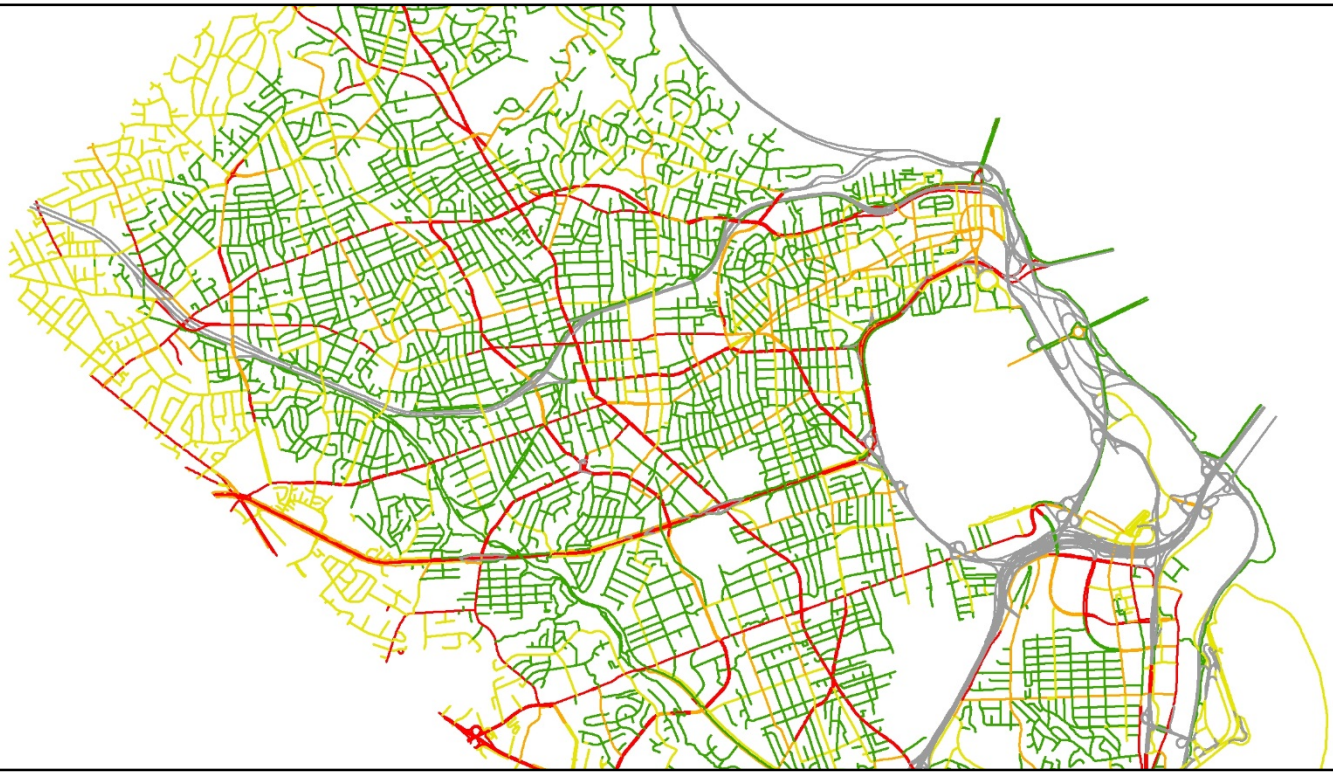
Low-Stress Connectivity Assessment to Prioritize Bicycle Infrastructure



Tracy Hadden Loh, PhD

rails·to·trails conservancy

Project goal:

Create a GIS tool to prioritize new bicycle facilities based on low-stress network connectivity

rails·to·trails conservancy

What is connectivity?

Many cities prioritize <u>based on connectivity</u>

- **Portland**
- **Seattle**
- **Minneapolis**
- **Vancouver, B.C.**

Connectivity, access and barrier reduction

- Does the project address a significant barrier?
- Does the project close a gap in the bikeway network?
- Will the treatment make the facility usable by the 'interested but concerned'?
- Does the project facilitate access to key destinations?

Prioritization Criteria

1. Equity
2. Community Support
3. Connectivity
4. Visibility of Bicycling

Investment

What is “low-stress” bicycling?

High Stress

Number of Lanes

Speed Limit

Low Stress

Stress Reducing

Protected Bike Lane

Buffered Bike Lane

Bike Lane

Sharrow

GPS trackers to observe route choice to quantify low-stress

Marginal Rate of Substitution

Roadway Number of Lanes	Speed Limit	
6+ lanes	35+ mph	140%
5 lanes	35+ mph	120%
3 lanes	35+ mph	100%
6+ lanes	30 mph	80%
5 lanes	30 mph	70%
5 lanes	25 mph	67%
3 lanes	30 mph	40%
4 lanes	25 mph	35%
3 lanes	25 mph	20%
2 lanes	30 mph	15%
2 lanes	25 mph	10%

Marginal Rate of Substitution

Roadway			Stress Reduction			
Number of Lanes	Speed Limit		Sharrows 5%	Bike Lane 40%	Buffered Bike Lane 60%	Protected Bike Lane 90%
6+ lanes	35+ mph	140%	133%	84%	56%	14%
5 lanes	35+ mph	120%	114%	72%	48%	12%
3 lanes	35+ mph	100%	95%	60%	40%	10%
6+ lanes	30 mph	80%	76%	48%	32%	8%
5 lanes	30 mph	70%	67%	42%	28%	7%
5 lanes	25 mph	67%	64%	40%	27%	7%
3 lanes	30 mph	40%	38%	24%	16%	4%
4 lanes	25 mph	35%	33%	21%	14%	4%
3 lanes	25 mph	20%	19%	12%	8%	2%
2 lanes	30 mph	15%	14%	9%	6%	2%
2 lanes	25 mph	10%	10%	6%	4%	1%

