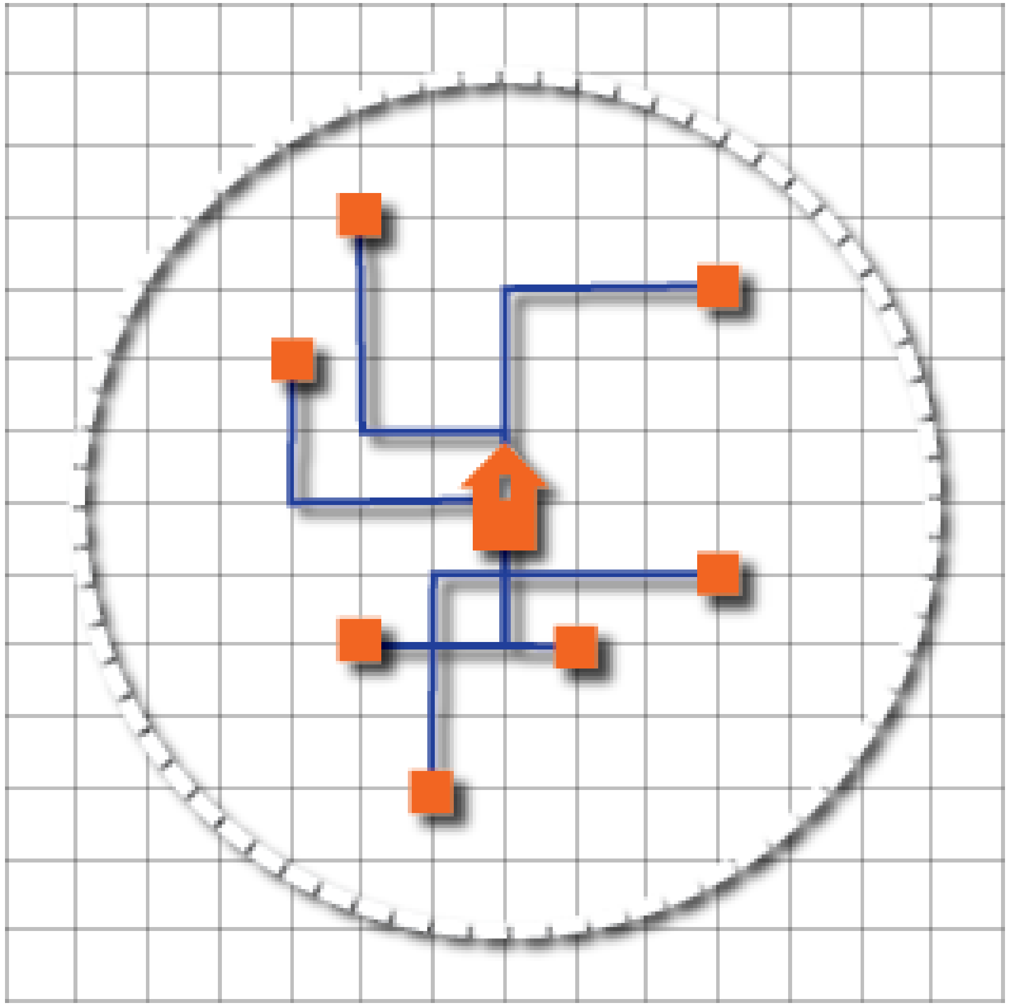
Detailed network data
example: NAVTEQ, augmented with bike facilities data

Land use



Detailed employment data
example: Dun and Bradstreet points

ACCESSIBILITY SCORE CALCULATION



Accessibility =

$$\sum \frac{Opportunities}{Travel\,Time * \mathbf{Decay}}$$

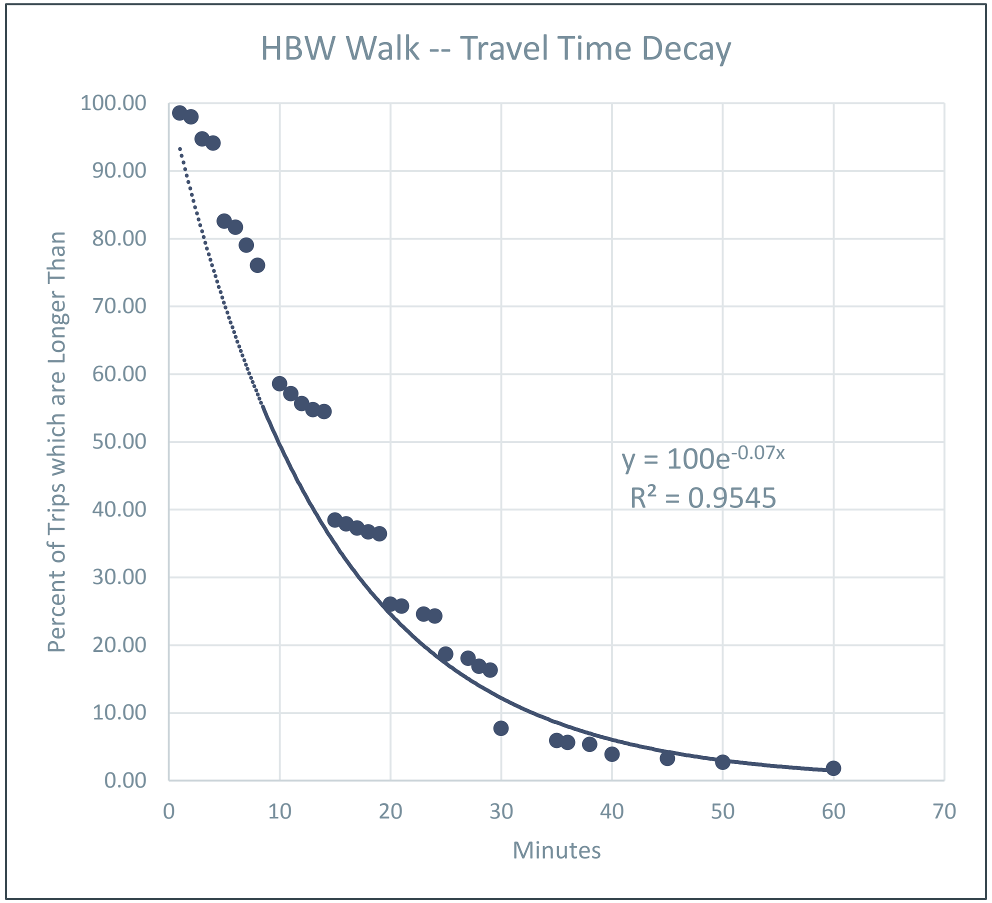
Where:

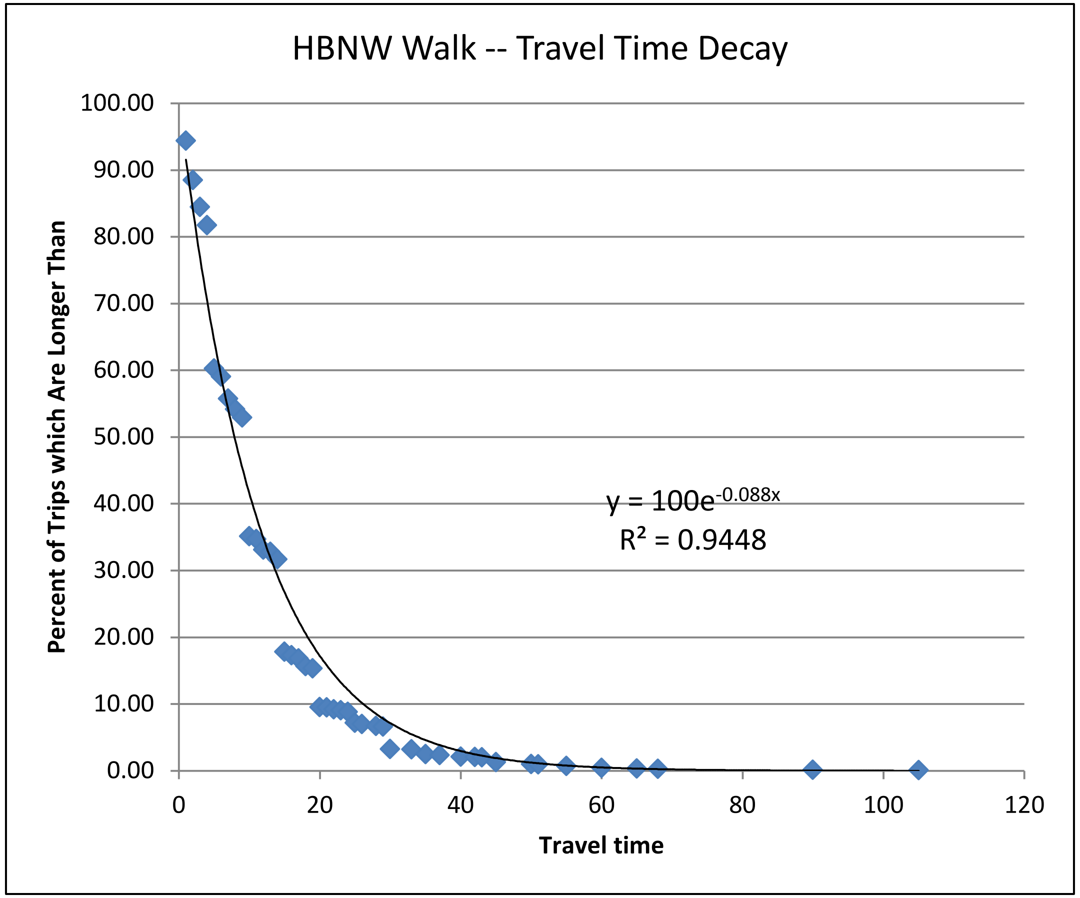
OPPORTUNITIES = Number of Jobs (HBW) or Number of Retail/Service Establishments (HBNW)

TRAVEL TIME = Time to reach opportunity over *actual network* (Network Analyst)

DECAY* = Factor reflecting decrease in value of opportunity that are farther away

Distance-Decay Relationships
(derived from travel survey trip distributions)

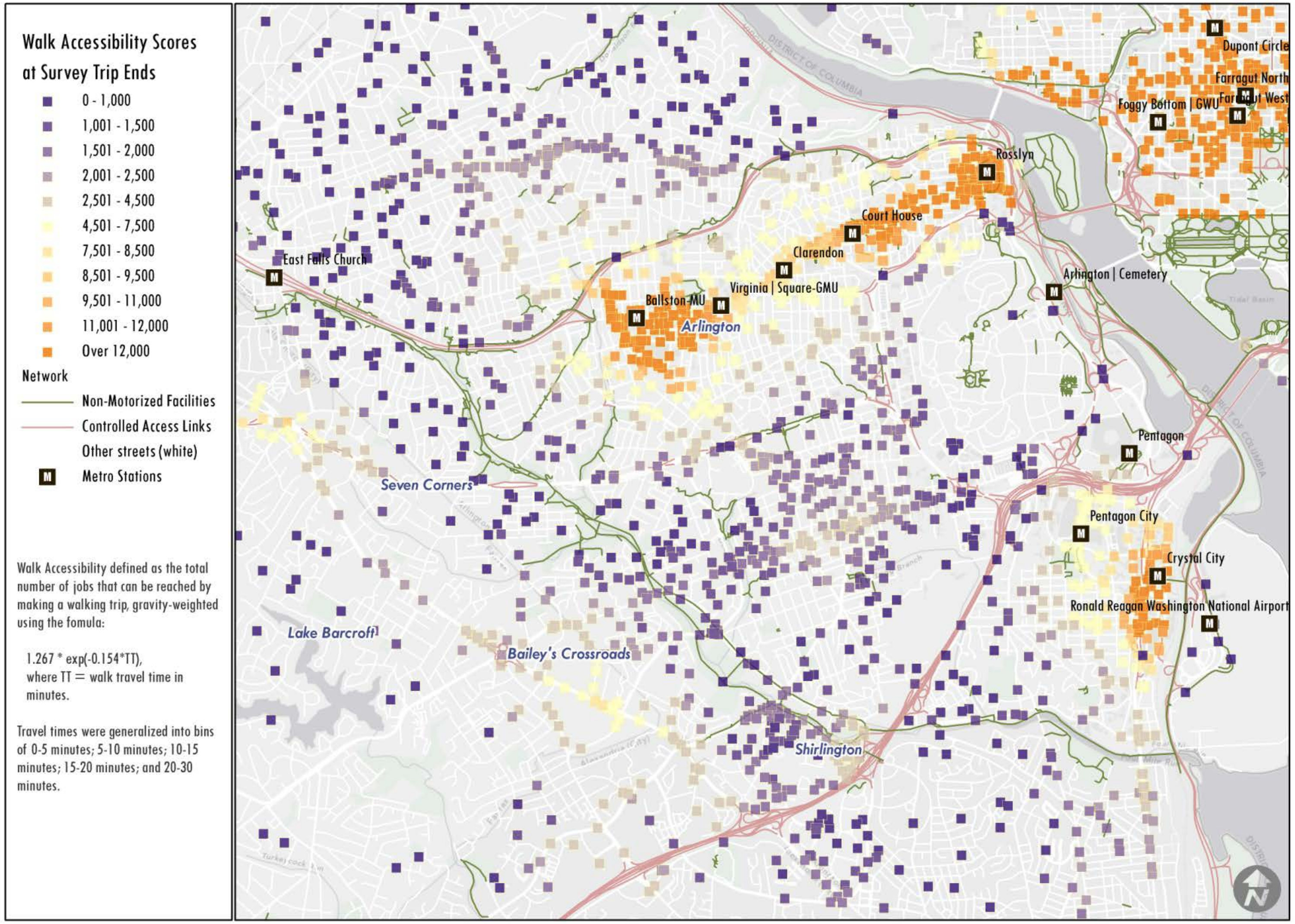




3 INTERPRETING OUTPUTS

WHAT DOES AN ACCESSIBILITY SCORE MEAN?

WALK ACCESSIBILITY SCORES AT SURVEY TRIP END LOCATIONS



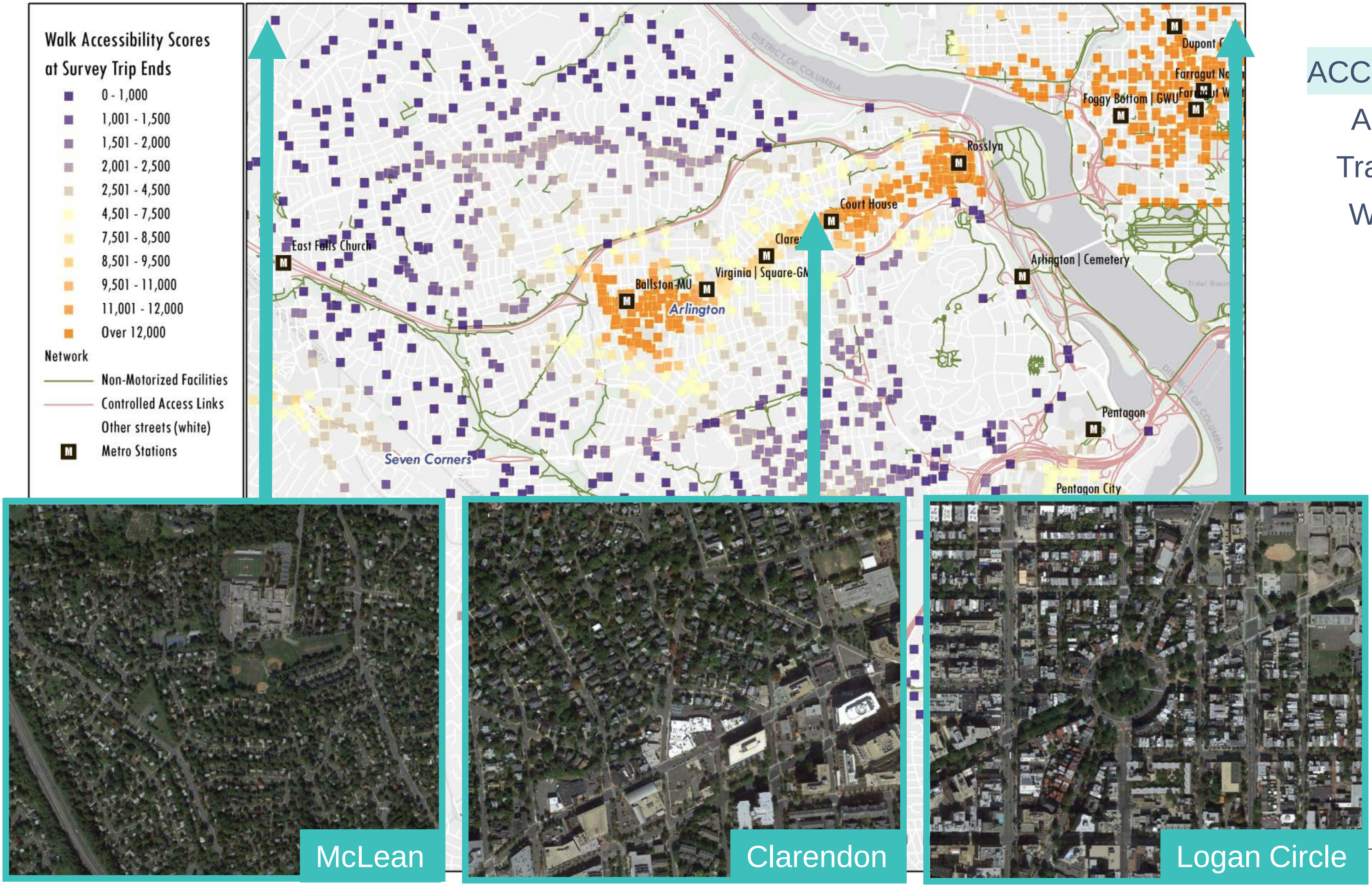
- Literally: the number of ‘gravity-weighted’ **opportunities** reachable from an origin
- Difficult to define thresholds or targets
  - Destination opportunities
  - Decay curves
  - Regional variation

Walk accessibility (multimodal accessibility)

Walk demand (multimodal demand)

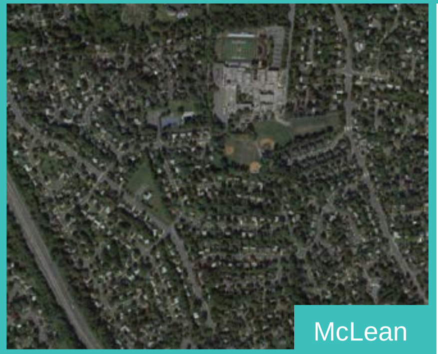
EXAMPLES OF COMPARITIVE ACCESSIBILITY SCORES

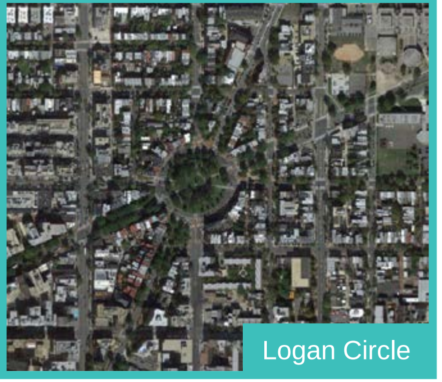
WALK ACCESSIBILITY SCORES AT SURVEY TRIP END LOCATIONS

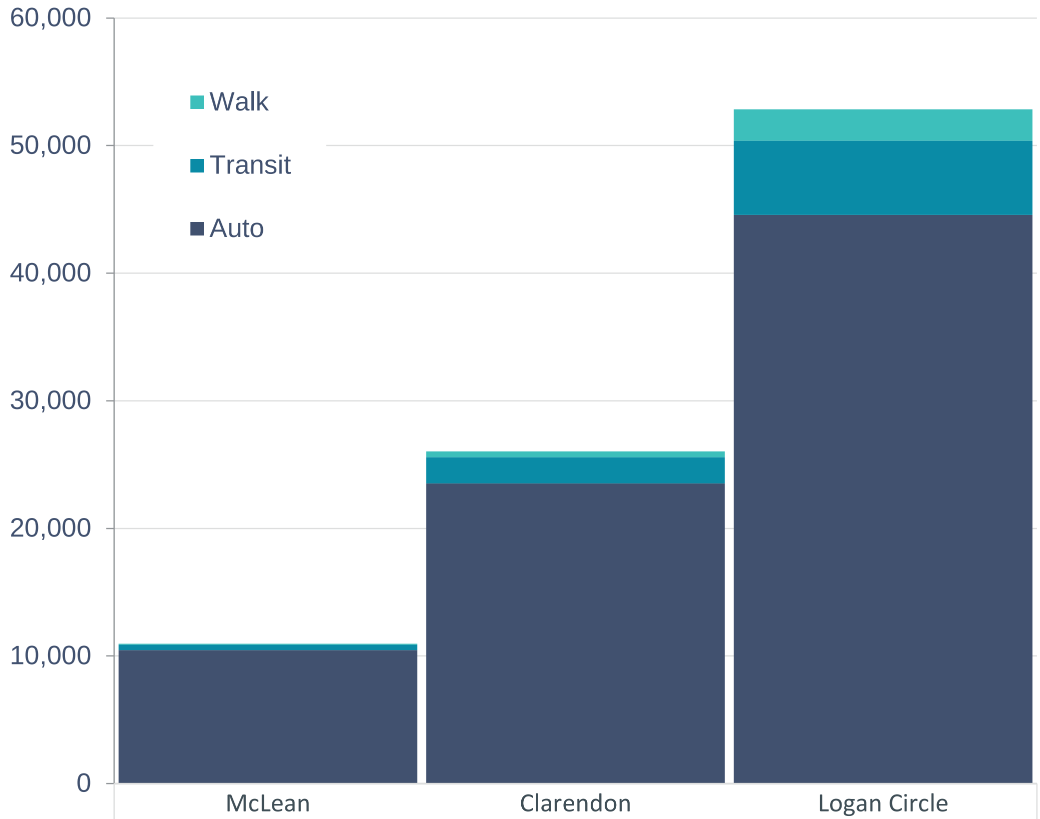


	McLean	Clarendon	Logan Circle
ACCESSIBILITY SCORES			
Auto	10,464	23,536	44,570
Transit	426	2,055	5,822
Walk	63	433	2,452

