Item #3

TPB Version 2.3 Travel Model on the 3,722-TAZ area system: Status report

Presentation to the TPB Travel Forecasting Subcommittee

September 23, 2011

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Topics for Today

- Status of the Version 2.3 travel model application for the 2011 CLRP air quality work
- Recent technical work relating to the Version 2.3 model:
  1. The so called “transit constraint”
  2. Version 2.3/Mobile 6.2-based speed post processor for modeling mobile source emissions

Recent Version 2.3 travel model releases

- Draft Version 2.3.17 released April 29
- Draft Version 2.3.27 made available June 30
  - includes several minor technical enhancements
    - Additional max. no of UE iterations in hwy. assignment
    - Expanded use of distributed processing
    - Modeling steps streamlined, etc.
  - #27 results are very consistent with those of #17
  - #27 being used in the TPB's air quality conformity work
- TPB has recently released a Version 2.3.28 but that reflects minor corrections made to the 2007 calibration network (already addressed in ongoing air quality work).

Status of Version 2.3 application

- Current disposition of AQC work
  - 2002, 2016, 2020, 2030 simulations completed
  - 2040 in progress
  - Overall results are being analyzed
- November release of “adopted” model is anticipated
- Enhancements to V2.3.27 are possible pending analysis of results of all simulation years

Transit Constraint: What is it?

- A technical adjustment to the mode choice model output trips to reflect the expectation that the "core" capacity of the Metrorail system will not be sufficient to meet *peak* demand beyond a *future point* in time
- "Core" relates to all Metrorail stations in the central employment (Ring 0,1) area.
  - The portion of the system bounded by Dupont Circle, Mt. Vernon Square, New York Avenue, Stadium Armory, Anacostia, National Airport, and Rosslyn stations

Transit Constraint: Background

- The “constraint” assumption was initiated by WMATA in 2000 to address funding shortfalls restricting rail fleet expansion
- The constraint assumption assumes that peak Metrorail demand in the core will reach capacity at a predetermined forecast year (the current year is 2020)
- Modeled peak-period Metrorail forecasts, beyond the year 2020, are adjusted to ensure that core Metrorail travel remains at 2020 levels

Transit Constraint: The procedure

- 2020 (constraint year) mode choice trips are modeled normally
- 2030 mode choice trips are modeled and adjusted
  - Peak 2020 Metrorail trips to/through the core are estimated using a time-of-day model
  - Peak 2030 Metrorail trips to/through the core are estimated using a time-of-day model
  - The peak 2030 Metrorail trips to/through the core are adjusted (downward) to match 2020 ridership levels
  - The “excess” 2030 Metrorail trips, that cannot be accommodated are converted to auto person trips
  - The constraint process occurs for each speed feedback iteration
- One important point: Non-Metrorail-related transit trips as well as off-peak Metrorail trips are *unaffected* by the constraint procedure

Transit Constraint Example: Regional results 2030 simulation constrained to 2020 conditions

Purpose	Mode	2030 Unconstrained	2030 Constrained	Difference Cons. - Uncons.
HBW	Metrorail	729,457	711,923	-17,534
	Transit	1,059,996	1,042,461	-17,535
	AutoPerson	3,688,739	3,706,761	18,022
	Person	4,748,735	4,749,222	487
	Transit %	22.3%	22.0%	-0.4%
Non-HBW	Metrorail	279,774	278,077	-1,697
	Transit	498,076	496,378	-1,698
	AutoPerson	17,747,628	17,749,203	1,575
	Person	18,245,705	18,245,581	-124
	Transit %	2.7%	2.7%	0.0%
Total	Metrorail	1,009,231	990,000	-19,231
	Transit	1,558,072	1,538,839	-19,233
	AutoPerson	21,436,367	21,455,964	19,597
	Person	22,994,440	22,994,803	363
	Transit %	6.8%	6.7%	-0.1%

Transit Constraint Application

- The mode choice model is executed normally with:
  - Mode_Choice.bat, which invokes:
    - AEMS mode choice model
    - Jurisdictional summary script: MC_NL_Summary.s
- The mode choice model & transit constraint process is executed with:
  - Mode_Choice_TC_V23.bat, which invokes
    - AEMS mode choice model
    - Jurisdictional summary script: MC_NL_Summary.s
    - Constraint adjustment script: MC_Constraint_V23.s
    - Jurisdictional summary script: MC_NL_ConSummary.s
  - Note: Both sets of mode choice outputs are saved in application

Concerns with the use of the transit constraint in the regional travel model

- Realistically, not all Metrorail trips would shift to auto mode during congested conditions
- The shift from transit to auto has air quality implications: added mobile emissions
- The constraint procedure should not necessarily be used in long-range project planning studies where unconstrained transit demand is being studied

TPB's speed post processor

- A post processor to the travel demand model
- Used to develop mobile emissions, serving federal requirements for air quality planning
- Essentially used to:
  - Refine the regional travel model output ("loaded" networks) to develop hourly speeds for specific seasons
  - Convert vehicular trip-ends (starts and stops) from four time periods to hourly periods
  - Apply emission rates to trip-ends, hourly VMT
    - The EPA mandated Mobile 6.2 model is currently used to develop rates
    - MOVES will soon replace Mobile

Federal guidance on speed post processors

- "Since emissions are extremely sensitive to vehicle speed, EPA and DOT recommend that speeds be estimated in a separate step after traffic assignment… using refined speed-volume relationships and final traffic assigned volumes"
- "… speeds estimated in the validation year should be adjusted to obtain reasonable agreement with observed speeds"
- "… every effort must be made to ensure that speed estimates are credible and based on a *reproducible* and *logical* analytical procedure"

Source: Transportation Conformity Reference Guide, FHWA, Revised 7/31/2001 (page D-6-9)

