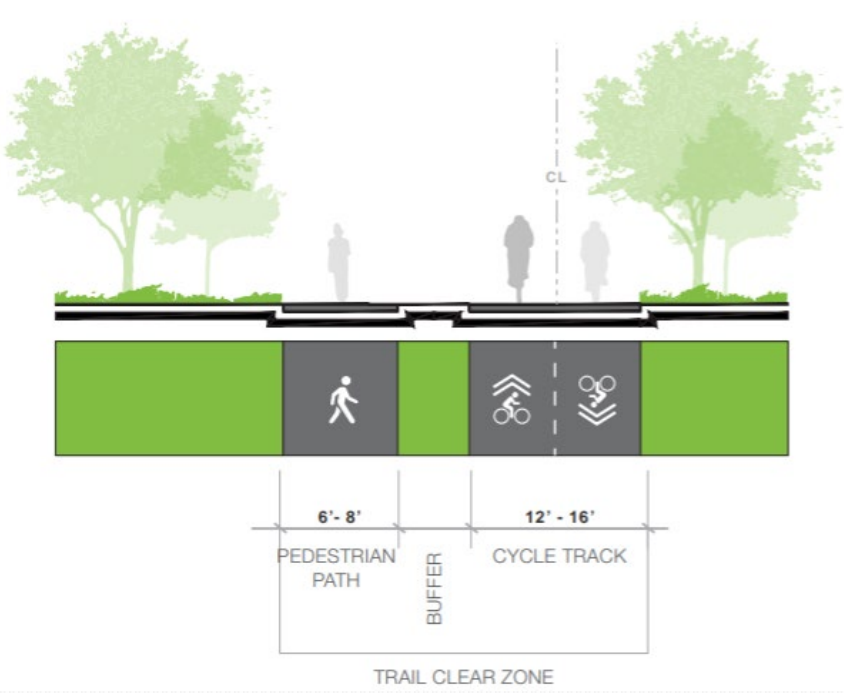
Predicting Ped & Bike Volumes on Greenways*

*and everywhere else

Matt Weschler
Email: mweschler@landdesign.com
Phone: 717-798-2831
12/5/2024

Why do we want to predict volumes?

Right sizing trail & Separating users



Quantifying benefits

- Health
- Amenity Value
- Mode Shift
- Economic Development

How do we predict volumes today?

Basic

Complex

Historic counts from other greenways

- Assume historic counts will be the same for future greenways

Simple statistical models

- Correlate population with counts

Trip generation and distribution

- Using ped or bike transportation analysis zones

What's the issue?

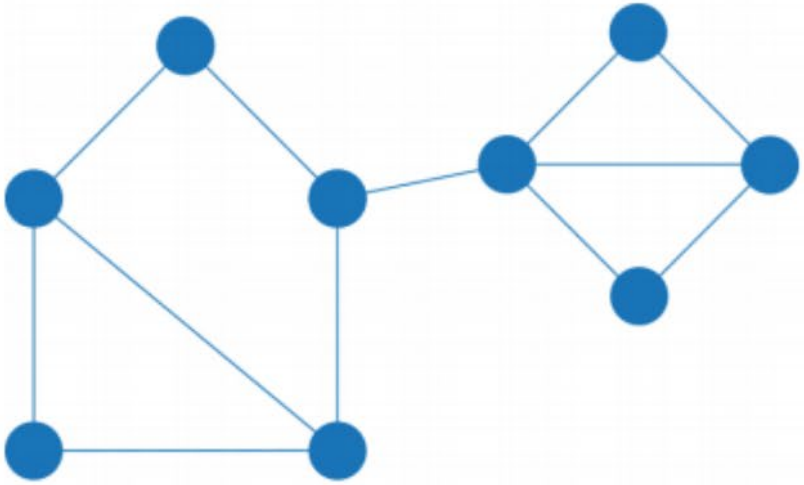
These methods struggle to answer important questions

For example, how are volumes affected by:

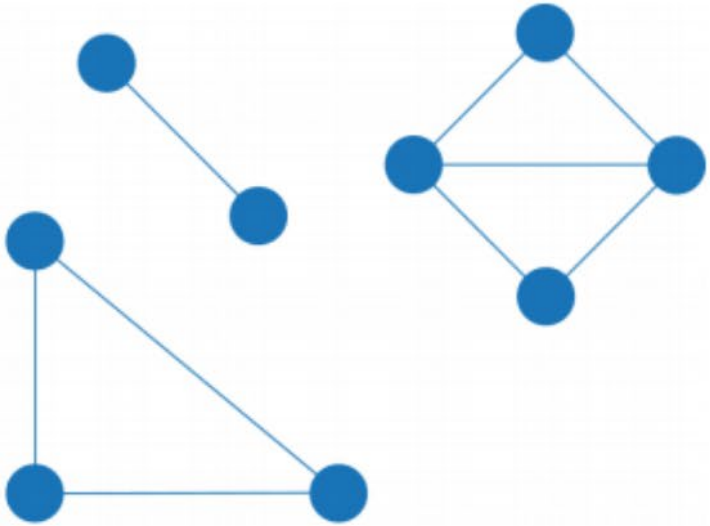
The stress level of the ped/bike network?

Credit: Chicago DOT

The connectedness of the ped/bike network?

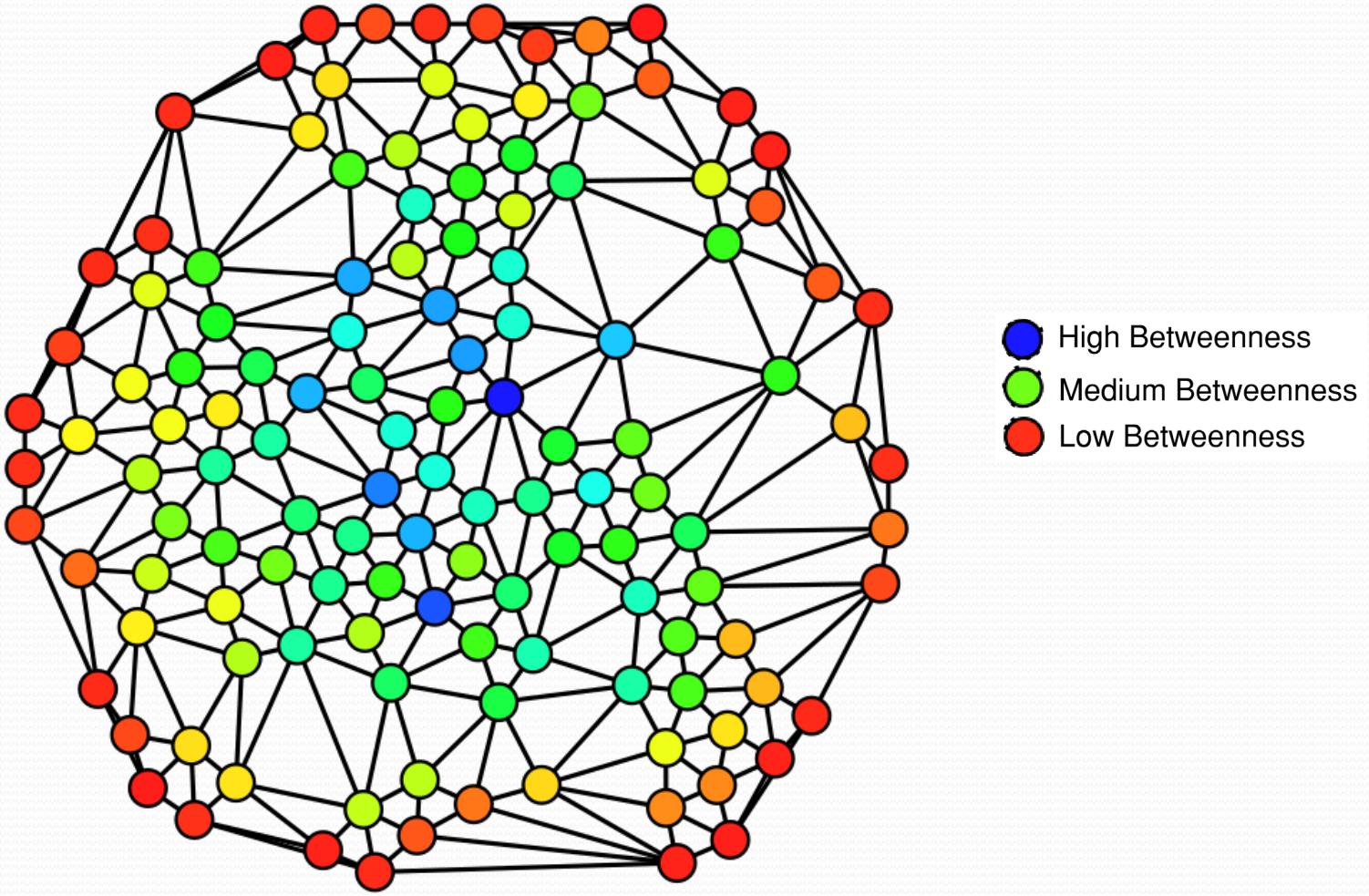


Connected Network
- Many ways to get around safely



Disconnected Network
- Few or no ways to get around safely

The “betweenness” of ped/bike links in the network?



What are the expected answers?