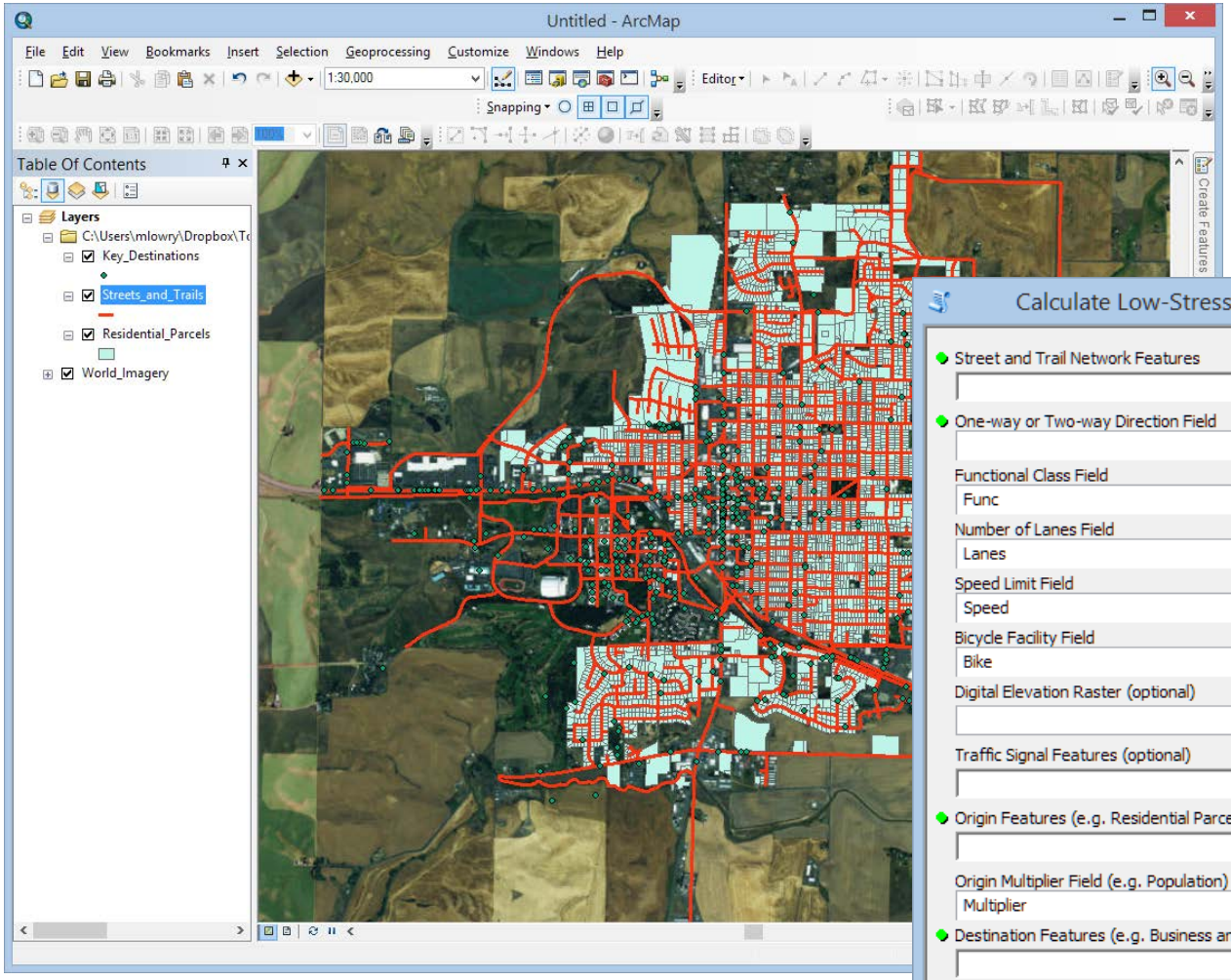
$$Percieved\ Stress = Roadway\ Stress * (1 - Reduction)$$

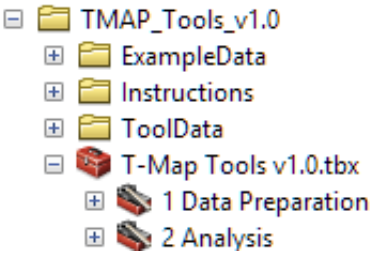
Intersections

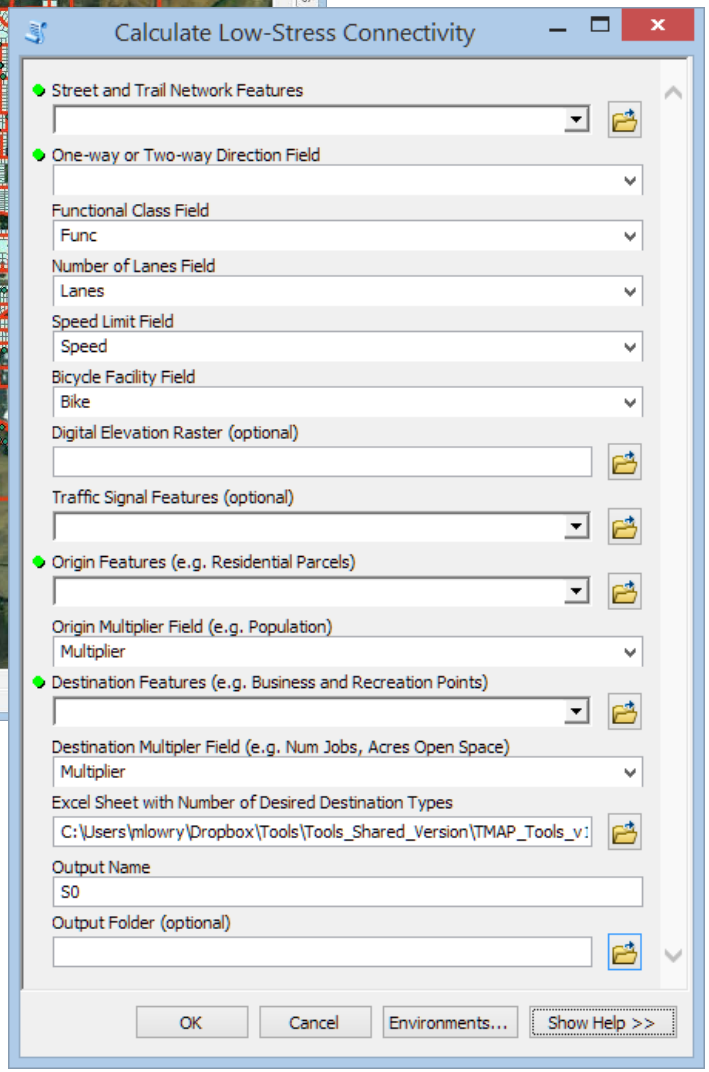
Roadway			Stress Reduction		
Number of Lanes	Speed Limit		Bike Box 15%	Traffic Signal 50%	Protected Turns 90%
6+ lanes	35+ mph	140%	119%	70%	14%
5 lanes	35+ mph	120%	102%	60%	12%
3 lanes	35+ mph	100%	85%	50%	10%
6+ lanes	30 mph	80%	68%	40%	8%
5 lanes	30 mph	70%	60%	35%	7%
5 lanes	25 mph	67%	57%	34%	7%
3 lanes	30 mph	40%	34%	20%	4%
4 lanes	25 mph	35%	30%	18%	4%
3 lanes	25 mph	20%	17%	10%	2%
2 lanes	30 mph	15%	13%	8%	2%
2 lanes	25 mph	10%	9%	5%	1%

