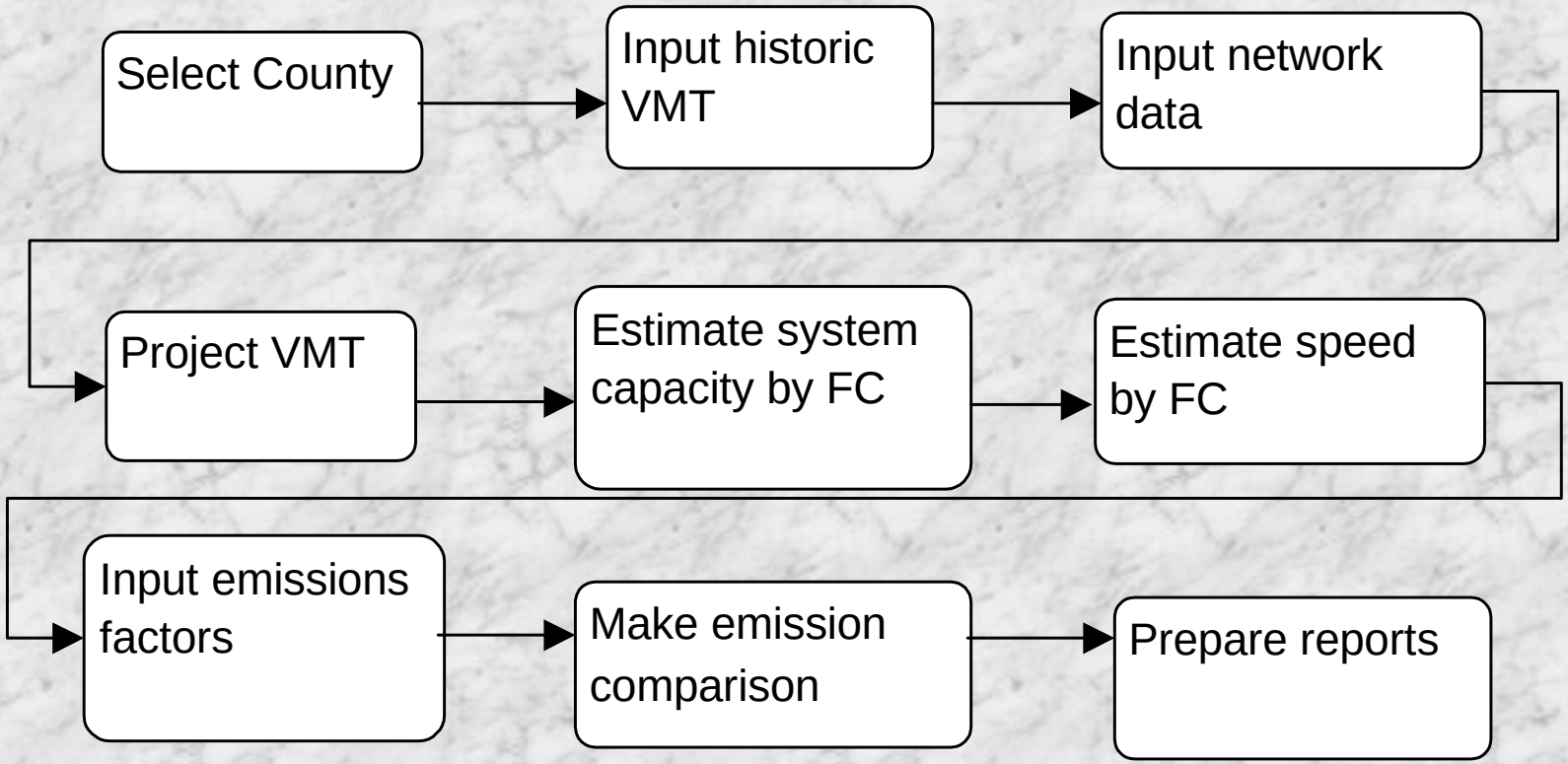
Rural Conformity Spreadsheet

Behshad Norowzi

NC Dept. Of Transportation

Rural Conformity Spreadsheet Flowchart



Data Requirements:

- Historic vehicle miles of travel for use in projection
- Base year lane miles from HPMS report
- Base year centerline miles from HPMS report
- New additions to lane miles for each analysis year based on TIP or TP
- New additions to centerline miles for each analysis year based on TIP or TP
- Emission factors and budget from NCDENR

Why do we need a rural conformity spreadsheet and what does it do?