Low Importance Links

- Higher Stress
- Less Connected
- Less In-between

High Importance Links

- Lower Stress
- More connected
- More In-between

The Theory

If we measure the importance of every link in a network

And we measure ped/bike activity at different places on some of those links

We can use AI (aka pattern learning) methods to find the relationship between link importance and ped/bike volumes

This ped/bike activity model can then be used to predict things like:

- Ped/bike counts where existing data is missing. Identify potential safety "hot spots".
- Future flows on proposed greenways
- The impact of road diets on ped/bike activity
- The impact of a new ped/bike bridge over a highway
- The effect of completing a greenway master plan on city-wide mode shift
- The impact of new developments on ped/bike flows – a "Ped/Bike Transportation Impact Study"
- And more…

To build the prediction model:

1. Measure the importance of links in the network
2. Collect ped/ bike activity data
3. Use AI to model the relationship between link importance and ped/bike activity and make predictions.

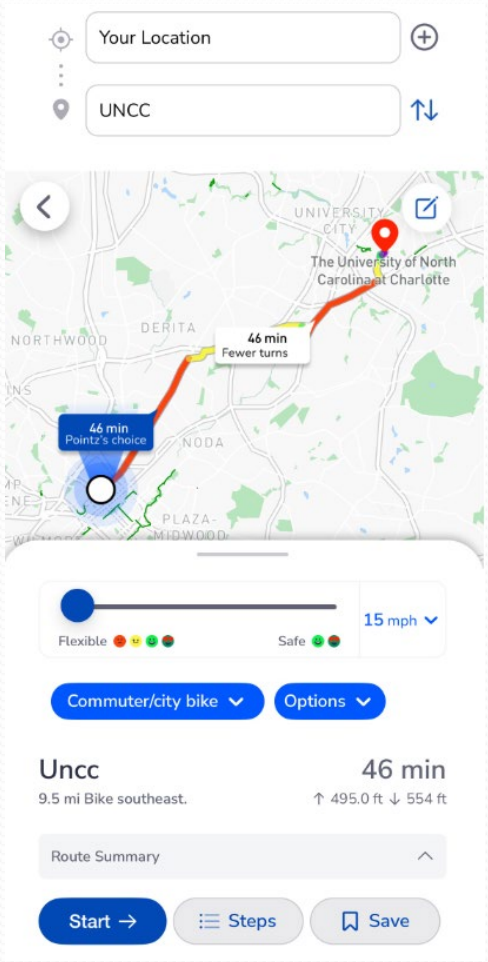
How do we measure which links are important?

Ped/Bike trips aren't like car trips

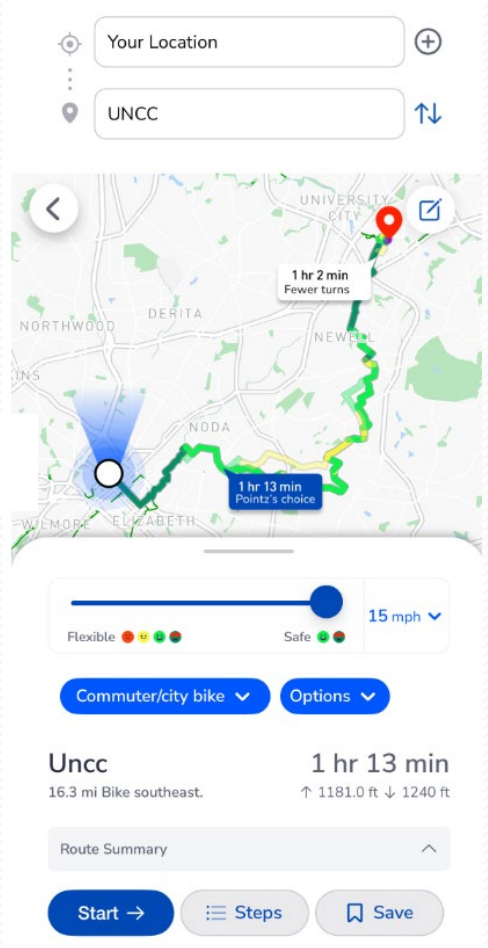
- Most of the time, drivers take the shortest time route to their destination. This is why highways are important links to drivers, and they're shown as big and bold on roadway maps.
- People walking and biking care about time, but more so than drivers they care about ***experience***.

Is experience measurable?

Prioritize Speed or Experience?



