Bicycle Network Analysis Workshop

APBP Conference
August 28, 2019
Portland, OR

Part I: All About the Bicycle Network Analysis (BNA)

BACKGROUND

Bicycle connectivity measures have evolved through research in the past three decades to provide nuanced assessments of how well the transportation network serves bicyclists. The measures differ in their statistical methods and inputs, and therefore their difficulty to implement in real-world scenarios.

There are two broad groups of bicycle network connectivity measures: stress measures and connectivity measures. **Stress measures** rate roads based on the expected stress experienced by prospective and current bicyclists as determined by a bundle of factors. **Connectivity measures** use road stress ratings to evaluate how well people can access select destinations using low-stress routes.

The PeopleForBikes Bicycle Network Analysis is software that performs a bicycle network connectivity analysis for a given region using a modified Bicycle Level of Traffic Stress (LTS) framework. The LTS framework was originally developed by Maaza Mekuria, Peter Furth, and Hilary Nixon at the Mineta Transportation Institute. Visit *https://transweb.sjsu.edu/research/low-stress-bicycling-and-network-connectivity* for details on their research.

WHY THE BNA?

- *Automates an otherwise lengthy analysis process*
- *Creates a consistent network evaluation framework for comparison across cities*
- *National data coverage, can be applied to any U.S. city*
- *Open-source, free to use and reproduce*
- *Lowers the barrier to network analysis*

TRAINING OBJECTIVES

THROUGH THIS WORKSHOP YOU WILL:

1. Understand the fundamentals of bicycle network connectivty measures.
2. Know how to find and interpret BNA data.
3. Develop skills to use BNA data in applied contexts.

Data Sources

The BNA uses three data sources: a boundary file, U.S. Census data, and OpenStreetMap data.

BOUNDARY FILE

A shapefile that outlines the area to be analyzed. The boundary file can be nearly any size or shape, however larger regions will require more computing power.

U.S. CENSUS

2010 Population and Housing Counts

Geographic units in the form of census blocks, and decennial population counts at the block level. Available as state files. Updated every ten years.

» *https://www2.census.gov/geo/tiger/TIGER2010BLKPOPHU/*

Longitudinal Employer-Household Dynamics Origin-Destination Employment Statistics (LODES)

Jobs distribution data at the block level. Updated annually for most states.

» *https://lehd.ces.census.gov/data/*

OPENSTREETMAP (OSM)

Bike infrastructure, road characteristics, intersection characteristics, and destination data. OSM is the Wikipedia of maps, a continuously updated, open-source map that anyone can edit and use. OSM data is incorporated into a wide variety of web applications.

» *https://www.openstreetmap.org*

You can find OSM editing guidance on the PFB website:

» *https://peopleforbikes.org/placesforbikes/bicycle-network-analysis/*

NOTES:

ACTIVITY: Explore Census Data

1. Load the **OregonNW** shapefile into GIS software.
2. Zoom in and explore the census block units -- size, shape, and distribution. What do you notice?
3. Open the attribute table. Identify the **BLOCKID10** (census block identifier) and **POP10** (population count) columns. Color the map using the **POP10** column. Where is population concentrated in the region?
4. Return to the attribute table. Identify the **S000** (jobs count) column. Color the map using the **S000** column. Where are jobs concentrated in the region?

NOTES:

ACTIVITY: Explore OpenStreetMap

1. Navigate to *openstreetmap.org*.
2. Zoom into a city you know containing on- and off-street bicycle infrastructure.
3. Click on an off-street bike path. In the left-side panel, click on **Cycle Path**. Read the panel details.
4. Find an on-street bike lane. Click on the road containing the bike lane. Read the panel details for that road segment.
5. Click on an intersection with traffic lights. Click on **Traffic Signals** in the panel. Read the panel details.
6. If the city is in the BNA, compare the bicycle infrastructure in the BNA to the infrastructure you identified in OpenStreetMap. How does it appear in the BNA?
7. Return to *openstreetmap.org*. Find a K-12 school. Click on it. Check the tags in the panel.
8. Find a park. Check the tags.
9. Find a hospital. Check the tags.
10. Return to the BNA website. Browse destination maps for the city.

» **NOTE** *OpenStreetMap data follows a key=value format, e.g. highway=tertiary, cycleway=lane. A collection of key=value pairs describes every object created in the map.*

Measuring Stress

WHAT THE BNA INCLUDES

- Bike facility type
  - Separated lanes
  - Buffered lanes
  - Conventional lanes
- Number of traffic lanes in each direction
- Speed limit
- Parking
- Facility width (bike infrastucture, road, or parking lane)
- Intersection treatment

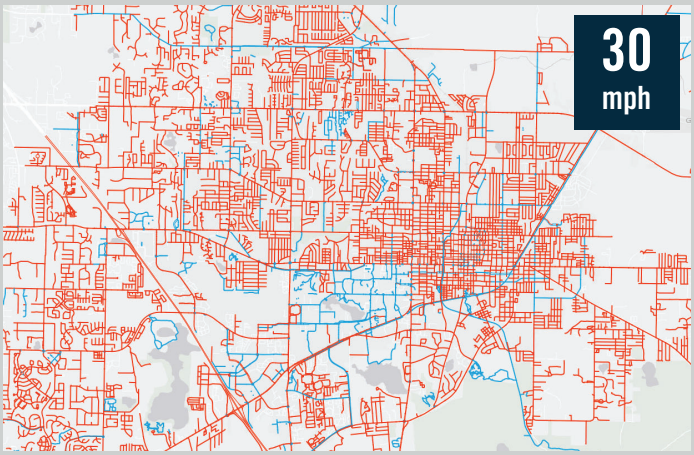
WHAT THE BNA DOESN'T INCLUDE

- Traffic volume
- Actual speeds
- Road shoulders
- Traffic calming features
- Lane markings
- Bicycle route designations
- Elevation change
- Weather
- Road surface conditions

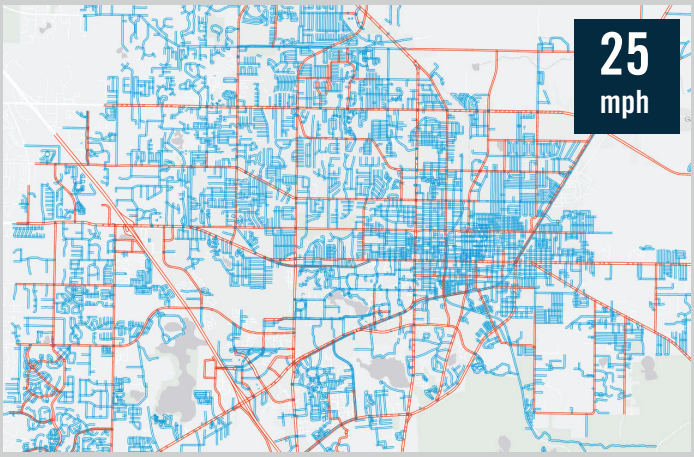
WHAT THE BNA ASSUMES (in the absence of data)