EXAMPLES OF COMPARITIVE ACCESSIBILITY SCORES



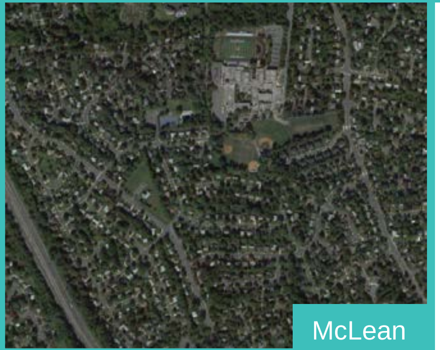


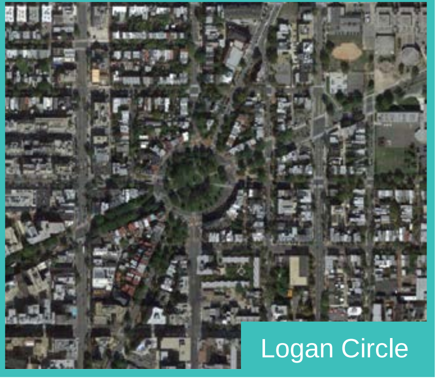


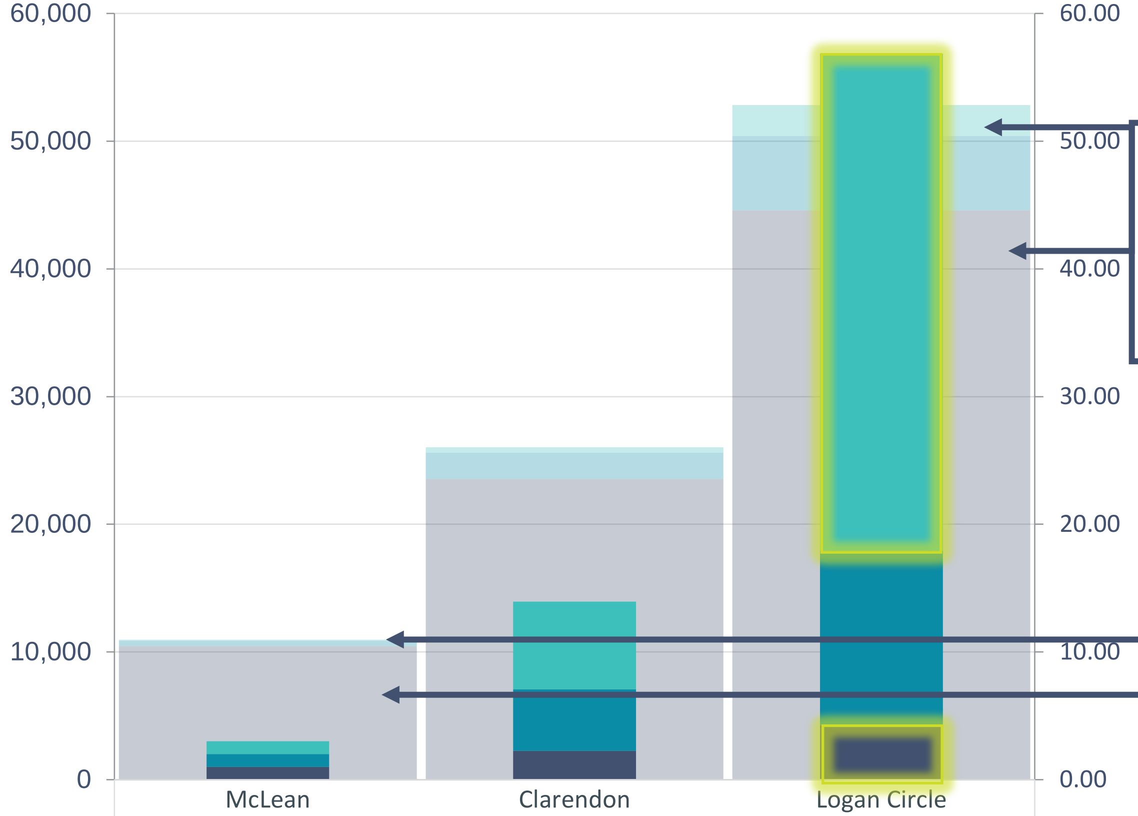
	McLean	Clarendon	Logan Circle
Walk	63	433	2,452
Transit	426	2,055	5,822
Auto	10,464	23,536	44,570

McLean has the lowest scores, so let’s treat it as a baseline condition

EXAMPLES OF COMPARITIVE ACCESSIBILITY SCORES







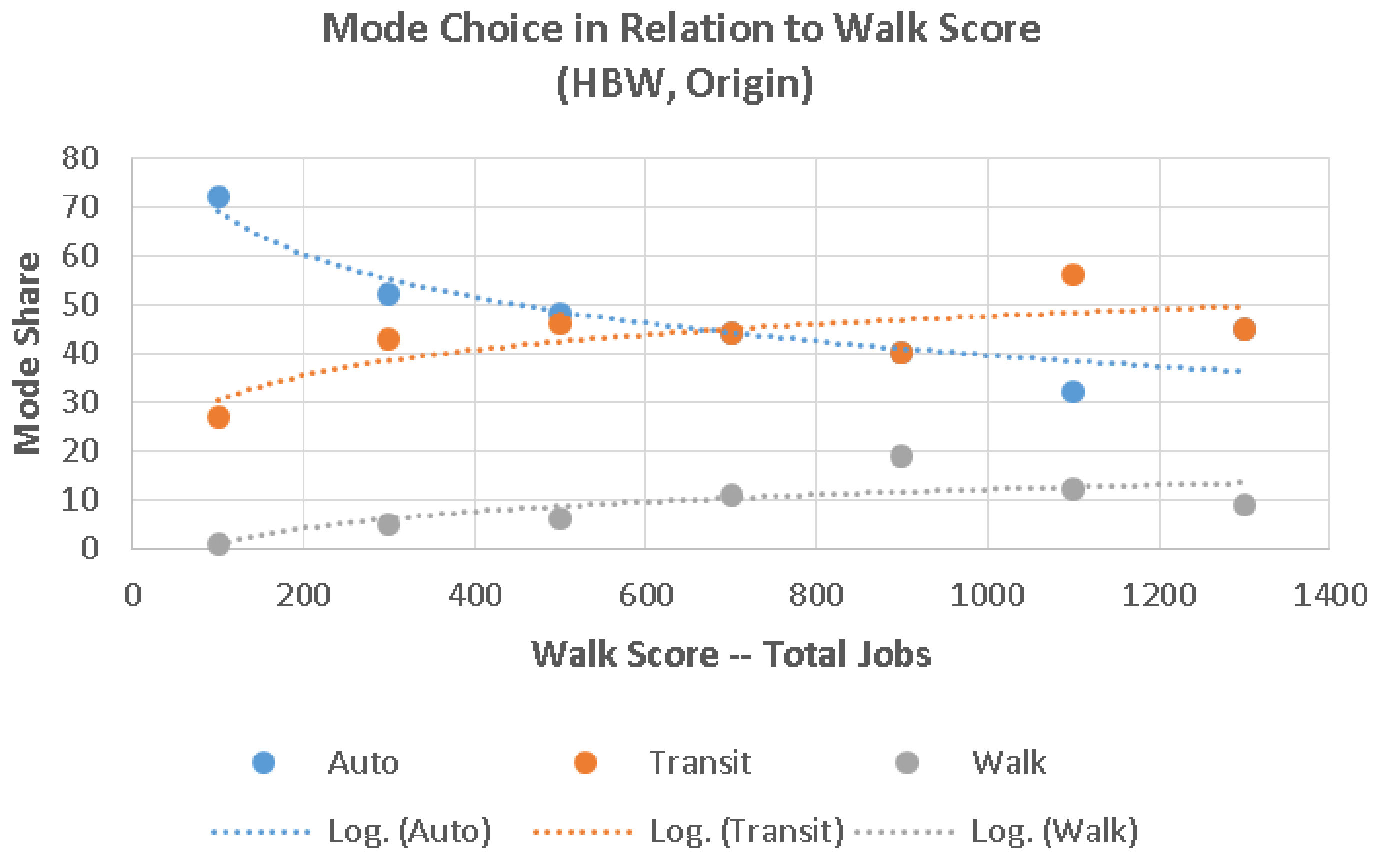
	McLean	Clarendon	Logan Circle
Walk	63	433	2,452
Transit	426	2,055	5,822
Auto	10,464	23,536	44,570
Walk	1.00	6.87	38.92
Transit	1.00	4.82	13.67
Auto	1.00	2.25	4.26

Logan Circle's auto access value is greater than McLean's by a factor of 4

Logan Circle's walk access value is nearly **40 times** greater than McLean's

NMT MODE SPLIT	
McLean	8%
Clarendon	21%
Logan Circle	41%

RELATING ACCESSIBILITY TO MODE SHARE

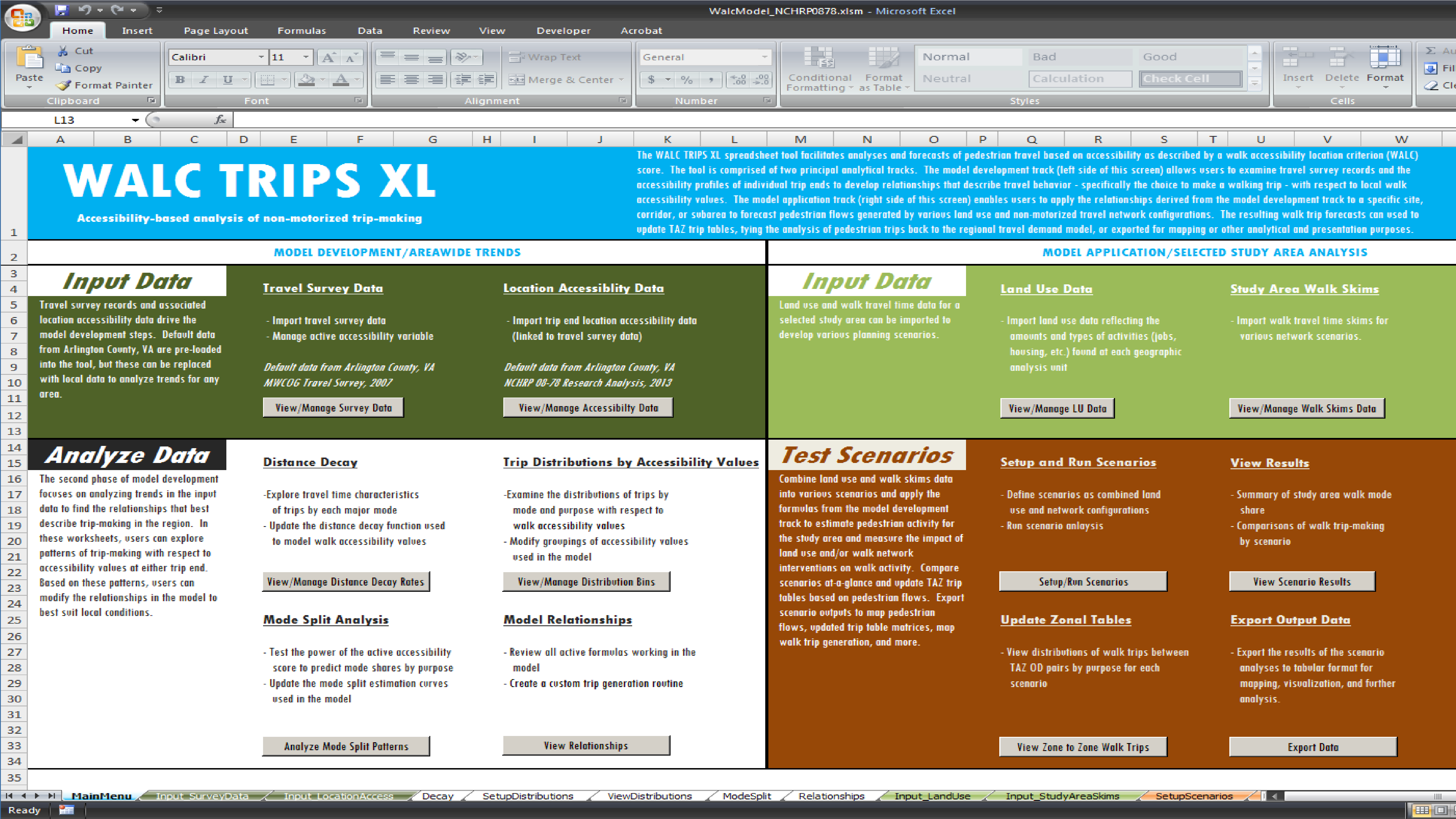


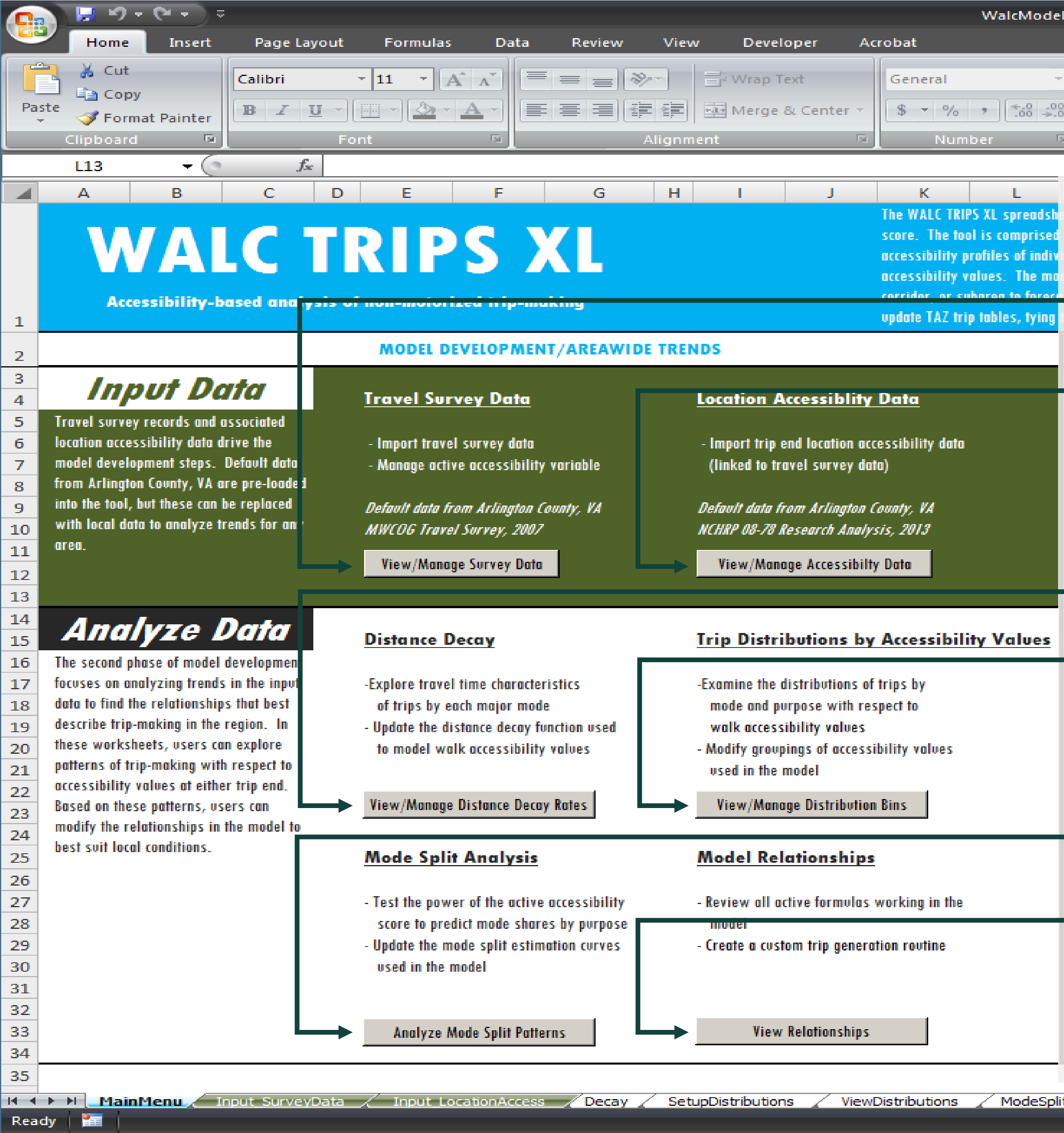
- Found simple relationships that allow estimation of **mode shares** based on **walk accessibility**
- Transferability of relationships unknown but results are encouraging

4 WALC TRIPS XL

A SPREADSHEET TOOL TO FACILITATE PLANNING

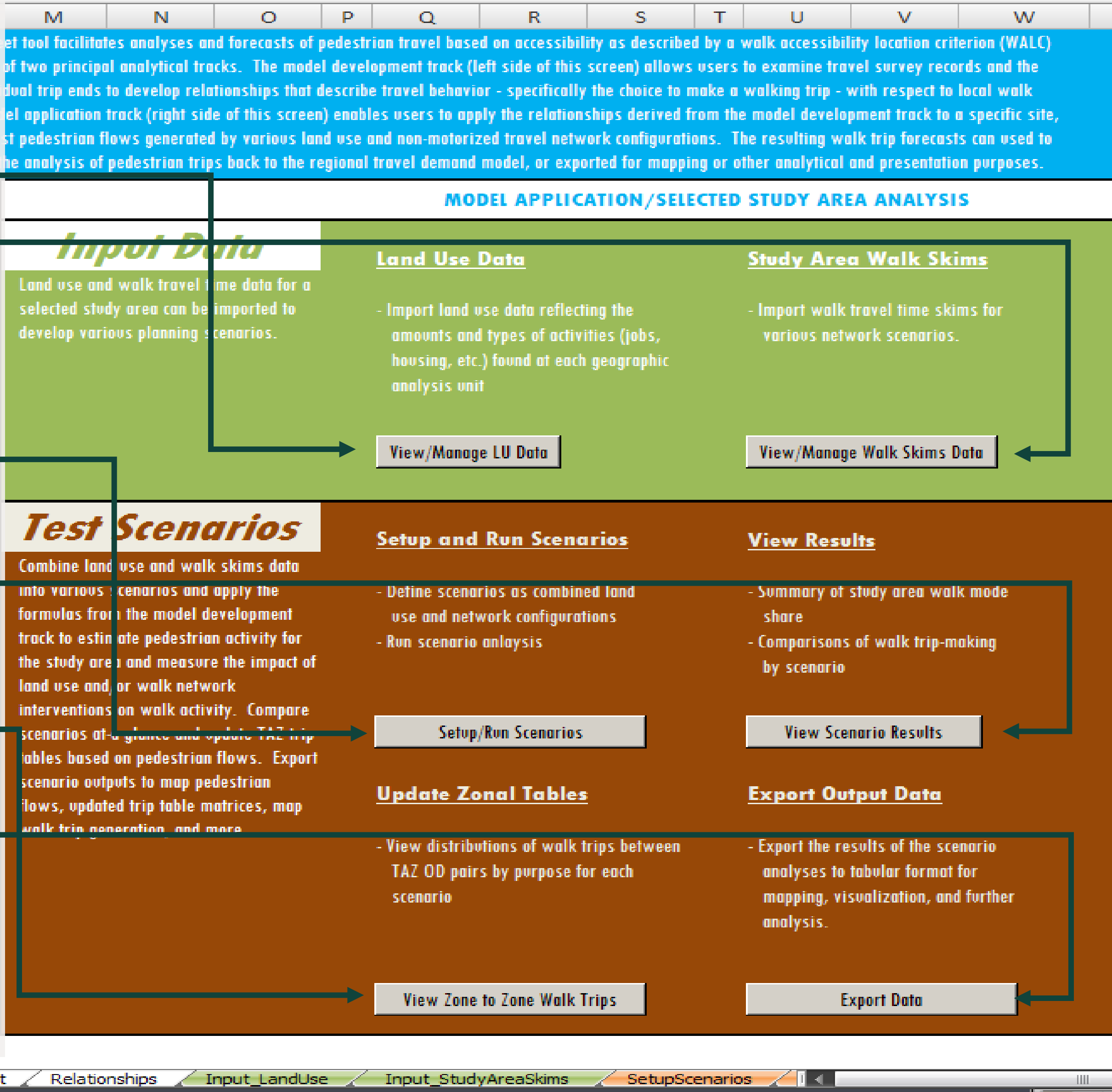
- Best suited to neighborhood-scale analyses
- Allows users to import data developed in a GIS or similar modeling environment
- Facilitates execution of model development and model application steps


