BICYCLE LEVEL OF STRESS METHODOLOGY

A bicycle level of stress analysis is a method of rating linkages in the bicycle transportation network (i.e., roads and multi-use paths) by how accessible they are to cyclists. Comfort level and risk tolerance for cycling vary widely among the public. Studies show that the public can be broken into four categories based on risk-tolerance and comfort with cycling: strong and fearless, enthused and confident, interested but concerned, and unable/not interested.[1] The strong and fearless group represent the small segment of the population that is willing to cycle in nearly any environment, including within fast-moving or congested mixed-traffic. On the opposite end of the spectrum, the unable/not interested group are unwilling to bicycle regardless of the quality of infrastructure. Approximately two-thirds of the population falls into the interested but concerned category, people who are interested in bicycling but have a low level of stress tolerance. This group may be willing to cycle in places where they have limited or no interactions with automobiles. When improving bicycle infrastructure, the goal is to create an environment that the interested but concerned group will be willing to utilize. By doing this, a majority of cyclists will be inclined to use the facility.

The level of stress analysis rates each linkage on a scale from one to four, with four representing an environment that is not recommended for cycling, and one representing a low-stress environment. Most of the public would likely choose to bicycle on linkages rated as a one. This analysis utilizes a simple methodology to overcome limitations in roadway data. The variables included in the analysis are: posted speed limit, number of travel lanes, and average annual daily traffic (AADT) for each road segment (along roadways were data is available). Note that it does not consider other cycling safety concerns such as the slope of the road, presence or absence of a shoulder, and the number of curb cuts. Hopefully in the future some of this data may be combined with the above criteria, as it becomes available, to give a clearer picture of expected cycling experiences in the George Washington Region.

The methodology starts by assigning a base level of stress score to a transportation link. The table below outlines the rubric used to assign a score for a link based on the aforementioned variables. A link automatically receives a level of stress of "1" if it is a bicycle path or a road segment that contains a separated bicycle path.

A score of 1 highlights roads with suitable conditions for the interested but concerned group of cyclists. These roads have slow traffic speeds and low volumes, making than conducive to bicycling in mixed traffic. A score of four emphasizes roads with the greatest level of stress. Due to high speeds and large traffic volumes, only a small segment of the population (approximately 1%) is willing to bicycle along these links.

		Mixed Traffic		
Posted Speed (MPH)	**# of Travel Lanes**	**≤3000 AADT***	**3000-6000 AADT**	**>6000 AADT**
≤25	1-2	1	2	3
	3-4	3	3	3
	≥5	4	4	4
>25 to ≤35	1-2	2	3	3
	≥3	4	4	4
>35	≥1	4	4	4

*or no AADT data available

[1] Jennifer Dill and Nathan McNeil, "Revisiting the Four Types of Cyclists: Findings from a National Survey," Transportation Research Record: Journal of the Transportation Research Board, Volume 2587, 2016.

GWRC BICYCLE DEMAND METHODOLOGY

A bicycle demand analysis is a method of determining where people are likely to bicycle. The analysis uses 16 measures which typically correlate with bicycling. These measures capture a diverse range of factors related to bicycle ridership and, when viewed together, provide a comprehensive picture of the demand for bicycling. The table below summarizes the measures used in the analysis, the rationale behind the measures, the weight given to each and the source of the data. The weighting is based on the perceived importance of the factor.

The goal of the analysis is to determine the level of demand as well as where this demand is located. Answering these questions helps to figure out where improvements should be targeted to get the biggest bang for the buck. Results are displayed at the census block group level.

FACTOR	RATIONALE	WEIGHT (points)*	DATA SOURCE
Residential Density	Most trips start or end at a home, job or retail location, making residential and employment clusters the major indications of the demand for bike travel.	0 to 30	US Census: 2015 American Community Survey (ACS) 5-year estimates
Employment Density		0 to 30	
Hospitality and Retail Employment Density		0 to 30	
Density of Bicycle Commuters		0 to 10	
Density of Population with Income Below 150% of the Poverty Line	Households in poverty are limited to a shorter radius of travel compared to higher income households. They have the lowest rates of single occupancy vehicle use and the highest usage of less costly travel modes: carpool, transit, bike and walk.	0 to 30	US Census: 2015 ACS 5-year estimates
Through Trip Demand	This factor captures the desire to travel between activity centers.	0 to 15	GWRC GIS and StreetLight Data®
Proximity to VRE Station	Cycling is a solution to the "last mile" problem, the distance between one's home or work and a transit stop.	0 to 15	GWRC GIS
Proximity to FRED Bus Stop		0 to 5	
Density of Bicycle Boardings at Bus Stops		0 to 10	
Proximity to Trails	Those destinations generate demand for people to bicycle.	0 to 10	GWRC GIS
Proximity to Recreation Centers		0 to 1	
Proximity to Libraries		0 to 1	
Proximity to Elementary Schools	Students that live close to a public school are more likely to bicycle, and school bus service is typically only provided to students living more than one mile from school.	0 to 1	GWRC GIS
Proximity to Middle Schools		0 to 2	
Proximity to High Schools		0 to 3	
Proximity to Universities	College students tend to bicycle more than any other group. Many students lack cars; others do not wish to pay for parking.	0 to 10	GWRC GIS

* The points for each block group were added to produce a composite score. Point values for the block groups ranged from 0 around Lake Anna to nearly 165 in Downtown Fredericksburg. Of the 178 block groups in Planning District 16, only 9 received more than 100 points. Therefore, block groups with more than 100 points received the highest category of demand shown as black.

** The Through Trip analysis captures bicycle demand between trip generators by:

- Creating a Trip Table: Trip tables indicate the number of trips by all transportation modes between each TAZ in the region in a matrix format. In this model, we created a synthetic trip table by summing the productions and attractions for each TAZ and then distributing them based on column and row totals.
- Developing a Bicycle Decay Function: The bicycle decay function indicates the potential for a trip to be made by bicycle and is based on the trip distance. It was developed from MWCOG travel surveys and represents the distance that cyclists travel for existing bike trips.
- Creating a Bicycle Decay Table: This table indicates the potential for trips between each TAZ to be made by bicycle. It was created by applying the distance between each TAZ to the bicycle decay function.
- Creating a Bicycle Trip Table: This table indicates the number of cyclists that will travel between each TAZ. It was created by multiplying the number of trips in the Trip Table by the potential for bicycling in the Bicycle Decay Table.
- Calculating the Bicycle Trips per TAZ: Using GIS, lines were created connecting each TAZ. The bicycle trips in the Bicycle Trip Table were then assigned to those lines. The number of bicycle trips passing through each TAZ were then summed. Results were normalized by dividing the result by the area of the TAZ.
- Scaled each TAZ: The resulting value for each TAZ was then converted to a scale from 0 to 1 by dividing the number of trips passing through the TAZ by the maximum number of bicycle trips traveling through a TAZ. The higher the number, the greater the demand for travel between activity centers.

NOTE: The number of bicycle trips is based on the distance the cyclists travel for existing bicyclists, not the distance the potential cyclists will travel. For that reason, the bicycle trip totals are likely inflated. However, the impact on the relative demand for travel between each TAZ should be limited.