TPB's emission categories

	Mobile Emission Source	Emission rates Applied to:	Emissions Estimated
On-Network	Starting	Vehicle trips	VOC, CO, NOx
	Soaking	Vehicle trips	VOC
	Running	VMT	VOC, CO, NOx, PM 2.5
Off-Network	Diurnal	Registered Vehs.	VOC
	Resting Loss	Registered Vehs.	VOC
	Local	VMT	VOC, CO, Nox. PM 2.5
	School Buses	Fleet VMT	VOC, CO, Nox. PM 2.5
	Transit Buses	Fleet VMT	VOC, CO, Nox. PM 2.5
	Auto Access	Estimated VMT	VOC, CO, Nox. PM 2.5

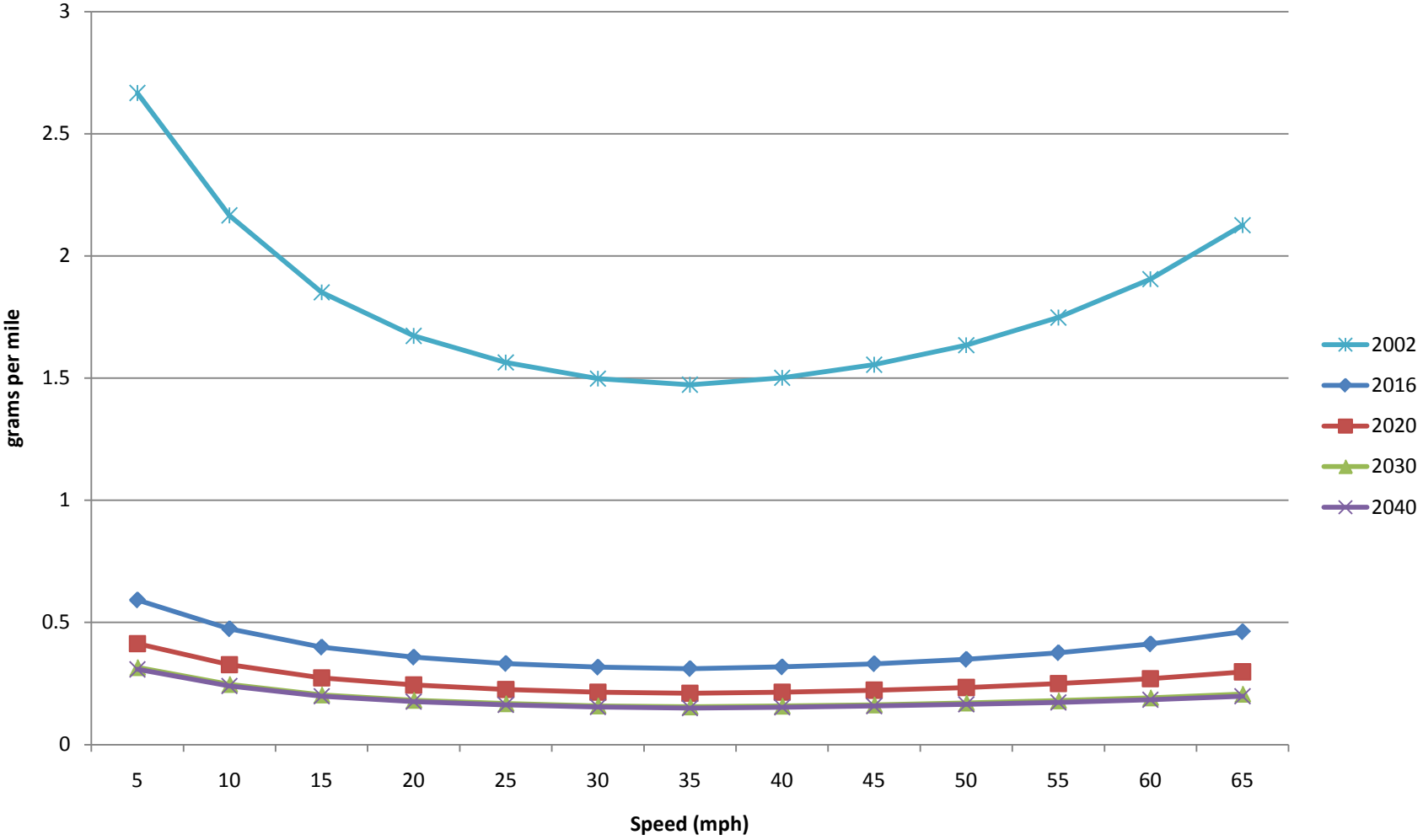
Seasonal periods analyzed

Seasonal Analysis Period	Pollutants Analyzed	VMT Adjusted to reflect
"Ozone Day" / Summertime	VOC, NOx	Weekday / May-Sept.
Wintertime	CO	Weekday / Dec.-Feb.
Full Year	PM 2.5, NOx	Day / Jan.-April
	PM 2.5, Nox	Day / May-Sept.
	PM 2.5, NOx	Day / Oct.-Dec.