WalcModel_NCHRP0878.xlsm - Microsoft Excel
Home
Insert
Page Layout
Formulas
Data
Review
View
Developer
Acrobat
Paste
Cut
Copy
Format Painter
Clipboard
Calibri
11
Font
Wrap Text
Merge & Center
Alignment
General
Number
Conditional Formatting
Format as Table
Normal
Bad
Good
Neutral
Calculation
Check Cell
Styles
Insert
Delete
Format
Cells
L13
WALC TRIPS XL
Accessibility-based analysis of non-motorized trip-making
The WALC TRIPS XL spreadsheet tool facilitates analyses and forecasts of pedestrian travel based on accessibility as described by a walk accessibility location criterion (WALC) score. The tool is comprised of two principal analytical tracks. The model development track (left side of this screen) allows users to examine travel survey records and the accessibility profiles of individual trip ends to develop relationships that describe travel behavior - specifically the choice to make a walking trip - with respect to local walk accessibility values. The model application track (right side of this screen) enables users to apply the relationships derived from the model development track to a specific site, corridor, or subarea to forecast pedestrian flows generated by various land use and non-motorized travel network configurations. The resulting walk trip forecasts can used to update TAZ trip tables, tying the analysis of pedestrian trips back to the regional travel demand model, or exported for mapping or other analytical and presentation purposes.
MODEL DEVELOPMENT/AREAWIDE TRENDS
MODEL APPLICATION/SELECTED STUDY AREA ANALYSIS
Input Data
Travel survey records and associated location accessibility data drive the model development steps. Default data from Arlington County, VA are pre-loaded into the tool, but these can be replaced with local data to analyze trends for any area.
Travel Survey Data
- Import travel survey data
- Manage active accessibility variable
Default data from Arlington County, VA MWCOG Travel Survey, 2007
View/Manage Survey Data
Location Accessiblity Data
- Import trip end location accessibility data (linked to travel survey data)
Default data from Arlington County, VA NCHRP 08-78 Research Analysis, 2013
View/Manage Accessibilty Data
Input Data
Land use and walk travel time data for a selected study area can be imported to develop various planning scenarios.
Land Use Data
- Import land use data reflecting the amounts and types of activities (jobs, housing, etc.) found at each geographic analysis unit
View/Manage LU Data
Study Area Walk Skims
- Import walk travel time skims for various network scenarios.
View/Manage Walk Skims Data
Analyze Data
The second phase of model development focuses on analyzing trends in the input data to find the relationships that best describe trip-making in the region. In these worksheets, users can explore patterns of trip-making with respect to accessibility values at either trip end. Based on these patterns, users can modify the relationships in the model to best suit local conditions.
Distance Decay
-Explore travel time characteristics of trips by each major mode
- Update the distance decay function used to model walk accessibility values
View/Manage Distance Decay Rates
Trip Distributions by Accessibility Values
-Examine the distributions of trips by mode and purpose with respect to walk accessibility values
- Modify groupings of accessibility values used in the model
View/Manage Distribution Bins
Mode Split Analysis
- Test the power of the active accessibility score to predict mode shares by purpose
- Update the mode split estimation curves used in the model
Analyze Mode Split Patterns
Model Relationships
- Review all active formulas working in the model
- Create a custom trip generation routine
View Relationships
Test Scenarios
Combine land use and walk skims data into various scenarios and apply the formulas from the model development track to estimate pedestrian activity for the study area and measure the impact of land use and/or walk network interventions on walk activity. Compare scenarios at-a-glance and update TAZ trip tables based on pedestrian flows. Export scenario outputs to map pedestrian flows, updated trip table matrices, map walk trip generation, and more.
Setup and Run Scenarios
- Define scenarios as combined land use and network configurations
- Run scenario anlaysis
Setup/Run Scenarios
View Results
- Summary of study area walk mode share
- Comparisons of walk trip-making by scenario
View Scenario Results
Update Zonal Tables
- View distributions of walk trips between TAZ OD pairs by purpose for each scenario
View Zone to Zone Walk Trips
Export Output Data
- Export the results of the scenario analyses to tabular format for mapping, visualization, and further analysis.
Export Data
MainMenu
Input_SurveyData
Input_LocationAccess
Decay
SetupDistributions
ViewDistributions
ModeSplit
Relationships
Input_LandUse
Input_StudyAreaSkims
SetupScenarios
Ready



- Model development tools:
  - Survey data
    - Trip records with mode, travel time, purpose information
    - Trip end accessibilities
    - These support the development of mode split relationships
  - Evaluate/apply distance decay based on survey data
  - View frequency distributions of trips by accessibility scores (at O or D end)
    - Relies on binning scores – an exercise in nuance
  - Analyze walk mode split (and others) by accessibility group
  - Review model relationships
    - Decay, mode split (internal)
    - Trip gen (external)

- Model application tools:
  - Study area data
    - Land units (blocks, parcels, e.g.)
    - Activities data (jobs, pop, e.g.)
    - Walk skims (usually from GIS)
  - Set up and run scenarios
    - Mix and match land use and walk network scenarios
  - View scenario results
    - Walk trips by mode and purpose
  - Use findings to update TAZ trip tables
  - Export data for use in other applications



WALC TRIPS XL

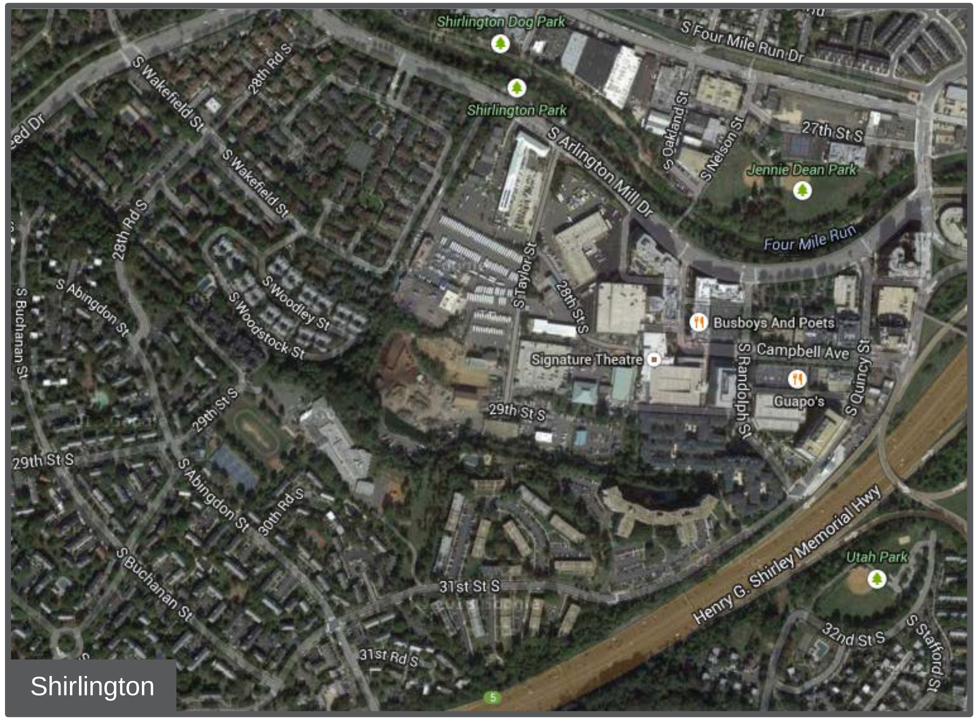
Outputs

- View summary of changes in walk trip-making
- Update TAZ trip table based on distribution of walk trips
- Export outputs for mapping, visualization, or additional analysis

5 EXAMPLE APPLICATION

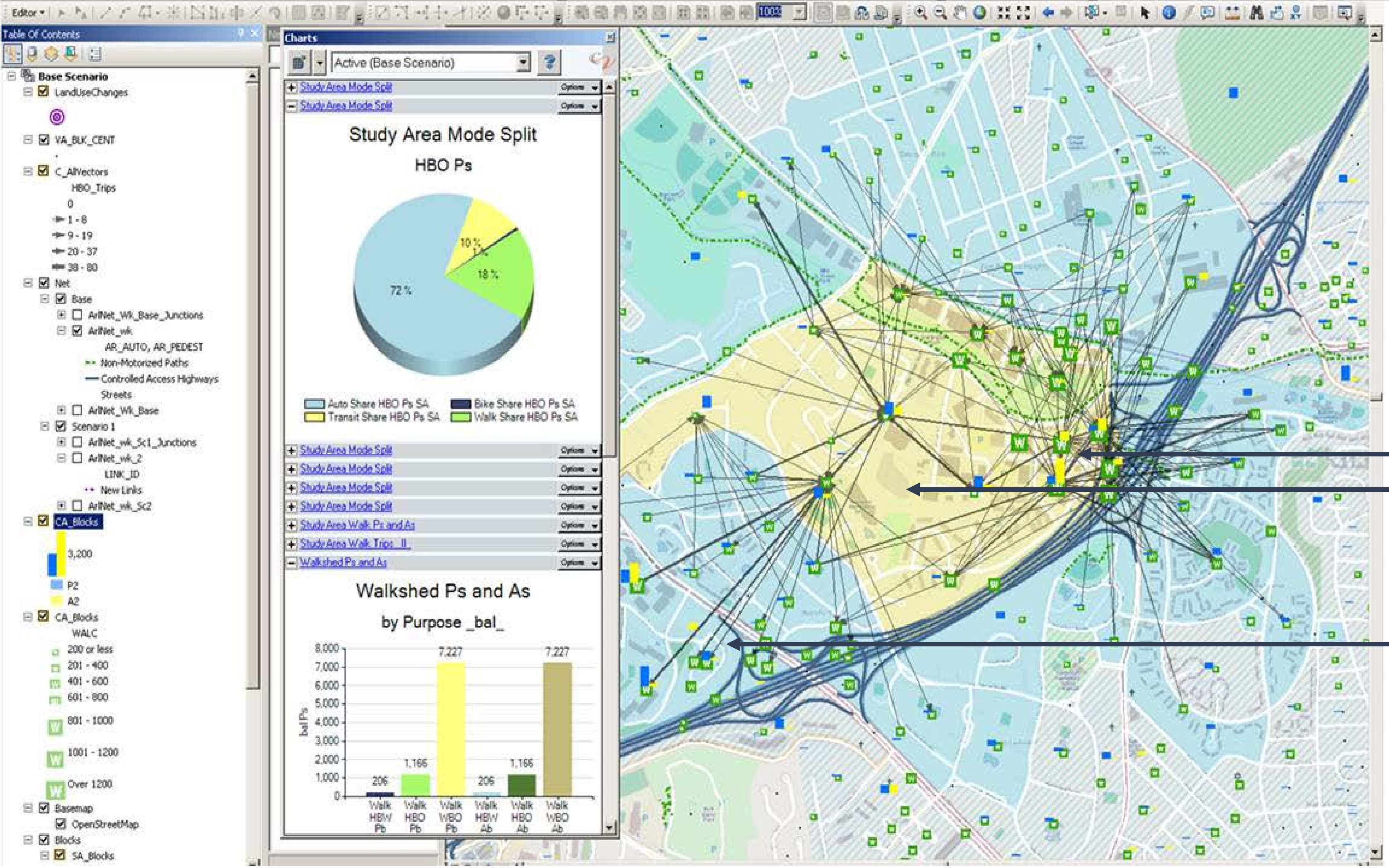
SHIRLINGTON EXAMPLE (HYPOTHETICAL)

- Mixed use center
- Not a TOD but well-served by multiple bus routes
- Less than optimal walking connections between center and surrounding neighborhoods



EXAMPLE APPLICATION

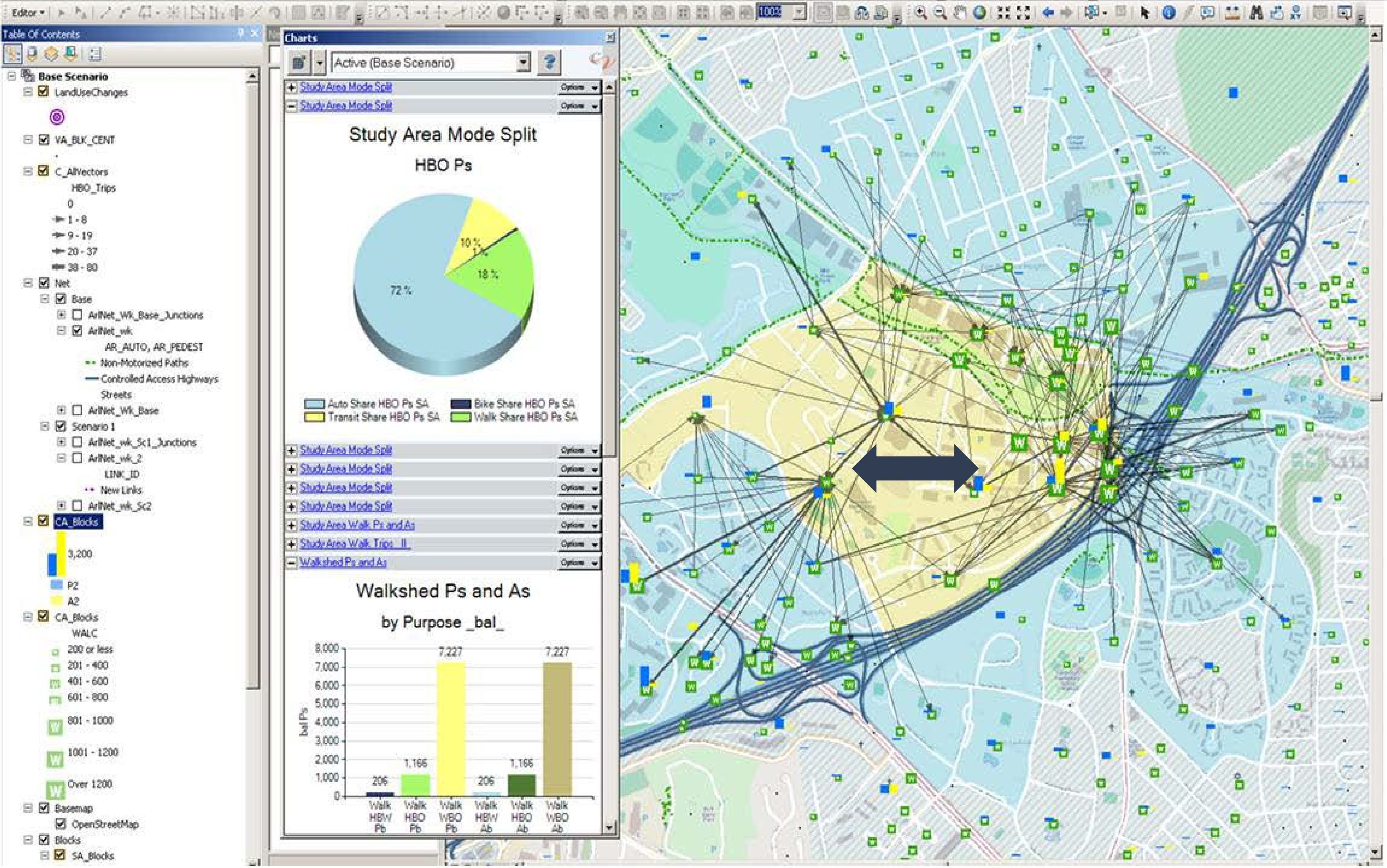
SHIRLINGTON EXAMPLE (HYPOTHETICAL)



Estimated pedestrian demand in existing condition

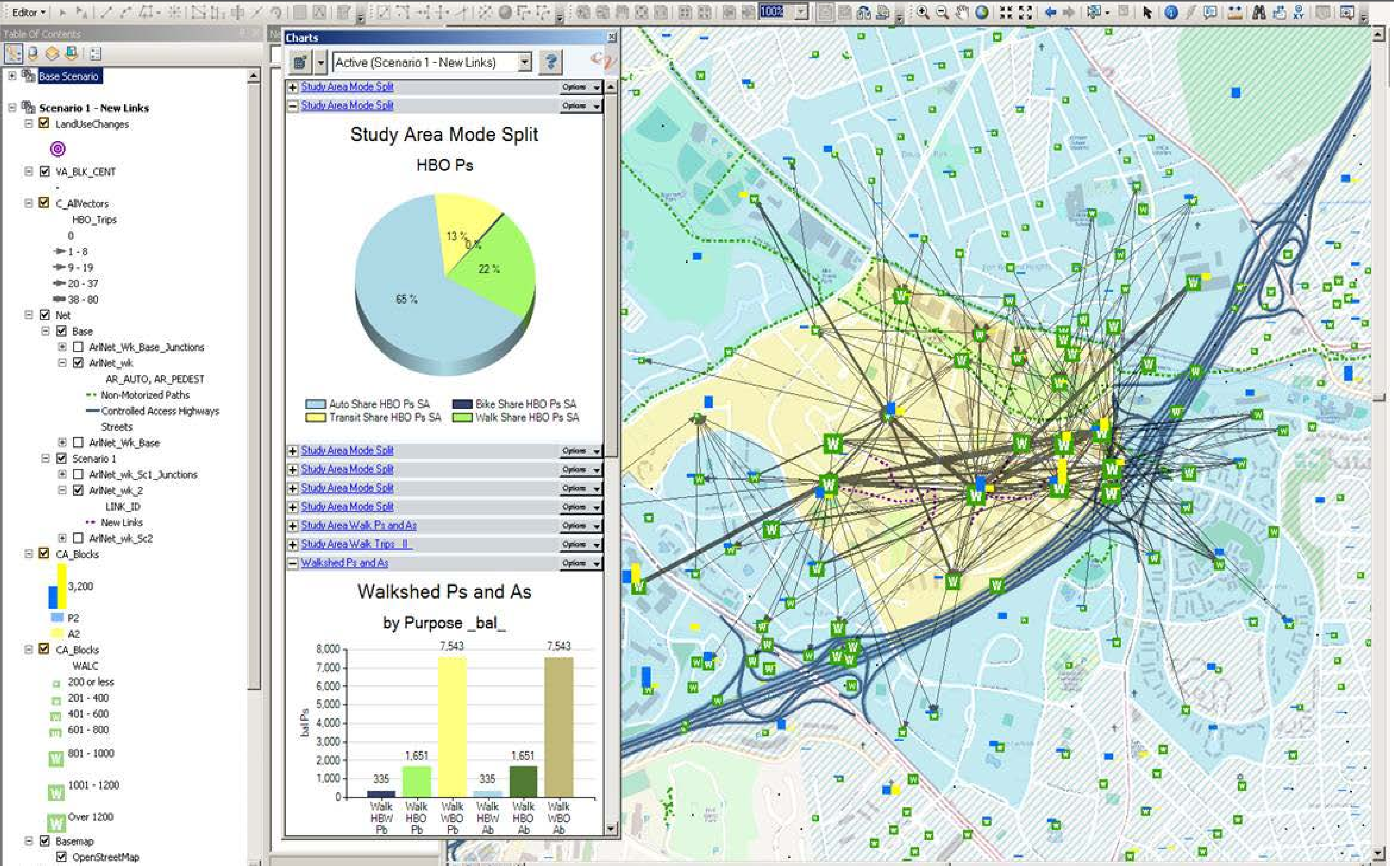
- Areas of major trip **production** and **attraction**
- Limited **connectivity**

SHIRLINGTON EXAMPLE (HYPOTHETICAL)



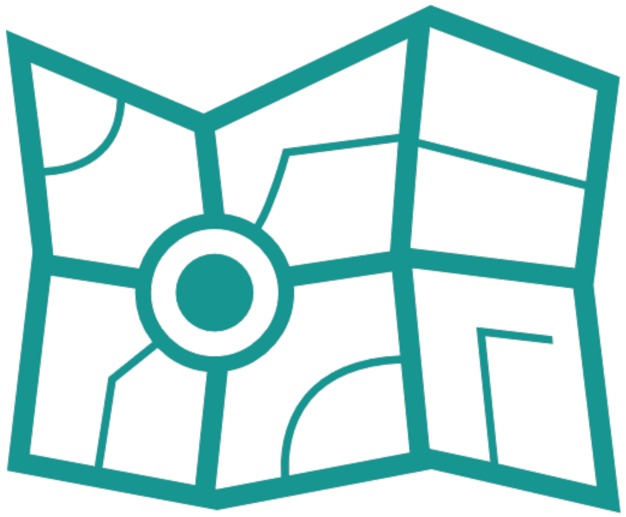
- Modeled new connections

SHIRLINGTON EXAMPLE (HYPOTHETICAL)



- New connections engender increased pedestrian activity

SUMMARY



- Elegant and promising approach to estimating and forecasting pedestrian demand
- Bike models less reliable (small sample size)
- Evolving toolkit
  - Conceptual advancement outpacing beta tests
  - Applicability to many other planning applications
  - Multimodal dynamics