Pointz



Physical vs Perceived Distance

1 Mile feels like…

1 Mile

Most Bike-Friendly

Shared-use paths

Protected bike lanes

1.2-1.3 Miles

Bike-Friendly

Low traffic and low speed

Low-Moderate traffic with bike lane

1.5-1.7 Miles

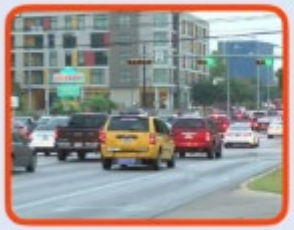
Somewhat Bike-Friendly

Moderate traffic with wide shoulders

Moderate traffic with unprotected bike lane

2.0-3.0 Miles

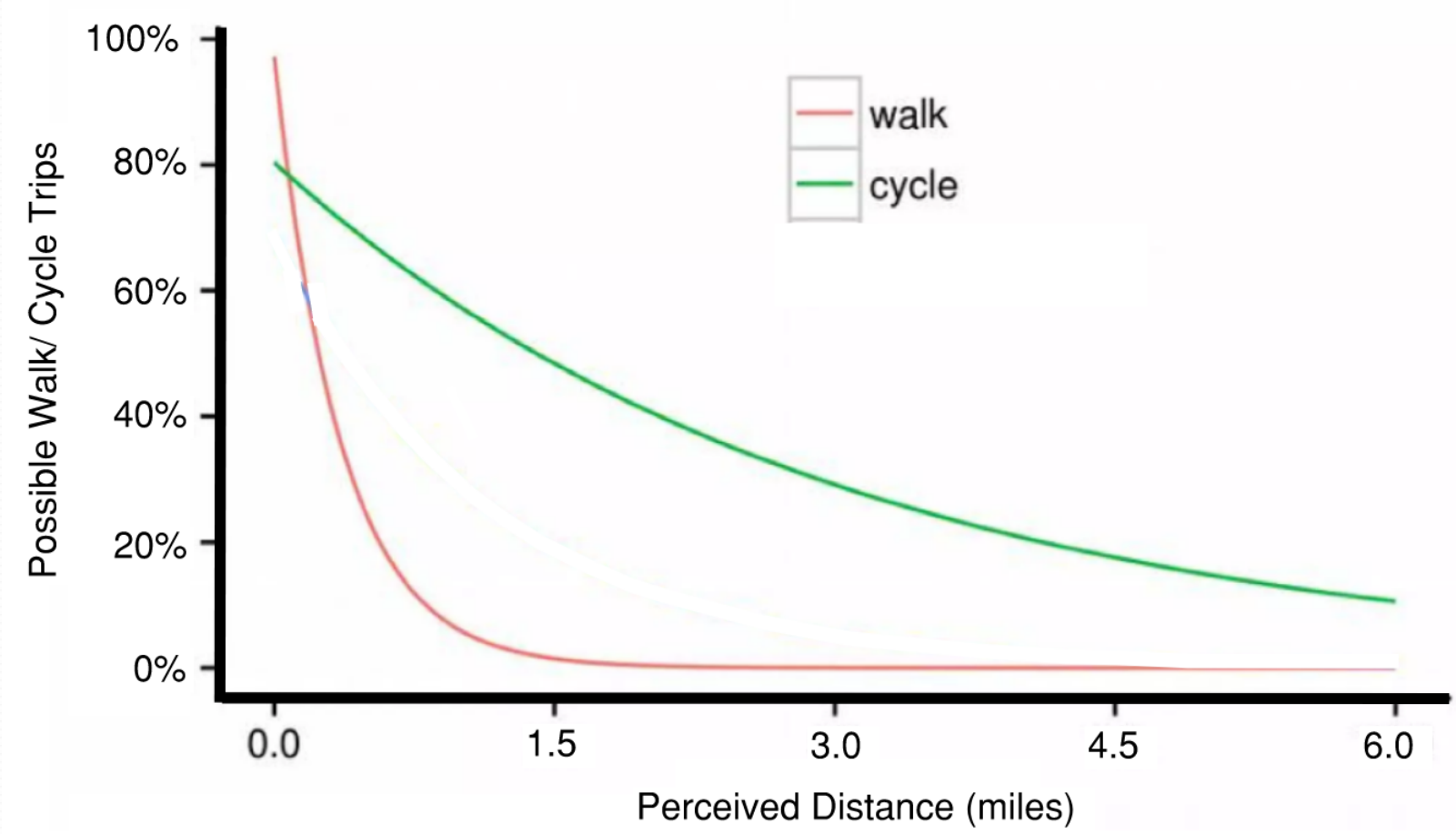
Not Bike Friendly



Main roads with no bike infrastructure

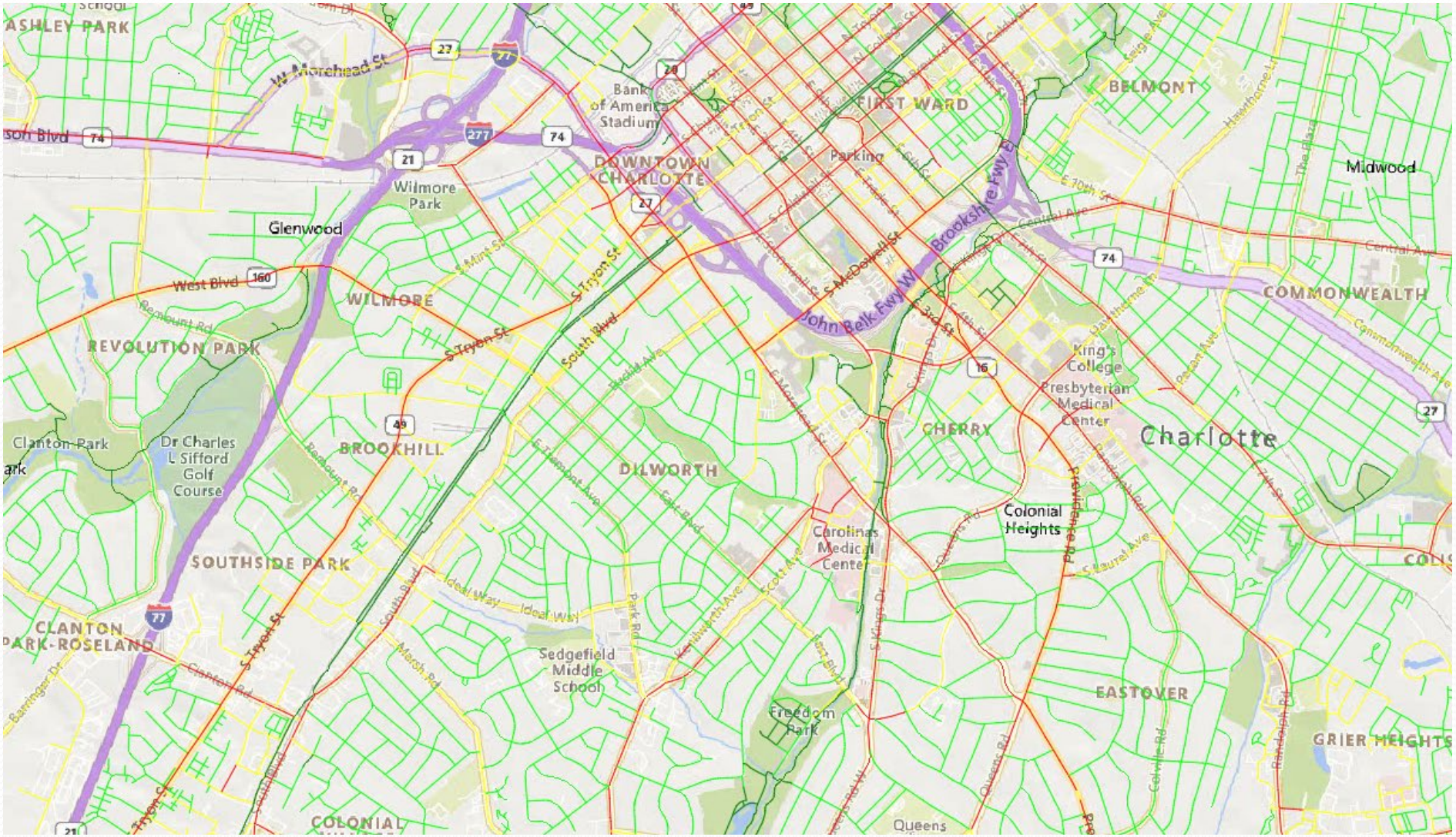
High traffic with shoulders or unprotected bike lanes

Ped/bike activity goes does down as the ***perceived distance*** between places get further apart

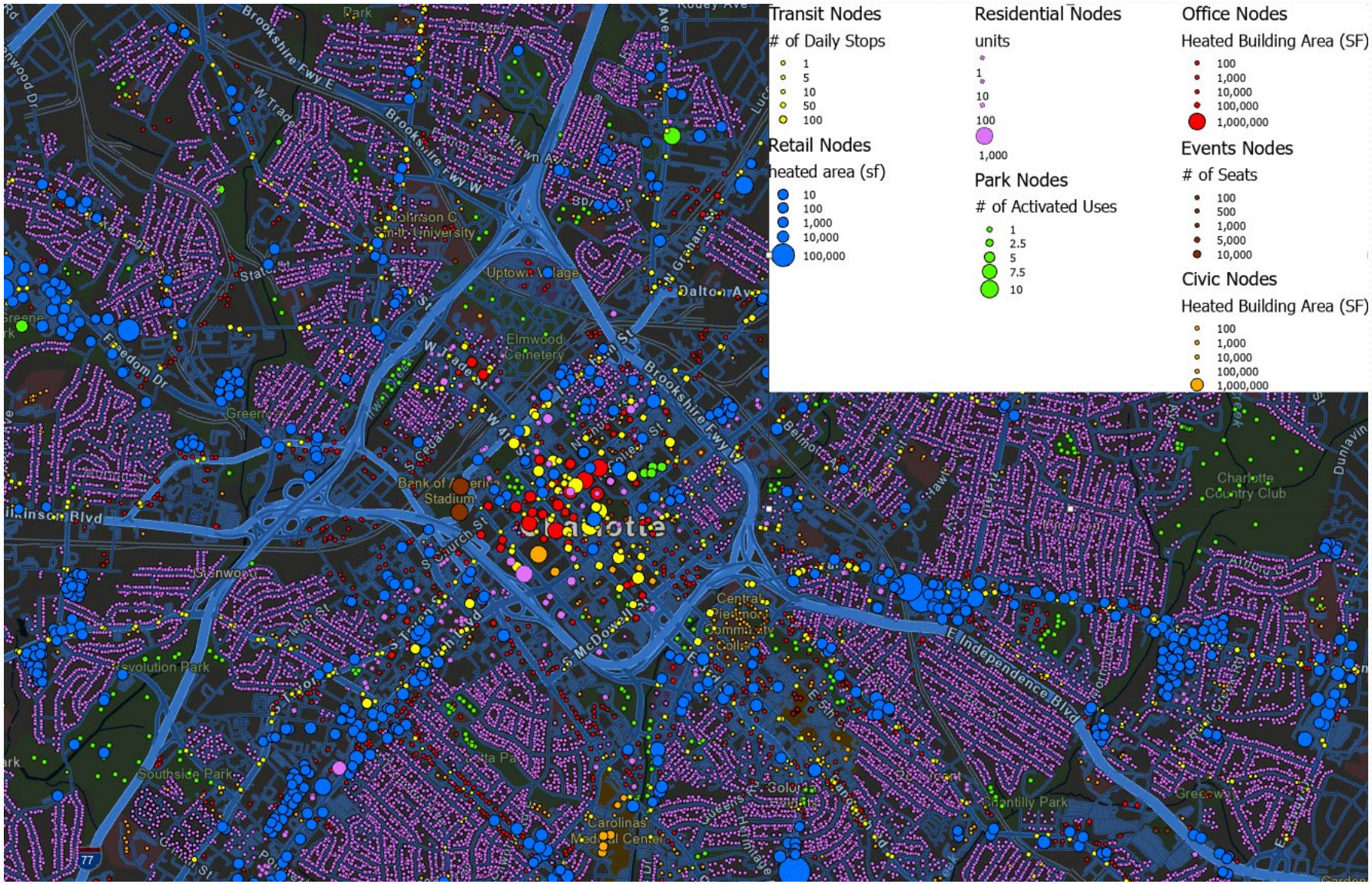


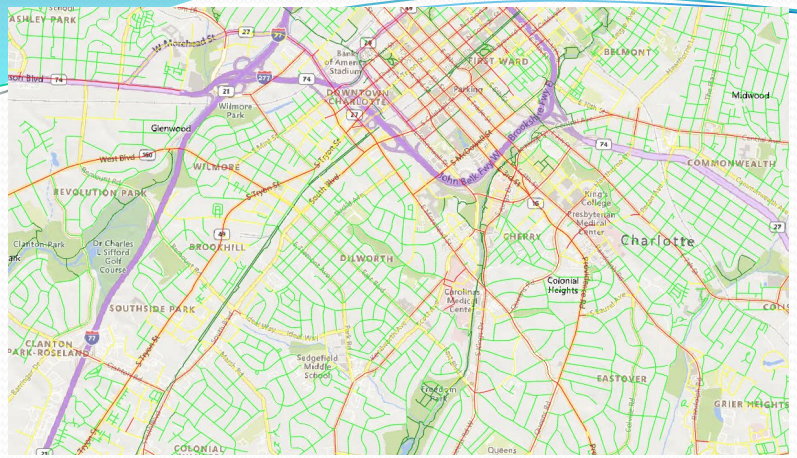
Charlotte example – define the "perceived distance" network

Most Bike-Friendly | Bike-Friendly | Somewhat Bike-Friendly | Not Bike Friendly



Charlotte example – define the origins and destinations





Using the perceived distance network

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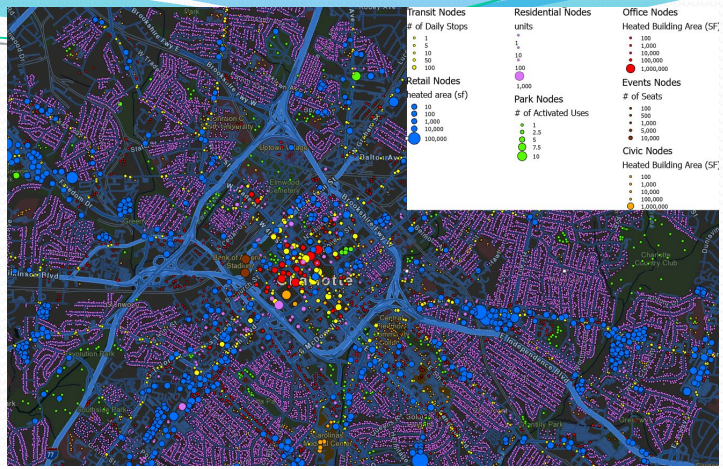


And all origins and destinations

From this data we run an analysis that measures
"**the importance of each link in the network**"

Connects less development

Connects more development

Less "in-between"

More "in-between"

Low **Link Importance** **High**

Higher perceived distance between land uses

Lower perceived distance between land uses

1. Measure the importance of links in the network ✓
2. Collect ped/ bike activity data
3. Use AI to model the relationship between link importance and ped/bike activity and make predictions.