- Speed limit
  - Residential street speed limits if defined in state or city law — city law supercedes state law
- Parking
- Number of lanes
- Facility width (bike infrastucture, road, or parking lane)
- Intersection treatment

» **NOTE** *The following 10 states have legislated default residential street speed limits greater than 25 mph: Colorado, Florida, Georgia, Idaho, Kentucky, Maryland, New Hampshire, New Mexico, New York, North Carolina.*



ASSUMED RESIDENTIAL STREET SPEED



Street Segment Assumptions

Functional class	Speed	Number of Lanes	Parking	Parking lane width	Buffered bike lane width	Bike lane width (with parking)	Bike lane width (no parking)	Roadway width
Primary	40 mph	2	Y	8 ft	6 ft	5 ft	4 ft	N/A
Secondary	40 mph	2	Y	8 ft	6 ft	5 ft	4 ft	N/A
Tertiary	30 mph	1	Y	8 ft	6 ft	5 ft	4 ft	N/A
Unclassified	25 mph	1	Y	N/A	N/A	N/A	N/A	27 ft
Residential	25 mph	1	Y	N/A	N/A	N/A	N/A	27 ft

Intersection Assumptions

Functional classes	Signalized
Primary - Primary	Y
Primary - Secondary	Y
Primary - Tertiary	N
Primary - Residential	N
Secondary - Secondary	Y
Secondary - Tertiary	N
Secondary - Residential	N
Tertiary - Tertiary	Y
Tertiary - Residential	N
Residential - Residential	N

» **NOTE** *"Number of lanes" refers to the number of travel lanes in each direction, not the total number of travel lanes on the road.*

FUNCTIONAL CLASSES

OPENSTREETMAP ROAD DESIGNATIONS

MOTORWAY A restricted access major divided highway, normally with 2 or more running lanes plus emergency hard shoulder. Equivalent to the Freeway, Autobahn, etc.
TRUNK The most important roads in a country's system that aren't motorways. (Need not necessarily be a divided highway.)
PRIMARY The next most important roads in a country's system. (Often link larger towns.)
SECONDARY The next most important roads in a country's system. (Often link towns.)
TERTIARY The next most important roads in a country's system. (Often link smaller towns and villages)
UNCLASSIFIED The least important through roads in a country's system – i.e. minor roads of a lower classification than tertiary, but which serve a purpose other than access to properties. (Often link villages and hamlets.)
RESIDENTIAL Roads which serve as an access to housing, without function of connecting settlements. Often lined with housing.

Source: https://wiki.openstreetmap.org/wiki/Key:highway

Segment Stress (except residential or unclassified streets)

Facility Type	Speed	Number of Lanes	Parking	Facility Width	Stress
Cycle Track	---	---	---	---	Low
Buffered Bike Lane	> 35 mph	> 1	---	---	High
		1	---	---	High
	35 mph	>1	---	---	High
		1	Yes	---	High
			No	---	Low
	30 mph	> 1	Yes	---	High
			No	---	Low
		1	---	---	Low
	<= 25 mph	---	---	---	Low
Bike lane without parking	> 30 mph	---	---	---	High
	25 - 30 mph	> 1	---	---	High
		1	---	---	Low
	<= 20 mph	> 2	---	---	High
		<= 2	---	---	Low
Bike lane with parking	---	---	---	>= 15 ft	Treat as buffered lane
				13 - 14 ft	Treat as bike lane without parking
				< 13 ft	Treat as shared lane
Shared lane	> 20 mph	---	---	---	High
	<= 20 mph	>1	---	---	High
		1	---	---	Low

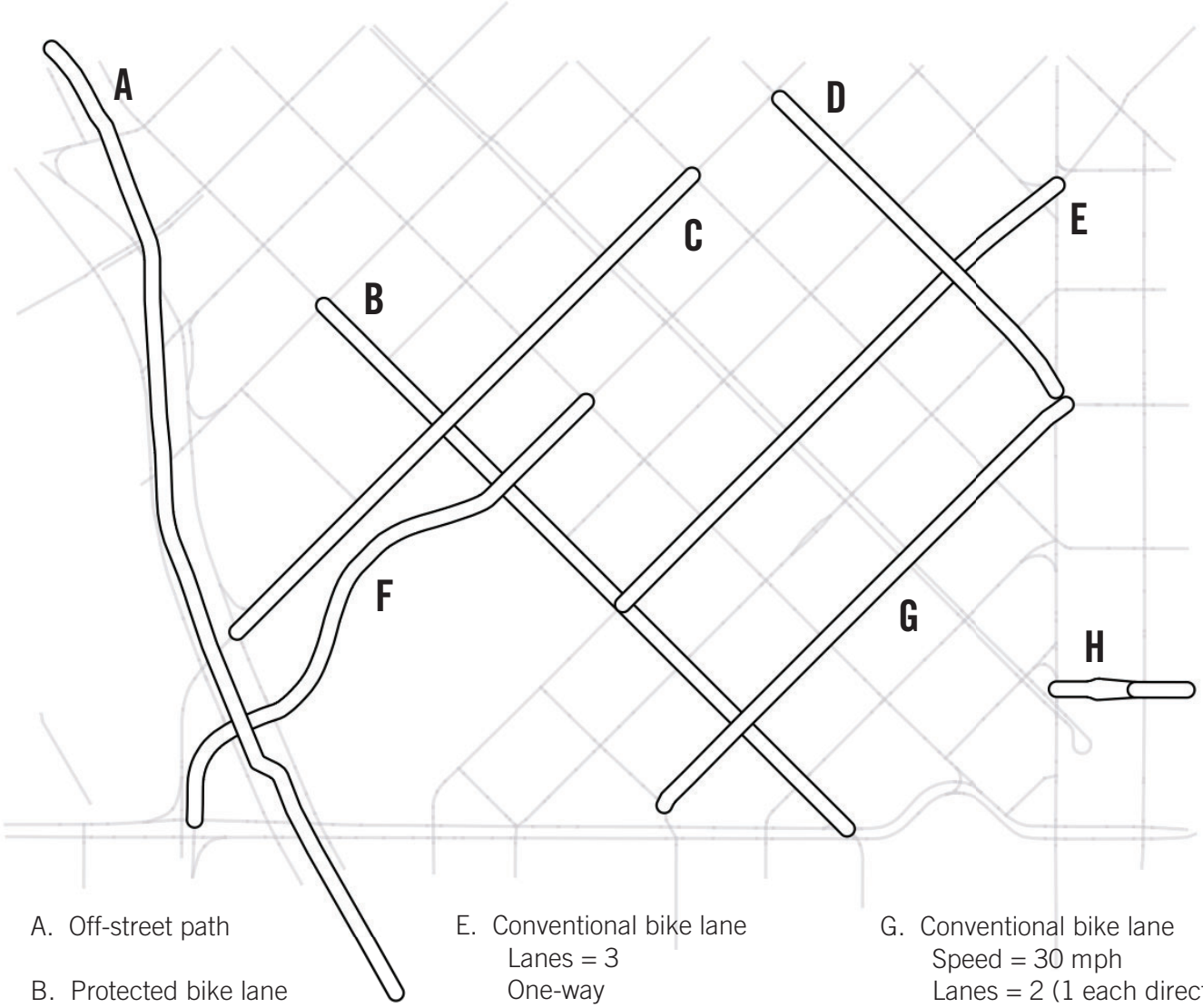
Segment Stress for Residential & Unclassified Streets