$$Percieved\ Stress = Roadway\ Stress * (1 - Reduction)$$

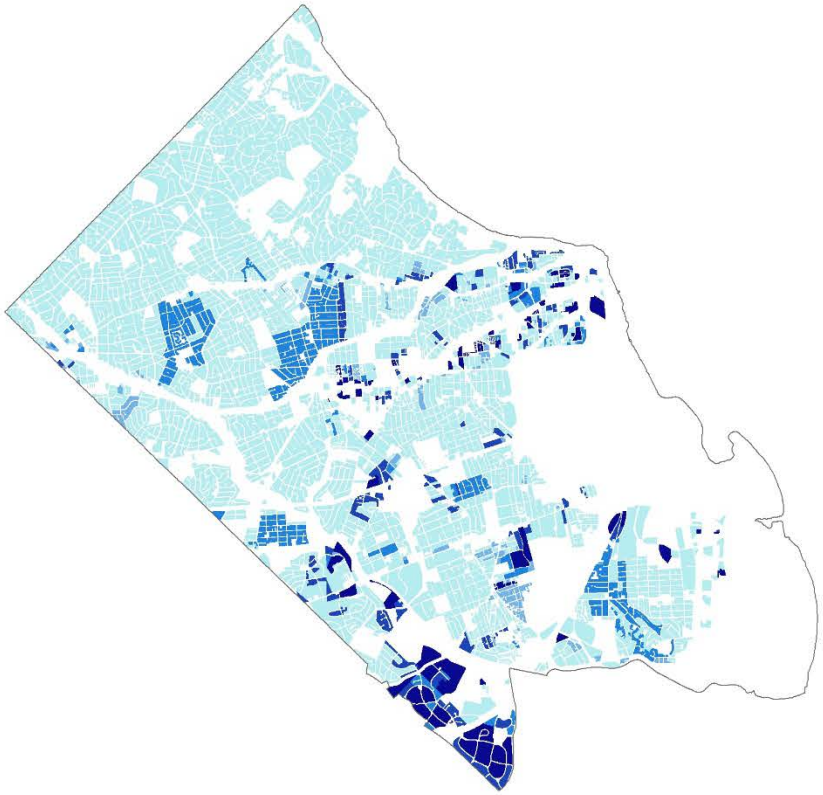
Method and GIS Tool


Untitled - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
1:30,000
Editor
Snapping
Table Of Contents
Layers
C:\Users\mlowry\Dropbox\T
Key_Destinations
Streets_and_Trails
Residential_Parcels
World_Imagery
Create Features

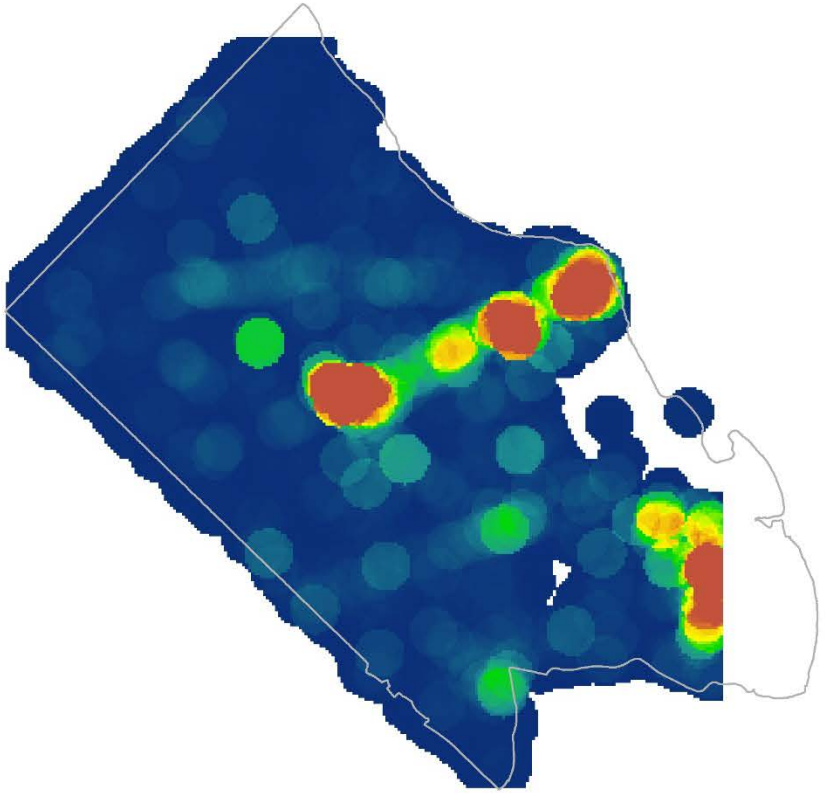

TMAP_Tools_v1.0
ExampleData
Instructions
ToolData
T-Map Tools v1.0.tbx
1 Data Preparation
2 Analysis


Calculate Low-Stress Connectivity
Street and Trail Network Features
One-way or Two-way Direction Field
Functional Class Field
Func
Number of Lanes Field
Lanes
Speed Limit Field
Speed
Bicycle Facility Field
Bike
Digital Elevation Raster (optional)
Traffic Signal Features (optional)
Origin Features (e.g. Residential Parcels)
Origin Multiplier Field (e.g. Population)
Multiplier
Destination Features (e.g. Business and Recreation Points)
Destination Multipler Field (e.g. Num Jobs, Acres Open Space)
Multiplier
Excel Sheet with Number of Desired Destination Types
C:\Users\mlowry\Dropbox\Tools\Tools_Shared_Version\TMAP_Tools_v
Output Name
S0
Output Folder (optional)
OK
Cancel
Environments...
Show Help >>