- In areas without travel demand model for rural counties to estimate:
- 1. VMT
- 2. Speed
- 3. Emissions

VMT Projections

- Perform linear regression using the latest ten years of data
- Project data at county level
- Apportion the VMT to the functional classes in the same ratio as the most recent year of VMT data

Estimating VMT for Donut areas

- The entire County needs to be analyzed
- Model covers urban portion of the county
- Donut area is the rural portion of the county
- The modeled urban area VMT can’t simply be subtracted from HPMS based county VMT due to inherently higher estimation of VMT by Models compared to HPMS

Remedy

- Using population ratio to apportion the HPMS based county VMT
- Population estimate from model and census data will provide the needed data to calculate the ratio
- Ratios could vary for the base and future years when the urban portion of the county is expected to grow faster than rural portion

Methods of Calculating Speed

- Texas Transportation Institute (TTI) method
- Greenshields method
- Bureau of Public Roads (BPR)

TTI Method

- Delay: congestion delay (in minutes/mile);
- A & B: volume/delay equation coefficients;
- M: maximum minutes of delay per mile;
- V/C: time of day directional V/C ratio
- For C>3,400: A=0.015, B=3.5 and M=5.0
- For C<3,400: A=0.050, B=3.0 and M=10.0

$$Delay = Min\left[Ae^{B\left(\frac{V}{C}\right)}, M \right]$$

$$\text{Congested speed} = \frac{60}{\left[\frac{60}{Freeflow\ Speed}\right] + Delay}$$

Bureau of Public Roads (BPR) Method

- Ci = capacity of the lane group
- si = hourly lane capacity
- N = the number of lanes
- T = congested travel time
- T_f= freeflow travel time
- V = hourly volume
- C = hourly capacity of the lane group

$$C_i = S_i * N$$

$$ADT = \frac{VMT}{Centerline_Miles}$$

$$T = T_f \left(1 + .84\left(\frac{v}{c}\right)^{5.5}\right)$$

Greenshields Method

- V = the average speed
- V_f = the freeflow speed
- K = the vehicle density
- K_j = 220 is the concentration at jam

$$V = V_f\left(1 - \frac{K}{Kj}\right)$$

$$K = \frac{ADT}{Lane_Miles}$$

$$ADT = \frac{VMT}{Centerline_Miles}$$

Freeflow Speed

- Using off-peak speed from travel time studies as freeflow speed

Functional Class	Mecklen-burg	Triangle	Triad	Avg.
Urban Interstate	62.7	62.8	65.2	64
Urban Expressway	50.8	60.6	58.5	57
Urban PA	30.9	31.9	27.8	30
Urban Minor Arterial	28.7	34.0	36.3	33
Urban Collector	34.8	33.5	28.7	32
Urban Local	36.9	36.9	23.5	32
Rural Interstate	67.0	67.2	67.7	67
Rural PA	47.0	42.4	54.0	48
Rural Minor Arterial	40.8	52.8	43.8	46
Major Collector	42.3	45.7	46.9	45
Minor Collector	41.7	43.6	47.6	44
Urban Local	42.2	42.2	47.6	44