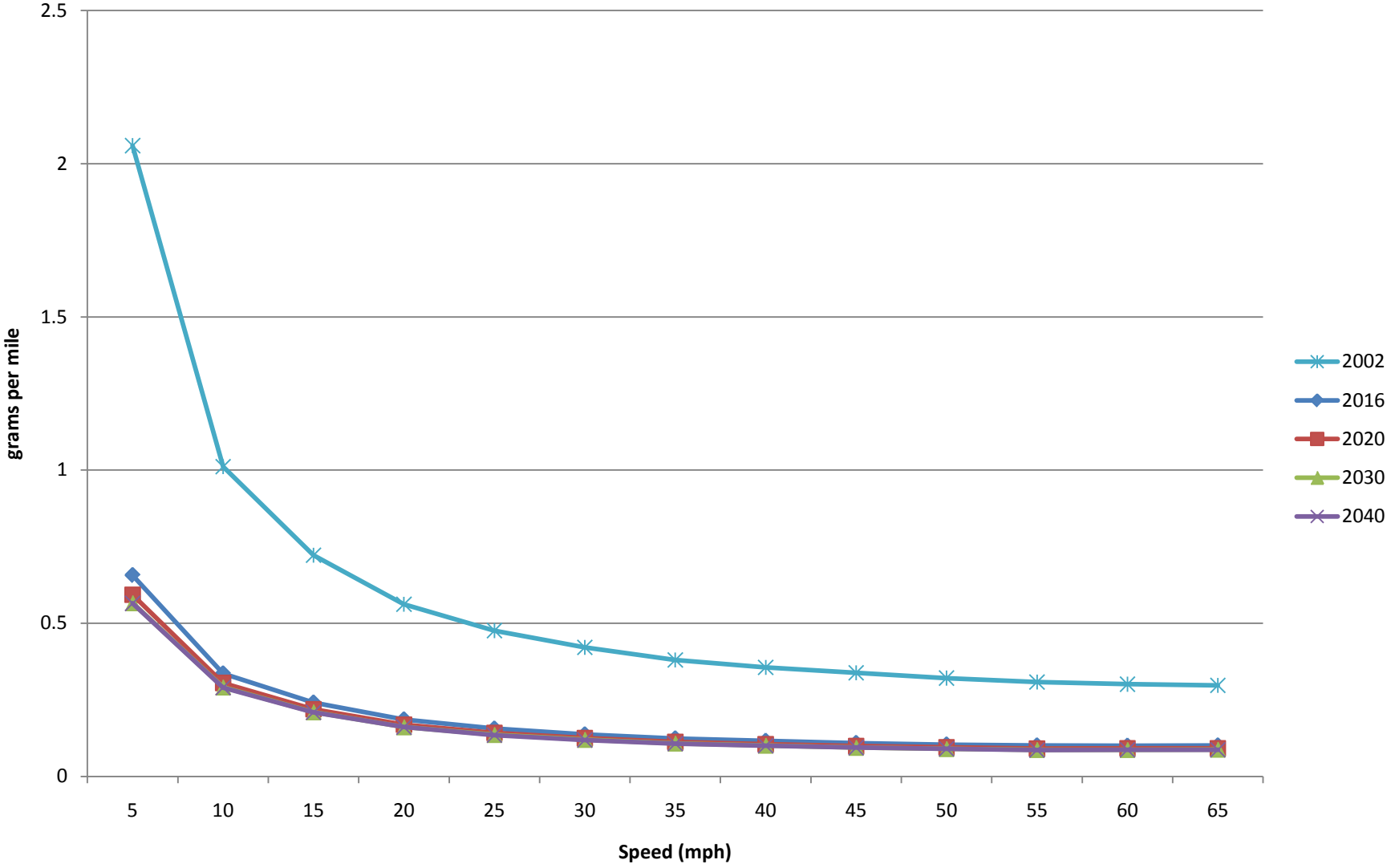
Mobile 6 emission rates

- Prepared by jurisdiction, season
  - Based on local inputs pertaining to fleet mix, I/M program standards, fuel formulation, etc.
- Running (per mile) rates prepared by:
  - Local, non-local
  - Jurisdiction
  - Facility type: Freeway, Arterial, Ramp
  - Speed: 0 – 65, in 5-mph increments
- Starting rates prepared by jurisdiction, and as "Cold"&"Hot"

NOx COMPOSITE MOBILE6.2 ARTERIAL RUNNING EMISSION RATES FOR FAIRFAX COUNTY (2011 CLRP)



VOC COMPOSITE MOBILE6.2 ARTERIAL RUNNING EMISSION RATES FOR FAIRFAX COUNTY (2011 CLRP)



Emission rates calculation

- All emission rates are composite, based on daily vehicle trip distributions; for example if:
  - 30% of trips to DC are from Alexandria
  - 20% of trips to DC are from Arlington
  - 50% of trips to DC are from DC

Then, the composite emissions rate applied in DC would equal:

$$0.30*rate_{Alx} + 0.20*rate_{Arl} + 0.50*rate_{DC}$$

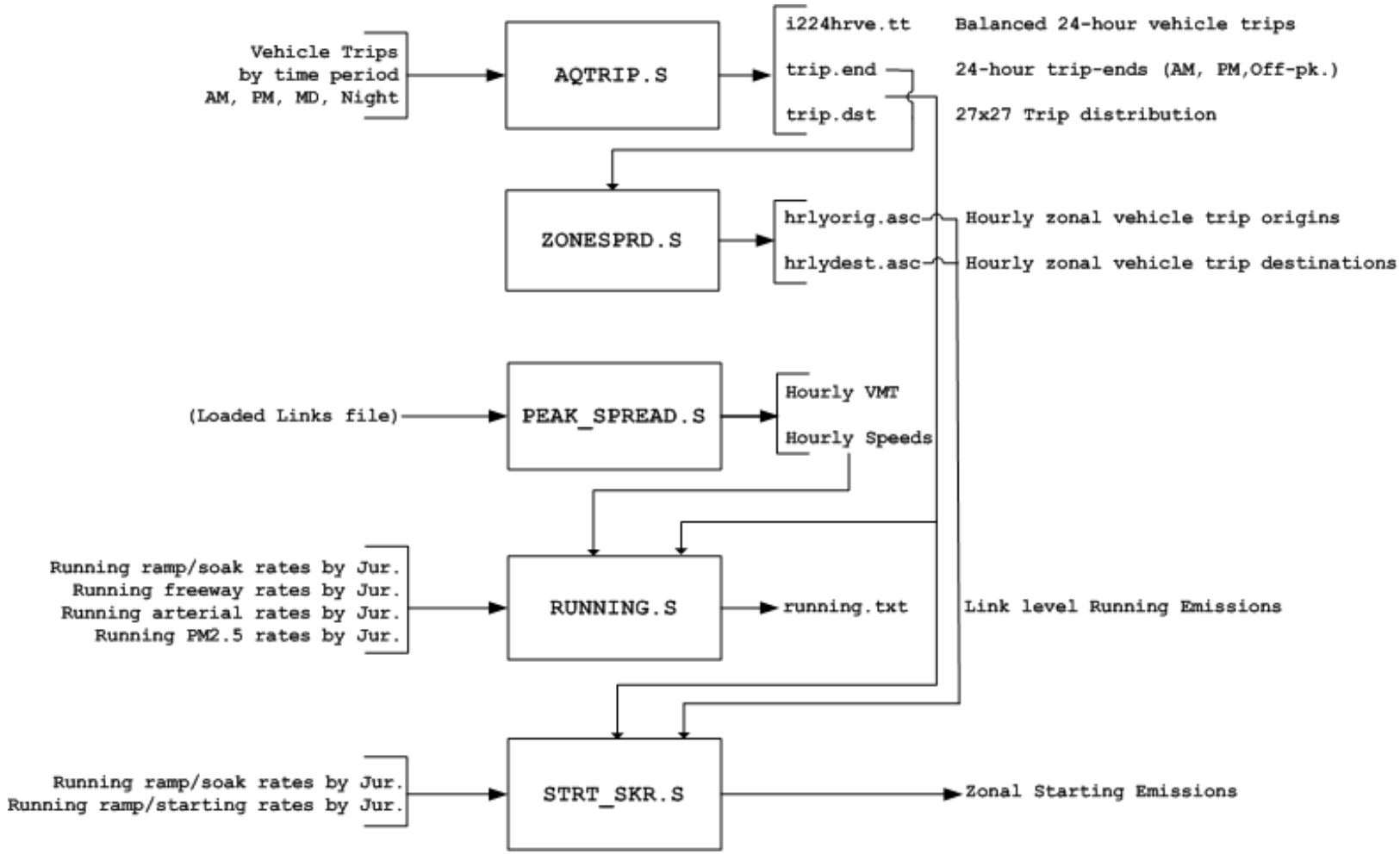
Emission calculation level

- VOC, Nox, CO Starting emissions, soaking
  - Rates applied at zone level by hour of day
- VOC, Nox, CO running emissions
  - Rates applied at link level by hour of day
- PM2.5 emissions
  - Applied at jurisdiction level (not a function of speed)

Running Emissions

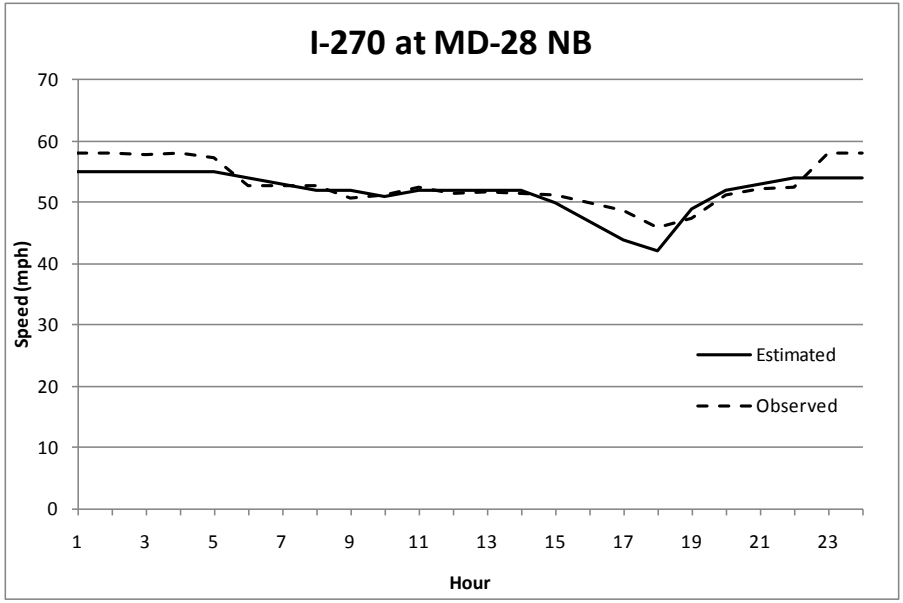
- Since emissions are based on speed levels, much of the post processor focuses on hourly speed development from the regional model
  1. The traffic orientation of each link is assessed as either “inbound”, “outbound”, or “circumferential”
  2. Daily traffic is apportioned among hourly periods with respect to its orientation (peak, off-peak volumes from the model are preserved)
  3. Traffic in peak hours is compared against capacity; for cases where peak demand exceeds capacity, a peak spreading procedure is used to move traffic into adjacent hours
  4. Hourly speeds are next calculated based on final volumes and capacities using reasonable, acceptable speed-flow curves
  5. Speeds are used to lookup rates, that are applied to hourly VMT