Ped/Bike Data Options

Manual Counts

- Short duration
- Low sample size

Automated Sensors

- Long duration
- Low sample size

Mobile Device Location Data.

- Long duration
- High sample size

STREETLIGHT DATA

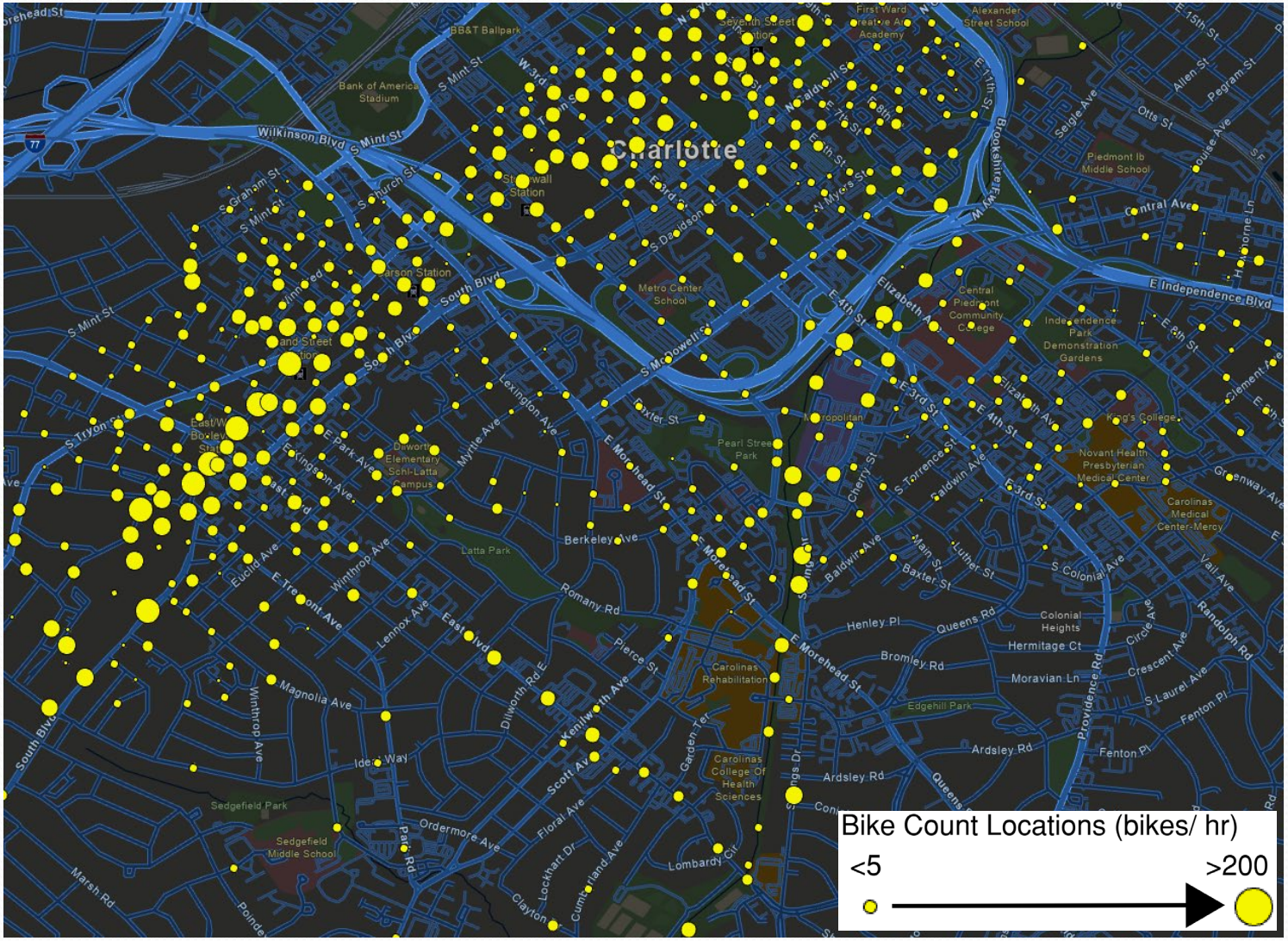
What kind of data could we collect?

- Average weekly peak hour flow
- Average daily flow per year or month
- Total annual flow

If mobile device location information is everywhere, why do we need a prediction model?

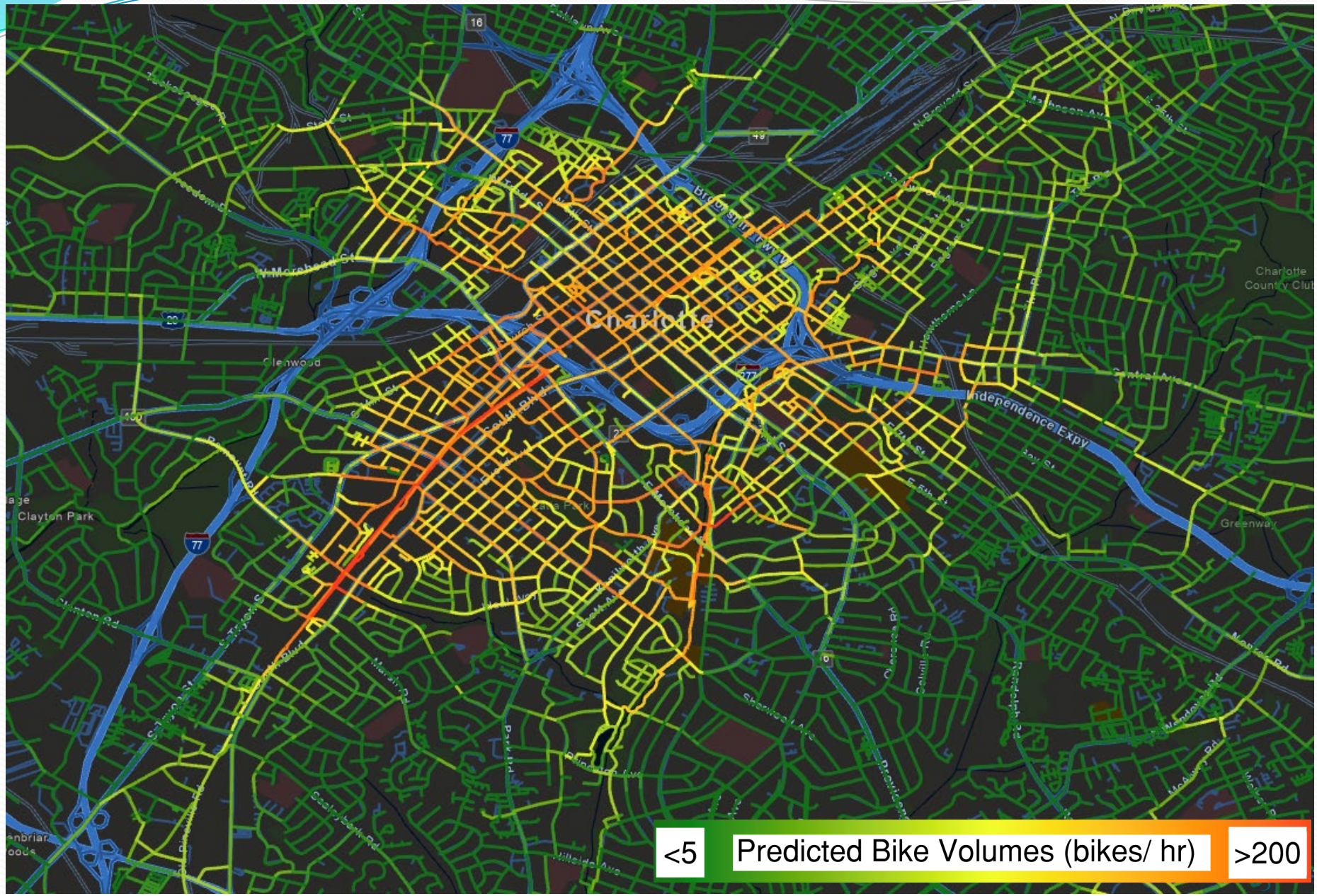
- Data isn't free
- No ped/bike data provided by StreetLight after April 2022 (as of now)
- Data by itself can't predict the future

Example Bike Data: Average weekly peak hour traffic April 2022
Counts collected from 600 spots around Charlotte



1. Measure the importance of links in the network ✓
2. Collect ped/ bike activity data ✓
3. Use AI to model the relationship between link importance and ped/bike activity and make predictions. ⟸

Predicted bike volumes example



Predicted ped volumes example

Caveats

- Prediction models will never be better than the data they are trained on.
- Perceived distance is not a hard science and needs more research
- Creating GIS representations of active transportation networks is cumbersome but may be automated in the future.

Acknowledgements

- StreetLight Data for their generous academic partnership
- Mecklenburg County Park and Rec, who shared their greenway EcoCounter data
- The MIT City Form Lab, whose ideas and network analysis code helped inform this work

Thank you for listening!

Matt Weschler
Email: mweschler@landdesign.com
Phone: 717-798-2831




Creating a Comprehensive & Defensible Economic Impact Analysis

Carolina Thread Trail Forum

December 5, 2024

CAROLINA THREAD TRAIL

“Not everything that can be counted counts, and not everything that counts can be counted.”