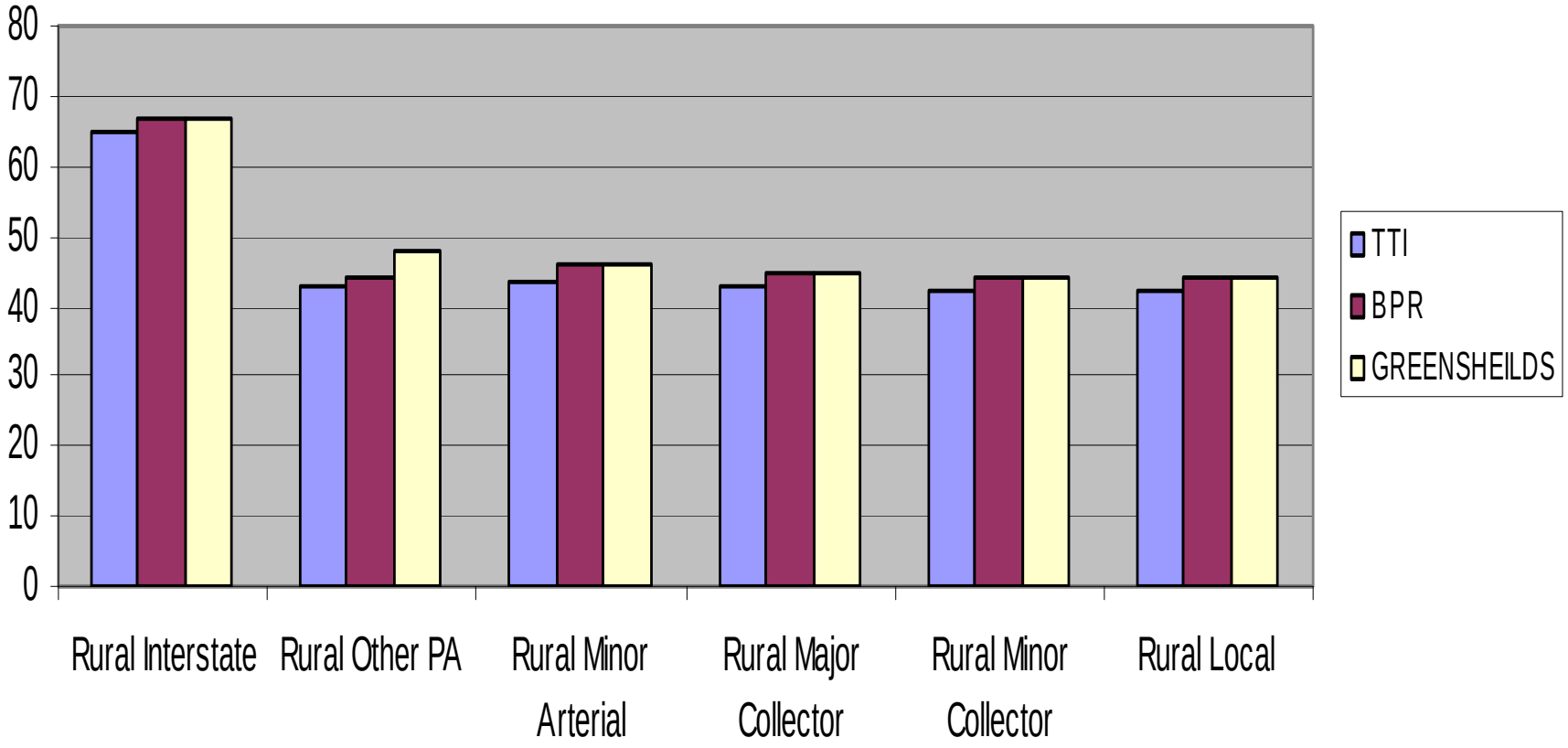
Table 4: Speed Study Summary Results.