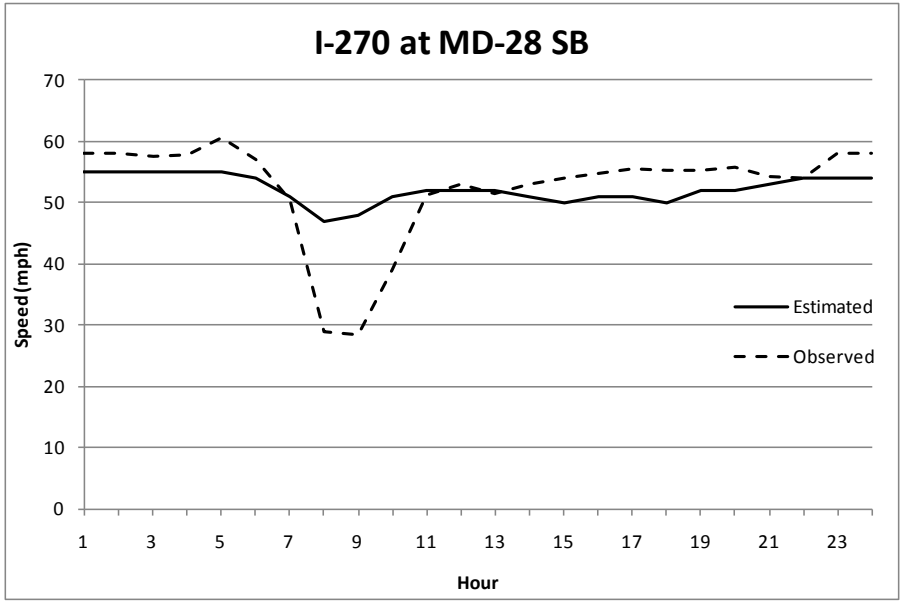
Cube Voyager based running, start, and soak emissions calculation procedure



Comparison of 2007 simulated post processor speed and hourly INRIX reported speeds
(INRIX speeds reflect weekday travel in October, 2008)

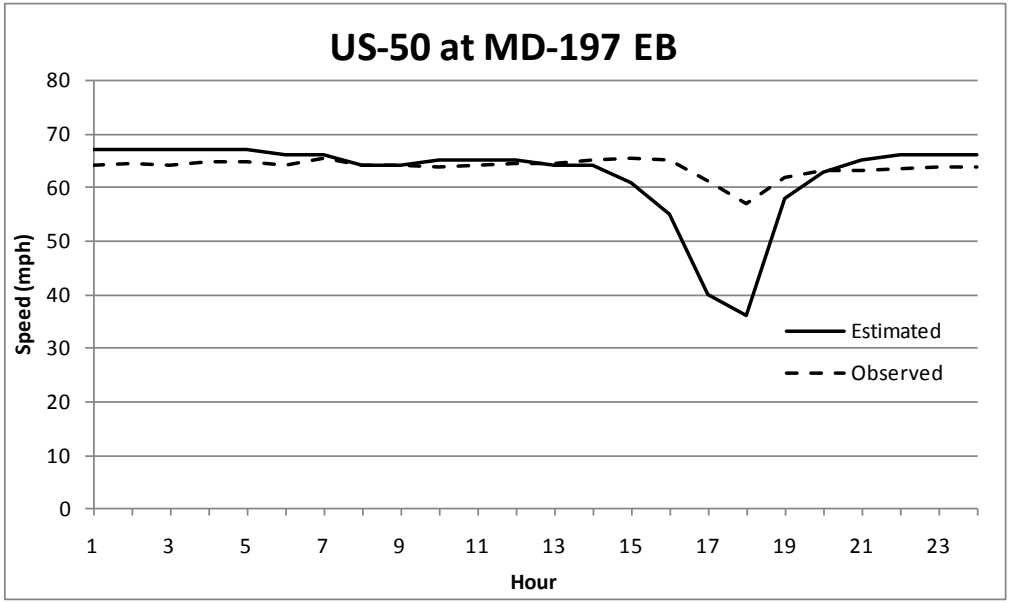
Location: I-270 at MD-28

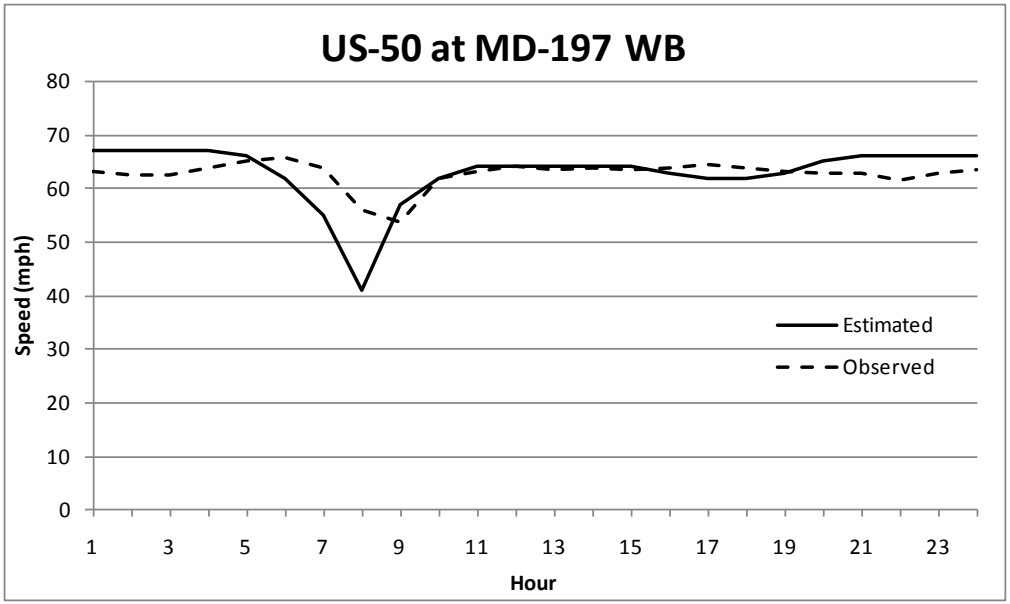




Comparison of 2007 simulated post processor speed and hourly INRIX reported speeds
(INRIX speeds reflect weekday travel in October, 2008)