⇄km²in.kgmm³mmmmℓ
←mm²mmmℓtkm²
⇄kgin.mkm²kℓmℓkℓm²mm³mmmmℓ
←mm²mmmℓtkm²
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Why Economic Impact Studies?

- Value of trails to communities, regions, and economies
- Empower stakeholders to make informed decisions about land use, funding allocations, and policy priorities
- Serve as compelling advocacy tools, building support for sustainable infrastructure

Economic Impact Methods

Economic impacts facilitated by trail use

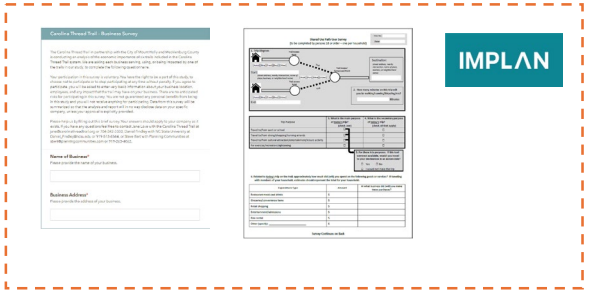
Physical activity supported by trail use

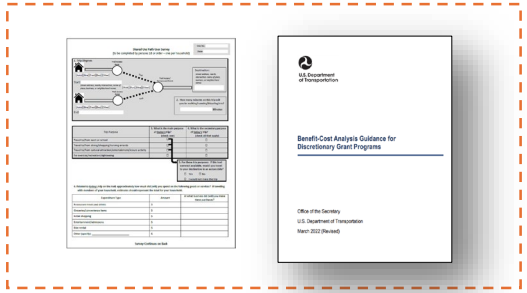
Environmental benefits

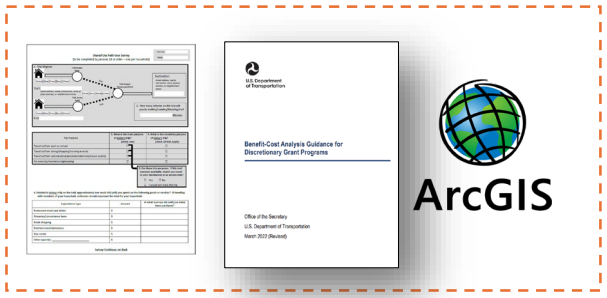
> Land preservation

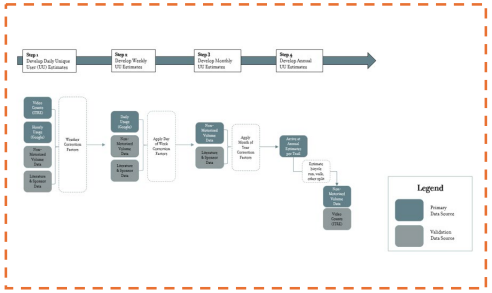
> Reduced vehicular emissions

Impacts annualized using unique trail user estimation









Input / Output
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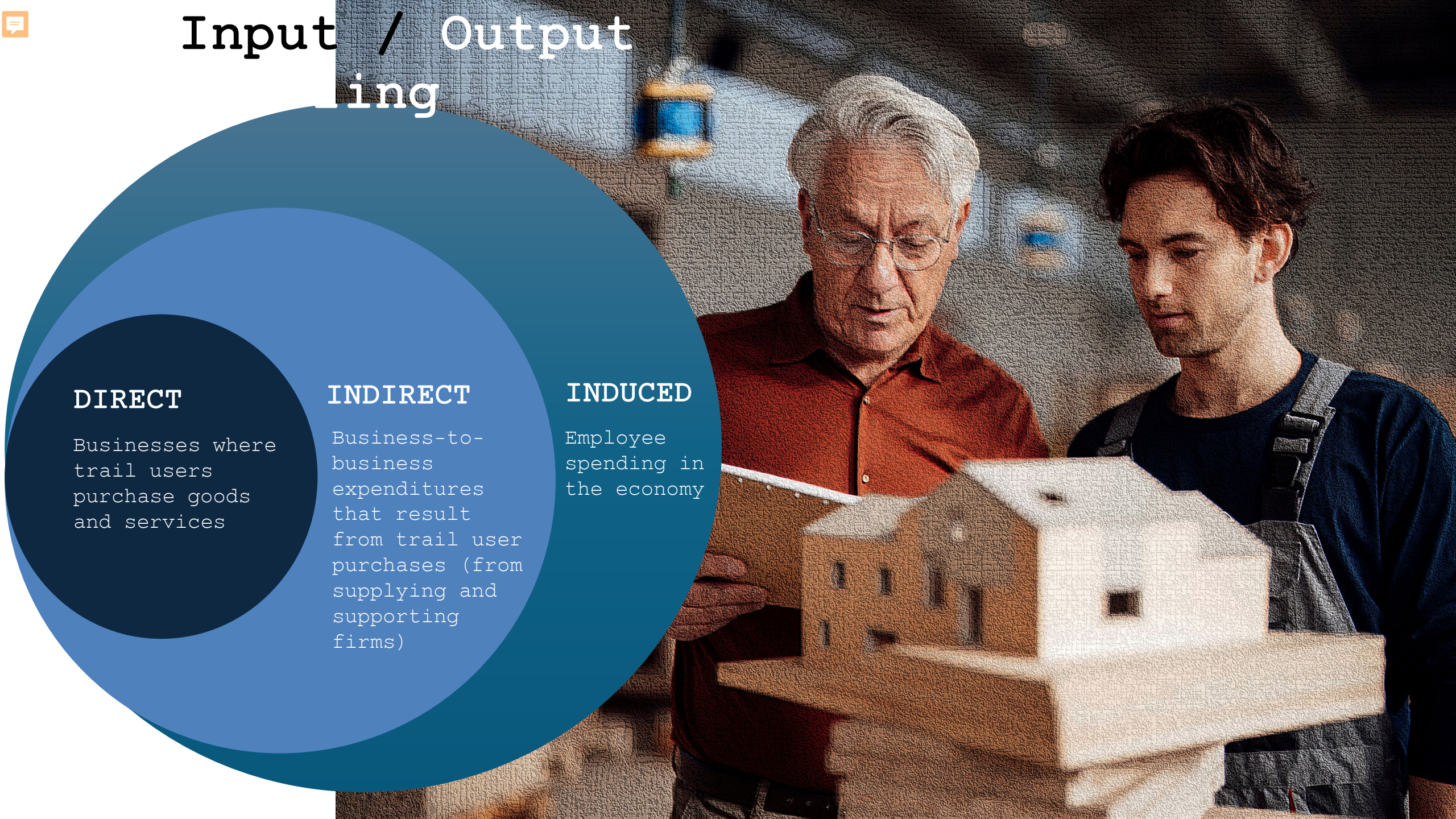


DIRECT

Businesses where trail users purchase goods and services

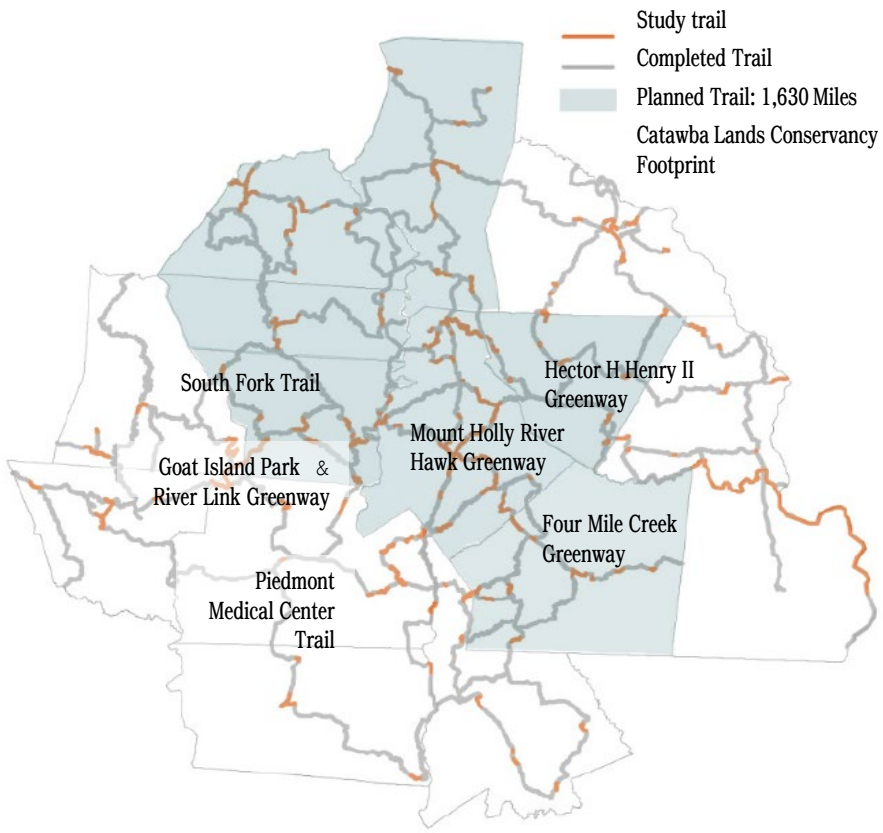
INDIRECT

Business-to-business expenditures that result from trail user purchases (from supplying and supporting firms)

INDUCED

Employee spending in the economy

Economic Impact



	Total Impact of All Six Study Trails	Average Impact per Trail Mile	Impact Range Across All Six Study Trails
EMPLOYMENT	190 jobs	15 jobs	16-58 jobs
LABOR INCOME	$9.7 million	$770 thousand	$0.9-$2.9 million
ECONOMIC OUTPUT	$25.8 million	$2.1 million	$2.2-$7.9 million
TAX REVENUE	$3.3 million	$262 thousand	$0.3-$1.0 million

Physical Health Benefits

Across all six study trails…

558K

Trail Visits

441K

Walk Visits

2.8 visits per week

56 min per visit l 158 min per week

51K

Run Visits

3.5 visits per week

43 min / visit | 157 min / week

$3.9M

Annual Health Care Savings

Benefit of $7 per trail visit

38K

Bike Visits

2.4 visits / week

52 min per visit | 126 min per week

28K

Other Exercise Visits

1.3 visits / week

48 min per visit | 62 min per week

Vehicle Miles Traveled Reduction Benefits

Across all six study trails…

Eliminated Car Trips. Car trips were deemed to be eliminated if survey respondents who used active transportation to get to the trail said they would drive to their destination, or a similar destination, if the trail did not exist.