Hourly Capacity

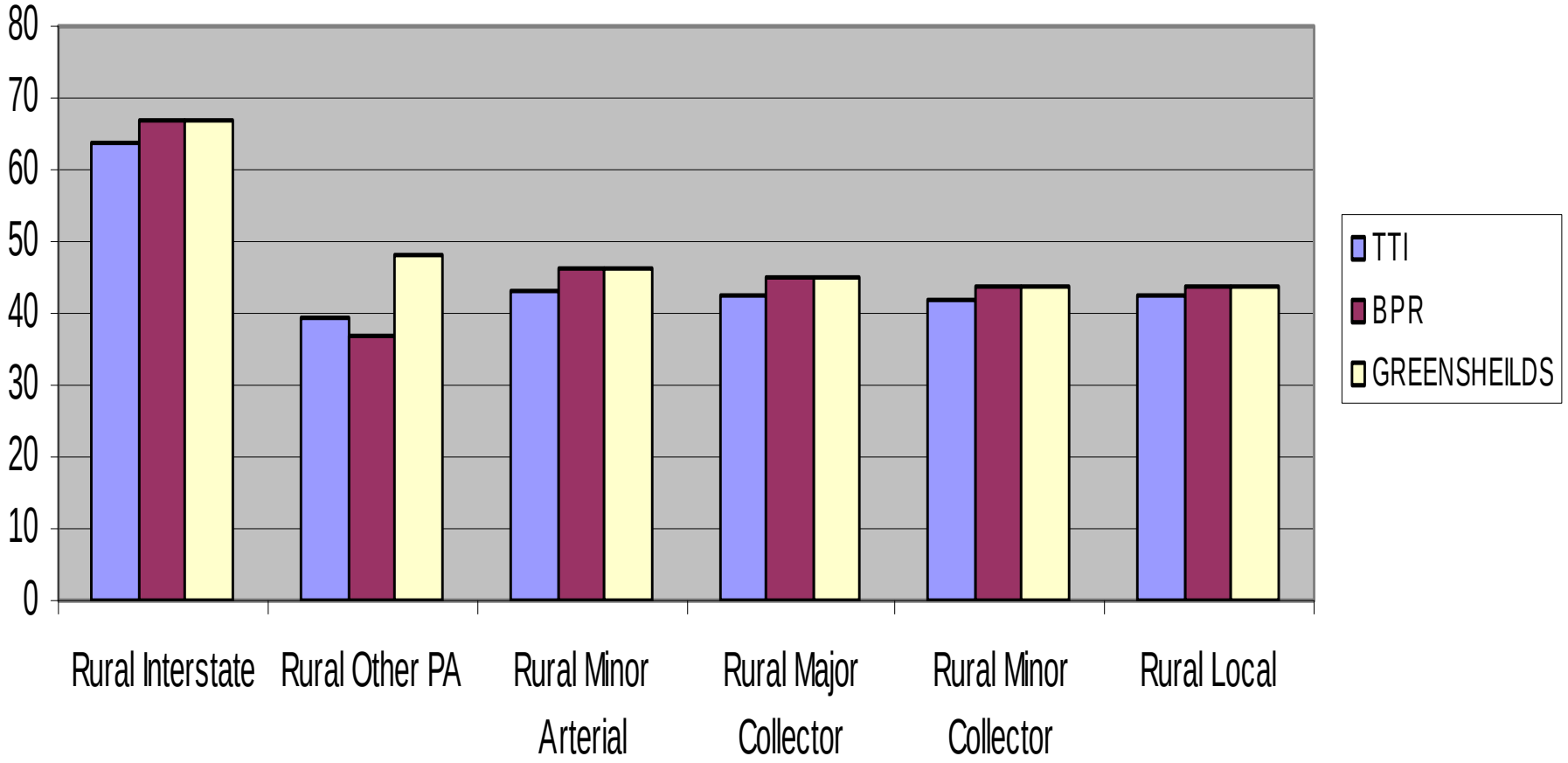
- Number of lanes = lane miles/centerline miles
- Total capacity= per lane capacity * number of lanes
- Large variation of speeds for urban PA, rural PA and rural minor arterial

Functional Class	Worst Case	Mid-Range	Best Case	Speed Range
Urban Interstate	2000	2200	2300	66.7 – 67.1
Urban Expressway	2000	2100	2300	63.1 – 63.2
Urban PA	500	670	1400	30.5 – 39.0
Urban Minor Arterial	450	620	1300	31.2 – 33.4
Urban Collector	400	560	1200	28.8 – 29.1
Urban Local	200	340	800	29.0 – 29.2
Rural Interstate	2000	2200	2300	67.0 - 67.3
Rural PA	500	1000	1400	34.5 – 52.9
Rural Minor Arterial	450	920	1300	43.0 – 49.0
Major Collector	400	840	1200	36.6 – 38.2
Minor Collector	300	670	1000	32.7 – 33.7
Urban Local	200	500	800	29.2 – 29.2