Facility Type	Speed	Number of Lanes	Parking	Facility Width	Stress
Cycle Track	---	---	---	---	Treat as tertiary
Buffered Bike Lane	---	---	---	---	Treat as tertiary
Combined bike/parking lane	---	---	---	---	Treat as tertiary
BIke lane	---	---	---	---	Treat as tertiary
Shared lane	>= 30 mph	---	---	---	Treat as tertiary
	25 mph	>1	---	---	Treat as tertiary
		1	One side or none	>= 19 ft	Low
				18 ft	High
				< 18 ft	High
			Both sides	>= 27 ft	Low
				26 ft	High
				< 26 ft	High
	<= 20 mph	> 1	---	---	Treat as tertiary
		1	One side or none	>= 19 ft	Low
				18 ft	Low
				< 18 ft	Low
			Both sides	>= 27 ft	Low
				26 ft	Low
				< 26 ft	Low

Intersection Stress

Intersection control	Number of crossing lanes	Crossing speed limit	Median island	Stress
None/yield to cross traffic	> 4	---	---	High
	4	> 30 mph	---	High
		30 mph	Yes	Low
			No	High
		<= 25 mph	---	Low
	< 4	> 30 mph	Yes	Low
			No	High
		<= 30 mph	---	Low
RRFB	> 4	---	---	High
	4	>= 40 mph	---	High
		35 mph	Yes	Low
			No	High
		<= 30 mph	---	Low
	< 4	> 35 mph	Yes	Low
			No	High
		<= 35 mph	---	Low
Signalized, HAWK, four-way stop, or priority based on class	---	---	---	Low

ACTIVITY: Color the highlighted streets according to their network stress



A. Off-street path

B. Protected bike lane

C. Buffered bike lane
Speed = 30 mph
Lanes = 4 (2 each direction)
No parking

D. Shared lane
Tertiary road
Sharrows

E. Conventional bike lane
Lanes = 3
One-way
No parking

F. Shared lane
Speed = 20 mph
Lanes = 1
One-way

G. Conventional bike lane
Speed = 30 mph
Lanes = 2 (1 each direction)
Parking, width = 15 ft.

H. Shared lane
Residential road
Speed = 25 mph
Lanes = 2 (1 each direction)
Parking one side
Road width = 19 ft.

ACTIVITY: Explore the Network Map

DOWNLOAD DATA

1. Navigate to a city of your choice at *bna.peopleforbikes.org*.
2. Download the **Neighborhood Ways** shapefile for the city and open it in GIS software.
3. Download the **Data Dictionary** Excel file and open it in spreadsheet software. Select the **Neighborhood Ways** tab.

VISUALIZE INFRASTRUCTURE

4. Identify on-street infrastructure: Color segments based on the column **FT_BIKE_IN**.
5. Identify off-street paths: Color segments where the column **Functional = 'path'** and **FT_BIKE_IN is null**.
6. Remove crosswalks from off-street paths: Add condition **XWALK is null**.

VISUALIZE NETWORK STRESS

7. Identify high- and low-stress streets: Color segments based on the column **FT_SEG_STR**.
8. For comparison, view the map with only the low-stress streets visible. This is the existing safe, comfortable road network for bikes. Is it well connected? Are there islands of poor connectivity?

» **NOTE** *"FT" in variable names represents the FROM-TO direction based on how the line segment is drawn in OpenStreetMap. "TF" represents TO-FROM, the reverse. To visualize stress in both directions, duplicate the map and color segments by TF_SEG_STR, then offset the lines so that both street directions are visible.*

CHALLENGE: Visualize High-Stress Infrastructure

1. Color segments based on the constraints **FT_BIKE_IN in 'buffered_lane' OR 'lane' AND FT_SEG_STR > 1**. This is high-stress infrastructure.
2. Remove high-stress infrastructure from the infrastructure map: Visualize all bike infrastructure again, but this time add the rule-based constraint **FT_SEG_STR = 1**.
3. Identify high-stress intersections: Set **FT_INT_STR = 3 OR TF_INT_STR = 3**. Compare to Network Stress map.

» **NOTE** *Paths and cycle tracks are always low stress because they fully separate bicycles from cars.*

» **NOTE** *Sharrows do not have any impact on the stress rating of a street.*

Measuring Connectivity

Connectivity measures use road stress ratings to evaluate how well bicyclists can travel to places they want to go.

In the BNA, census blocks serve as the starting and ending points for all destinations. If a bicyclist can start from any point within the origin or **source** census block and reach any point within the destination or **target** census block using a low-stress route, that destination is considered accessible and points are awarded. Any high-stress street segment or intersection along the route will negate that route as a feasible option and no points are awarded.

Only destinations within the bikeshed of the source census block are evaluated. The bikeshed distance is a flexible variable. The BNA default bikeshed distance is 2680 meters, or approximately 1.67 miles, a distance representing a 10-minute bike ride traveling at 10 mph.