Location: US 50 at MD-197





Comparison of 2007 simulated post processor speed and hourly INRIX reported speeds
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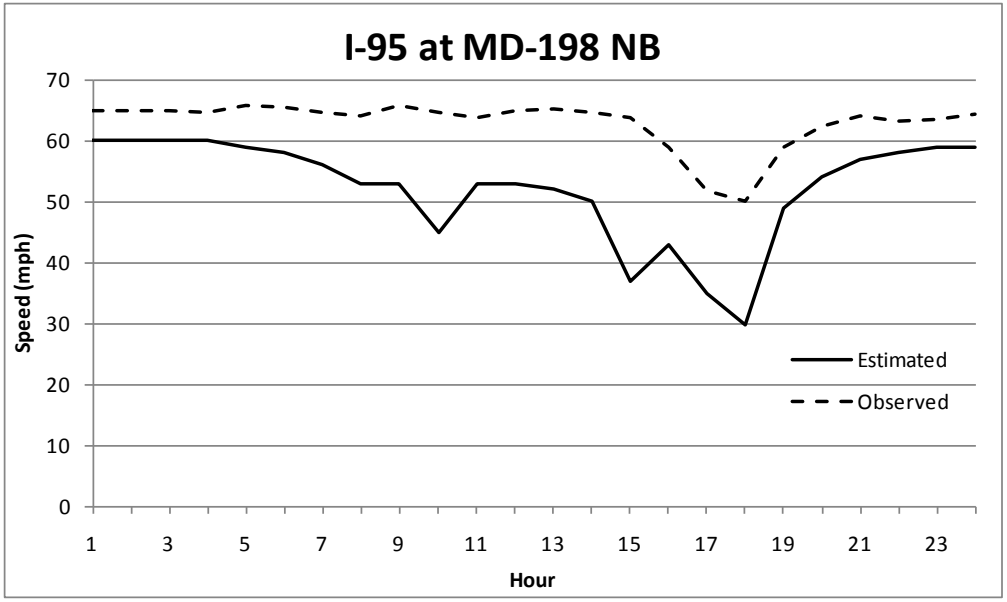
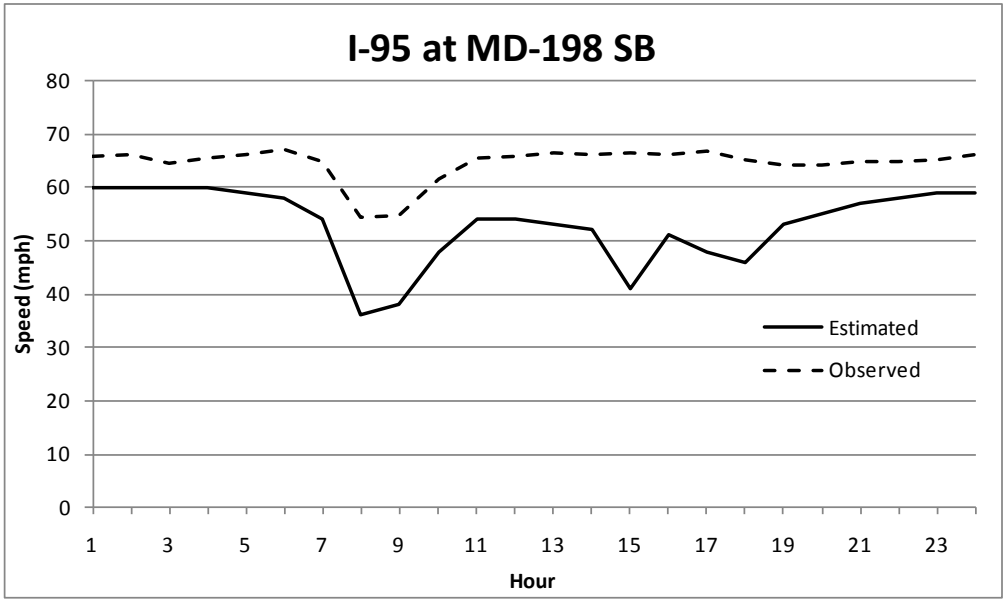
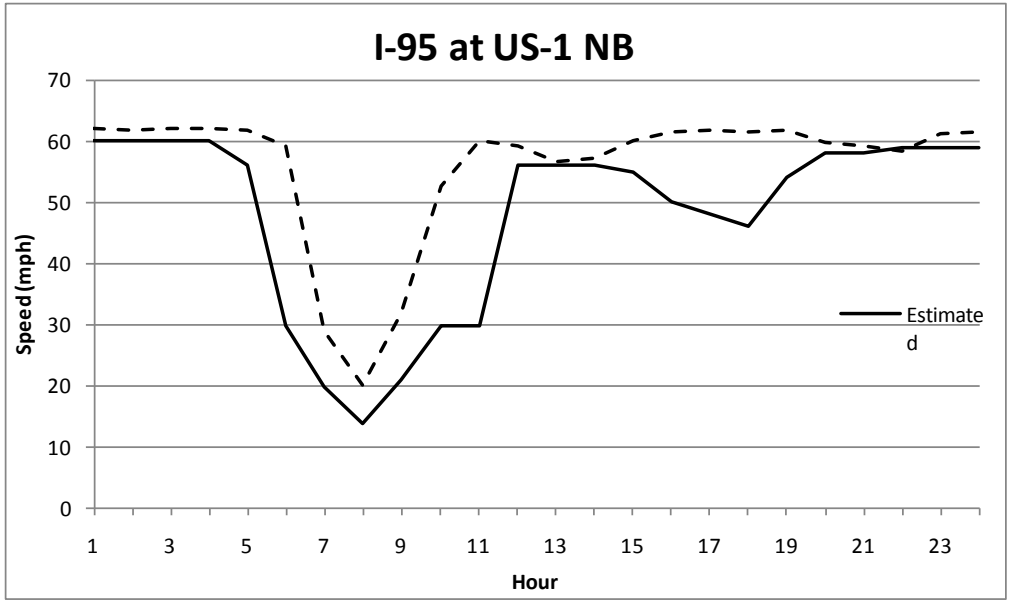
Location: I-95 at MD-198

