

# Ex-Post Evaluation of COG/TPB Transit Forecasts

Presentation to the Travel Forecasting Subcommittee  
July 19, 2013

Ronald Milone, COG/TPB staff  
National Capital Region Transportation Planning Board (TPB)  
Metropolitan Washington Council of Governments (COG)

# Background

- On March 20, 2013, the TPB was briefed on the COG Cooperative Forecasting process
  - Presentation focused on how land activity forecasts are developed as an input the regional travel model
  - Presentation included an analysis of how previous land activity forecasts compared to actual 2010 land activity
- WMATA subsequently followed up TPB staff with a request for historical documents containing transit forecasts for 2010

Key question:

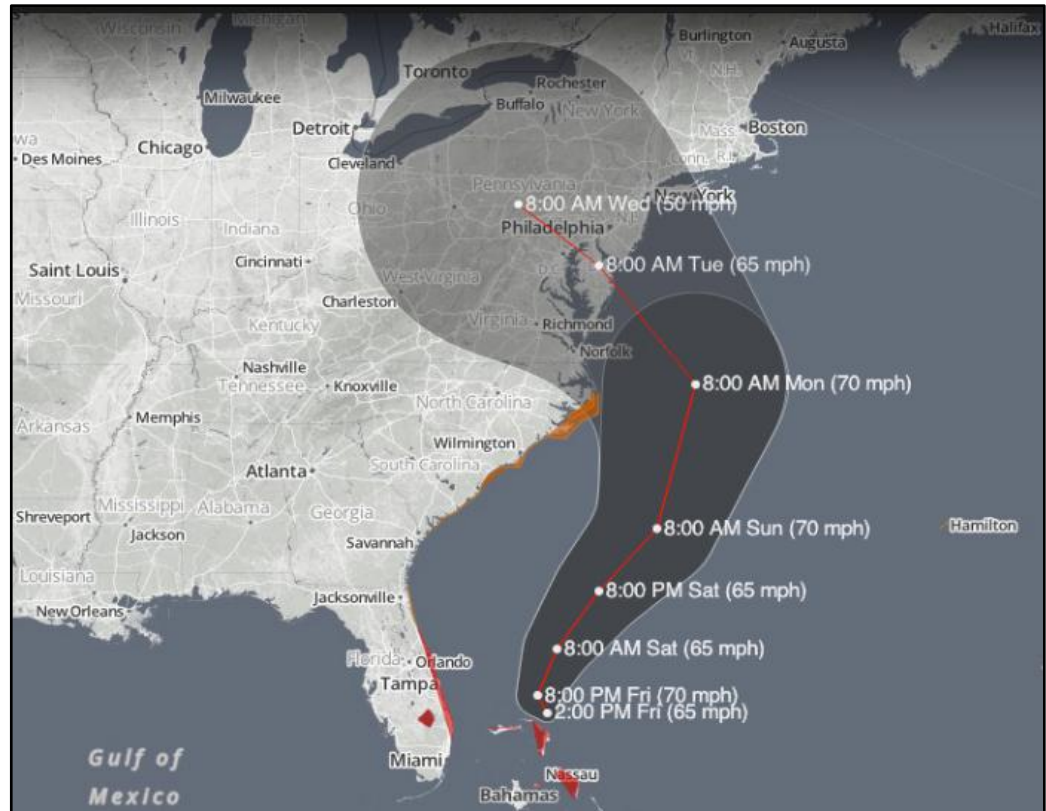
**How well have past transit ridership forecasts compared with actual ridership?**

# Why is this question avoided?

1. Practitioners understand the planning process is subject to inherent uncertainty
  - Model inputs and assumptions are subject to error
  - Relative analysis of modeling outputs is preferred over an absolute analysis in most project planning studies
2. While uncertainty in the process is recognized, it is difficult to understand and quantify
  - The process is subject to propagating errors
3. There are practical problems
  - historical modeling data are difficult to retrieve
  - archiving past travel modeling is not mandated