Reduced Distance Car Trips. Car trips were deemed to be made at a reduced distance if survey respondents who used vehicular transportation to get to the trail said they would drive to a similar destination, often requiring a further distance of travel, if the trail did not exist. Based on survey response data it was estimated that vehicle trips to a similar destination would be approximately 20 percent farther.

1.57M
Vehicle Miles Eliminated

$90K
Emissions Cost-Savings

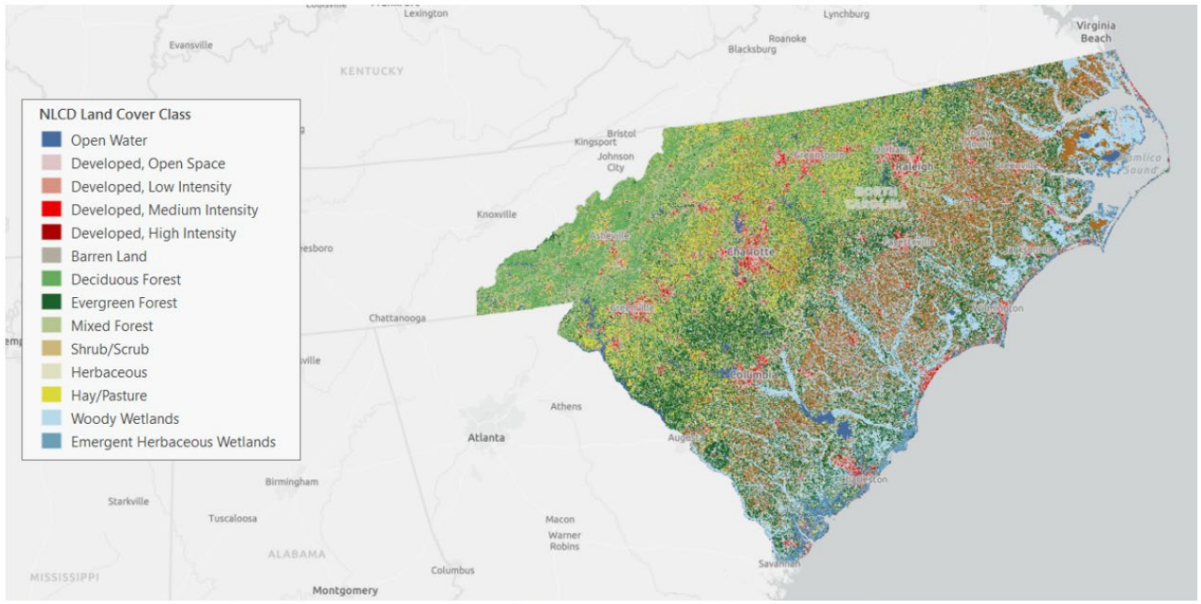
104K
Eliminated Car Trips

227K
Reduced-Mileage Car Trips

Environmental Benefits

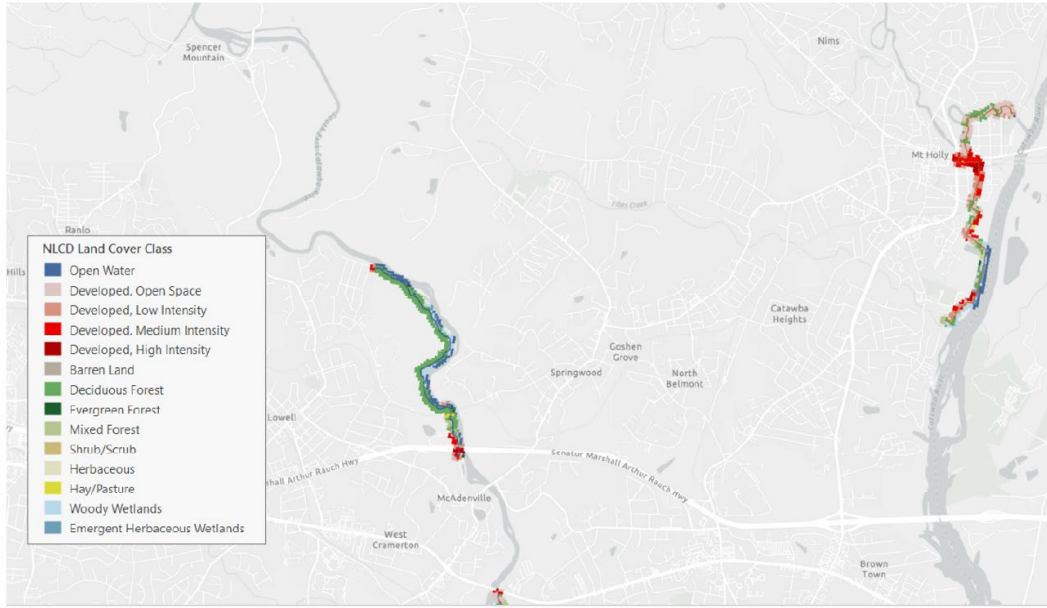
Land Preservation Benefits

Figure 1: North Carolina and South Carolina Land Cover Classes



Data from the National Land Cover Database. Source: Multi-Resolution Land Characteristics Consortium, 2019

Figure 2: Sample Extraction of Land Cover Data for Carbon Analysis



GIS analysis of data from the National Land Cover Database. Source: Multi-Resolution Land Characteristics Consortium, 2019

Land Preservation Benefits

Land cover designations

- Multi-Resolution Land Characteristics Consortium's (MRLC) National Land Cover Database

Carbon Stock and Sequestration Rates

- European Environmental Agency's
- (EEA) terrestrial and marine carbon stocks and sequestration rates data tables

Carbon stock (also known as carbon storage) is the absolute quantity of carbon held in a habitat pool at any specified time.

Carbon sequestration is the annual rate at which carbon is extracted from the air and stored within a habitat pool.

Land Cover Classifications, Carbon Stock Values, and Annual Sequestration Rates

Class\Value	Classification	Carbon Stock	Carbon Sequestration
		Mg C per Hectare	Mg C per Hectare
11	Open Water	20.0	0.15
21	Developed, Open Space	10.0	0.01
22	Developed, Low Intensity	10.0	-0.01
23	Developed, Medium Intensity	10.0	-0.02
24	Developed High Intensity	10.0	-0.02
31	Barren Land (Rock/Sand/Clay)	24.0	1.00
41	Deciduous Forest	138.5	3.60
42	Evergreen Forest	92.4	2.40
43	Mixed Forest	115.5	3.00
52	Shrub/Scrub	33.5	1.10
71	Grassland/Herbaceous	61.3	1.20
81	Pasture/Hay	80.1	1.40
82	Cultivated Crops	99.0	1.80
90	Woody Wetlands	154.5	1.60
95	Emergent Herbaceous Wetlands	115.9	1.20

Source: ITRE analysis of National Land Cover Database (2019) and the European Environmental Agency's carbon stocks and sequestration rates database (2022).

Land Preservation Benefits

Across all six study trails…

Habitat Carbon Stock. The absolute quantity of carbon held in a habitat pool at any specified time is the carbon stock or store.

Annual Carbon Sequestration. The annual rate at which carbon is stored within a geographic boundary is referred to as its carbon sequestration rate.[1]

[1] For this analysis, carbon stocks and sequestration rates were evaluated for the land area within a 200-foot buffer of the trail.