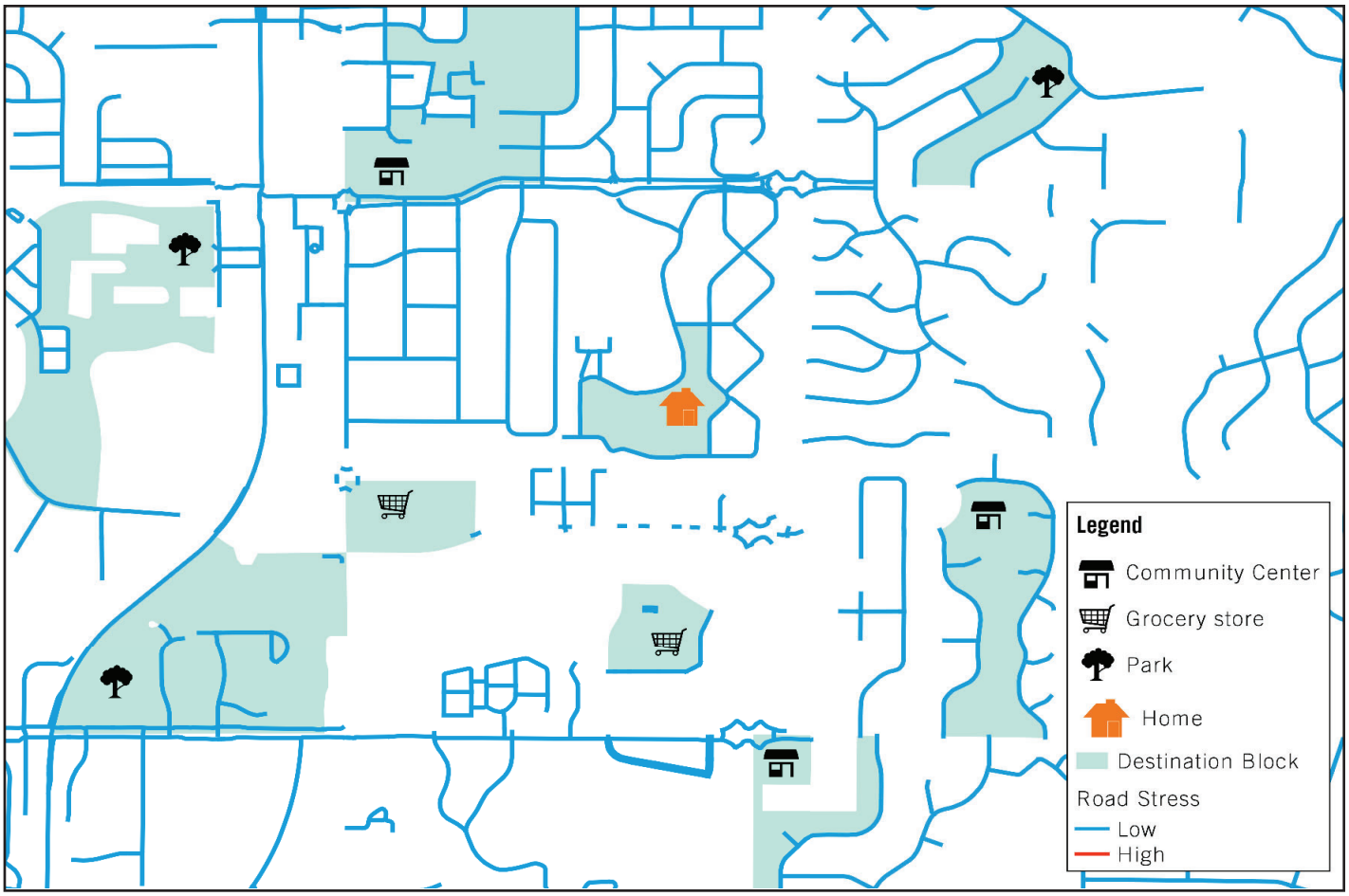
The BNA uses a selection of destination types with a scoring system reflecting the relative importance and dispersion of those destination types across cities and neighborhoods.

ACTIVITY: Assess Destination Access

1. From the highlighted census block containing the orange house (see map next page), assess whether someone bicycling using only low-stress routes can access each of the highlighted census blocks containing symbolized destinations: community centers, grocery stores, and parks. **NOTE:** For simplicity, ignore intersection stress in this exercise.
2. Circle each accessible destination. Mark an X over each inaccessible destination.
3. Fill out the table below the map with the number of accessible locations for each destination type.

NOTES:

ACTIVITY: Assess Destination Access



Destination Type	# Low-Stress Access	# Any Access
Parks		3
Grocery Stores		2
Community Centers		3

Destination Scoring Rubric

Scoring Category	Weight	Measure	Subcategory Weight	Scoring process
Population	15	Population	---	Calculate ratio of low stress:high stress Assign points: • Up to 3% = 10 points • Up to 20% = 40 points • Up to 50% = 80 points • 100% = 100 points
Opportunity	20	Employment	35	See Population scoring process
		K-12 education	35	Add points for each accessible destination: • First = 30 points • Second = 20 points • Third = 20 points • After three, prorate based on ratio of low stress:high stress destinations • All destinations = 100 points
		Technical/vocational schools	10	Add points for each accessible destination: • First = 70 points • After one, prorate based on ratio of low stress:high stress destinations • All destinations = 100 points
		Higher education	20	See Technical/vocational schools scoring process
Recreation	15	Parks	40	Add points for each accessible destination: • First = 30 points • Second = 20 points • Third = 20 points • After three, prorate based on ratio of low stress:high stress destinations • All destinations = 100 points
		Recreational trails	35	Add points for each accessible destination: • First = 70 points • Second = 20 points • After two prorate based on ratio of low stress:high stress destinations • All destinations = 100 points
		Community centers	25	Add points for each accessible destination: • First = 40 points • Second = 20 points • Third = 10 points • After three, prorate based on ratio of low stress:high stress destinations • All destinations = 100 points

Destination Scoring Rubric

Scoring Category	Weight	Measure	Subcategory Weight	Scoring process
Core Services	20	Doctor offices/ clinics	20	Add points for each accessible destination: • First = 40 points • Second = 20 points • Third = 10 points • After three, prorate based on ratio of low stress:high stress destinations • All destinations = 100 points
		Dentist offices	10	See Doctor offices/clinics scoring process
		Hospitals	20	Add points for each accessible destination: • First = 70 points • After one, prorate based on ratio of low stress:high stress destinations • All destinations = 100 points
		Pharmacies	10	See Doctor offices/clinics scoring process
		Supermarkets	25	Add points for each accessible destination: • First = 60 points • Second = 20 points • After two, prorate based on ratio of low stress:high stress destinations • All destinations = 100 points
		Social services	15	See Hospitals scoring process
Retail	15	Retail shopping	N/A	See Doctor offices/clinics scoring process
Transit	15	Transit centers	N/A	Add points for each accessible destination: • First = 60 points • After one, prorate based on ratio of low stress:high stress destinations • All destinations = 100 points

» **NOTE** *A destination only qualifies as accessible via the low-stress network if it does not require a detour of greater than 25% of the distance required to access the location using a high-stress route.*

ACTIVITY: Calculate destination scores

1. Use the destination scoring rubric and the results from the destination access activity to fill in the missing scores in the table below.