# The hurricane map is a useful analogy

- The actual storm track depends on many variables
- Approximate path direction can be forecasted based on known conditions and known behavior of past storms
- Variables affecting storm are changing in real time
- Uncertainty of forecasted path gradually increases over the forecasting period



*Tracking map for Hurricane Sandy*

# TPB staff's documented response

- 2010 regional transit ridership forecasts prepared in 1994 were compared with an *approximation* of actual transit ridership for 2010
- Known and unknown factors affecting the transit ridership forecasts were presented
- Improvements to the TPB's modeling practices since 1994 were summarized

# What kind of transit forecasts did TPB staff produce 19 years ago?

- Only Home-Based-Work (HBW) transit trips were estimated
- Transit trips were not distinguished among sub-modes
- The model did not include a transit assignment process, and therefore, did not include the ability to compute transit boardings (or unlinked trips)
- External transit trips were not addressed

Modeled transit trips were, in 1994, defined as:  
linked /internal /HBW trips only

Long Range Plan Report published in 1994 was the source of our forecasted 2010 transit trips

- Plan was adopted in 1991 and amended in 1993
- Round 5.1 Cooperative Forecasts used
- Travel model documented in the “Volume A: Current Applications” report (6/30/94)



## Long-Range Transportation Plan for the National Capital Region

National Capital Region  
Transportation Planning Board

September 21, 1994

# Inputs to the travel model: Comparison of forecasted/actual HHs

	Round 5.1 1990	Round 5.1 2010	2010	Ratio	Diff.
Jurisdiction:	Base Year	Forecast Year	Actual	Fcst./Act.	Fcst. - Act.
District of Columbia	249,600	252,100	266,700	0.95	-14,600
Arlington Co., VA	78,500	96,300	98,100	0.98	-1,800
City of Alexandria, VA	53,300	64,400	68,100	0.95	-3,700
Montgomery Co., MD	282,000	368,500	361,000	1.02	7,500
Prince George's Co., MD	258,000	326,400	304,000	1.07	22,400
Fairfax Co. & Cities, VA	303,900	398,700	399,500	1.00	-800
Loudoun Co., VA	30,700	65,300	104,600	0.62	-39,300
Prince William Co. & Cities VA	81,400	131,600	147,800	0.89	-16,200
Frederick Co., MD	52,600	92,500	84,800	1.09	7,700
Charles Co., MD	33,000	55,900	51,000	1.10	4,900
<b>Total</b>	<b>1,423,000</b>	<b>1,851,700</b>	<b>1,885,600</b>	<b>0.98</b>	<b>-33,900</b>



# Inputs to the travel model: Comparison of forecasted/actual jobs

	Round 5.1 1990	Round 5.1 2010	2010	Ratio	Diff.
Jurisdiction:	Base Year	Forecast	Actual	Fcst./Act.	Fcst. - Act.
District of Columbia	747,300	885,900	783,500	1.13	102,400
Arlington Co., VA	183,100	264,600	223,300	1.18	41,300
City of Alexandria, VA	92,200	125,000	106,000	1.18	19,000
Montgomery Co., MD	465,500	625,000	510,100	1.23	114,900
Prince George's Co., MD	310,400	426,600	342,600	1.25	84,000
Fairfax Co. & Cities, VA	443,900	653,300	680,000	0.96	-26,700
Loudoun Co., VA	39,300	85,800	143,700	0.60	-57,900
Prince William Co. & Cities VA	84,500	151,400	143,600	1.05	7,800
Frederick Co., MD	54,000	106,000	98,700	1.07	7,300
Charles Co., MD	38,700	52,500	62,200	0.84	-9,700
<b>Total</b>	<b>2,458,900</b>	<b>3,376,100</b>	<b>3,093,700</b>	<b>1.09</b>	<b>282,400</b>

# Assessment of Rnd. 5.1 forecasted land activity

- Households forecasts were more accurate than job forecasts (0.98 vs. 1.09 e/o ratios)
- Households in the “core” jurisdictions were underestimated slightly (~5%)
  - An under-estimation of transit trips would be expected
- Montgomery and Prince George’s County jobs were over-estimated (>20%)
  - This would work to bias the O-D pattern of transit trips estimated by the model