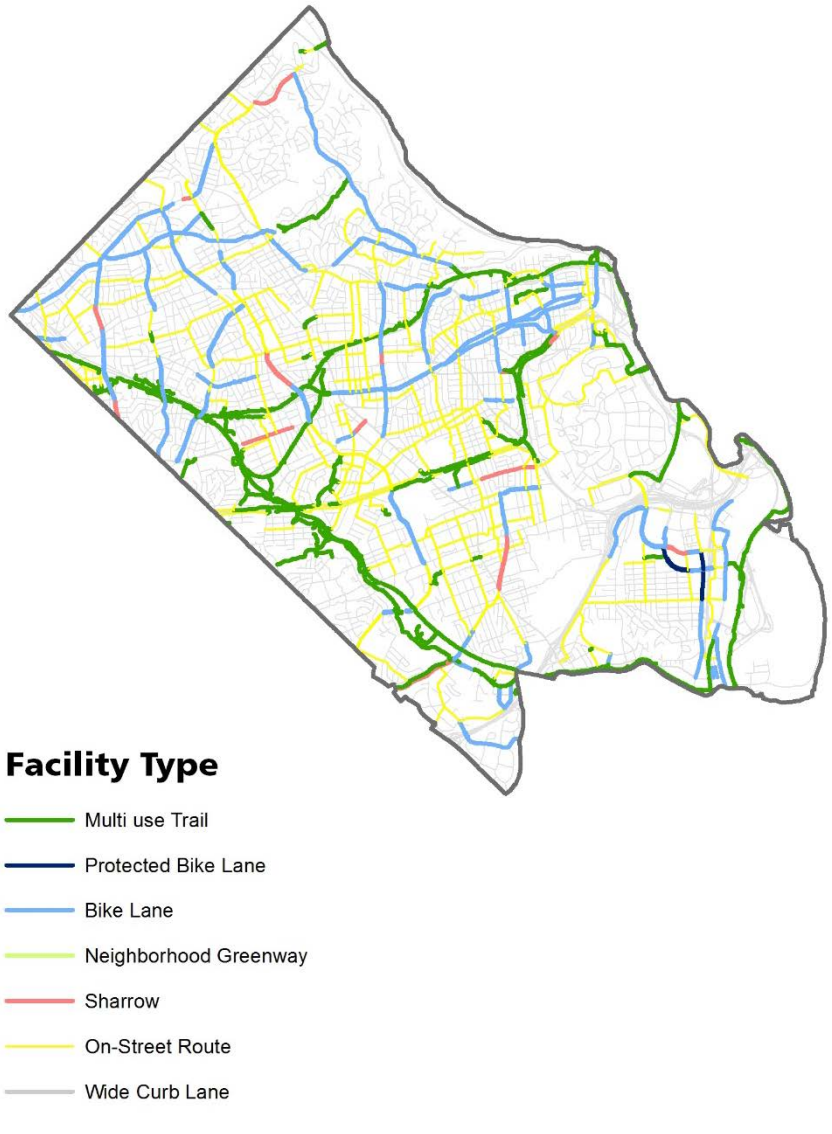
Input:



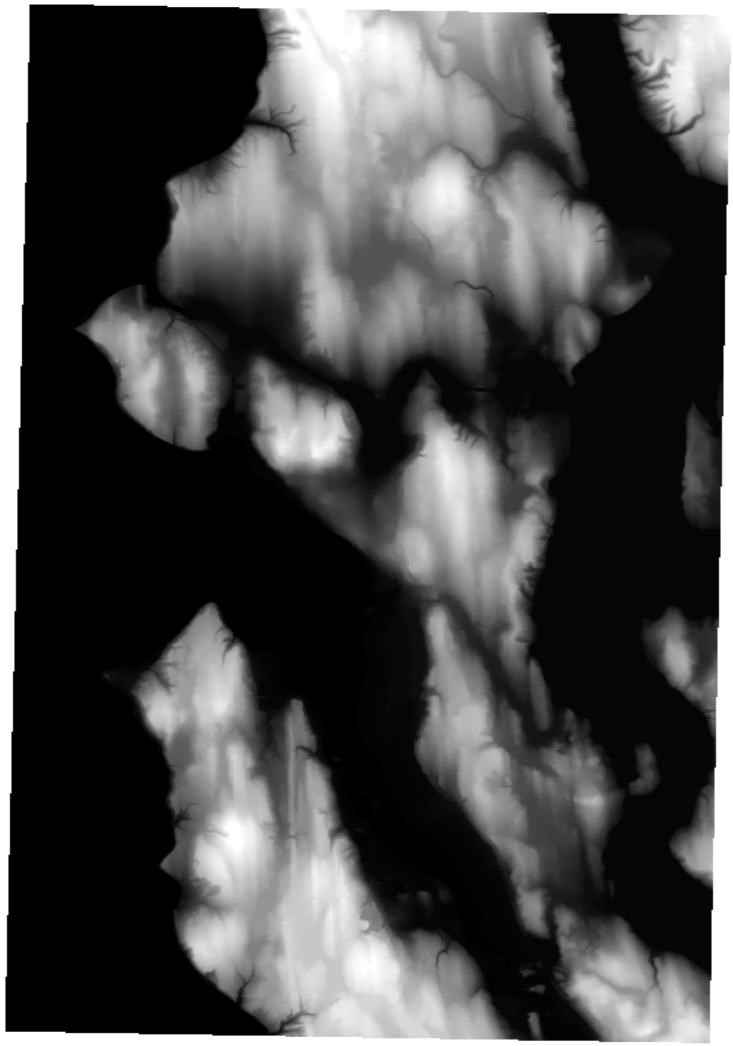
1. Origins



2. Destinations

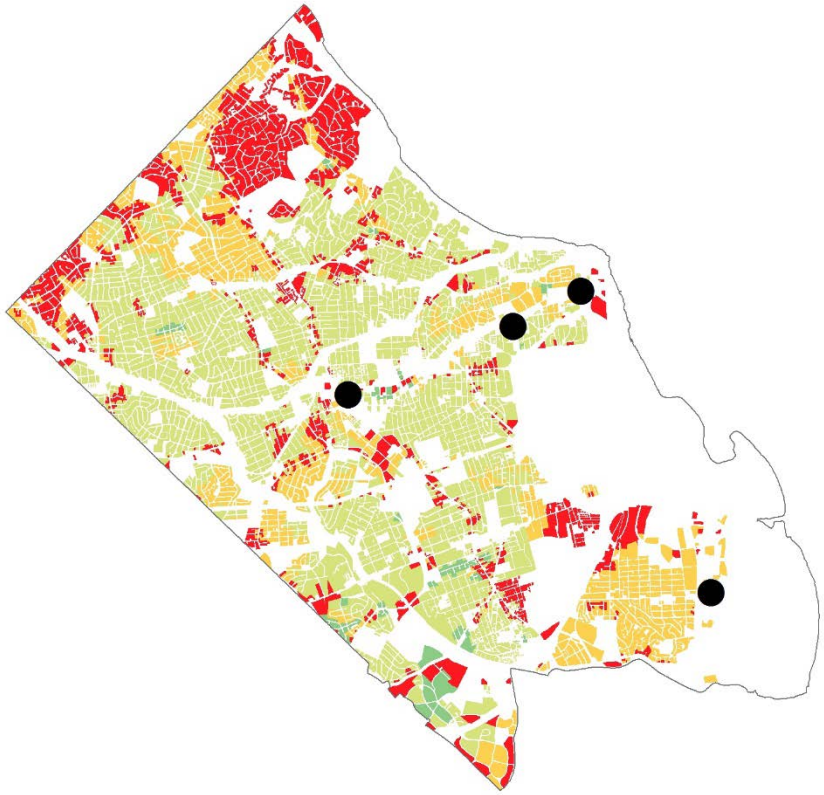


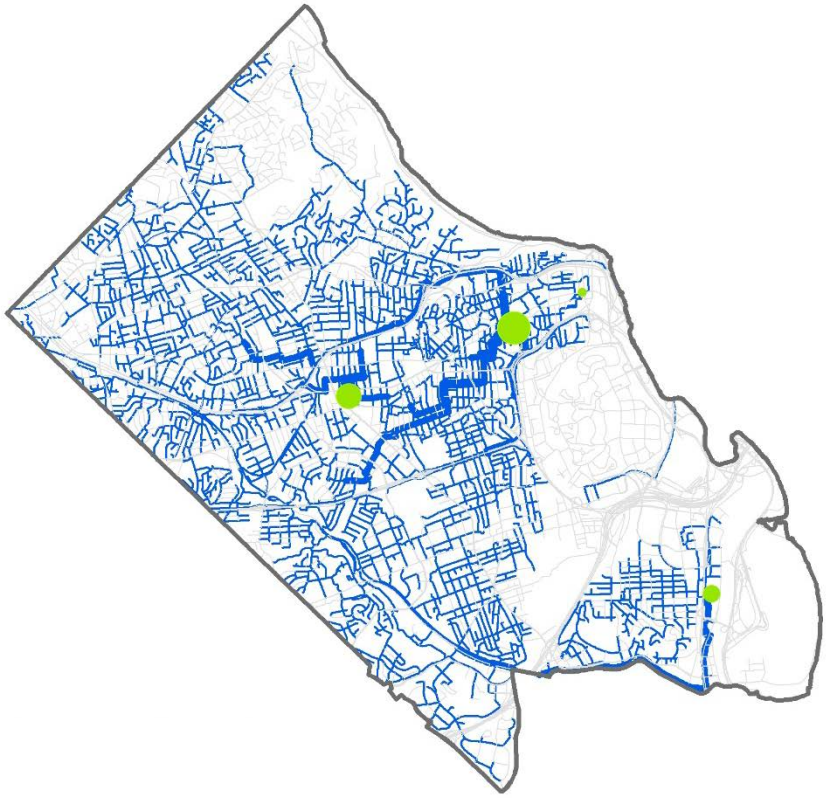
3. Street and Trail Network



4. Digital Elevation

Output:





1. Connectivity to Destinations

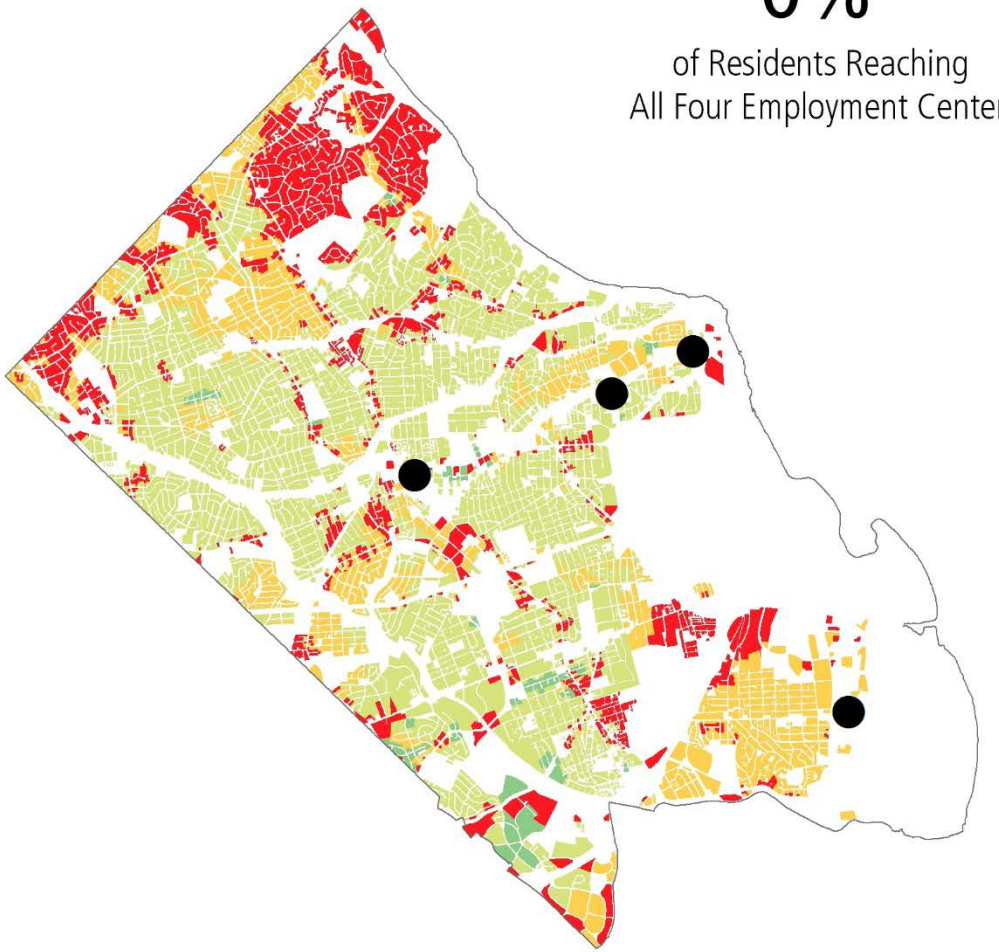
2. Network Flow

Arlington, VA


Barriers
Low Stress Routes
Level of Traffic Stress
1
2
5
0
1
2 Miles
N

0%

of Residents Reaching
All Four Employment Centers



Number of Employment Centers Reached by Destination

- Employment Centers
- 0
- 1
- 2
- 3
- 4

Proposed future improvements

Facility Type	Base Case	Future Case	% Change
Bike Lane	45.6	37.4	-18%
Multi use Trail	48.4	53.3	10%
Neighborhood Greenway	0.0	2.1	-
Protected Bike Lane	1.1	30.4	2665%
Sharrow	6.3	3.3	-48%
Signed Bicycle Route	81.5	70.1	-14%
Wide Curb	0.0	0.2	-