RENAISSANCE PLANNING

Part 4: Examples

Rich Kuzmyak

RECENT APPLICATIONS

- Washington, DC (MWCOG TLC Grant) – Healthy by Design Guidelines for Affordable Housing
- Asheville, NC - Multimodal Accessibility Analysis in Support of Bicycle and Pedestrian Planning & Programming
- Maryland Route 355 Multimodal Corridor Study (Maryland DOT)

Transportation and Land Use Coordination (TLC) project

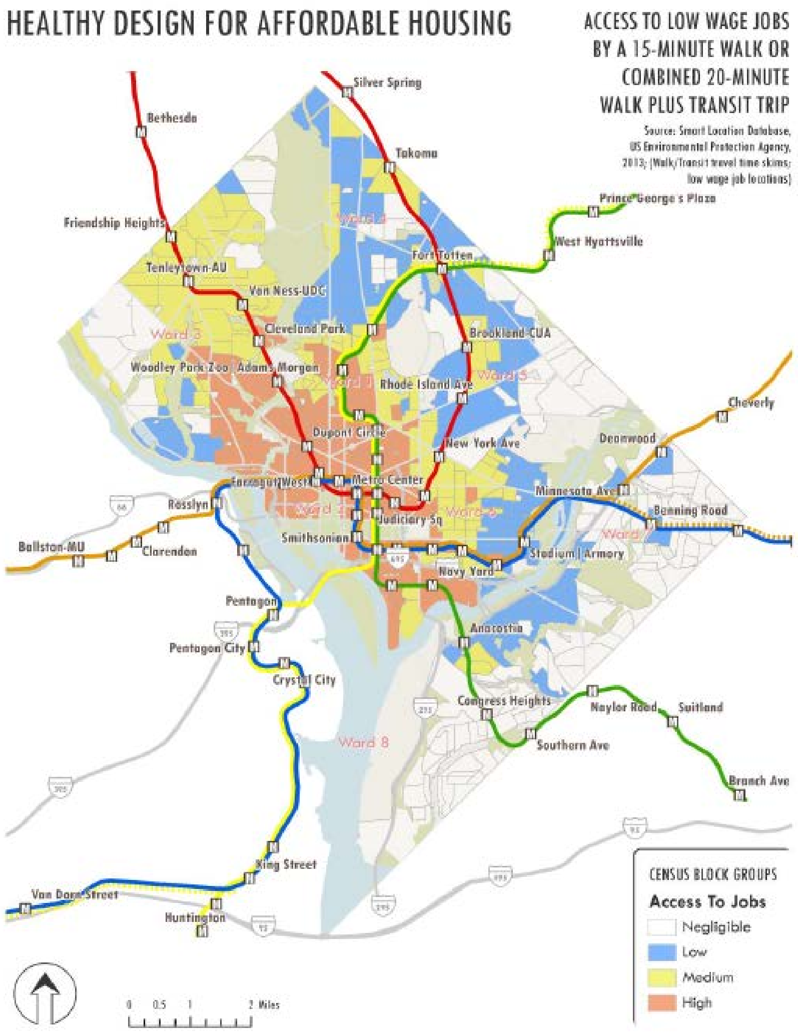
Develop guidelines for optimal locations for affordable housing in DC, based on:

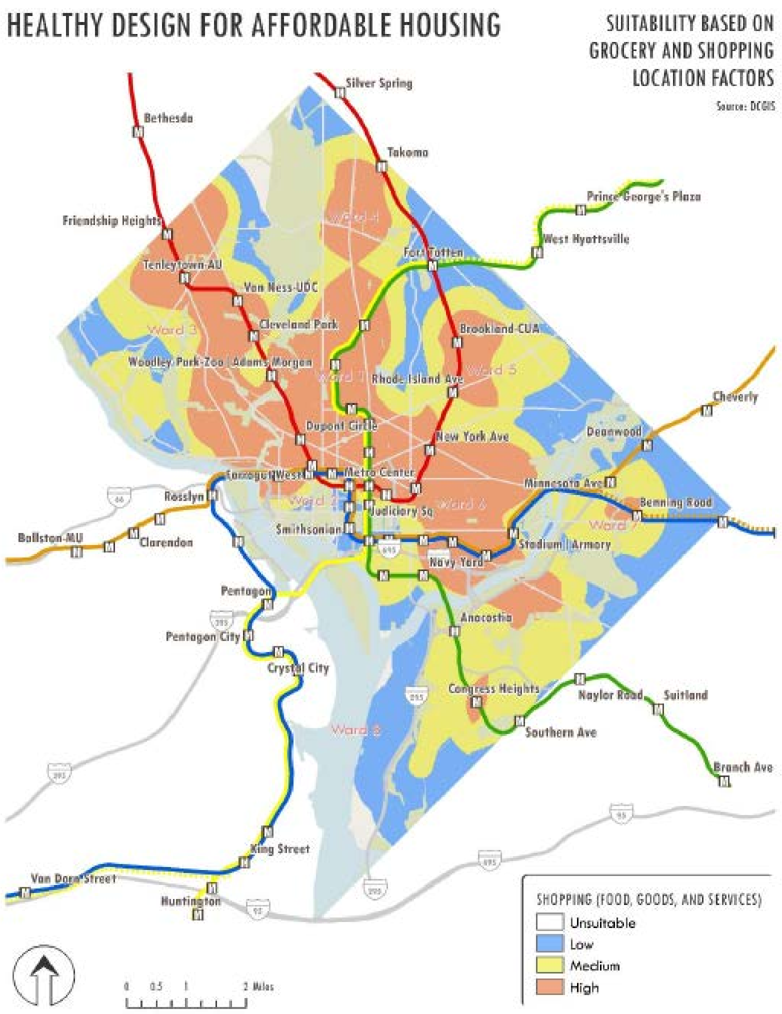
- Multimodal transportation (walk, bike, transit) access to key opportunities
  - Jobs
  - Schools
  - Fresh food retailers
  - Health care & services
  - Parks & open space
- *Away from:*
  - Environmental hazards
  - Fast food
  - Liquor stores

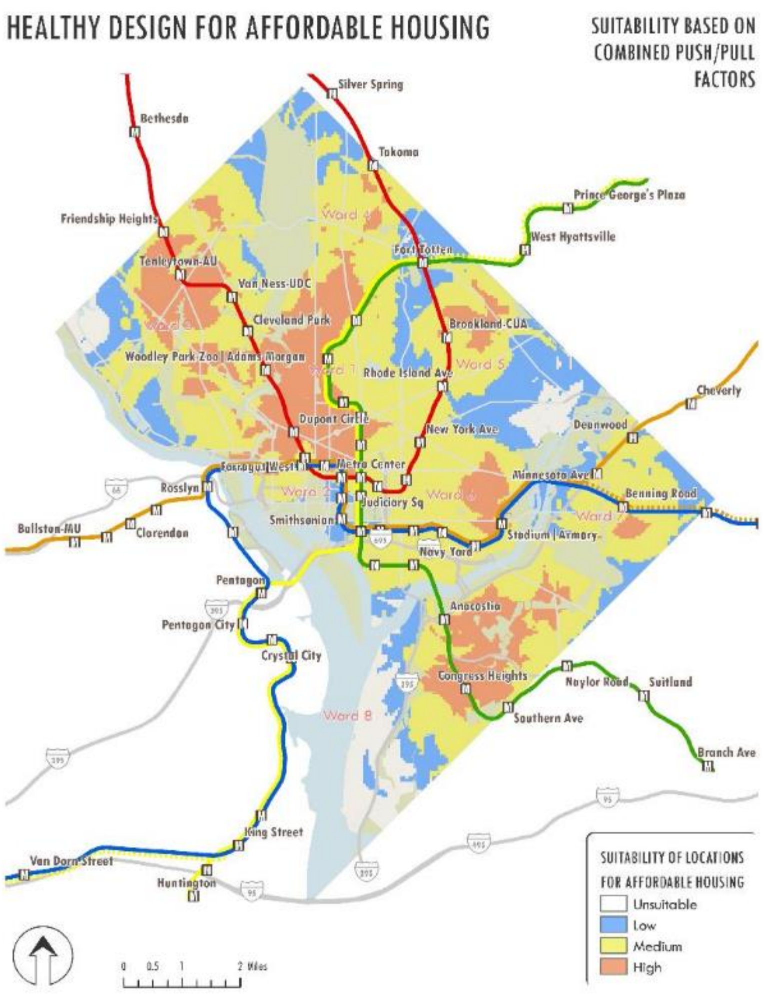
Location & Accessibility + Site & Building Design

Within 15 minute walk or combined 20 minute walk + transit

USED ACCESSIBLITY MAPPING TO IDENTIFY BEST LOCATIONS







MWCOG/TLC HEALTHY BY DESIGN FOR AFFORDABLE HOUSING

RESULTS

- Maps clearly delineate comparative advantages of different locations based on respective criteria
- Overlaying maps – including *undesirable* uses -- allows for multiple criteria identification of candidate locations
- Provides Washington DC with direction on where to target its affordable housing efforts and/or where accessibility enhancements are needed

EXAMPLES

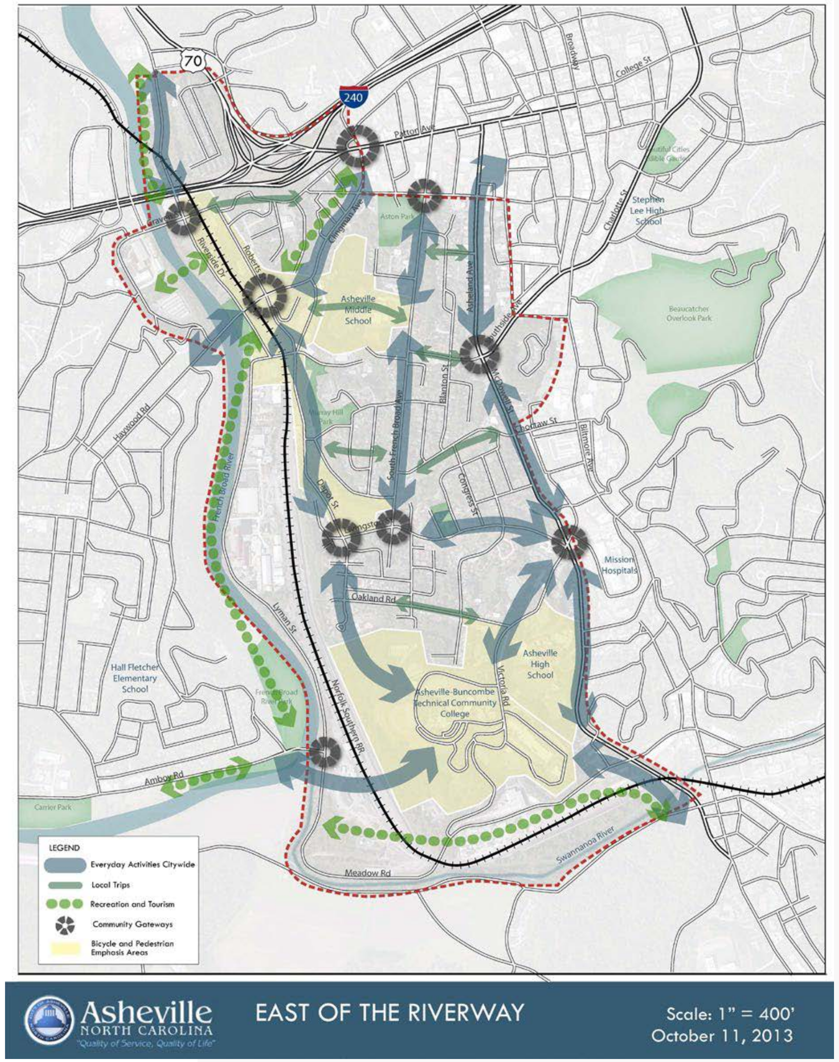
EAST OF THE RIVERWAY TRANPORTATION NETWORK PLAN

The Project:

- Asked to prepare comprehensive multimodal network plan for 1,100 acre tract under TIGER grant
- Also to further develop 6-mile network of pedestrian, bicycle, roadway and streetscape improvements

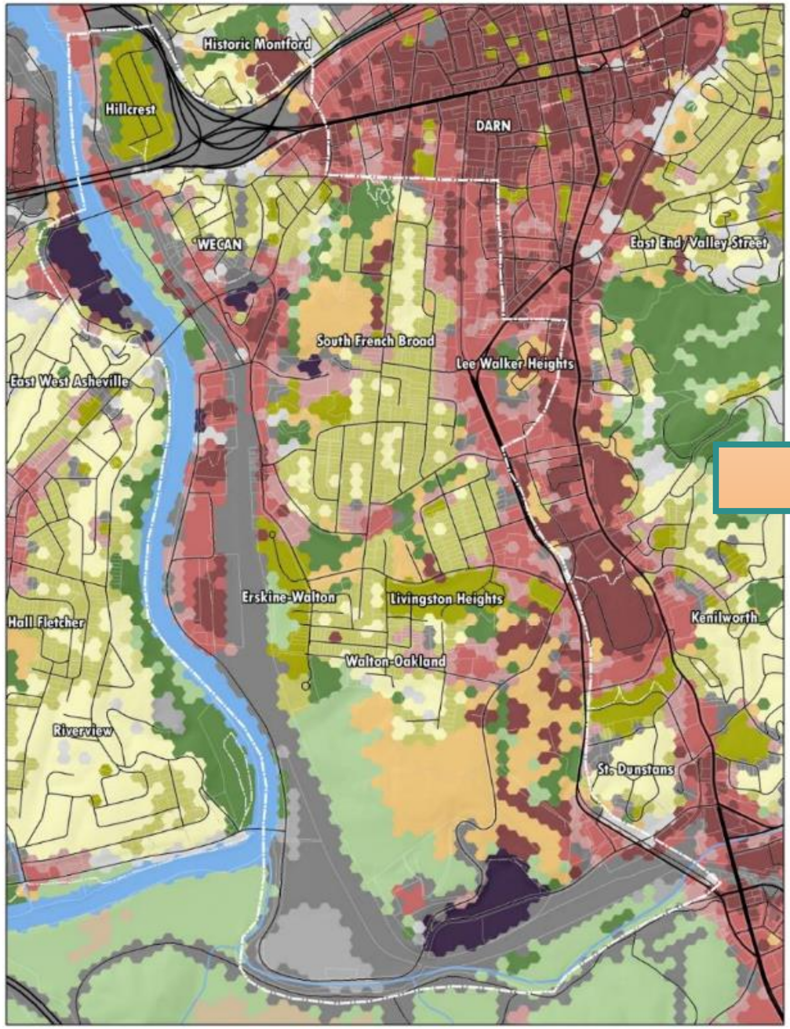
The Goals:

- Improving connectivity to, from and within the area
- Strengthening existing neighborhoods
- Improving multimodal access to jobs, housing, services
- Reducing vehicle dependency and VMT