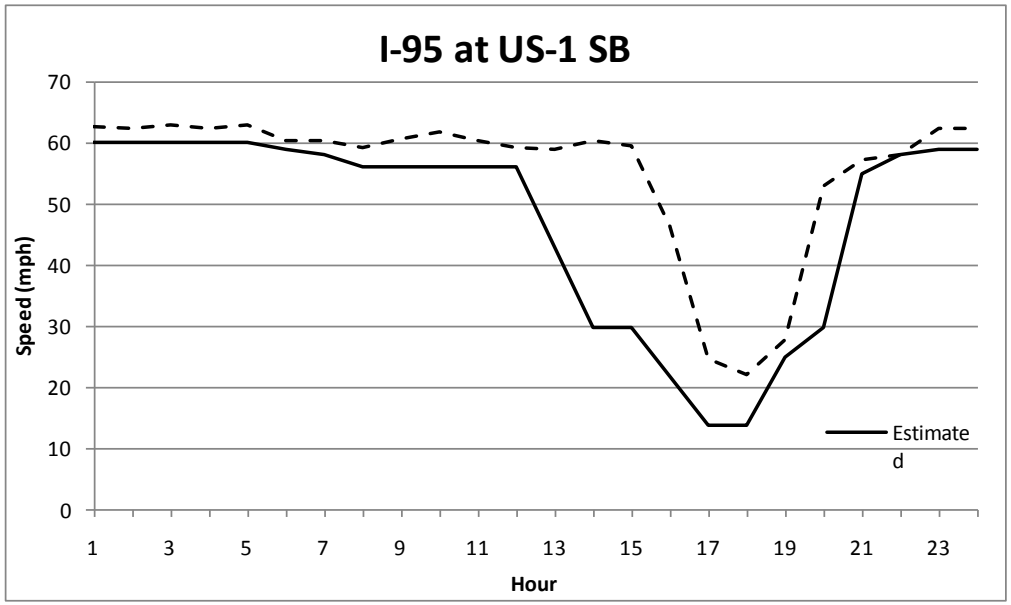




Comparison of 2007 simulated post processor speed and hourly INRIX reported speeds
(INRIX speeds reflect weekday travel in October, 2008)