Scoring Category	Weight	Score	Subcategory	Weight	# Locations w/ Low-Stress Access	# Locations w/ High-Stress Access	Score
People	15	49	Population	N/A	8,929	33,414	49
Opportunity	20	66	Employment	35	8,735	30,841	51
			K-12 education	35	6	12	80
			Tech/vocational schools	10	-	-	-
			Higher education	20	-	-	-
Recreation	15		Parks	40			
			Trails	35	2	3	60
			Community centers	25			
Core Services	20		Doctor	20	2	6	60
			Dentist	10	4	16	72
			Hospital	20	0	2	0
			Pharmacy	10	2	7	60
			Supermarket	25			
			Social services	15	1	8	80
Retail	15	81	Retail shopping	N/A	14	32	81
Transit	15	100	Transit centers	N/A	1	1	100
Overall Score	100	66					

ACTIVITY: Explore the Census Block Access Map

1. Download the **Census Blocks** shapefile for any city on the BNA website and open it in GIS software.
2. In the **Data Dictionary** Excel file, select the **neighborhood_census_blocks** tab to see the variables provided in the **Census Blocks** shapefile.
3. Map overall block scores for the city using the **OVERALL_SC** column.
4. Map block scores for a different destination category for comparison, e.g. Parks.
5. Select blocks with zero population (**POP10 = 0**). Visually assess the distribution of these blocks. Blocks with zero population will not contribute to the overall BNA score for the city although they receive block-level scores.
6. Identify the five or ten blocks with the highest populations. Blocks with high populations will have a strong impact on the city score.

» **NOTE** *If there are no locations for a destination type, the score will be null and will not count towards the overall block BNA score.*

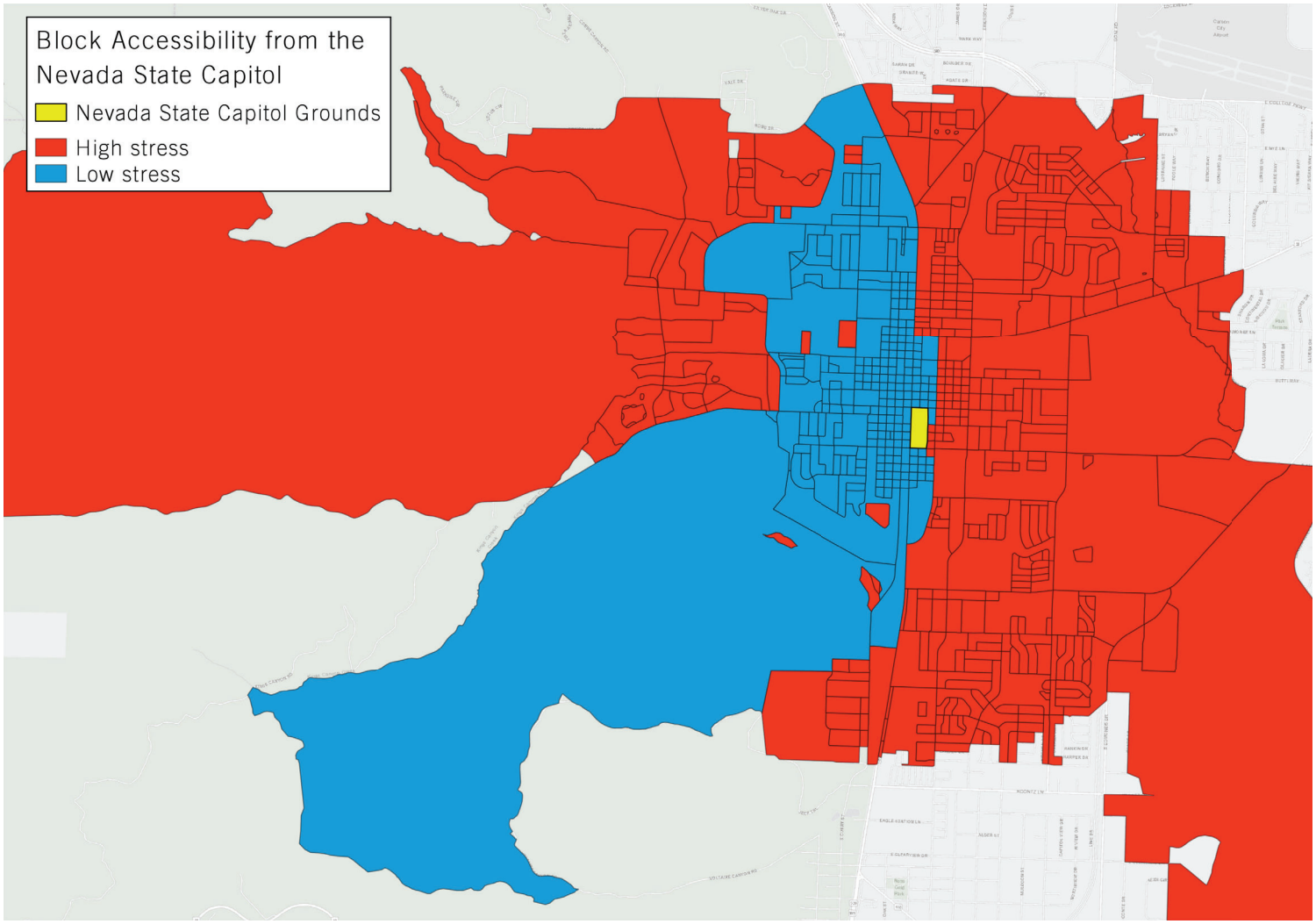
» **NOTE** *A city's BNA score is the weighted average of all blocks in the city based on population.*

CHALLENGE: Map the Bikeshed

1. Download the **Connected Census Blocks** csv and the **Census Blocks** shapefile from the BNA website for Carson City, NV.
2. Open the **Connected Census Blocks** file in a spreadsheet editor.
3. Filter the **source_blockid10** column by the census block number for the capitol: 325100001001128.
4. Save the filtered values (in Excel: Data > Filter > Copy values > Paste in new workbook > Save workbook as csv).
5. Load the filtered csv and the **Census Blocks** shapefile into GIS software.
6. Join the files using **target_blockid10** in the csv and **BLOCKID10** in the shapefile.
7. Color the map by the **low_stress** column in the joined file (**t** or **f** values).