Base Case Scenario

Future Case Scenario

Facility Type

- Multi use Trail
- Protected Bike Lane
- Bike Lane
- Neighborhood Greenway
- Sharrow
- On-Street Route
- Wide Curb Lane

0 1 2 Miles

N

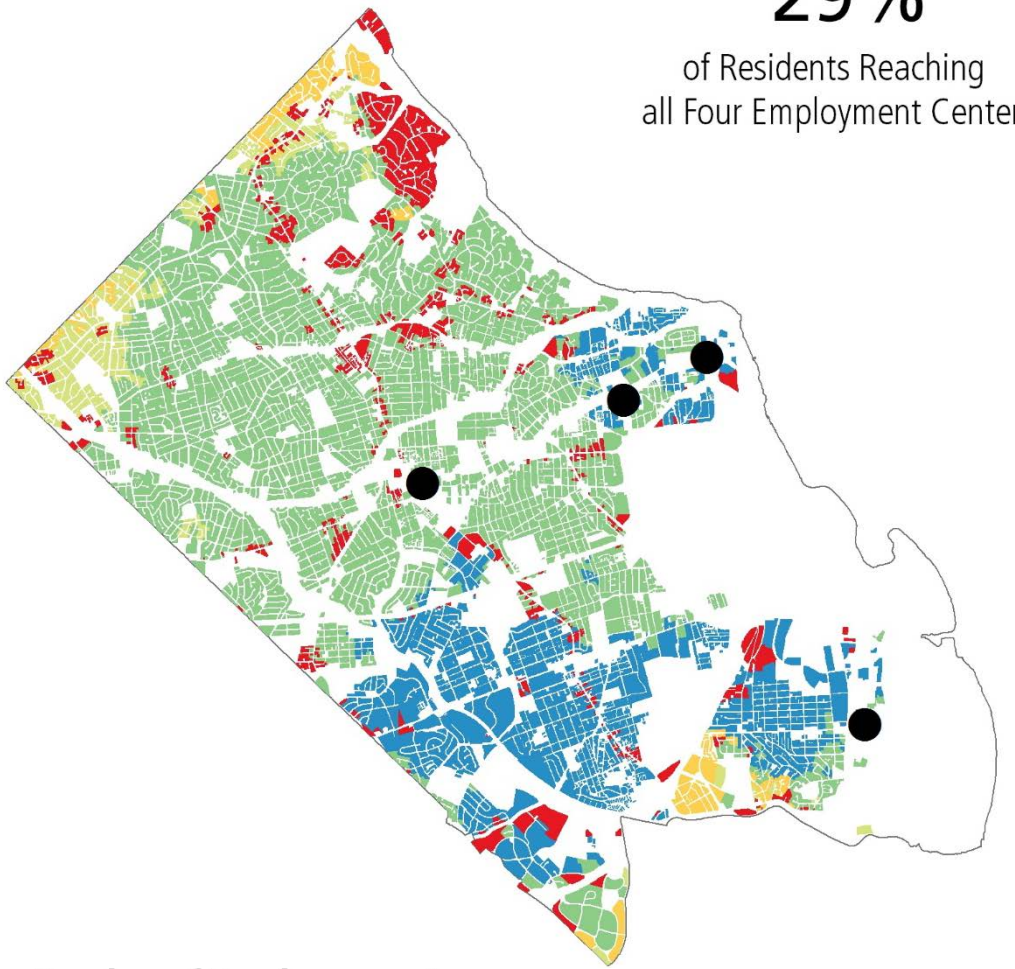

Change in LTS
New Facility
3
2
1
0
0
1
2 Miles
N

Table 5: Summary of Connectivity Results

Basket	Max #	Base	Future	Reach Definition
Residential to Key Destinations	2 miles	87%	92%	60% of types
Residential to Public Facilities	1.5 miles	77%	84%	60% of types
Residential to Employment Centers	6 miles	0%	29%	4 (100%) centers
Bikeshare to Bikeshare	3 miles	19	28	Avg of all stations
Employment Locations to Key Destinations	6 miles	74%	93%	60% of types
Employment Locations to Loop trail heads	2 miles	70%	88%	60% of types

29%

of Residents Reaching
all Four Employment Centers



Number of Employment Centers Reached by Destination

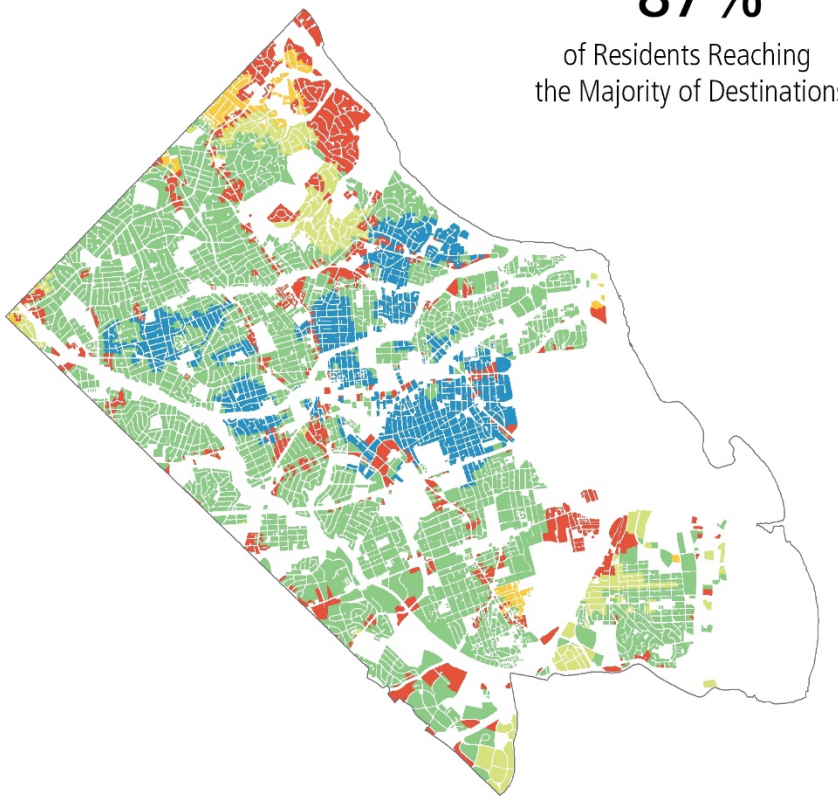
- Employment Centers
- 0
- 1
- 2
- 3
- 4

Which projects will most effectively improve connectivity?