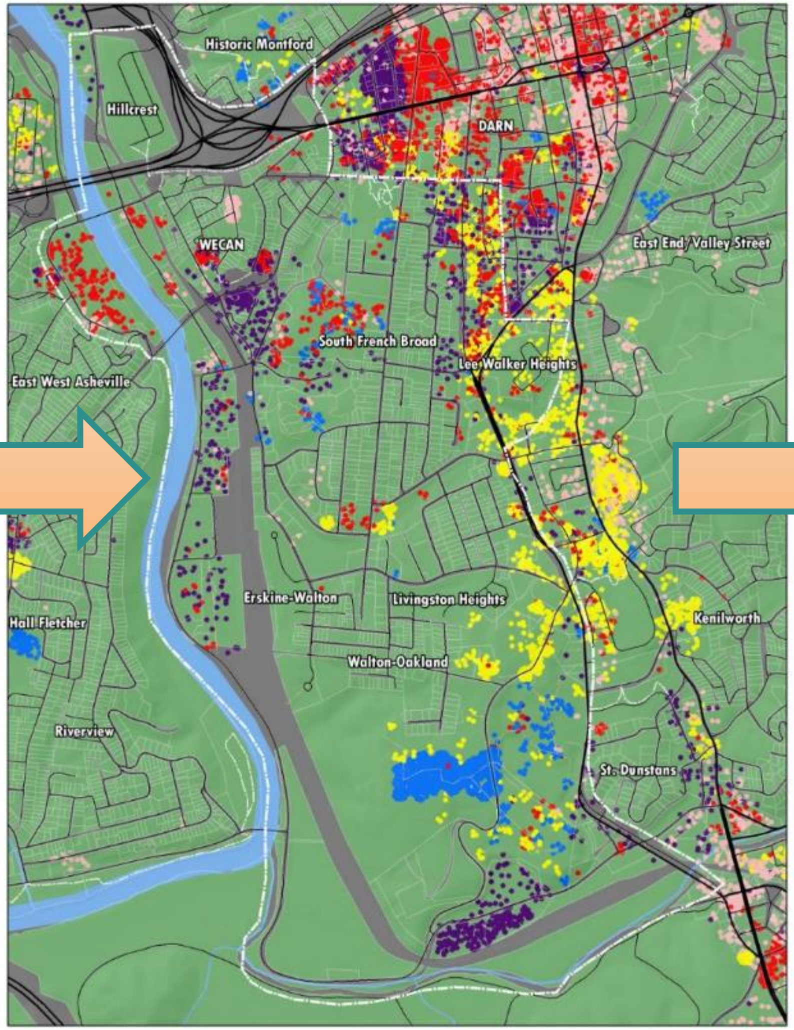


ASHEVILLE MULTIMODAL TRANSPORTATION NETWORK PLAN

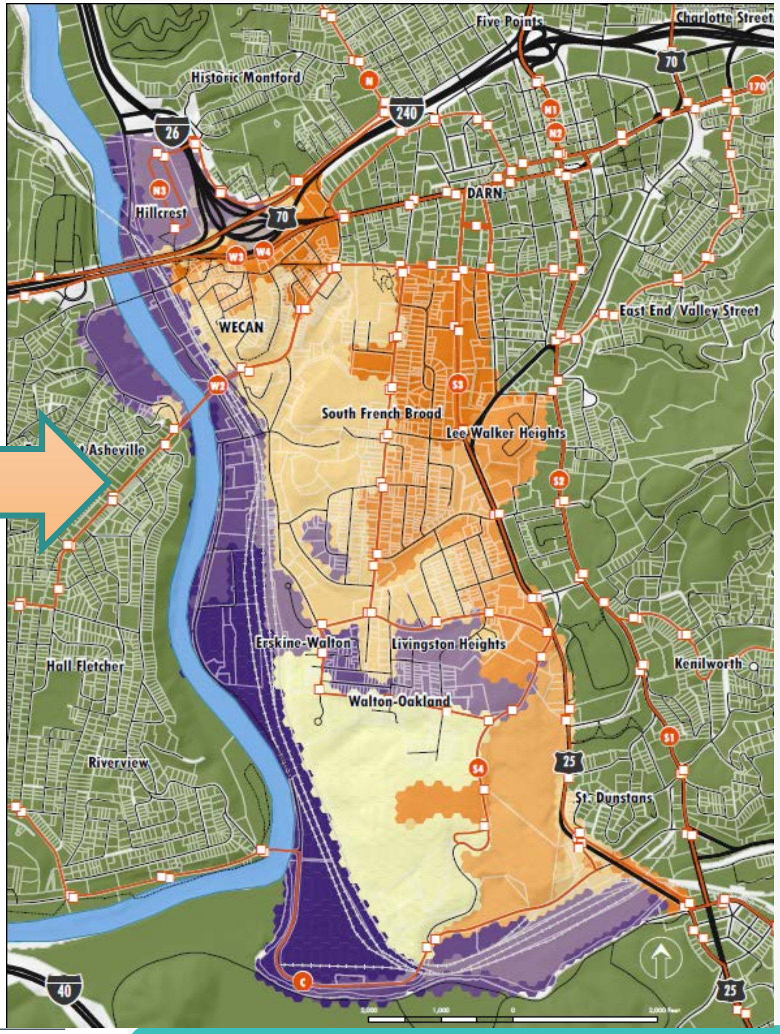
1. Mapped Existing Land Use



2. Quantify Resid, Emp, Commercial Activity



3. Calculate Accessibility Scores

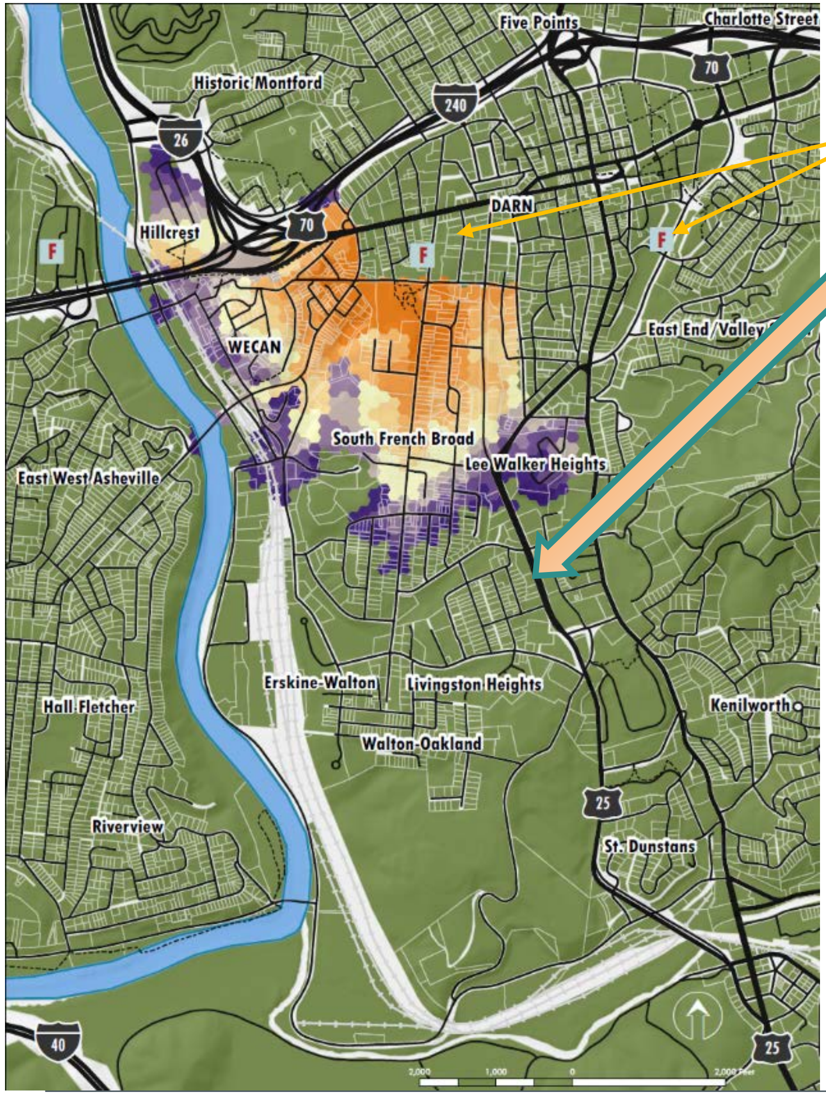


Asheville Multimodal Network

Value and Findings

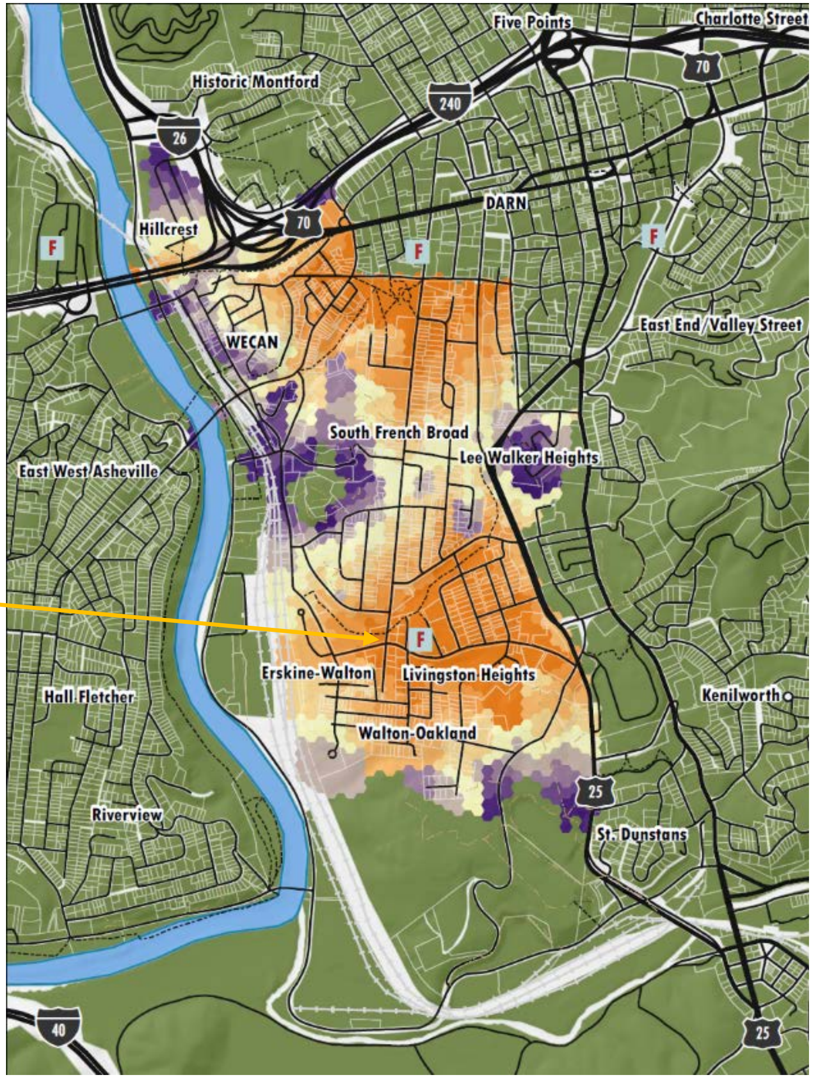
- Maps used to support public meetings to identify transportation concerns and opportunities – greatly enhanced stakeholder involvement
- Clearly show patterns in accessibility based on existing and planned land use and network features
- Able to focus assessment on specific population or travel markets, modal opportunities
- Help identify which improvements are most beneficial
- Identify whether transportation or land use interventions are most important

EXAMINE ACCESSIBILITY NEEDS



Discover poor access to food markets for disadvantaged populations

Best solution – provide new food market! Existing markets too far for walking.

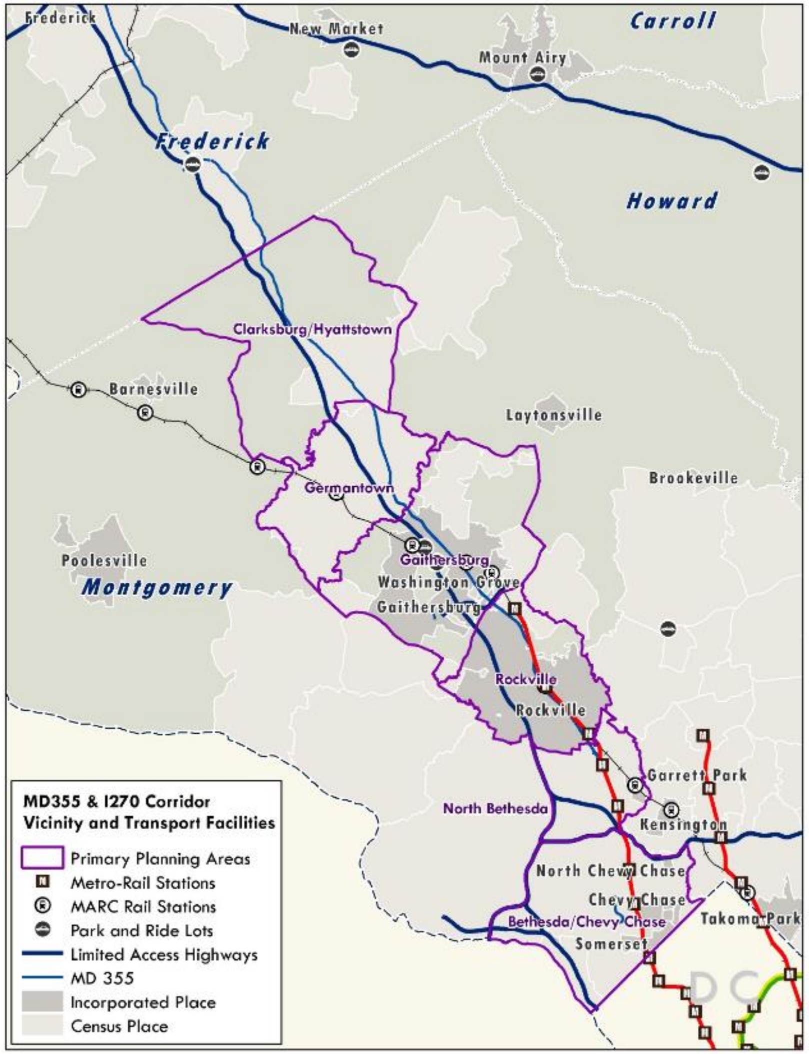


Providing planning and policy support to a state DOT

- Existing tools lack sensitivity for multimodal planning and programming needs
- Important to know about land use, transit, walk/bike
- See potential in NCHRP 8-78 Accessibility Model
- Recommend pilot application in major corridor

Maryland Department of Transportation

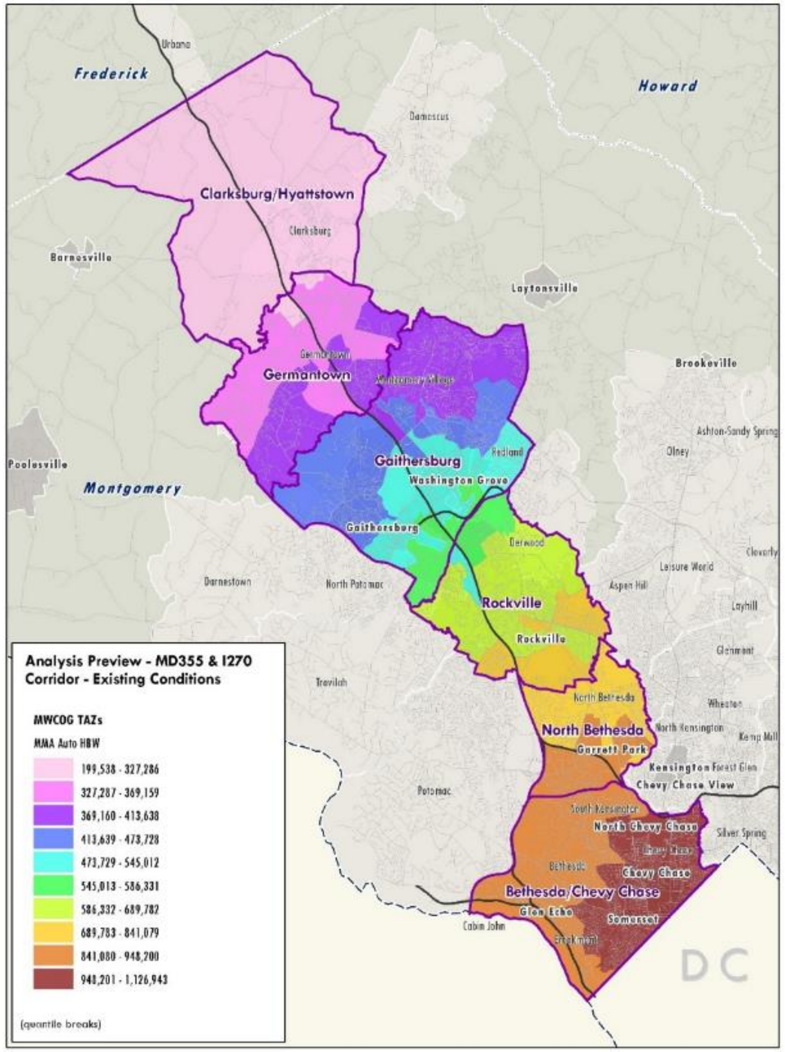
MD 355/I-270 SELECTED AS PILOT CORRIDOR



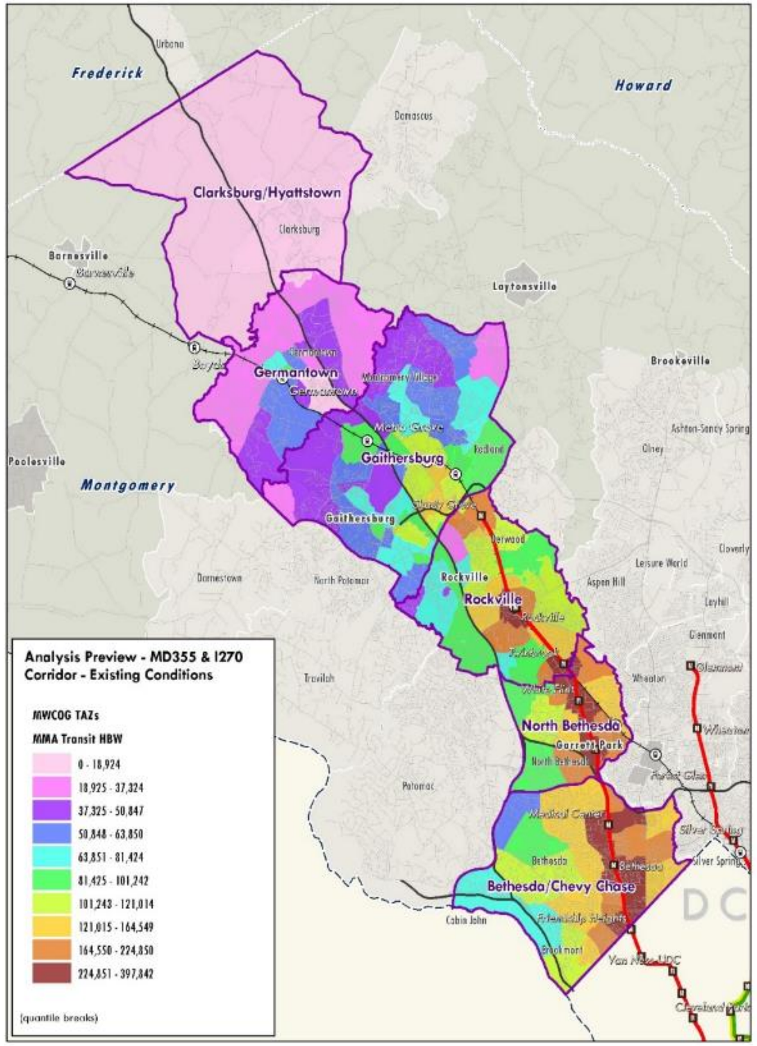
- 26 miles
- I-270 changed MD 355 to "Main Street"
- Metrorail, commuter rail, bus services in place
- Multimodal -- but still very auto-oriented
- Concerns about high growth on future transportation conditions/solutions

CALCULATED & MAPPED ACCESSIBILITY SCORES

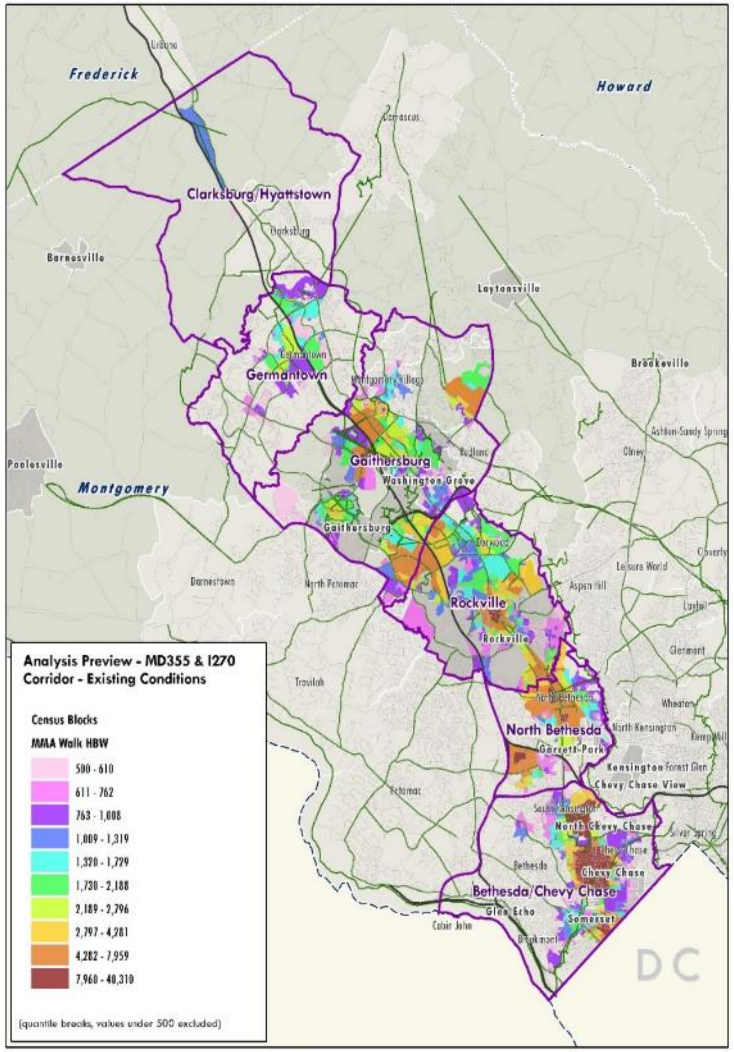
Auto



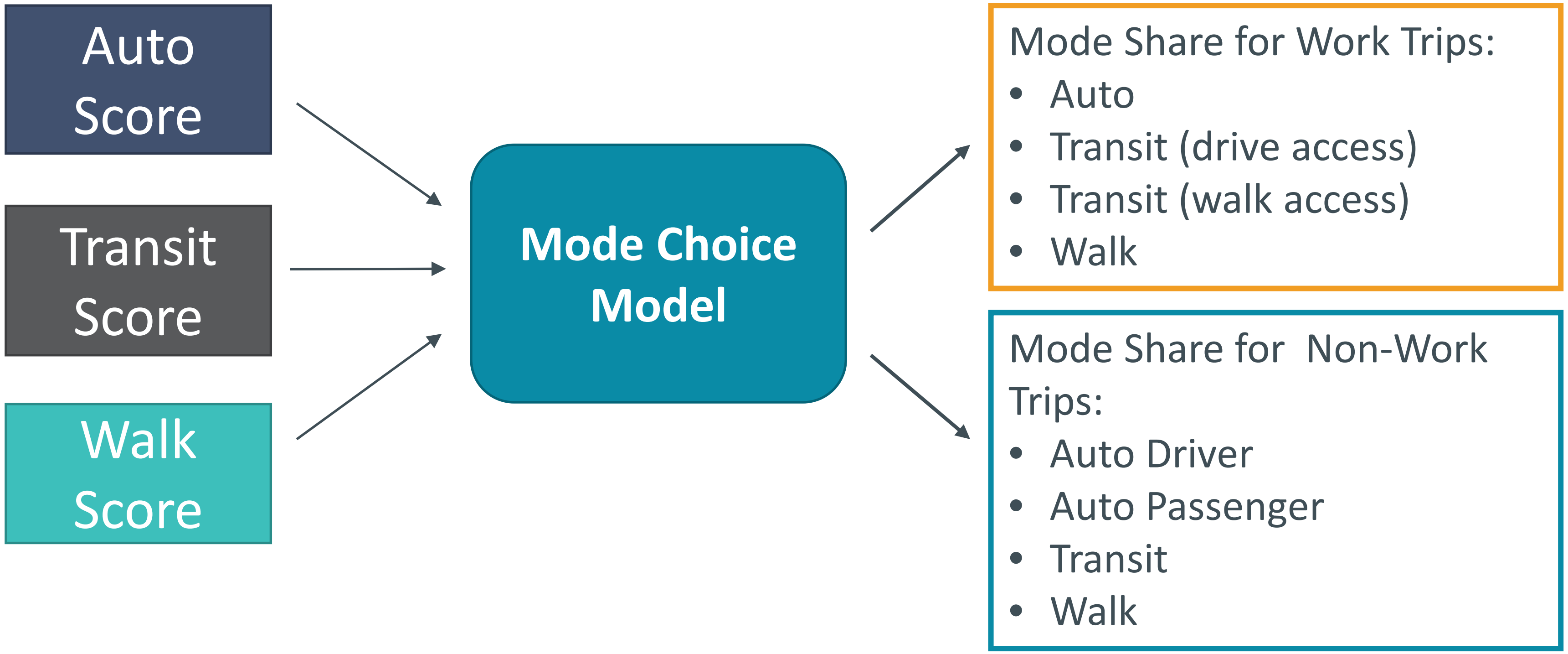
Transit



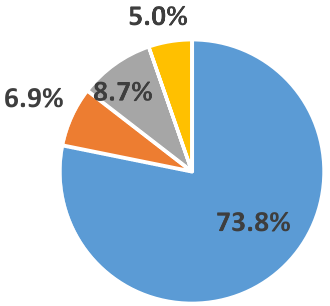
Walk

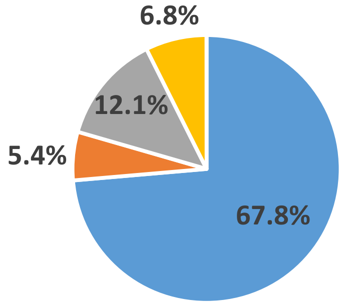


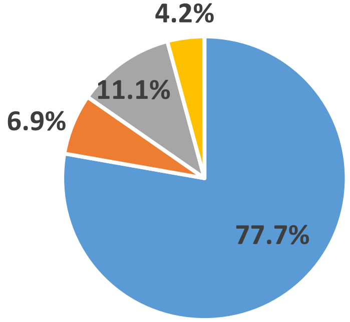
REGRESSION MODEL CONVERTS SCORES TO MODE SHARES