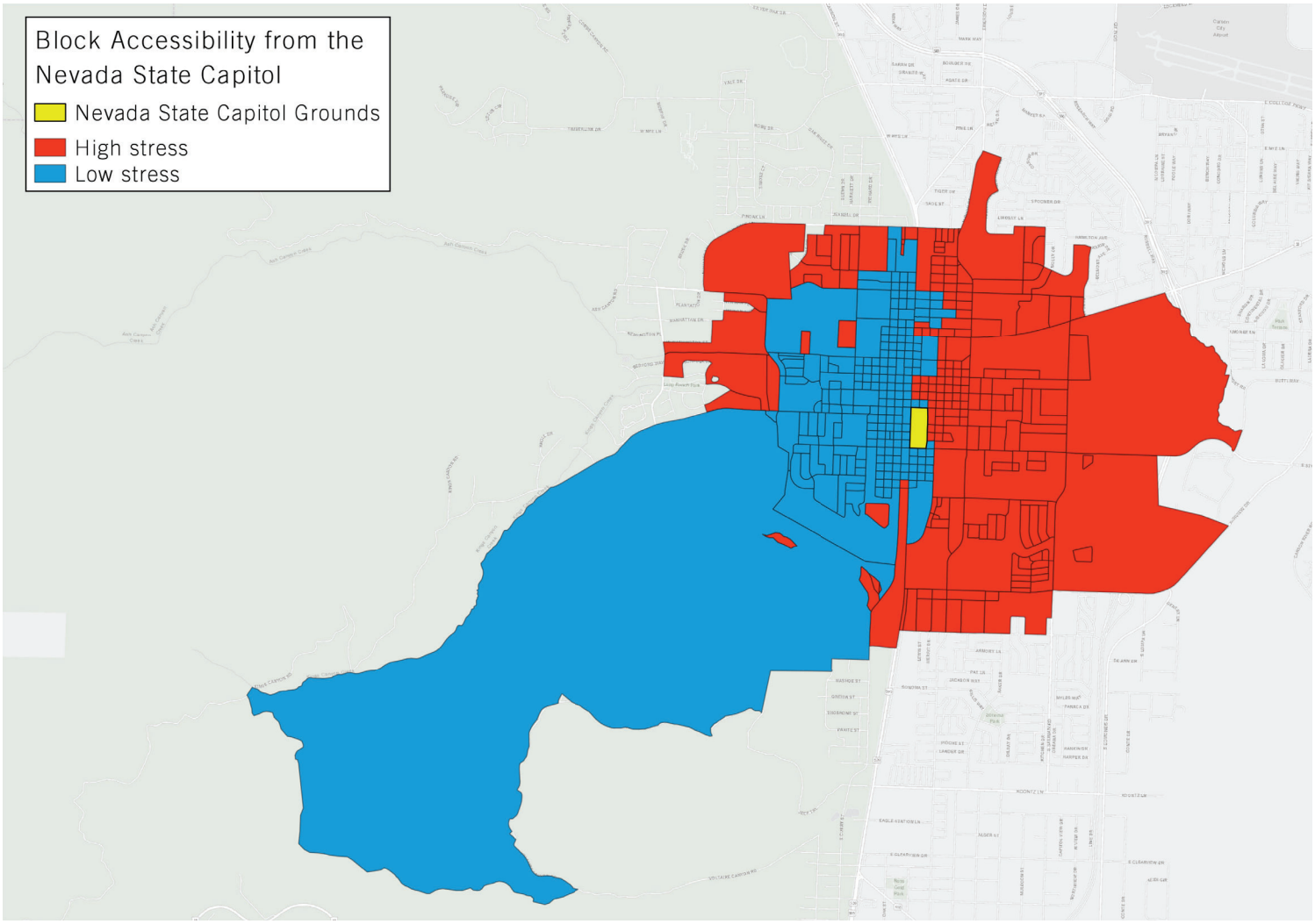
CHALLENGE: Map the Bikeshed

Recall that the bikeshed distance is a changeable variable that defaults to 1.67 miles, or a ten-minute bike ride at 10 mph. All of the blocks colored in the bikeshed map below are reachable from the Nevada State Capitol within a 10-minute, 10 mph bike ride, but the blocks in red are only reachable via high-stress routes.



CHALLENGE: Map the Bikeshed

In the bikeshed map below, the bikeshed distance has been set at 1 mile, illustrating that some blocks that are reachable from the Nevada State Capitol via low-stress routes within 1.67 miles are not reachable via low-stress routes within 1 mile, even though they are still within the bikeshed. This means the low-stress route to those blocks is not a direct route.



CHALLENGE: Compare Network Equity

Does the bicycle network serve all groups equally? PeopleForBikes asks this question in the City Ratings, measuring network equity through a city's Reach score. In the Reach calculation, we compare network connectivity for all census blocks to network connectivity for blocks with populations that meet a combination of demographic thresholds for age, income, and race and ethnicity. In the following challenge exercise, you will compare network connectivity for blocks that meet one demographic threshold with network connectivity for the entire region to see if there are differences in how well the network serves different populations.

1. Load the **wash_data** shapefile into GIS software. The file has been prepared with demographic American Community Survey census data and the BNA scores have been collapsed to the block group level to match the demographic data.
2. Select a city from the city variable column and create a new layer that contains only census blocks for that city.
3. Select a variable of interest (see list below) and criteria for inclusion. (Calculate basic statistics for the variable across the region if you'd like to use the data to inform your criteria.) Create a new map layer containing the block groups that meet the criteria.
4. Calculate the average overall BNA score for the block groups that meet the demographic criteria. Calculate the average overall BNA score for all of the block groups in the city.
5. Compare how well the network serves that community relative to the rest of the city.

Washington cities available to test:

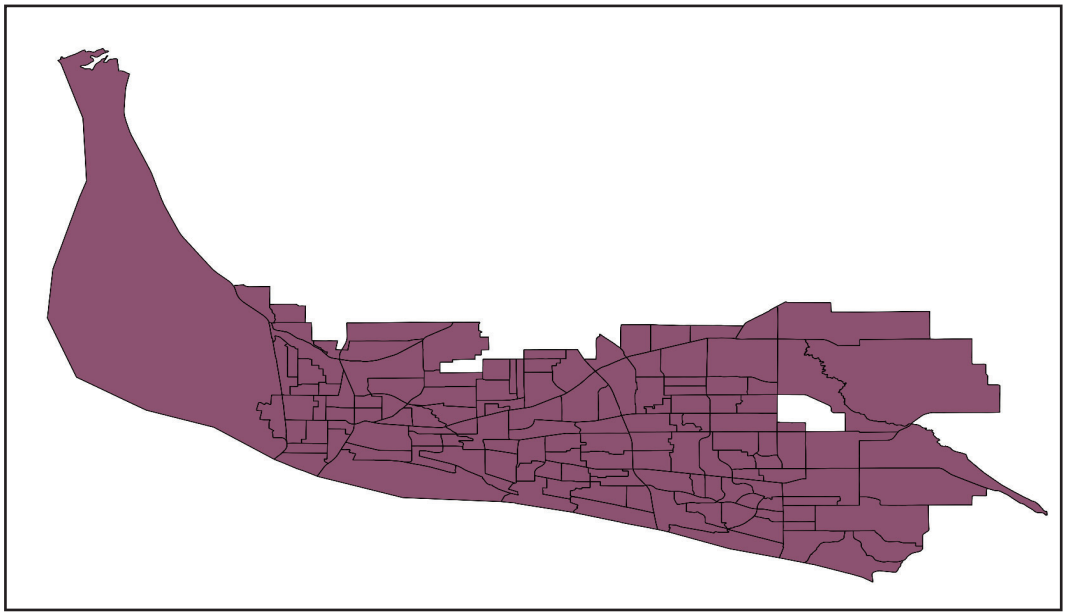
- Bellevue, Bellingham, Federal Way, Kent, Olympia, Redmond, Richland, Seattle, Spokane, Tacoma, Vancouver, Winthrop