26.8K
Carbon Stock
(metric tons)

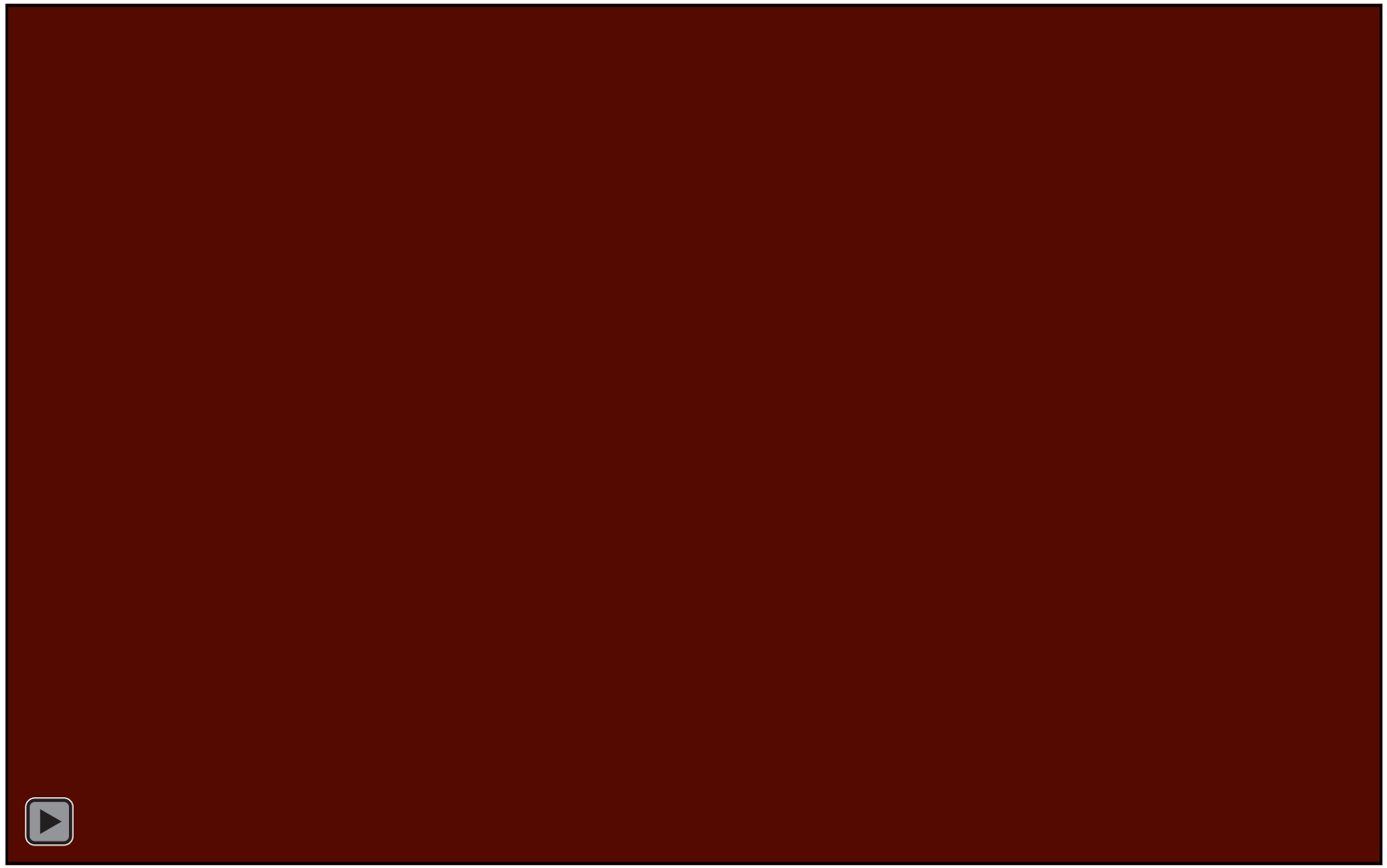
$1.45M
Annual Emissions Cost-Savings

559.5
Carbon Sequestration
(metric tons)

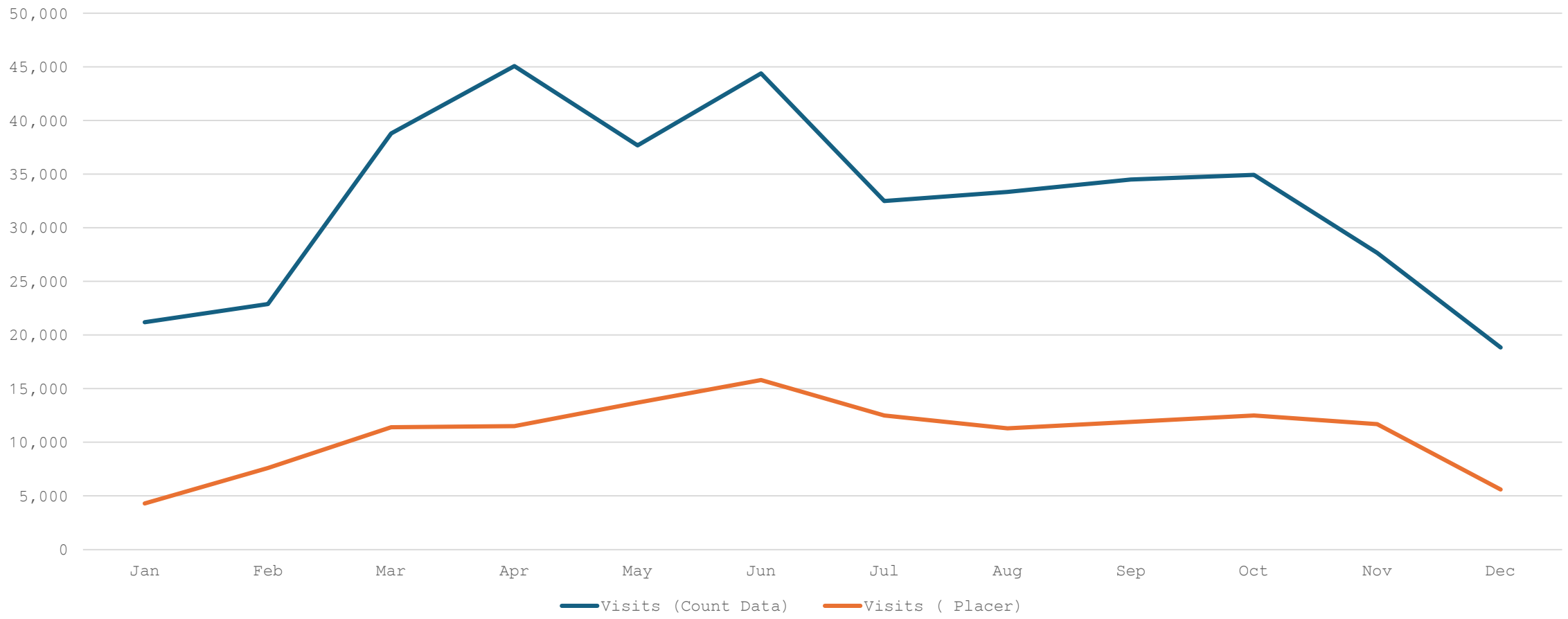
Incorporating Cell Phone Data

Data Options

Trail Counter and Cell Phone Comparisons



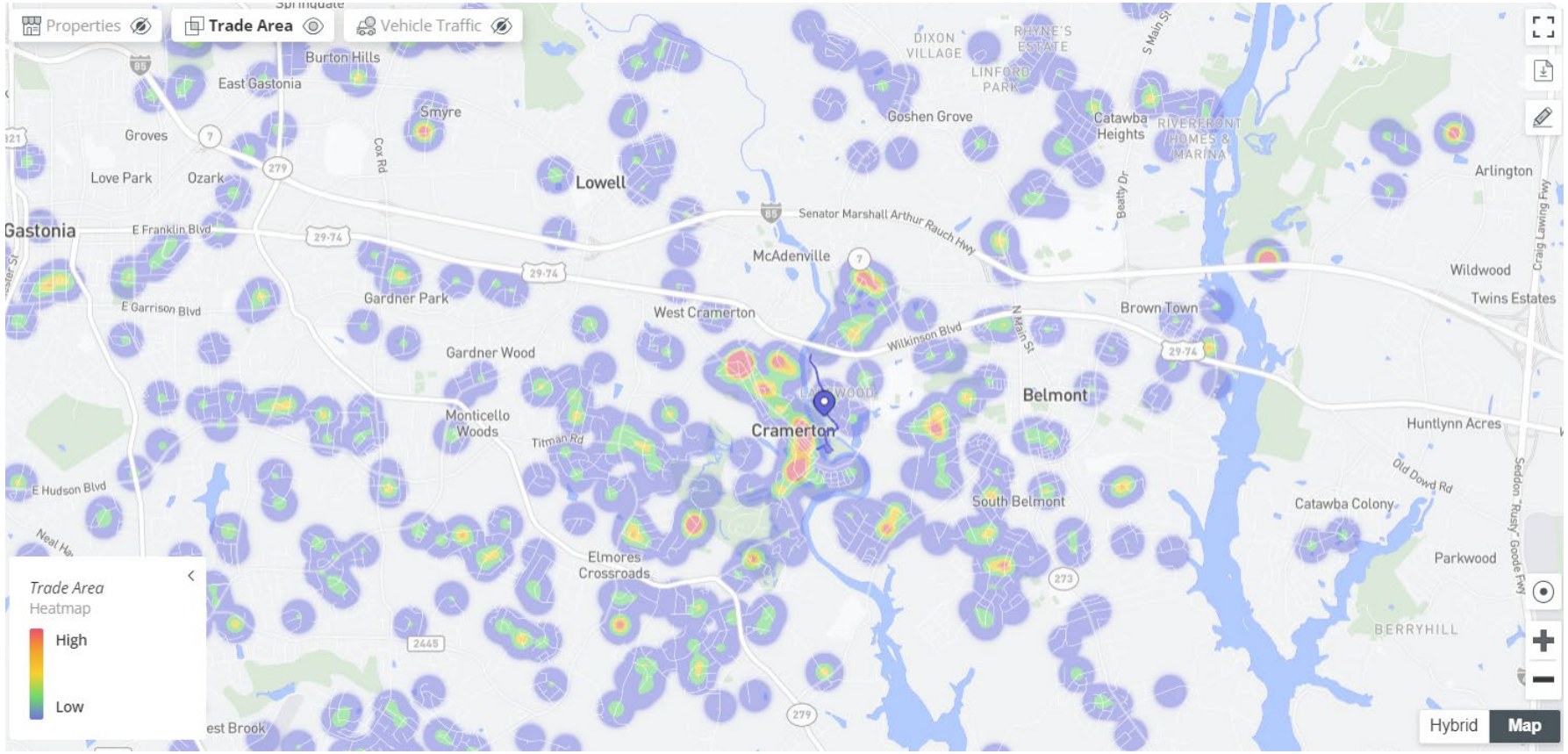
Trail Counter and Cell Phone Data Comparison