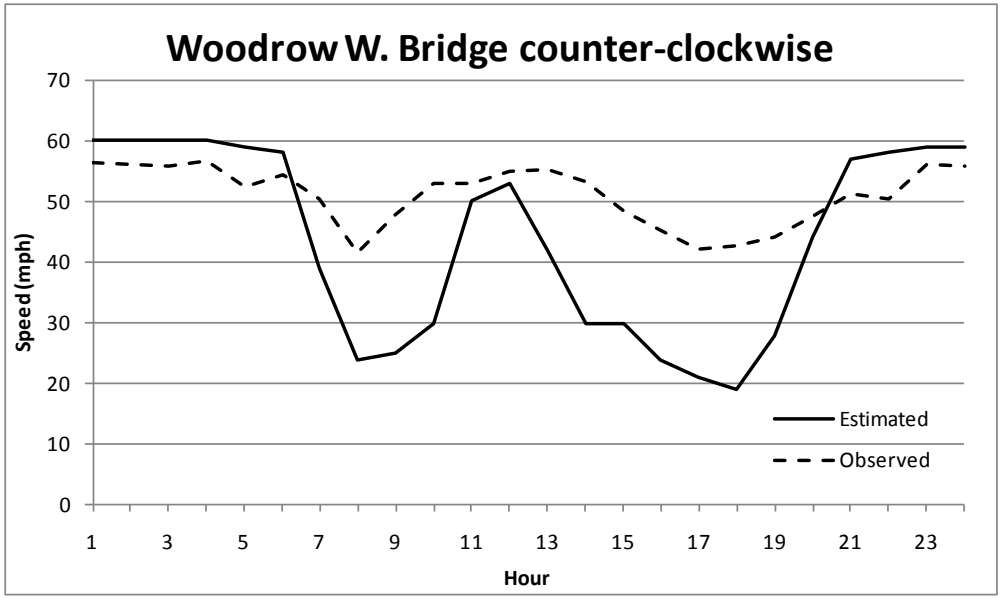
Location: I-95 at US-1

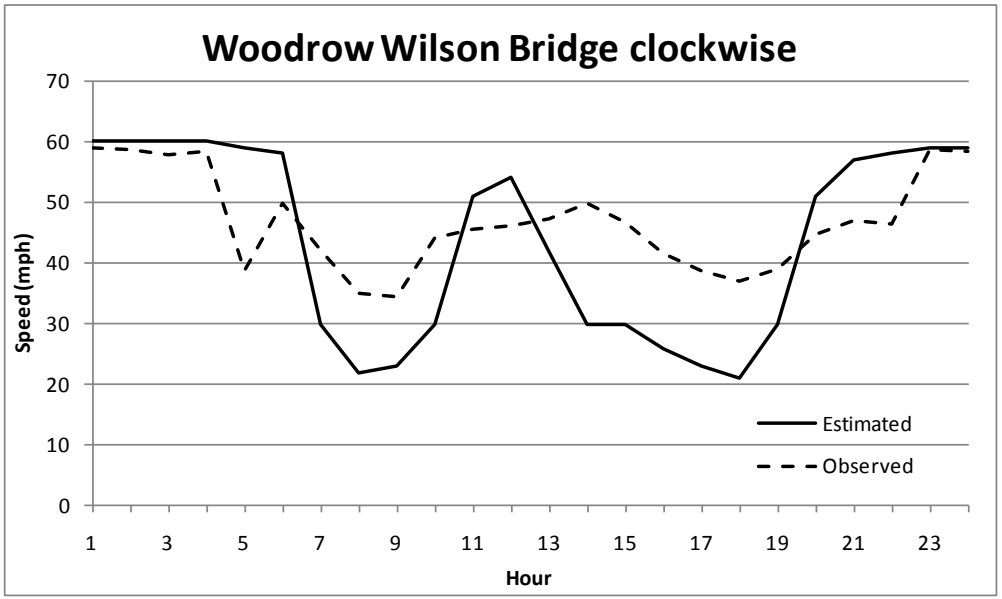




Comparison of 2007 simulated post processor speed and hourly INRIX reported speeds
(INRIX speeds reflect weekday travel in October, 2008)

Location: Woodrow Wilson Bridge counter clockwise and clockwise





Comparison of 2007 simulated post processor speed and hourly INRIX reported speeds
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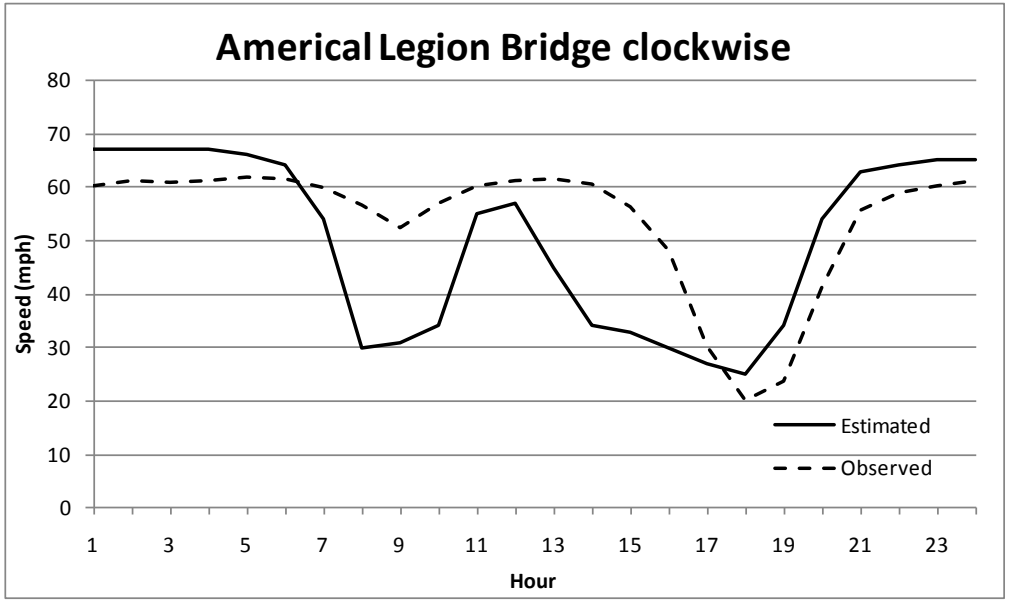
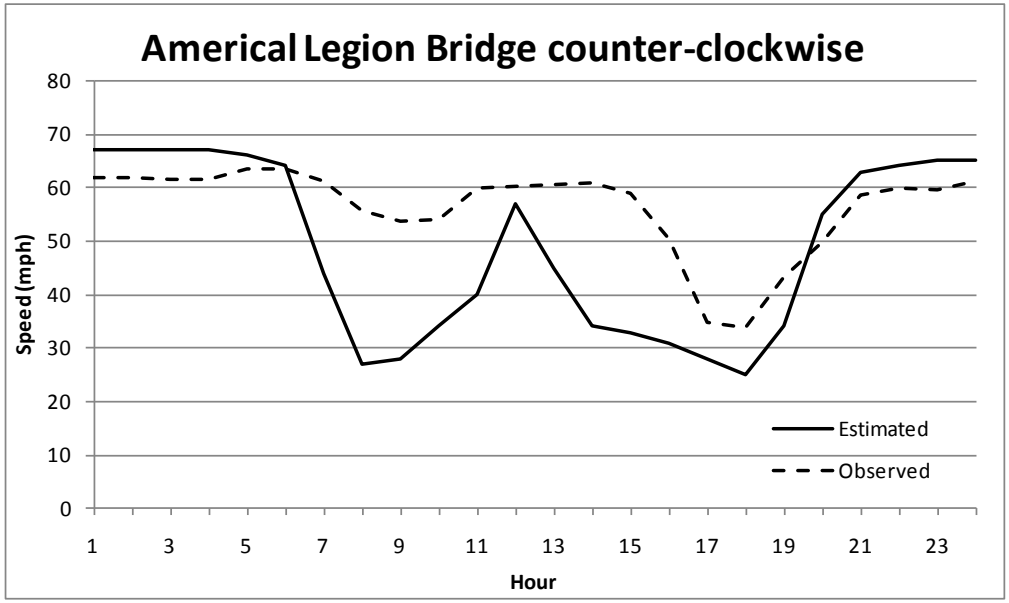
Location: American Legion Bridge clockwise and counter clockwise





Conclusions

- Progress has been made in applying Version 2.3 for application use
- Staff plans to share results in November, along with a presentation on any changes made to the model in between now and then.
- Final documentation and a transmittal package will be prepared November/December.