Variables available to test:

- **under_18** = percent of population under 18 years of age
- **over_75** = percent of population over 75 years of age
- **nonwhite** = percent of population that is nonwhite and not Hispanic
- **soc_secur** = percent of population that receives social security
- **pub_assist** = percent of population that receives public assistance
- **unemploy** = percent of population in the labor force that is unemployed

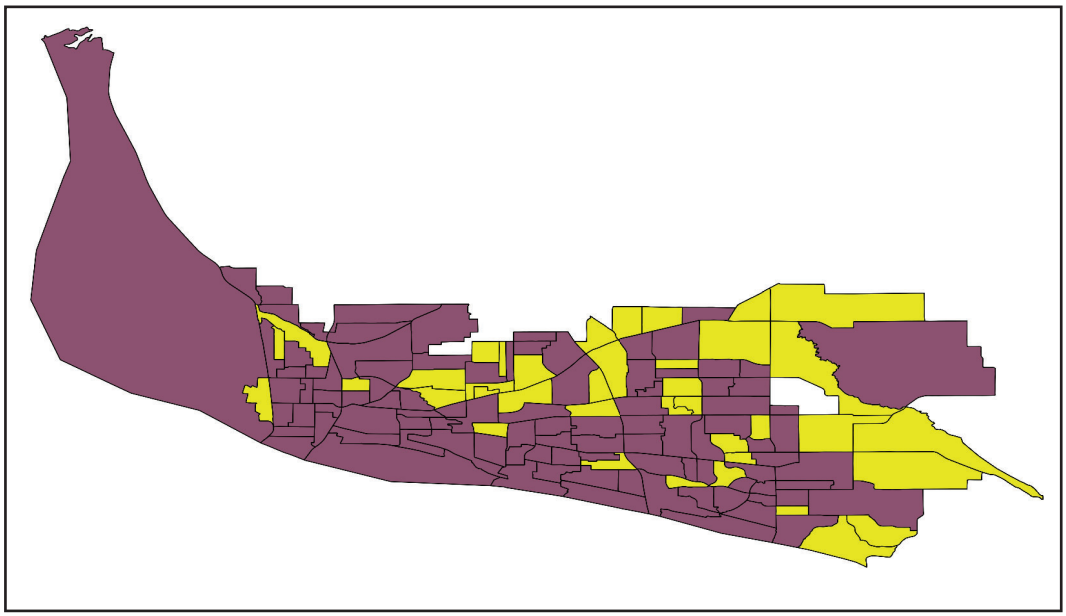
CHALLENGE: Compare Network Equity

The demo belows shows a sample result of the network equity analysis using the variable **under_18** for the city of Vancouver, WA.



On average, 23% of the population is under 18 years old in each census block group in Vancouver, WA.

The average BNA score for all census block groups is 30.



52 out of 164 census block groups in Vancouver have a youth population more than 25% above the city average (>= 28% of the population are under 18 years old, highlighted in yellow).

In the census block groups with a large youth population, the average BNA score is 27, meaning the network serves this population slightly worse than the city as whole.

Part II: Running the BNA

pyBNA BACKGROUND

The BNA website shares results for 500+ U.S. and Canadian cities updated annually. The original code underlying the BNA website results is written in shell scripts and SQL and lives in a public GitHub repository:

» *https://github.com/azavea/pfb-network-connectivity*

pyBNA is a Python version of the BNA recently developed by Spencer Gardner of Toole Design. pyBNA provides the same basic framework to run the anlaysis as the original version, without some of the customizations such as state-based residential speed limits. pyBNA offers multiple advantages over the original BNA:

- Written in Python, a language familiar to a broader audience
- Faster and lightweight, requiring less start-up and running time
- Easier to customize
- Additional features e.g. bikeshed map

The purpose of this workshop is to teach you how to run pyBNA.

WHY RUN THE BNA FROM SOURCE CODE?

» *Update the results anytime*

» *Customize the analysis with your own data and scoring scheme*

» *Grow a community of users who can share practices and insights*

» *Expand the tool's capabilities*

TECHNICAL CONCEPTS EMPLOYED IN pyBNA

- Coding with Python
- Working with the command line
- Manipulating SQL databases

TRAINING OBJECTIVES

THROUGH THIS WORKSHOP YOU WILL:

1. Prepare your computer to run the BNA.
2. Understand the components of the source code.
3. Know how to run the BNA from the source code.

Step 1: Setup

Installation Steps

Microsoft Windows, macOS and Linux are all suitable operating systems to run pyBNA. However, we've found some packages present challenges for installation on Windows. Below are general instructions for installing these tools, and Windows-specific instructions.

1. Download and install **PostgreSQL** from https://www.enterprisedb.com/downloads/postgres-postgresql-downloads. This installer also gives you the option to install the Spatial Extension PostGIS Bundle for PostgreSQL (via the Stack Builder prompt during installation). Choose to intall the PostGIS bundle, which will include **PostGIS** and **pgRouting**.
2. Download and install pgAdmin for administering databases from https://www.pgadmin.org/

Windows

3. Download and install **Anaconda** for Python 2.7. During the installation you will be asked to "Add Anaconda to my PATH environment variable." If you elect to do this, skip the next step. **Note**: pyBNA will not work with Python 3, so if you have a Python 3 Anaconda installation you will still need to install Anaconda 2.
4. Add Anaconda2 to your Windows PATH environment variable. See tutorial here: *https://medium.com/@GalarnykMichael/install-python-on-windows-anaconda-c63c7c3d1444*
5. Install **GeoPandas** as described in Geoff Boeing's post: *https://geoffboeing.com/2014/09/using-geopandas-windows/* **Note**: Make sure the wheels are installed in the Lib/site-packages folder of your Anaconda2 installation. To test your installations in a Python interpreter at the command prompt, locate and run the python.exe file in the Anaconda2 main folder, probably located at a path like the following: *C:\users\[username]\anaconda2\python.exe*