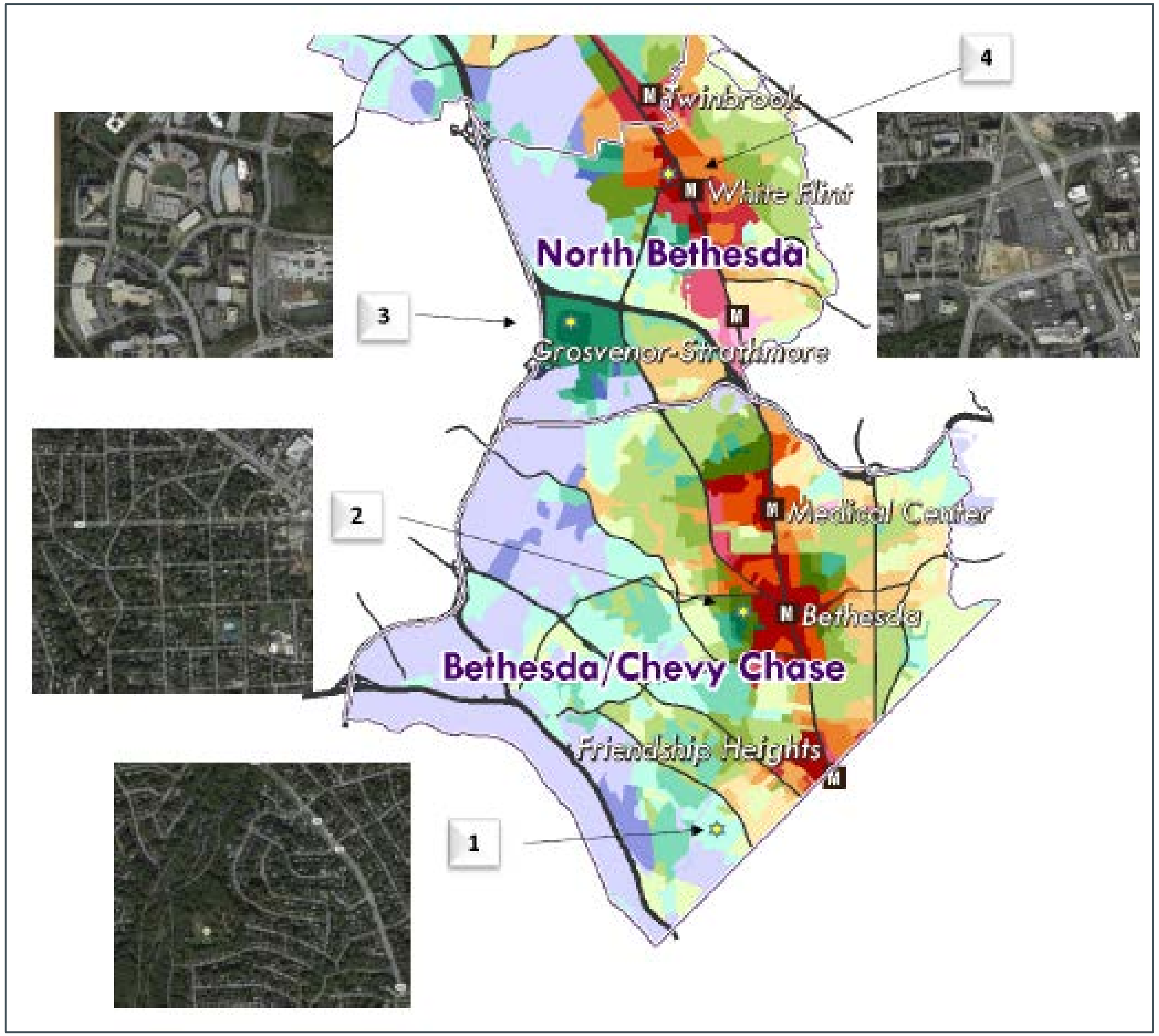


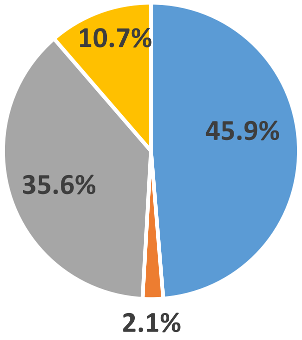
Ability to Use Scores in Any Place to Quantify Relationship Between Land Use, Transportation System and Travel Behavior







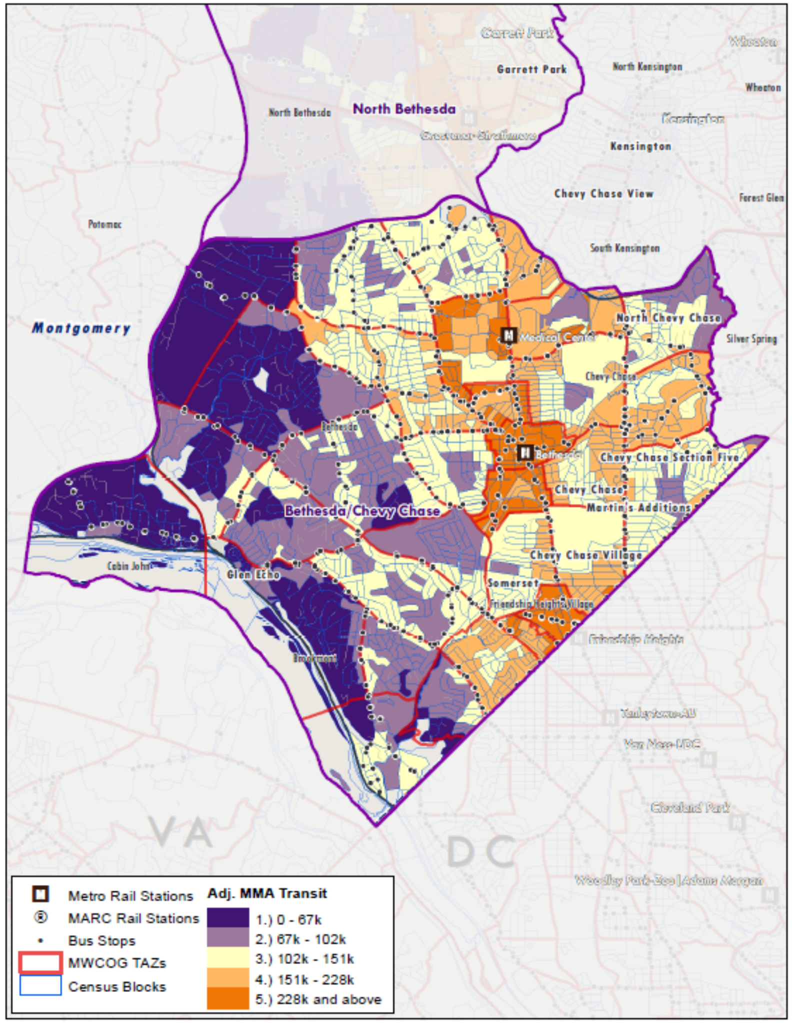




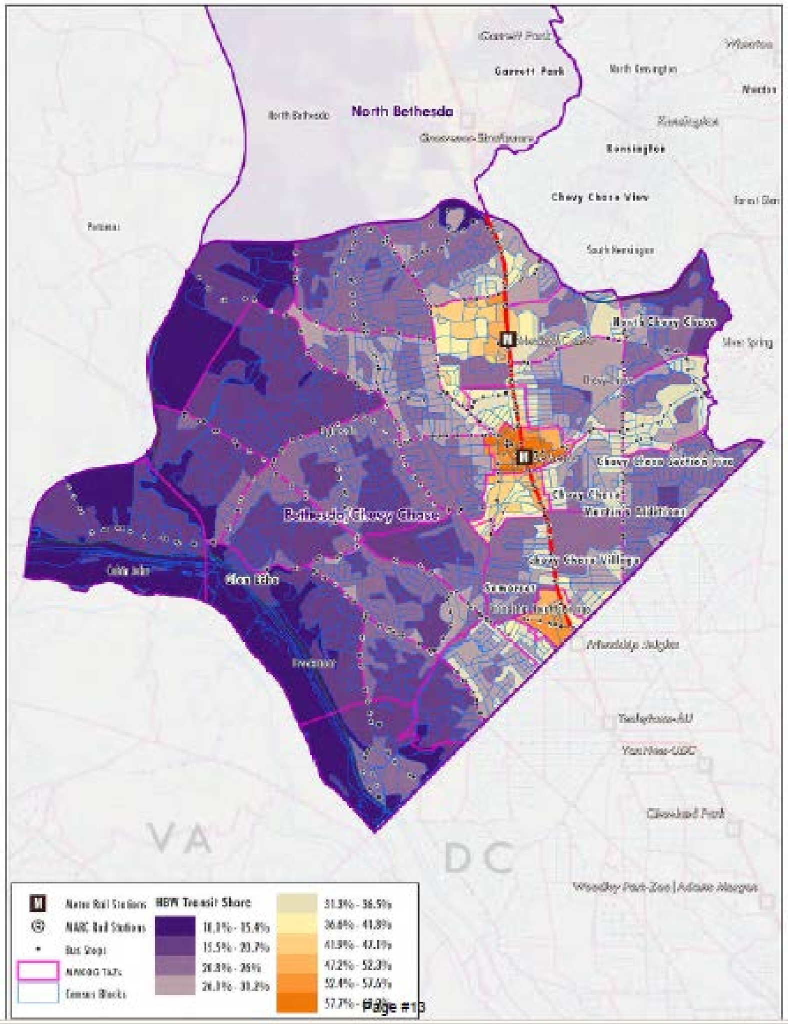
- Auto
- Drive-Transit
- Walk-Transit
- Walk

PREDICTING MODE SHARES AT BLOCK LEVEL

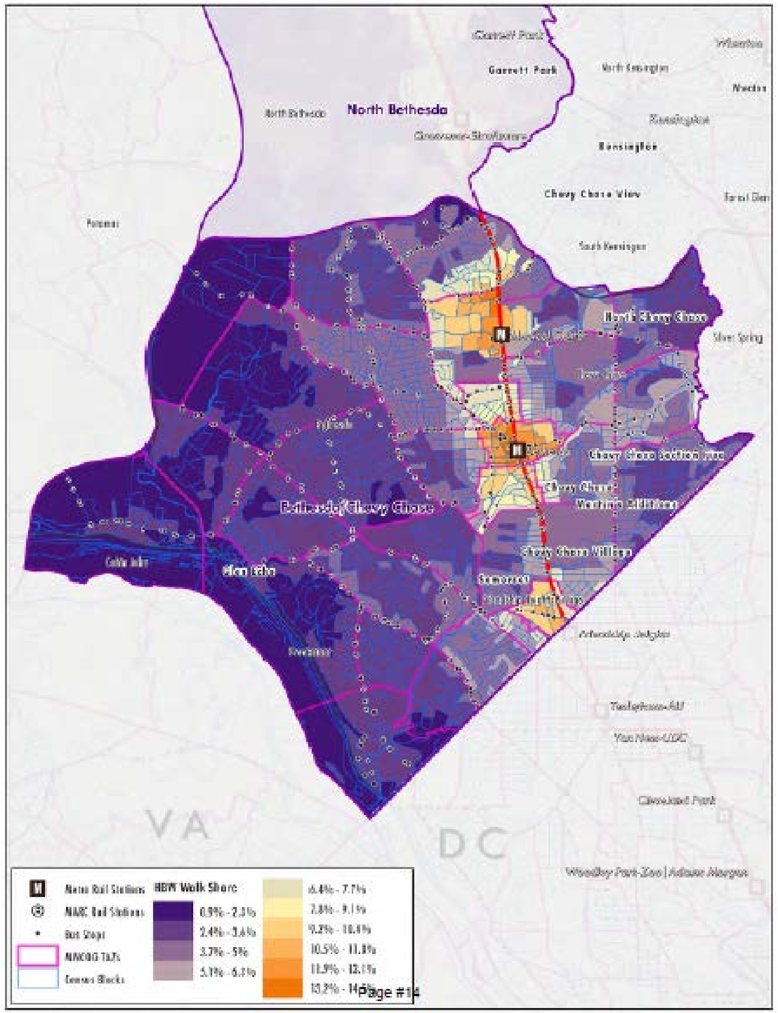
Transit Accessibility: HBW



Transit Mode Share: HBW



Walk Mode Share: HBW

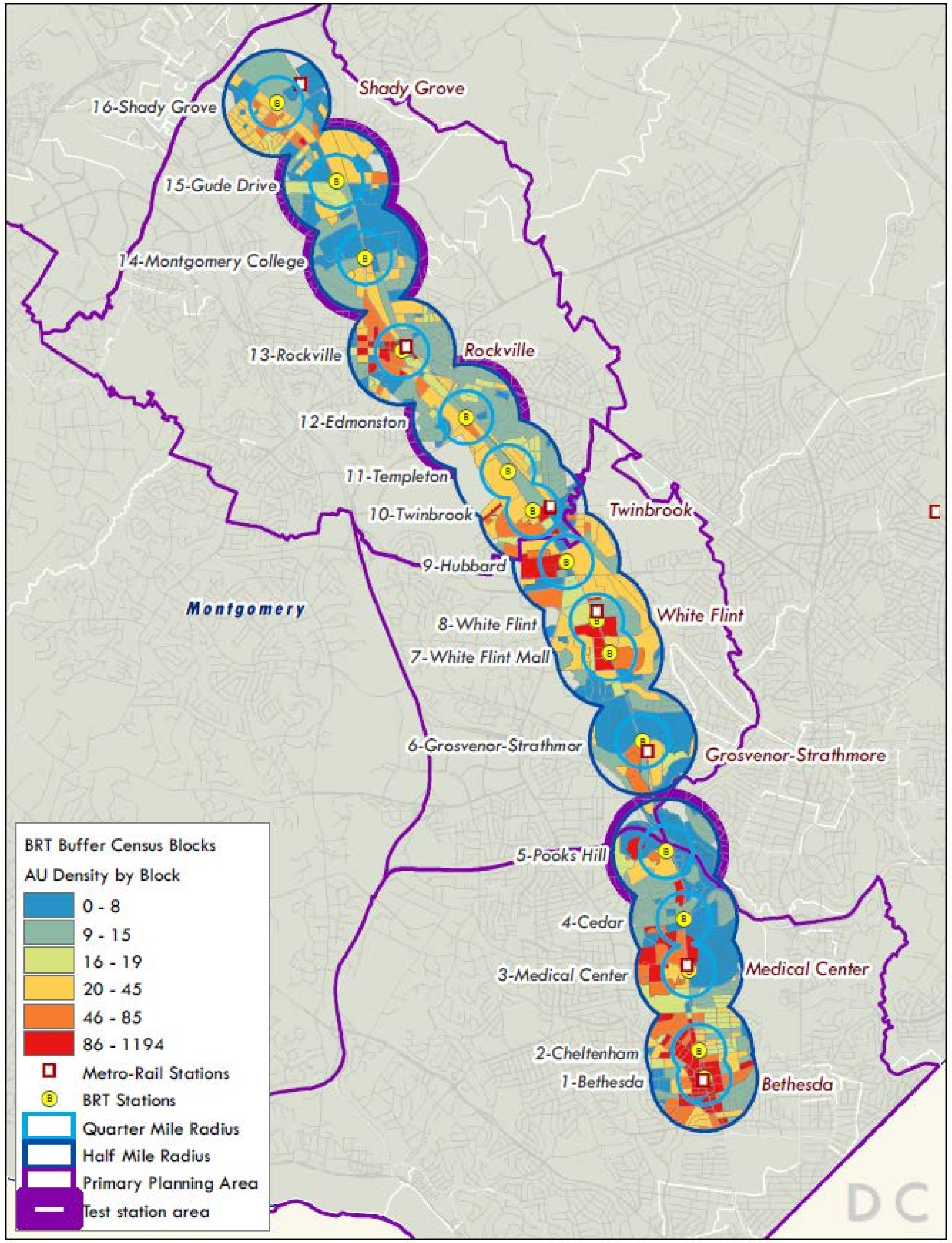


ONGOING WORK

- Expand mapping coverage to all of Central Maryland (MWCOG and BMC) to support multimodal planning studies and project evaluation
- Purpose & Need evaluation of BRT proposals in multiple corridors -- Adequate land use and walk access to support?

GOALS:

- Use platform to stage dialogue with regional, county and municipal planning and transportation agencies
- Eventual use for needs assessment and project prioritization



Part 5: Accessibility-Based Policy Framework for Planning and Project Prioritization

Whit Blanton

A MULTIMODAL ACCESSIBLITY POLICY FRAMEWORK FOR PLANNING AND PROJECT DEVELOPMENT

Transportation Research Board

April 14, 2015
Whit Blanton, FAICP

RENAISSANCE PLANNING

1 INTRODUCTION

Using Multimodal Accessibility to Shape Land Use and Transportation Policies for Public Health

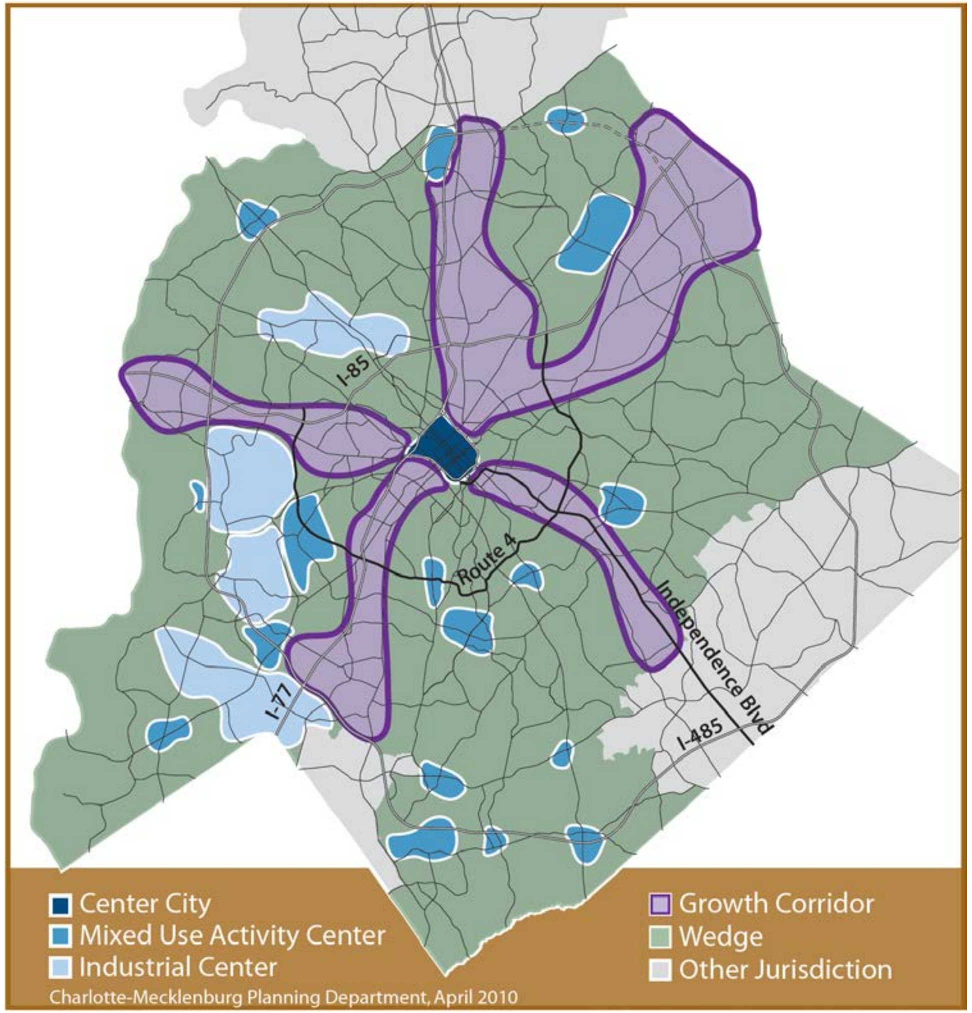
POLICY CONTEXT

- Transportation funding remains the most effective way to guide growth patterns and shape development form, but…
- Tight budgets – funding is increasingly competitive
- Complex environment requires partnerships to align strategies and resources
- Policy makers need clear sense of outcomes and cost implications
- Development community needs a predictable process and clear expectations

WHAT MAKES A GOOD POLICY FRAMEWORK?