Base Case Scenario

87%

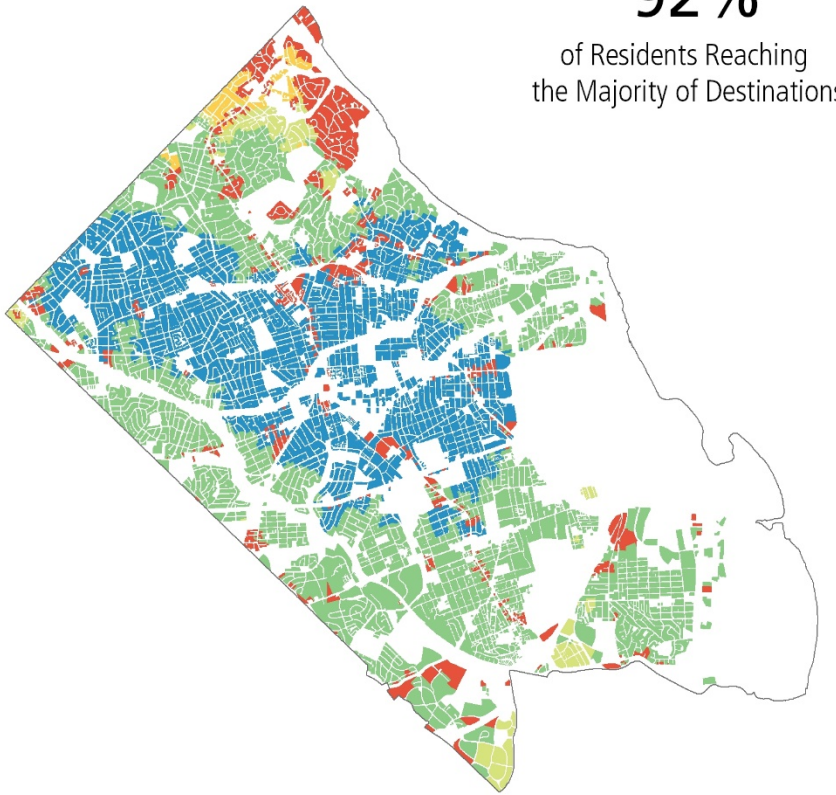
of Residents Reaching
the Majority of Destinations