All users

6. Install other Python dependencies (listed on next page) via the command prompt with pip, e.g. *pip install tqdm*.

Step 2: Prepare your PostgreSQL database

1. Under **Login/Group Roles**, create a new user with the name **gis**. Be sure to give this user all privileges under the Privileges tab. Set a password for the new user.
2. Create a new database with the name **bna** that is owned by the user **gis**. Run the queries: **CREATE Extension PostGIS;** and **CREATE Extension pgRouting;**
3. Create two new schemas: **received** and **generated**, both of which should be owned by the user **gis**.
4. Set the gis user's search path to find the received and generated schema with **ALTER ROLE gis SET search_path = generated, received, public;**.
5. Open the Anaconda command prompt and run the Python installation (step 5, p. 22).

PostgreSQL Overview

PostgreSQL is a database system accessed and updated using the SQL language. PostgreSQL stores BNA input data -- the boundary shapefile, census data, and OpenStreetMap data -- then stores the results of the analysis in new tables.

PostGIS and pgRouting are extensions of PostgreSQL that enable the database to handle and anlayze spatial data like shapefiles.

Software to Install

- Python 2 (comes with macOS and most Linux distributions)
  - psycopg2
  - tqdm
  - PyYAML
  - GeoPandas*
  - Munch
  - Overpass
  - OSMnx 0.8
  - Osmium* [optional]
- PostgreSQL 9.6 (or 10 or 11)
  - PostGIS 2.5.2
  - pgRouting 2.6
- pgAdmin

* We've found GeoPandas and Osmium can present challenges for installing in a Windows environment. If you have trouble with Osmium you can safely leave it out. For GeoPandas, see the installation instructions on p. 22.

Files on your USB drive:

» **pyBNA package:** *pyBNA (folder)*
» **Boundary shapefile:** *boundary.shp*
» **OpenStreetMap xml file:** *portland.osm*
» **Census jobs csv:** *or_od_main_JTOO_2014.csv.gz AND or_od_aux_JTOO_2014.csv.gz*
» **Census blocks and population:** *tabblock2010_41_pophu.shp*

Step 3: Running pyBNA

1. Install pyBNA

Windows: Copy the **pyBNA** folder from your USB drive to **Anaconda2\Lib\site-packages**.

Other: Copy the **pyBNA** folder from your USB drive to your local machine and navigate to the folder from the command prompt.

2. Save the sample files

Save the other APBP workshop files to your local machine, e.g. C:\apbp\[files]. Edit **apbp_config.yaml** to contain the password for your database named **gis**. Save the file.

3. Run the code below

The following code assumes you've saved the APBP workshop files to a folder at **C:\apbp** on your local machine. If not, substitute the correct path.

```
import pybna

# Import data
i = pybna.Importer("C:/apbp/apbp_config.yaml")
i.import_boundary("C:/apbp/boundary.shp")
i.import_census_blocks(fpath="C:/apbp/tabblock2010_41_pophu.shp")
i.import_census_jobs("received.neighborhood_census_block_jobs",fpath_main="C:/apbp/or_od_
main_JT00_2014.csv.gz",fpath_aux="C:/apbp/or_od_aux_JT00_2014.csv.gz")
# If your machine struggles to recognize the jobs files, rename them without '.csv' in the name
i.import_osm_network(osm_file="C:/apbp/portland.osm")
i.import_osm_destinations(osm_file="C:/apbp/portland.osm") # optional, requires Osmium

# Calculate stress
s = pybna.Stress("C:/apbp/apbp_config.yaml")
s.segment_stress()
s.crossing_stress()

# Calculate connectivity
bna = pybna.pyBNA("C:/apbp/apbp_config.yaml")
bna.calculate_connectivity()
bna.score_destinations("generated.scores",with_geoms=True)

# travel shed for this block
bna.travel_sheds(["410510106002002"],"generated.shed_hilton")
```

Step 4: Generate results

Now that you have run the analysis with pyBNA, you have results tables in the PostgreSQL database! But how do you retrieve them?

Shapefiles can be generated from the PostgreSQL database using **shp2pgsql**, a utility that comes with the PostgreSQL installation, using a **Powershell** command prompt. Visit *https://docs.microsoft.com/en-us/powershell/scripting/install/installing-powershell?view=powershell-6* to install Powershell.

Run the following commands in Powershell to generate shapefiles containing the results.

Streets

& 'C:\Program Files\PostgreSQL\9.6\bin\pgsql2shp.exe' -f c:/apbp/streets.shp -u gis -P "gis" bna generated.neighborhood_ways

Network

& 'C:\Program Files\PostgreSQL\9.6\bin\pgsql2shp.exe' -f c:/apbp/network_links.shp -u gis -P "gis" bna generated.neighborhood_ways_net

Census block scores

& 'C:\Program Files\PostgreSQL\9.6\bin\pgsql2shp.exe' -f c:/apbp/scores.shp -u gis -P "gis" bna generated.scores

Travel shed starting from the Hilton census block

& 'C:\Program Files\PostgreSQL\9.6\bin\pgsql2shp.exe' -f c:/apbp/hilton.shp -u gis -P "gis" bna generated.shed_hilton

The shapefiles can then be used as illustrated in Part I of the workshop.

Note: The current version of pyBNA does not calculate overall scores for the region (functionality to come).

Thanks for attending!

Add your city to the BNA

Submit a City Snapshot by January 10, 2020 to have your city added to the BNA website. Visit *https://peopleforbikes.org/city-snapshot-notification* to be notified when the City Snapshot survey opens. The City Snapshot should be completed by a city official with knowledge of the city's bicycle planning efforts.

City Ratings workshops

Join us at one of the following workshops for a mapathon (NYC only) and action planning around building better places to bike. Visit *https://peopleforbikes.org/placesforbikes/events/workshops/* to learn more.

September 21
OpenStreetMap Mapathon with the NYC Dept. of Transportation and BetaNYC
Brooklyn, NY

October 7
Colorado Bicycle Summit
Denver, CO

October 10
Memphis, TN

October 31
Santa Barbara, CA (Santa Barbara, San Luis Obispo, and Ventura counties)

November 7
Providence, RI

Stay in touch

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We want your feedback!

Please visit the link below to fill out a workshop evaluation and let us know how we did. We also want to hear your ideas for improving the BNA.

» https://www.surveygizmo.com/s3/5175620/Workshop-Satisfaction-Survey-APBP-2019

NOTES