- Directly addresses the ***conflict***
  - Recognizes the main policy goals
  - Responds to key issues, challenges or opportunities
- Easy to convey the objective (10 second elevator speech)
- Intuitive methodology
- Ability to monitor outcomes and measure success
- Broadly shared understanding and buy-in

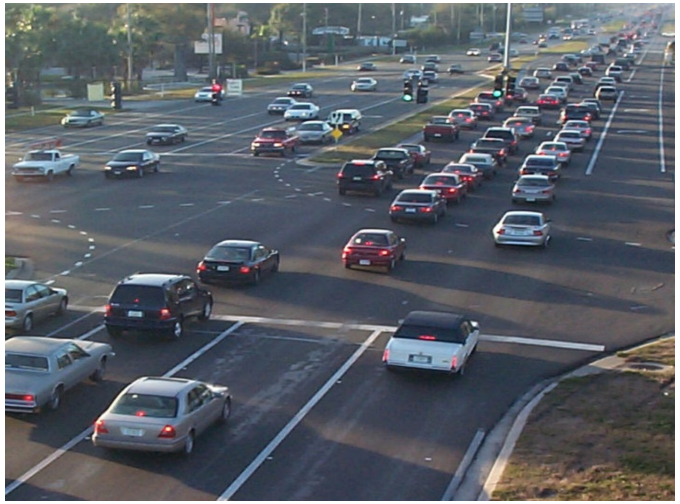
  Examples:
  - Charlotte, NC vision – Centers, Corridors & Wedges Growth Framework
  - Charleston, SC local food culture



WHAT YOU MEASURE IS WHAT YOU FUND

- Conventional speed-based approach: add turn lanes, road capacity

- Multimodal approach: improve the quality of service
  - Connectivity
  - Accessibility
  - Proximity

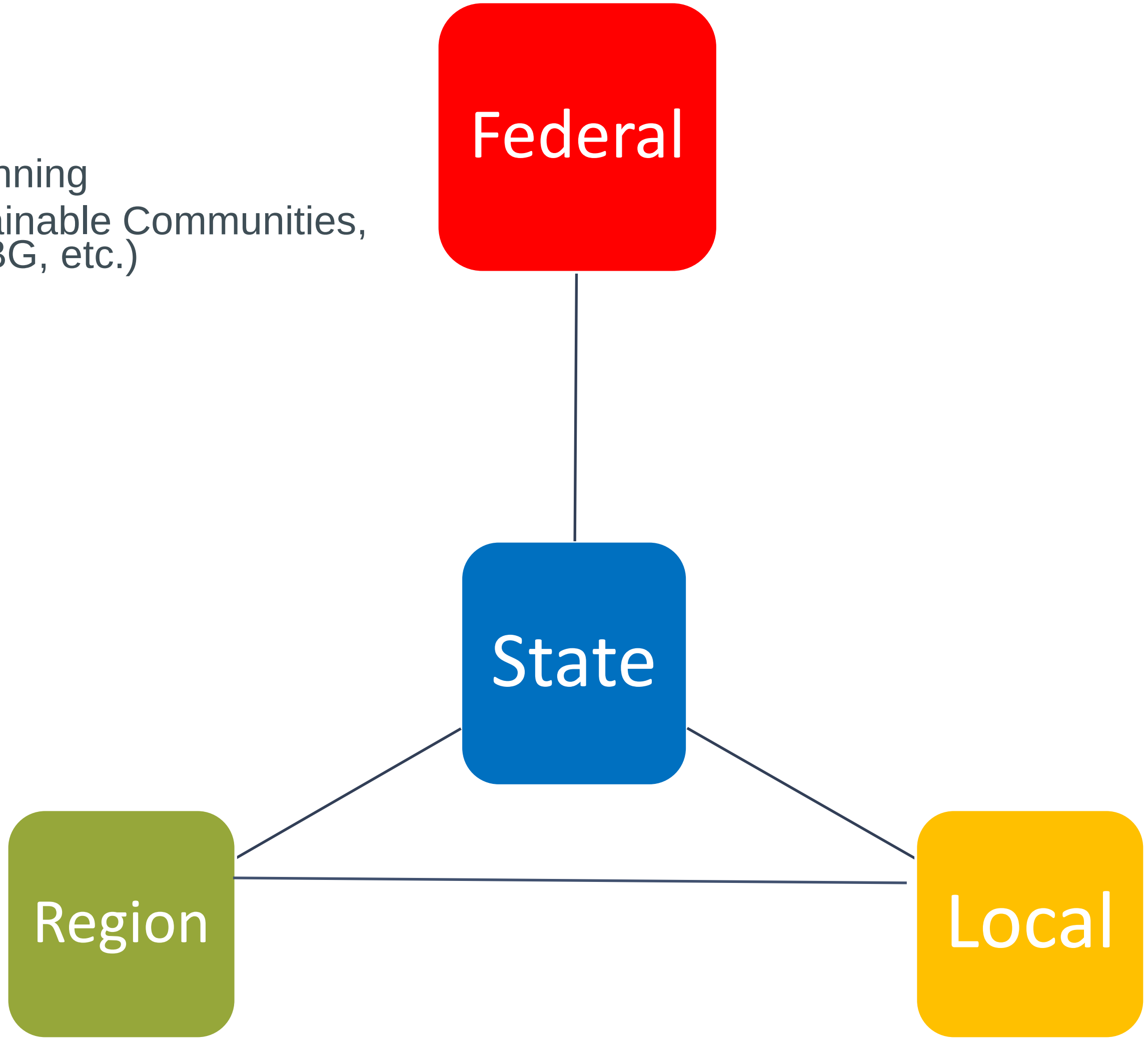


FIRST PRINCIPLES – POLICIES SUPPORTING MULTIMODAL ACCESSIBILITY

- Create policy recognizing public health and establish *performance thresholds*
- Enable *priority projects* to advance that support multimodal accessibility and public health *targets*
- Provide *incentives* for growth and redevelopment in targeted areas
- Match public funding and developer *mitigation* to complete projects that achieve shared planning objectives
- Reinforce desired physical *design and connectivity* of places

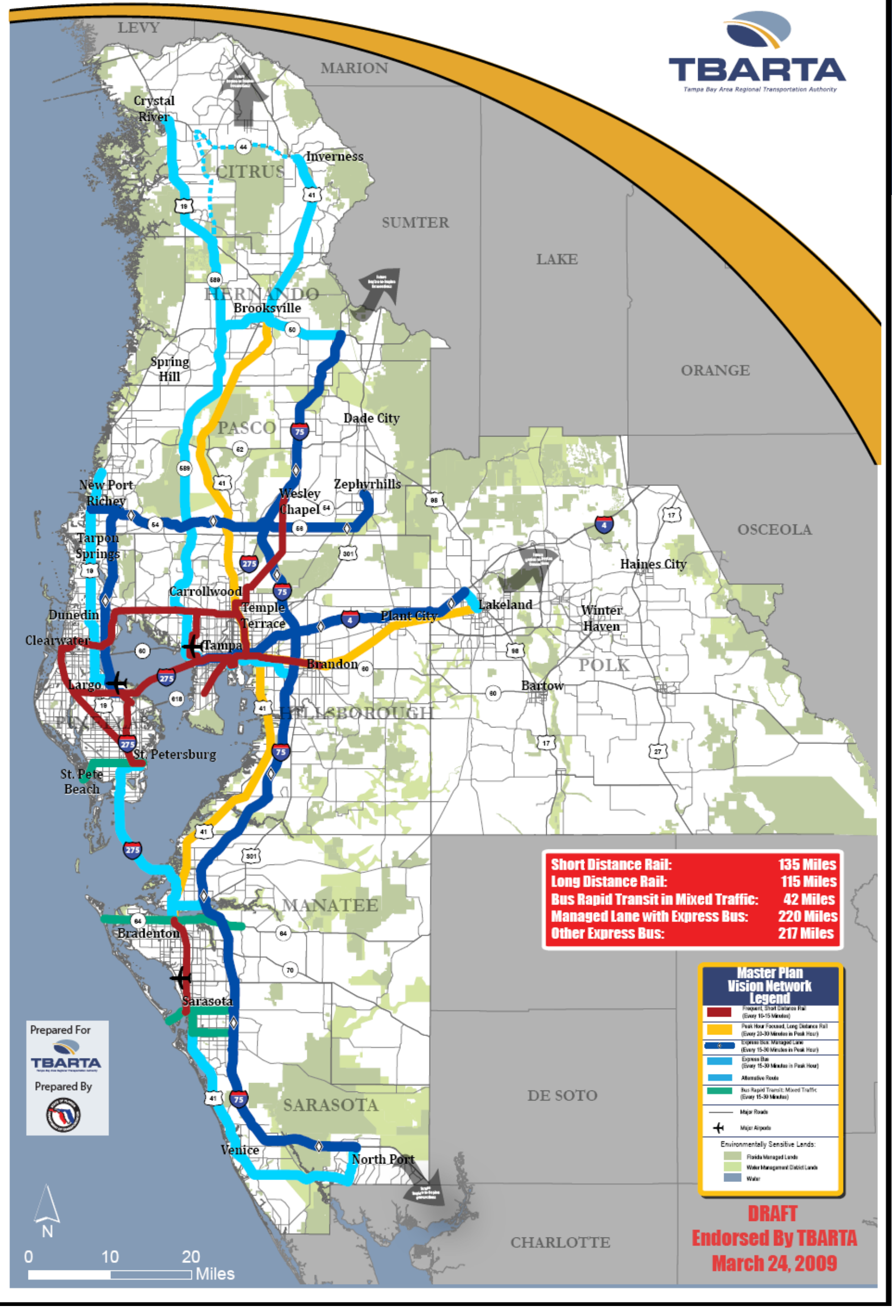
ALIGNMENT OF KEY POLICY TOOLS

- MAP-21 and Federal Agencies
  - Planning Emphasis Areas – statewide and metropolitan planning
  - Grant and program funds (TIGER, Building Blocks for Sustainable Communities, Regional Sustainable Development Plans, New Starts, CDBG, etc.)
- Statewide Transportation Plan or Growth Strategy
- Urbanized Area Transportation Plan
- Regional Development Framework Plan
- Transit Development Plan
- Local Government Comprehensive Plan
- Community Redevelopment Plan or Corridor Plan



CRITICAL POLICY ISSUES

- Establish desired growth/redevelopment framework
  - Region
  - Sub-region (county/parish, city)
  - Corridor or district
- Define target, catalyst or preferential growth areas
- Assess opportunities and create conditions for positive return on investment
  - Transit initiatives (rail, BRT, service expansion)
  - Non-motorized transportation projects
  - Other public infrastructure or incentive programs
- Leverage funding sources and generate additional revenue



ALIGNING POLICY, GOVERNANCE AND FUNDING

- Set broad regional or areawide transportation & growth strategy
- Establish principles for regional governance:
  - Funding commitment for seat at the table
  - Land use commitment for service expansion
- Cities find appropriate funding sources to join
- MPO or Regional Authority roles:
  - Convener to define principles and standards
  - Allocate funding based on principles
  - Set priorities

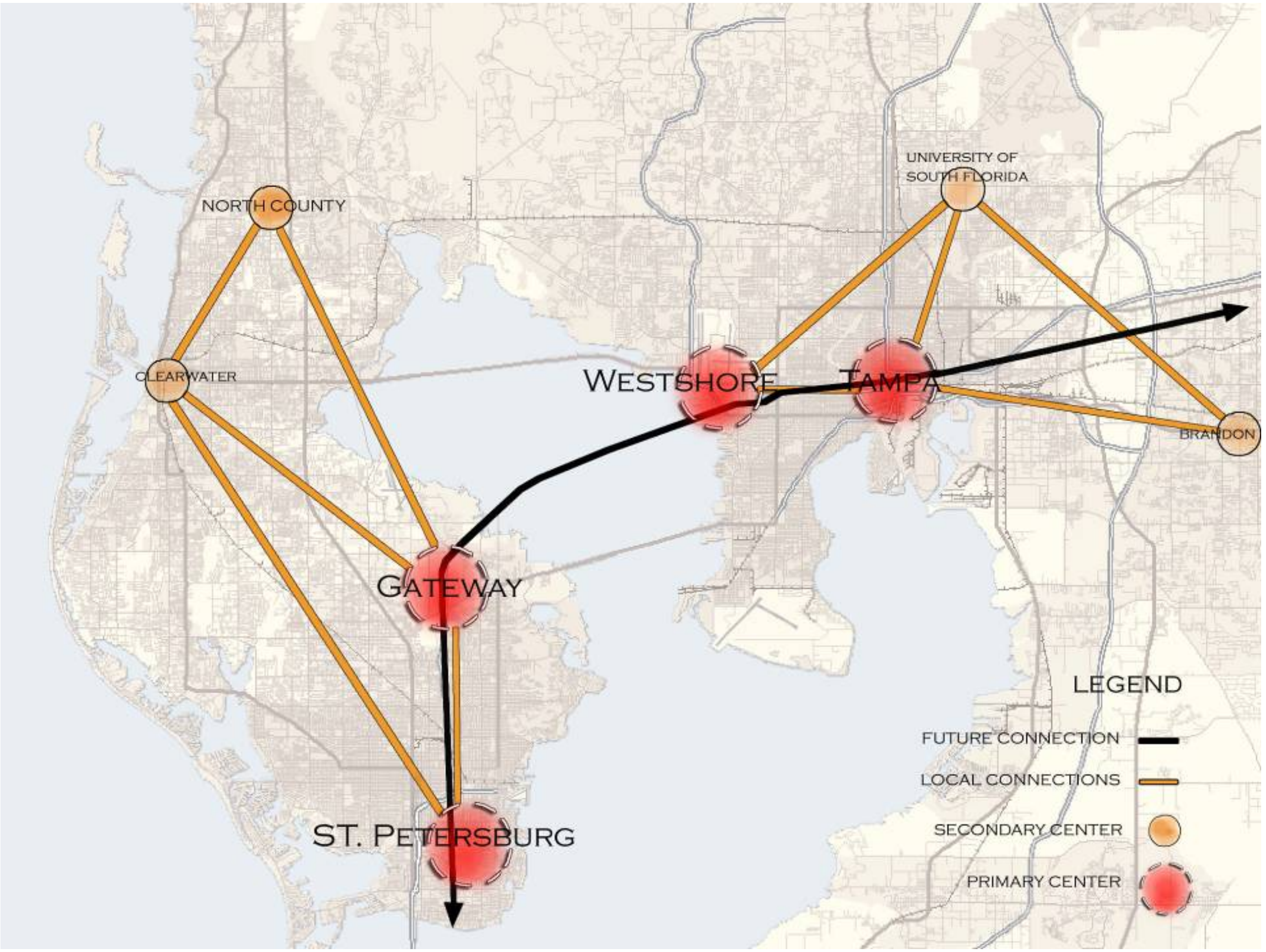
2

CASE STUDIES – ESTABLISHING A POLICY FRAMEWORK

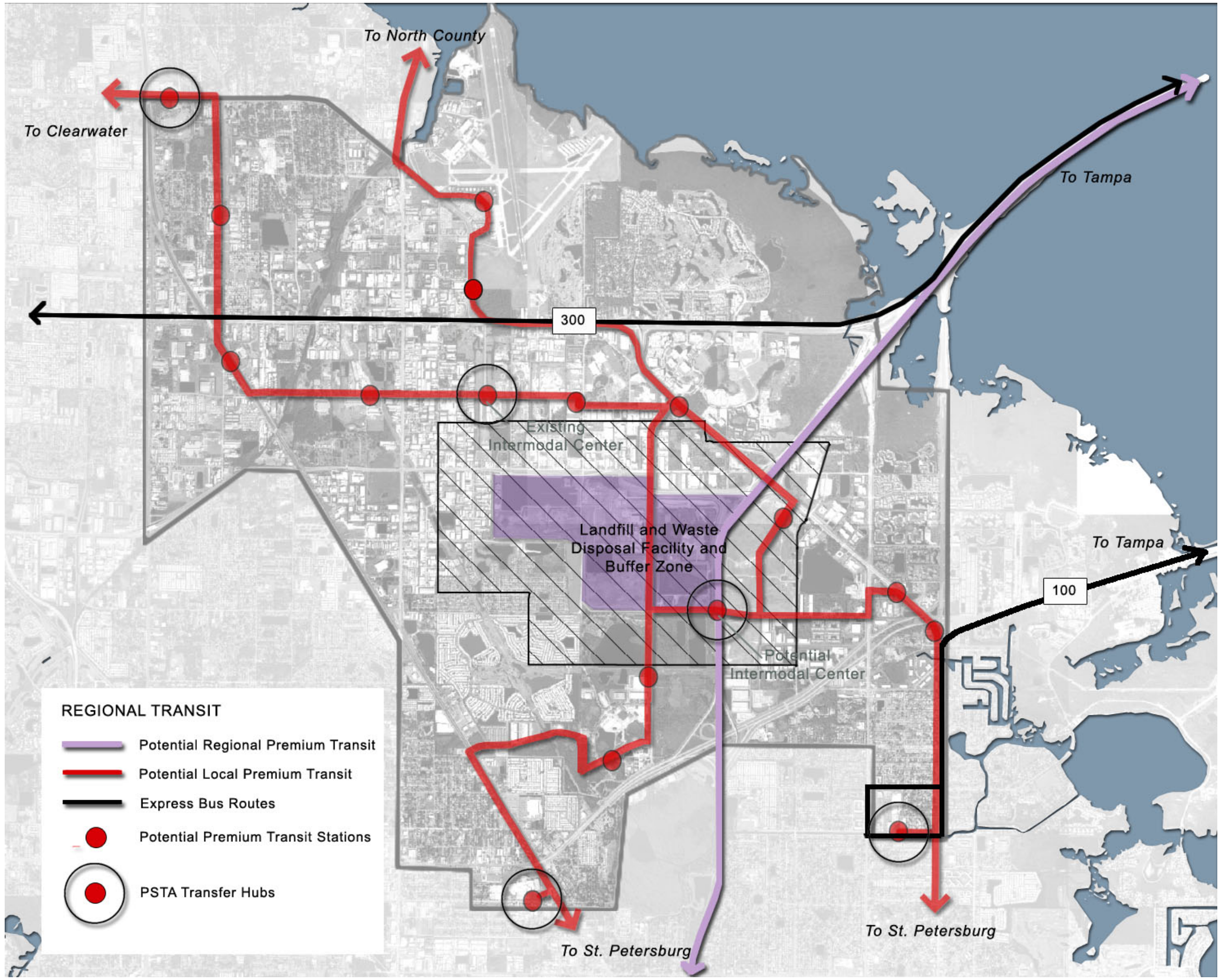
Mid-Pinellas County Multimodal Transportation District

Urban Infill and Redevelopment

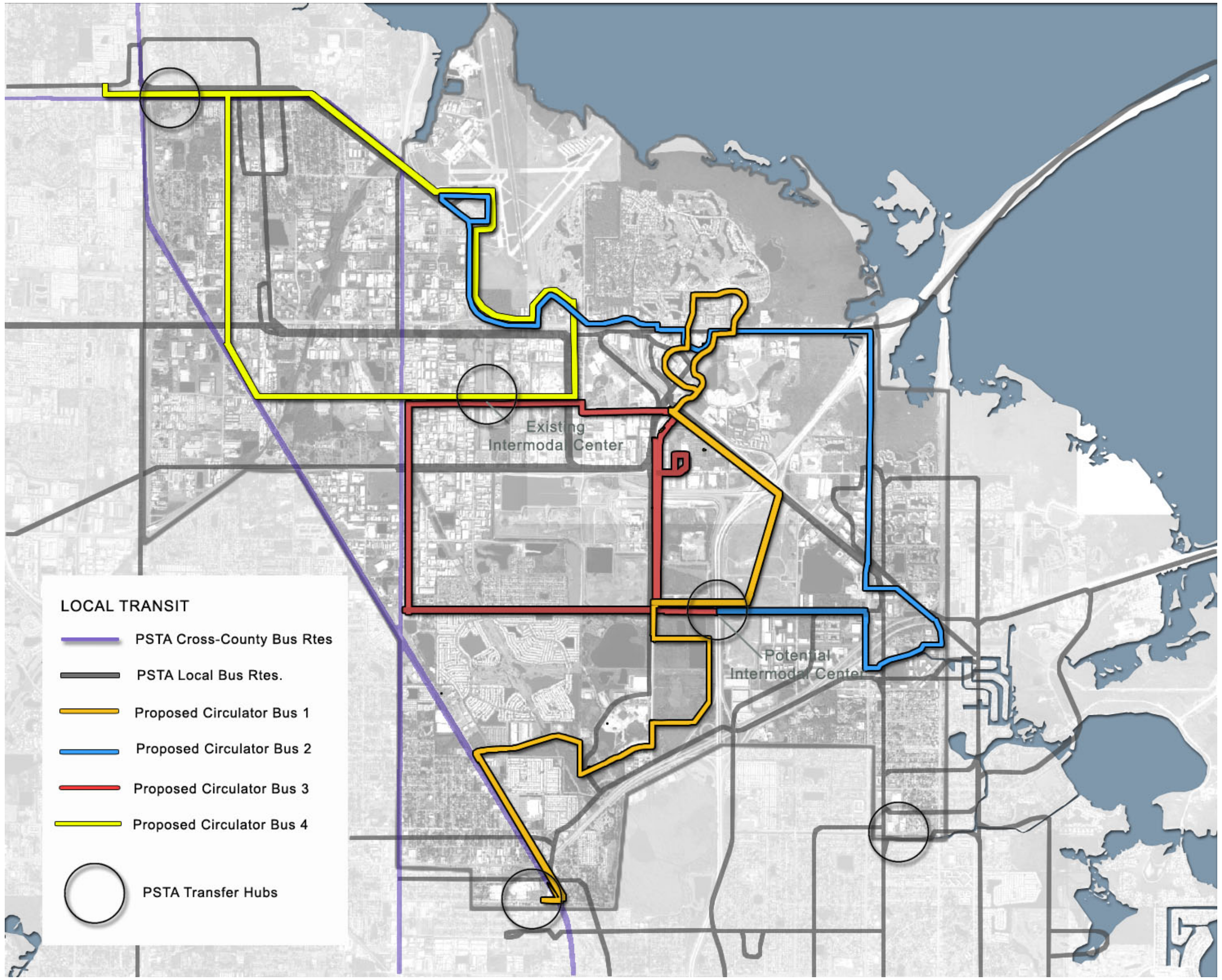
Mid-Pinellas County Multimodal Transportation District Urban Infill and Redevelopment