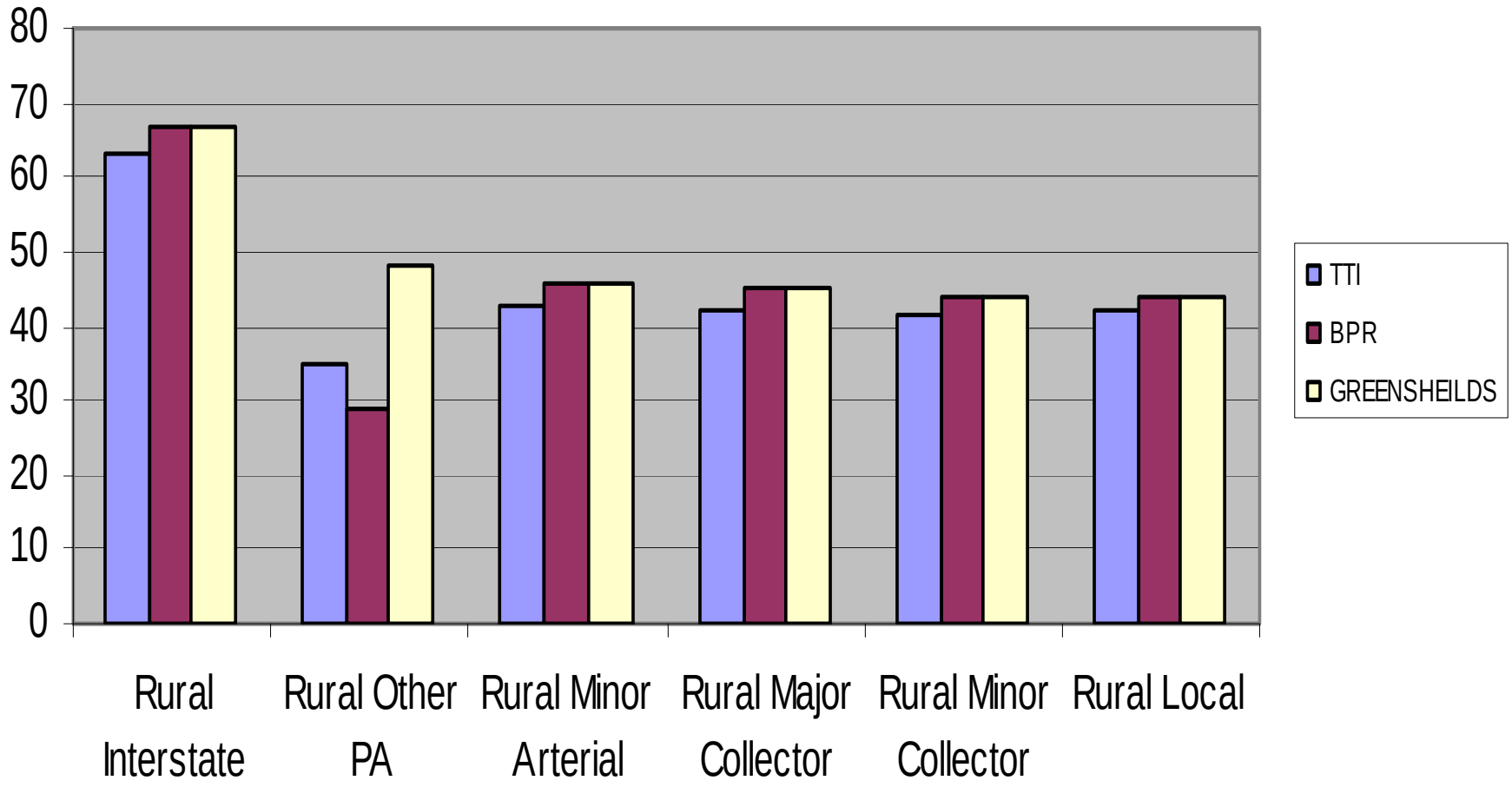
Speed Comparison for 2014 for Johnston County