Future Case Scenario

92%

of Residents Reaching
the Majority of Destinations



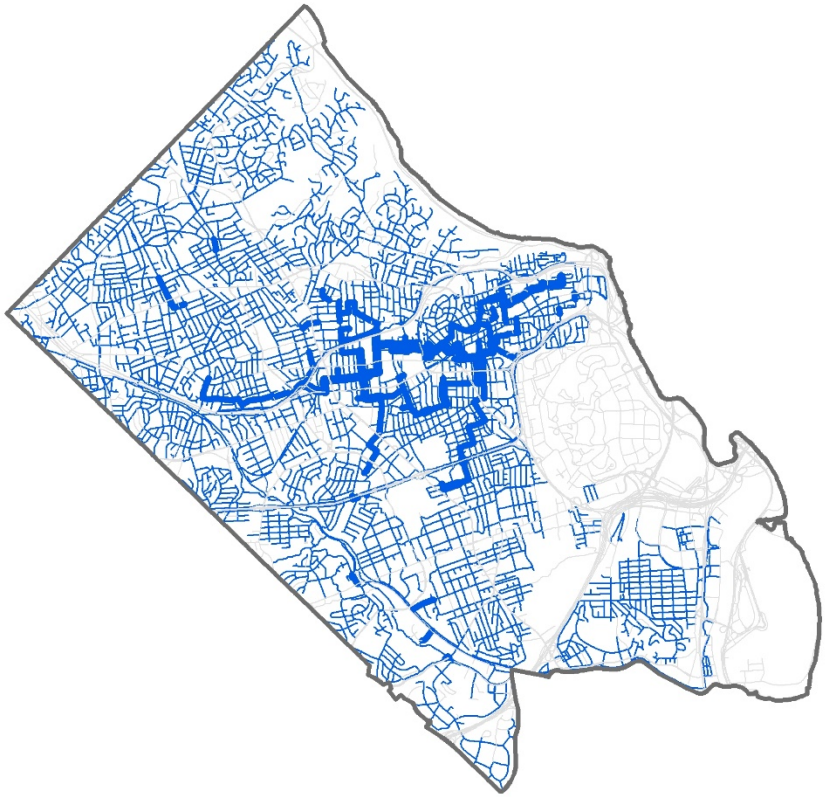
% Destinations Reached by Parcel

- 0% - 20%
- 21% - 40%
- 41% - 60%
- 61% - 80%
- 81% - 100%

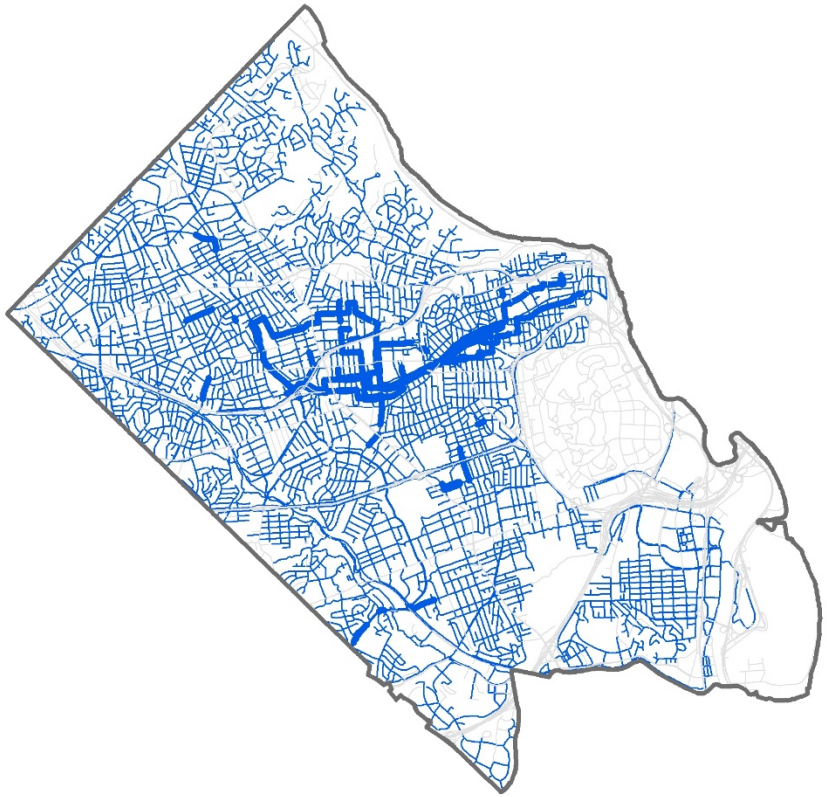
N

0 1 2 Miles

Base Case Scenario



Future Case Scenario



Potential Trip Flow

- None
- Low
- Medium
- High

0 1 2 Miles

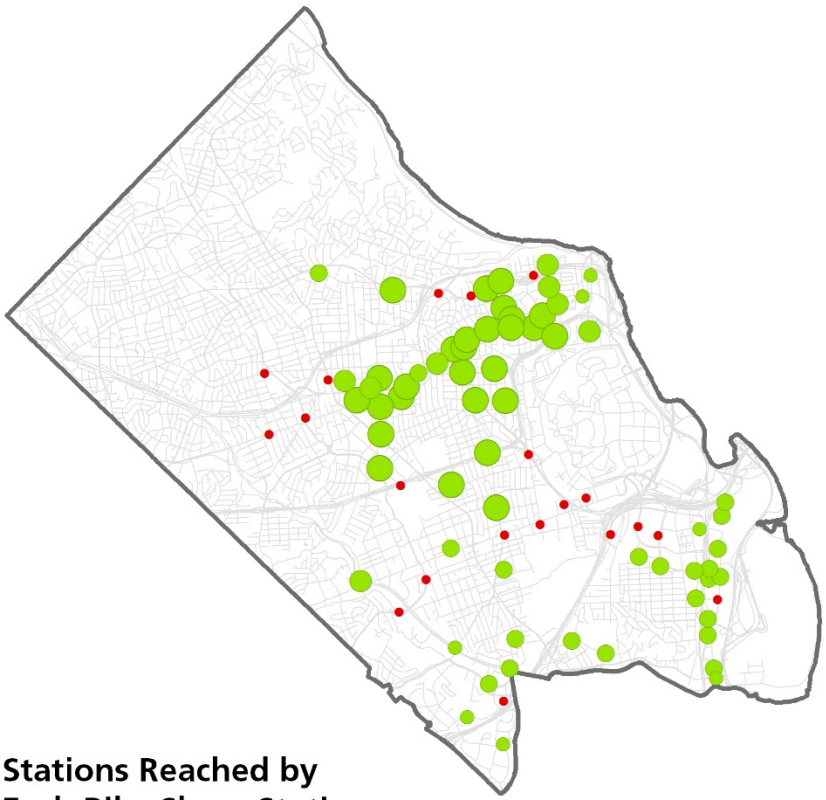
N

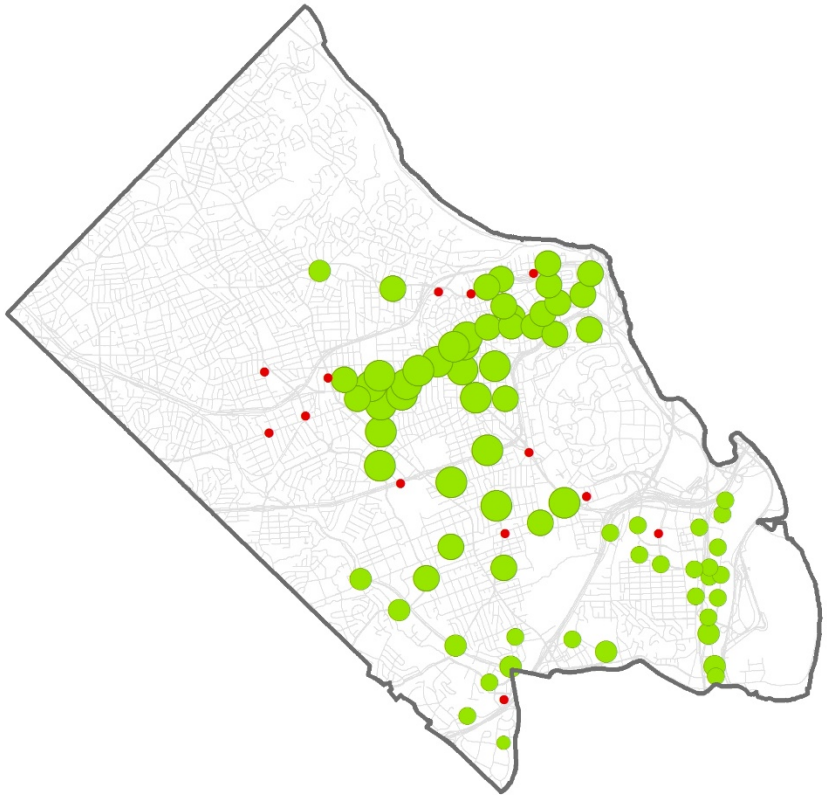
Top 10 Projects

Rank	Name	Improvement
1	Clarendon Blvd	Protected Bike Lane
2	Fairfax Dr	Protected Bike Lane
3	Wilson Blvd	Protected Bike Lane
4	N Irving Quietway @ Clarendon Circle	Quietway
5	Key Blvd (One Block)	Protected Bike Lane
6	Nash St	Protected Bike Lane
7	N Harrison St (south of Lee Highway)	Bike Lane
8	N Lynn St	Protected Bike Lane
9	N Barton St (Wilson to Clarendon link)	Protected Bike Lane
10	23rd St S	Protected Bike Lane

Base Case Scenario

Future Case Scenario





Stations Reached by Each Bike Share Station

- 1
- 2 - 11
- 12 - 22
- 23 - 33
- 34 - 44
- 45 - 55

0 1 2 Miles

N

Thank you…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