# Derivation of 2010 observed, linked HBW transit trips (shaded cells indicate derived figures)

	1994	2007	2010	
Total Avg. Daily Metrorail-Related Trips <sup>1</sup>	517,300	726,100	750,600	
Non-Resident Metrorail-Related Trips <sup>2</sup>	25,300	33,700	34,800	← 4.64% of 750,600
Resident Metrorail-Related Trips <sup>2</sup>	492,000	692,400	715,800	← 750,600 – 34,800
Non-Resident Metrorail Percentage	4.89%	4.64%		
Resident HBW Metrorail Trips <sup>2</sup>	329,400	476,800	492,900	← 68.86% of 715,600
Resident HBW Metrorail Trip Percentage	66.95%	68.86%		
Regional HBW Total Transit Trips <sup>3</sup>	476,500	755,700	781,200	← 492,900 / 63.09%
HBW Metrorail Trip Percentage of Total Regional HBW Transit Trips	69.13%	63.09%		

1) Source: WMATA - Avg. weekday Metrorail ridership computed by EDADS Editing System (revised 6/2011)  
2) Source: 1994 and 2007 WMATA Metrorail On-Board Surveys; 2010 figure based on 2007 percentages  
3) Source: MWCOG inventories of regional transit (bus, commuter rail, Metrorail) trips; 2010 figure based on 2007 percentage  
1994: FY-97 Models Development Program for COG/TPB Travel Models, COG/TPB Staff June 1997 (page 3-58)  
2007: Calibration Report for the TPB Travel Forecasting Model, Version 2.3, on the 3,722-Zone Area System, COG/TPB Staff, January 2012 (page 9-9)

# Model Output:

## Global estimate/observed results for transit

Forecasted 2010 HBW Transit Trips: 802,000

Actual/Derived 2010 HBW Transit Trips: 781,200

Difference: 20,800

Pct. Difference: 2.7%

# What did the model “know”?

- The travel model did not include:
  - the New York Avenue Metrorail station
  - the DC Circulator bus system
- The travel model did not consider the employer-based transit subsidy program (currently known as the SmartBenefit program)
- The model did not account for a lingering national recession in 2010
- The travel model did not effectively reflect the connection between localized land development and reduced motorized travel
- The model did not anticipate the growth in non-motorized travel in the District and changing travel preferences of the District’s younger residents who are more inclined to choose non-motorized modes

# Evolution of the travel model since 1994

	<b>Volume "A" Model (1994)</b>	<b>Version 2.3.52 Model (2013)</b>
Extent of the Study area	12 jurisdiction	22 Jurisdictions
Zonal matrix size	1,478	3,722
Trip Purposes	4 resident purposes	5 resident purposes
	2 truck purposes	2 truck purposes
	no commercial purpose	1 commercial purpose
Trip Generation	HBW motorized person rates	Motorized & non-motorized person rates
	Non-HBW auto driver rates	all purposes
	applied at (293) district level	applied at zone level
Trip Distribution	non-stratified trip-tables	HB purposes are income stratified
	applied at district level	applied at zone level
Mode Choice	HBW purpose model only	All Purposes modeled
	1 transit choice set	11 transit choice set
Traffic Assignment	1 daily trip table loaded	6 trip tables loaded by 4 time periods
	4 -iteration capacity restraint	User Equilibrium / $10^{-4}$ rel. gap critereon
Speed Feedback	trip distribution affected	trip distribution and mode choice affected
	HBW purpose affected	All trip purposes affected

# Conclusions

- TPB staff has evaluated transit forecasts developed almost 20 years ago
- An actual 2010 transit trip figure was derived, using available observed data and analogy methods
- Despite land activity (input) errors, incomplete system assumptions, and unaccounted factors, the estimated trips, at the system level, were within 3% of the actual figure
- The TPB travel model has evolved, and will continue, to evolve, in ways that benefit transit forecasts
- Inputs to the model are also updated, typically each year, in an effort to minimize uncertainty as much as possible