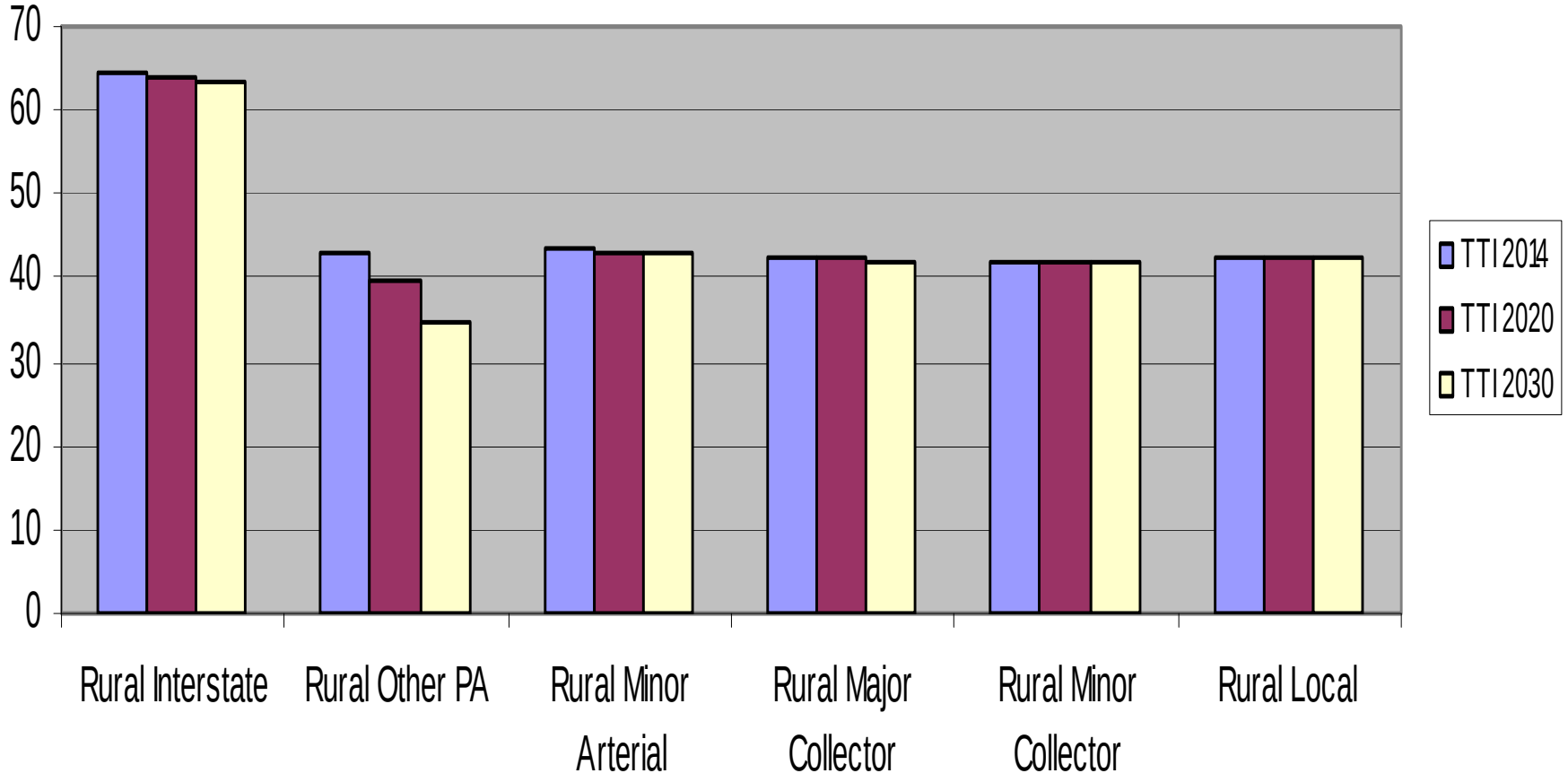
Speed Comparison for 2020 for Johnston County