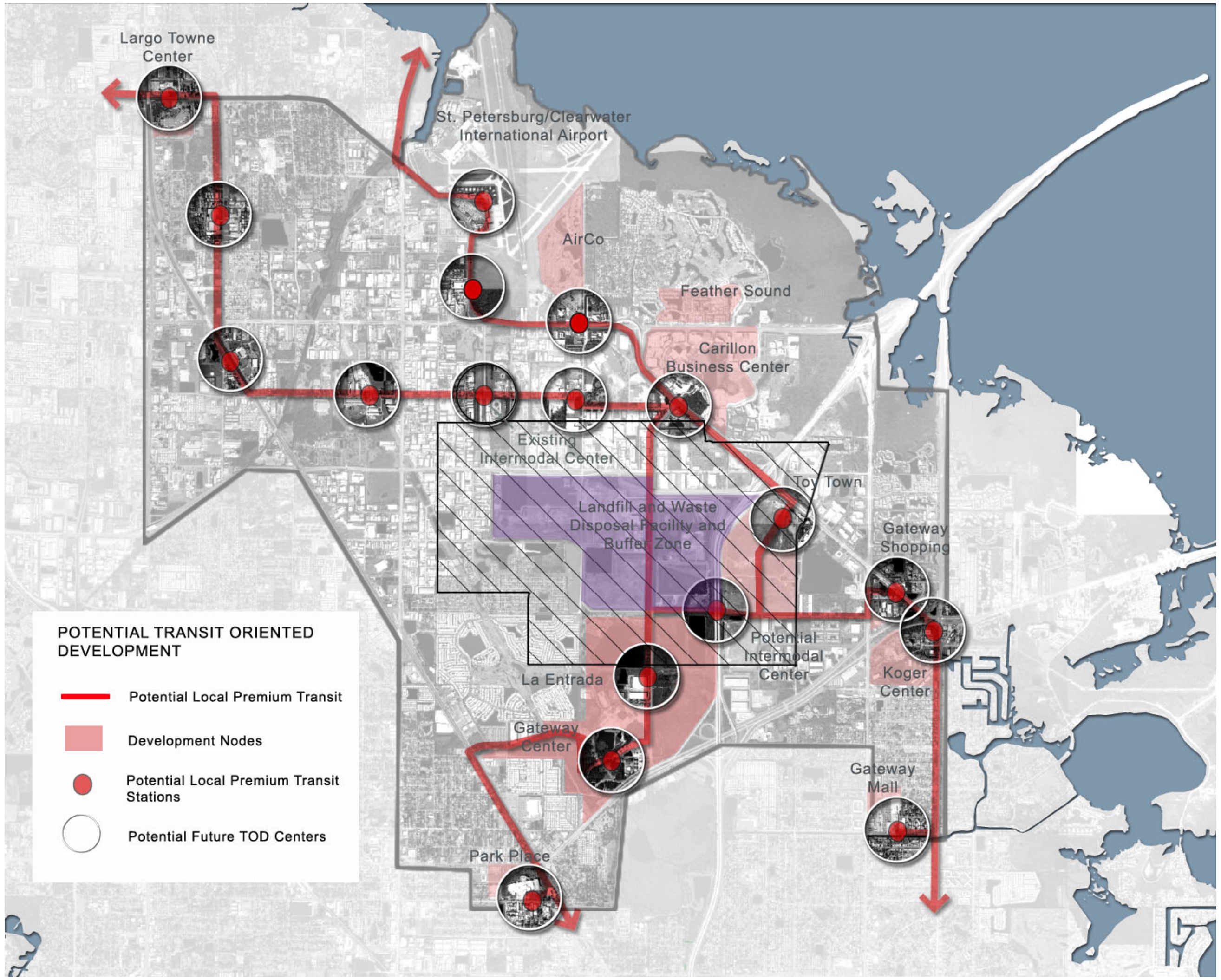
Mid-Pinellas County Multimodal Transportation District Urban Infill and Redevelopment



Mid-Pinellas County Multimodal Transportation District Urban Infill and Redevelopment

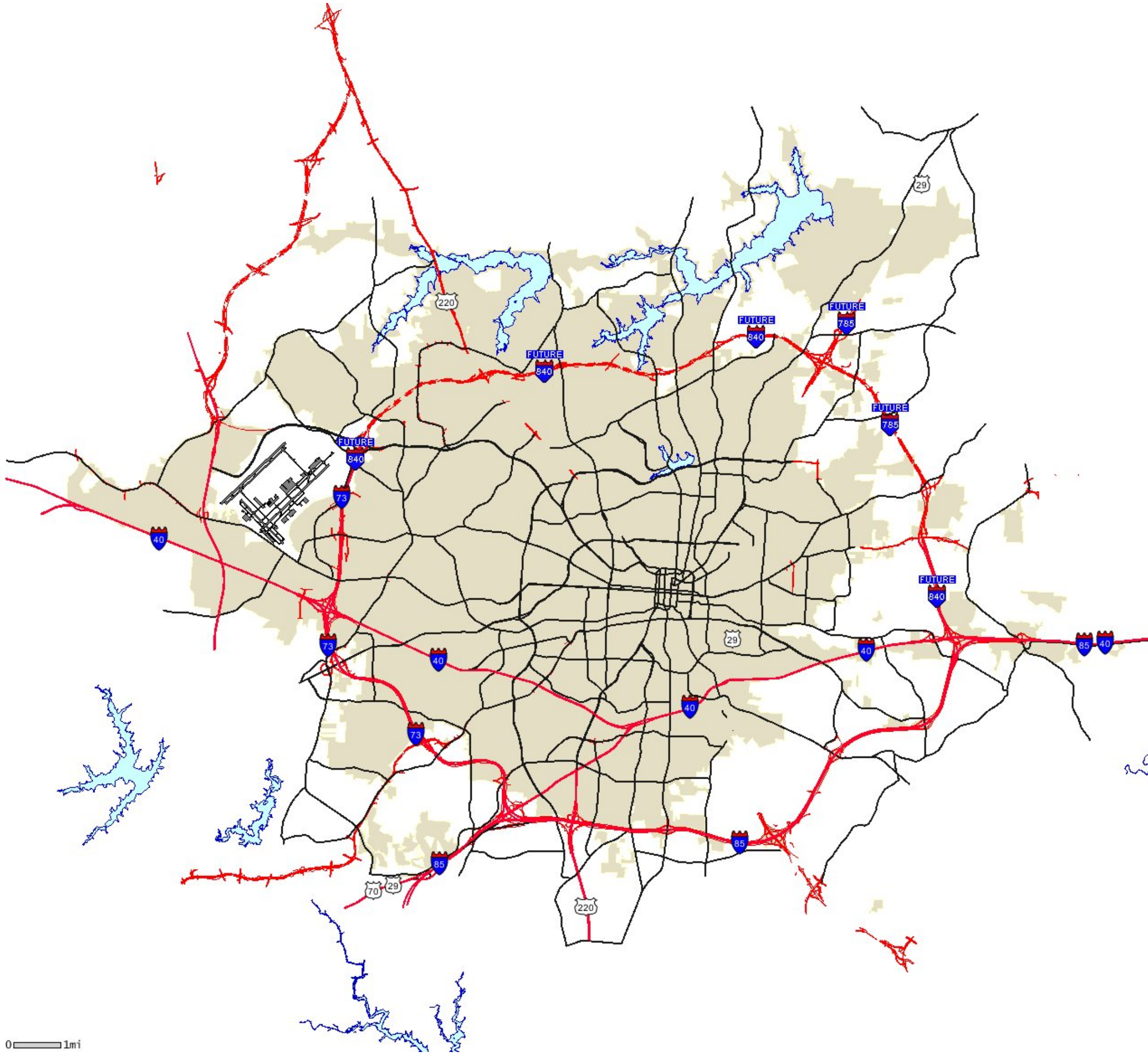


Mid-Pinellas County Multimodal Transportation District Urban Infill and Redevelopment



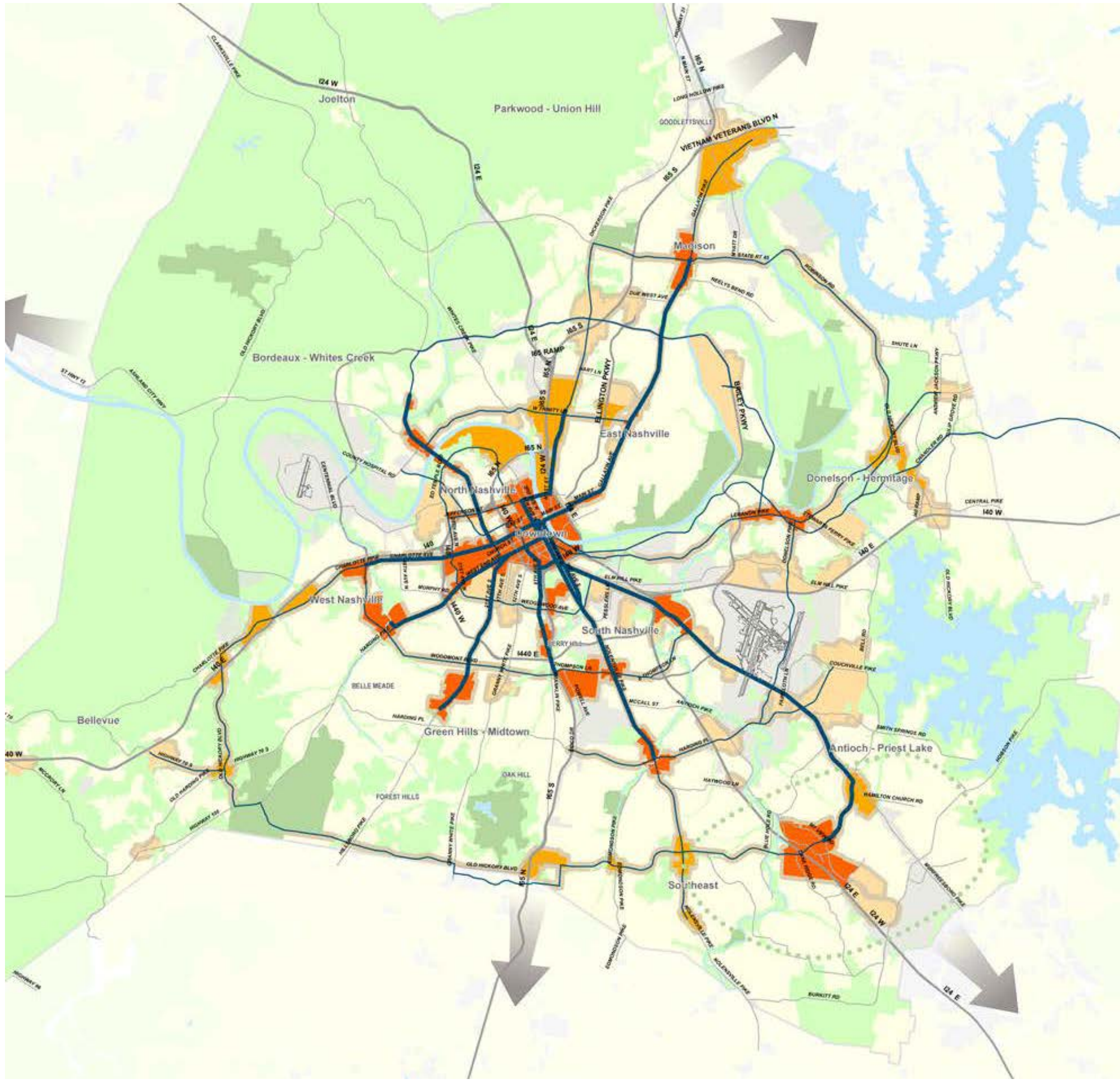
GREENSBORO INFILL 360 ASSESSMENT

- An infill strategy with no geographic focus is no strategy
  - No clear guidance for developers
  - Many conflicts with established neighborhoods
- Need to define target areas to clarify expectations
- Focus on economic development, linkage with higher education
- Align infill strategy with transit & trails network and street classification



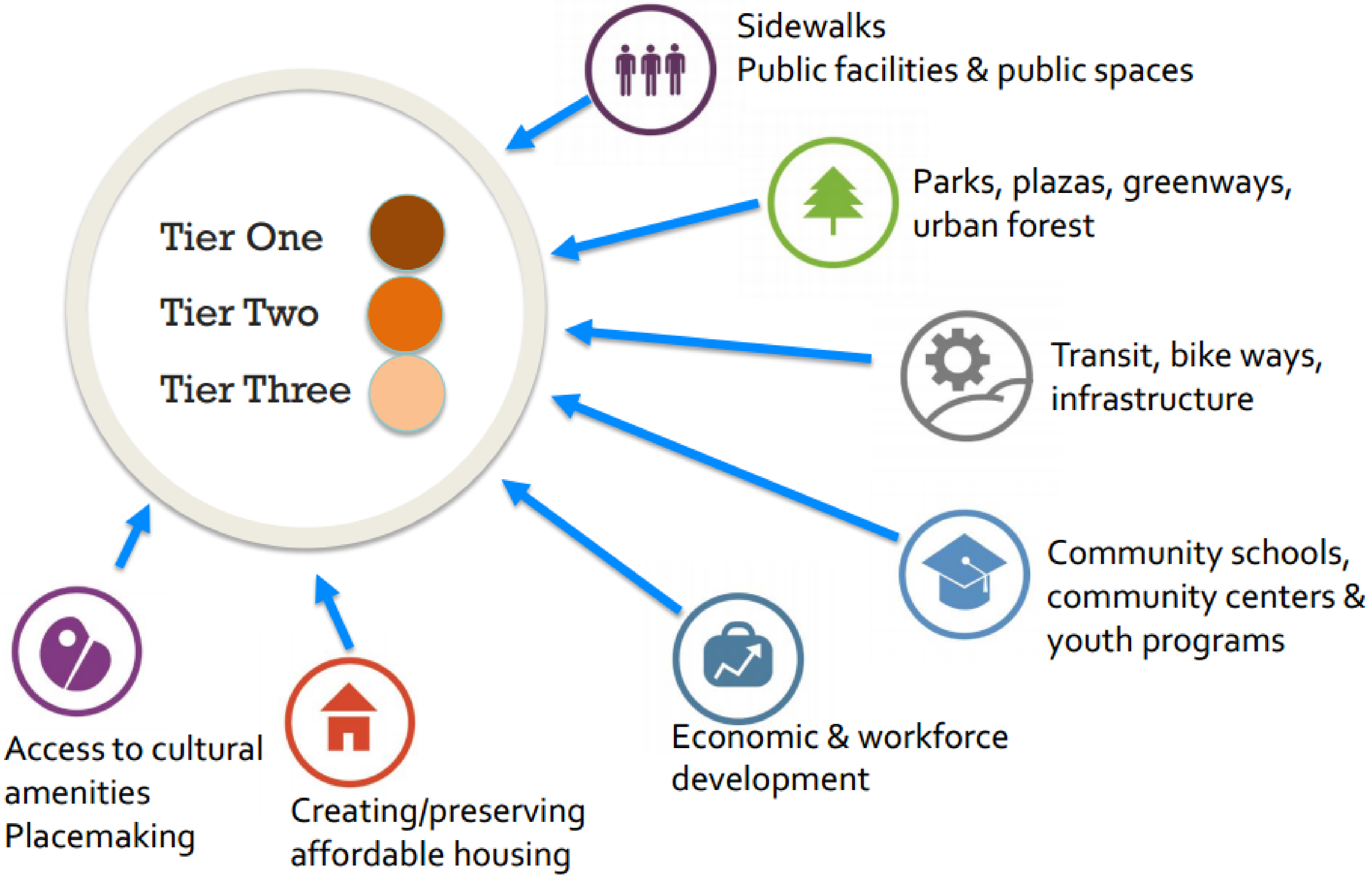
NASHVILLE AS POTENTIAL MODEL

- Nashville Next visioning
- Activity centers & targeted corridors
- Transect-based (defines scale, intensity)
- Transit-ready
- Community character districts (citizen-led process)

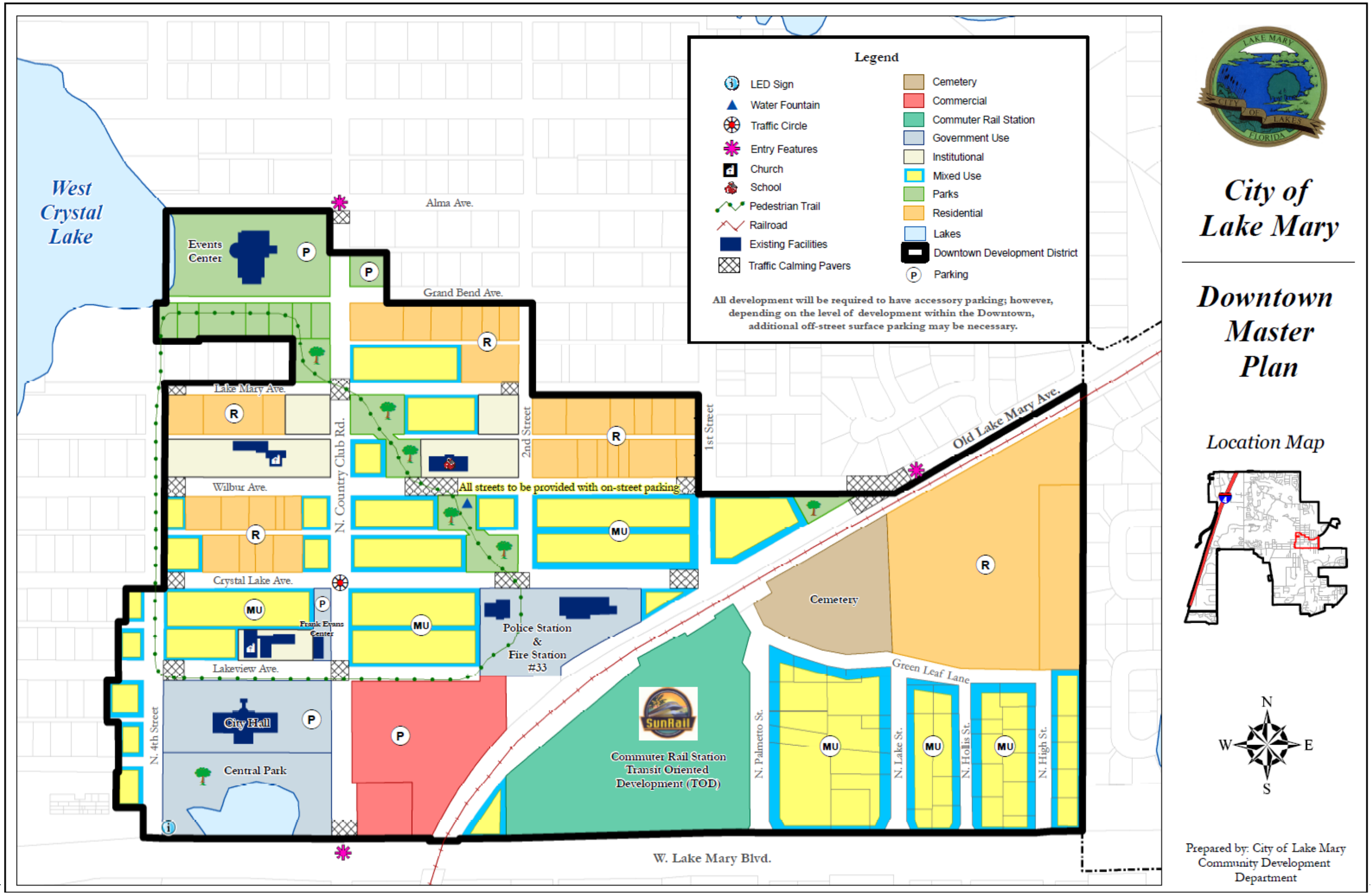


NASHVILLE, CONT'D.

- Small area plans → Form Based Codes
- Ask more of developers in hot markets
- Use public investments as catalysts in other target areas



LAKE MARY SUNRAIL STATION TOD – SETTING THE REGULATORY TABLE



- Not a MMTD, but a TCEA
- Master plan overlay to create proximity
- Density bank Transfer of Development Rights (TDR) program
- City investments in streetscape, stormwater and shared use path
- No on-site parking required

LAKE MARY STATION HOUSE TOD

http://blog.citiesthatwork.com/2015/02/achieving-successful-transit-oriented-development-in-suburbia/

STATION HOUSE DEVELOPMENT

- Long-term lease for use of public ROW
- 71 dwelling units per acre (including on-site garage)
- Only 13 of 200 units contain three bedrooms
- 300+ free parking spaces for SunRail

CONCLUSION – MULTIMODAL ACCESSIBILITY POLICY FRAMEWORK

- Establishing good policy requires building trust and creating a compelling narrative
  - Wise use of resources – effective “bang for the buck”
  - Mutually reinforcing goals, objectives and strategies among a broad constituency

- Tools provide analytical basis to define “areas of opportunity” and establish mode share targets

- Tools enable definition of transportation network and land use strategies to achieve targets

- Creating structure to urban growth and transportation investments enables a wide range of complementary policies

- Helps achieve a more predictable and achievable set of outcomes