New Data Options

Placer.Ai

Goat Island Park & River Link Greenways | Cramerton NC



Prior-Post Data

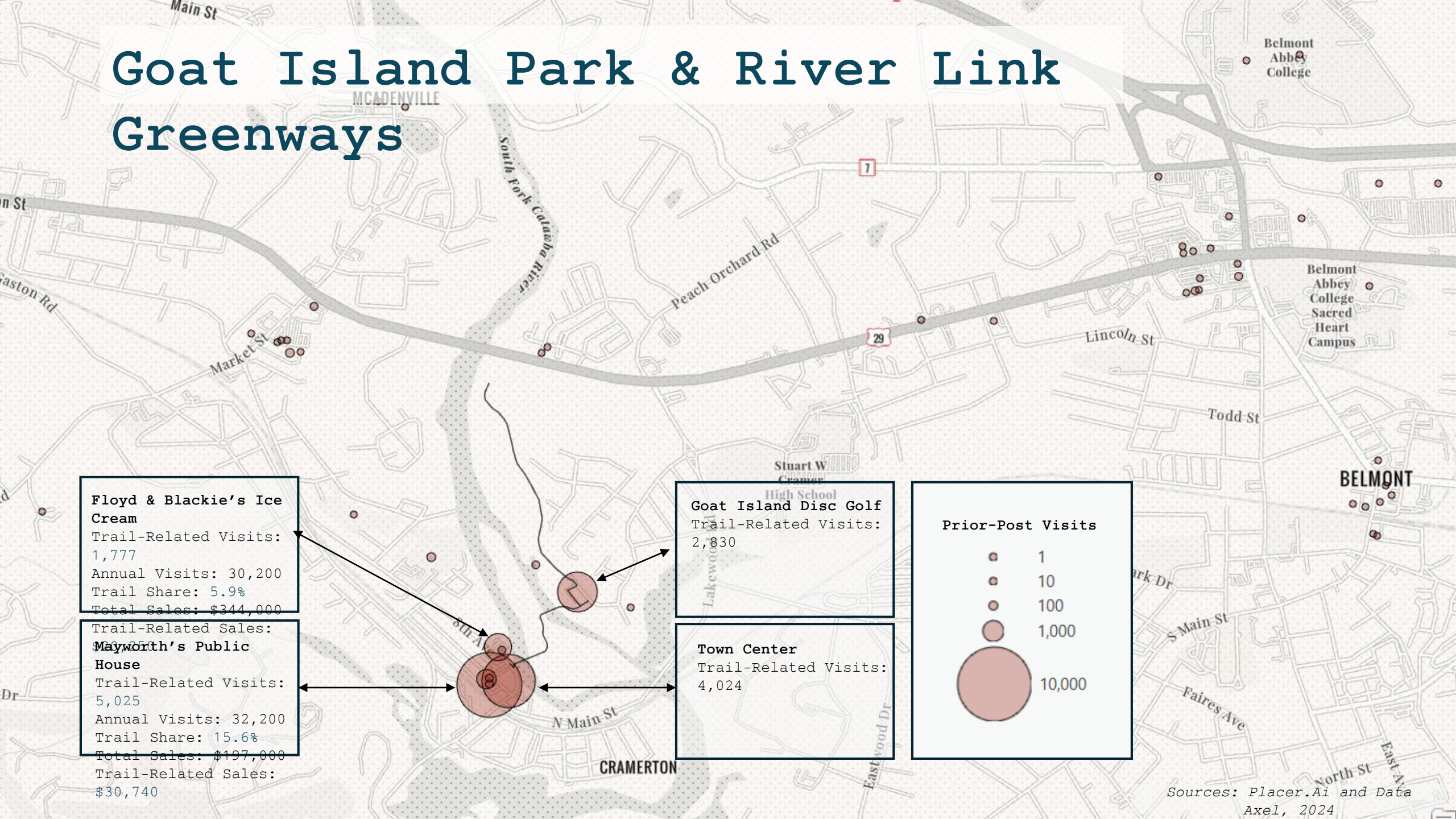
- Locations visited prior to using the trail
- Locations visits after using the trial

Visits Related to Trail Use

Raw Data Output

Name	Category	Sub Category	Address	Zip Code	City	Location	Prior Visits	Post Visits	Prior & Post Visits
Town Center	Leisure	Nature & Landmarks	100 Center Street	28032	Cramerton	35.235923	2709	1315	4024
Mayworth's Public House	Leisure	Bars & Pubs	115 Center St	28032	Cramerton	35.235787	2652	2373	5025
Goat Island Disc Golf Course	Leisure	Attractions	--	28032	Cramerton	35.239396	1883	947	2830
Floyd & Blackie's Coffee & Ice Cream	Dining	Breakfast, Coffee, Bak	137 8th Ave	28032	Cramerton	35.237247	1072	705	1777
About Face Bootcamp powered by PPBC	Fitness	Fitness	117 Center St	28032	Cramerton	35.236006	804	338	1142
Food Lion Grocery Store	Groceries	Groceries	202 A Market St	28032	Cramerton	35.248748	71	133	204
Center Street Tavern & Restaurant	Dining	Restaurants	115 Center St	28032	Cramerton	35.23581,	68	71	139
C.B. Huss Recreation Complex	Leisure	Nature & Landmarks	1 JULIAN St	28032	Cramerton	35.240783	65	78	143
Cramerton Drug	Medical & Health	Drugstores & Pharmac	149 8th Ave	28032	Cramerton	35.237137	65	40	105
Salon on center	Beauty & Spa	Beauty & Spa	119 Center St # A	28032	Cramerton	35.23603,	62	22	84
McDonald's	Dining	Fast Food & QSR	505 N Main St	28012-313	Belmont	35.251739	47	81	128
North Belmont Park	Leisure	Nature & Landmarks	--	28012	Cramerton	35.240466	44	44	88
BJ's Gas	Shops & Services	Gas Stations & Conveni	1715 Carolina Pl Pkwy,	28134	Pineville	35.075416	44	--	44
Old Stone Steakhouse	Dining	Restaurants	23 S Main St	28012	Belmont	35.241672	36	--	36
Belmont Community Gardens	Leisure	Nature & Landmarks	7 N Main St	28012	Belmont	35.242851	33	--	33
Dollar Tree	Shops & Services	Discount & Dollar Store	2104 W Franklin Blvd	28052	Gastonia	35.259510	33	--	33
Jia Asian Fusion & Sushi Bar	Dining	Restaurants	3418 S New Hope Rd	28056	Gastonia	35.224846	27	--	27
Exxon	Shops & Services	Gas Stations & Conveni	8924 Pineville-Matthews Rd	28226-000	Charlotte	35.089557	27	--	27
Studio Elite	Fitness	Fitness	225 Market St	28032	Cramerton	35.249511	25	--	25
BP	Shops & Services	Gas Stations & Conveni	3050 Union Rd	28056	Gastonia	35.215354	25	--	25
Holy Angels	Workplace	Workplace	6600 Wilikinson Blvd	28012	Belmont	35.251382	25	--	25
Bubba's 33	Dining	Restaurants	3287 E. Franklin Blvd	28056	Gastonia	35.257816	24	35	59
Times Turnaround Food Store	Shops & Services	Gas Stations & Conveni	6751 Wilkinson Blvd	28012	Belmont	35.252245	24	--	24
Lowe's	Home Improvements	Home Improvement	200 Caldwell Farm Road	28012	Belmont	35.255382	24	20	44
Bojangles' Famous Chicken 'n Biscuits	Dining	Fast Food & QSR	551 N New Hope Rd	28054	Gastonia	35.272129	22	--	22
7-Eleven	Shops & Services	Gas Stations & Conveni	1600 E Franklin Blvd	28054	Gastonia	35.262481	22	--	22
Kate's Place Bar & Grill	Leisure	Bars & Pubs	1809 Hwy 321 N	29710	Clover	35.151179	21	--	21
Nellie's Southern Kitchen	Dining	Restaurants	36 N Main St	28012	Belmont	35.243560	21	10	31
Belmont Abbey College	Education	Colleges, Universities,	100 Belmont Mount Holly Rd	28012	Belmont	35.260444	21	--	21
Wing Night	Leisure	Bars & Pubs	--	28012	Cramerton	35.238784	19	--	19
South Fork Station	Shopping Centers	Community Shopping C	6425 Wilkinson Blvd	28012	Belmont	35.252943	19	14	33

Goat Island Park & River Link Greenways



Floyd & Blackie's Ice Cream
Trail-Related Visits: 1,777
Annual Visits: 30,200
Trail Share: 5.9%
Total Sales: $344,000
Trail-Related Sales: $20,250

Maryworth's Public House
Trail-Related Visits: 5,025
Annual Visits: 32,200
Trail Share: 15.6%
Total Sales: $197,000
Trail-Related Sales: $30,740

Goat Island Disc Golf
Trail-Related Visits: 2,830

Town Center
Trail-Related Visits: 4,024

Prior-Post Visits

- 1
- 10
- 100
- 1,000
- 10,000

Sources: Placer.Ai and Data Axel, 2024

Economic Impact Study Costs

Typical Costs

Imagine if they were *free*

sophisticated modeling tools, and

Questions?

Steve Bert
Program Manager
Economic & Policy Assessment, ITRE
stevebert@ncsu.edu
919-263-4062