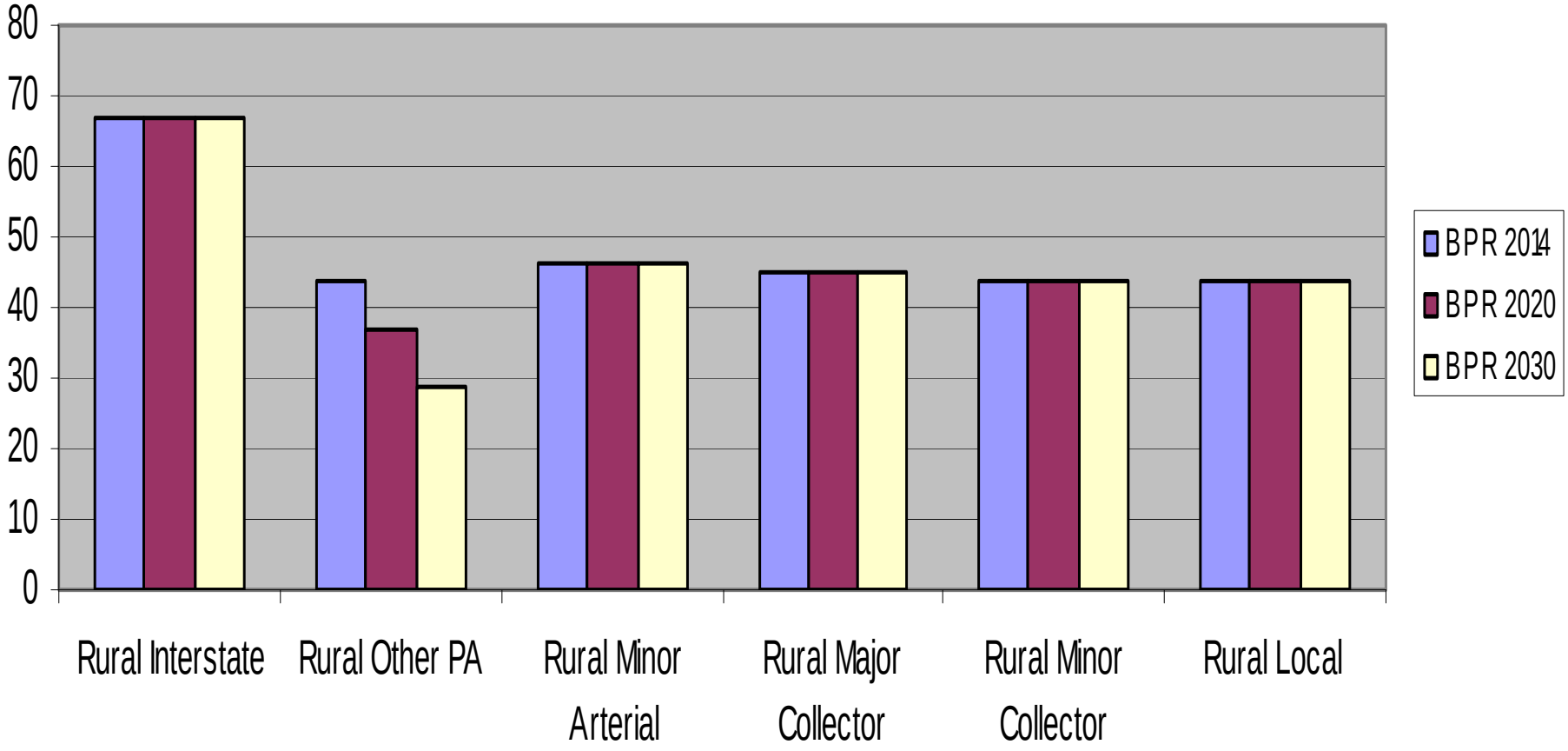
Speed Comparison for 2030 for Johnston County



TTI Speed Variations for Johnston County

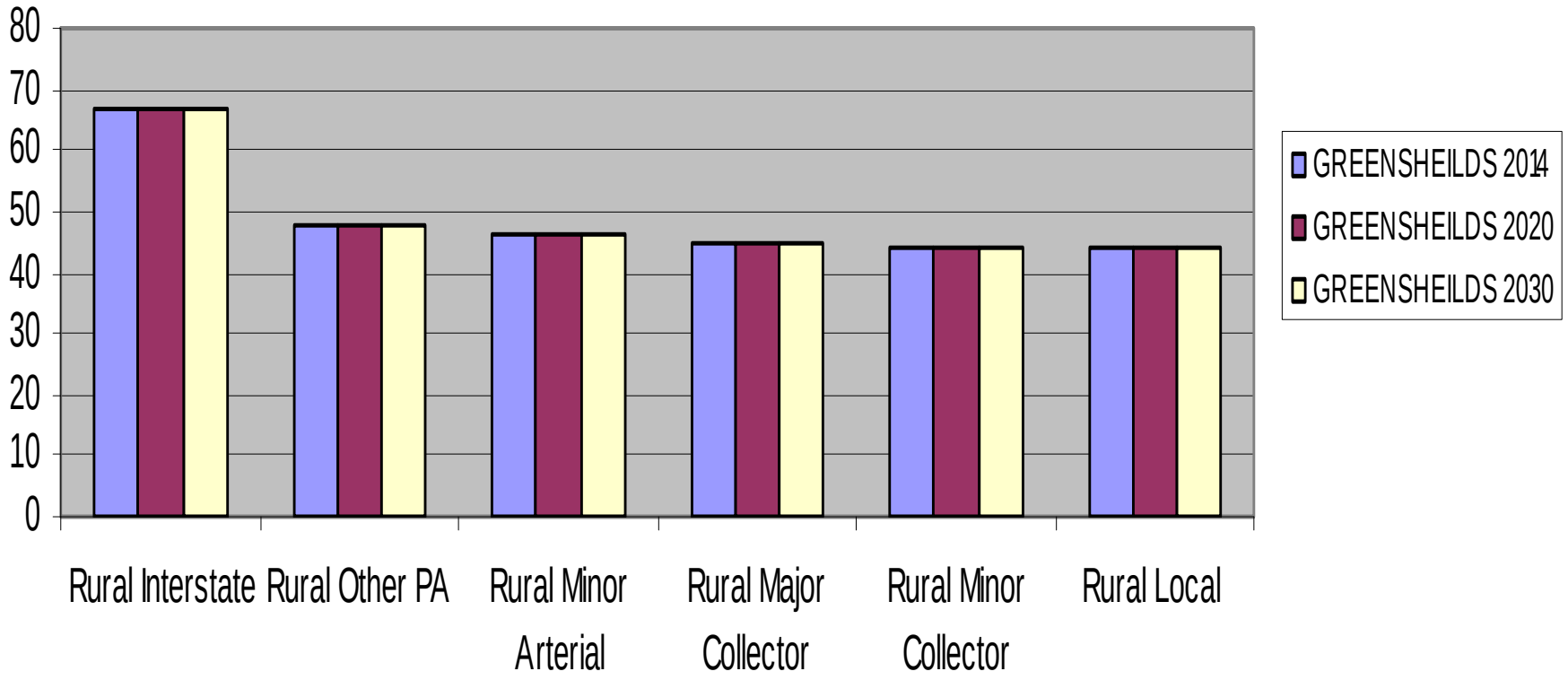


BPR Speed Variations for Johnston County



Greensheilds

Speed Variations for Johnston County



Recommendation

- 1. Project VMT using a trendline based on ten years of data
- 2. Estimate speed using Texas TTI method
- 3. Assignment of free-flow speeds based on travel time studies
- 4. Set the hourly capacities in the mid-range of values calculated from HCM

Recent and Future enhancements

- Revision to Hourly Capacity based on NC specific data
- Adjust HPMS based forecasted county VMT by the following formula:
- VMT= HPMS VMT+[(VMT/base year lane miles)*added lane miles]