

GEN2/VER. 2.3 MODEL DEVELOPMENT

Part 2 of 2: Updating the Calibration and Validation Targets for Commuter Rail

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Travel Forecasting Subcommittee
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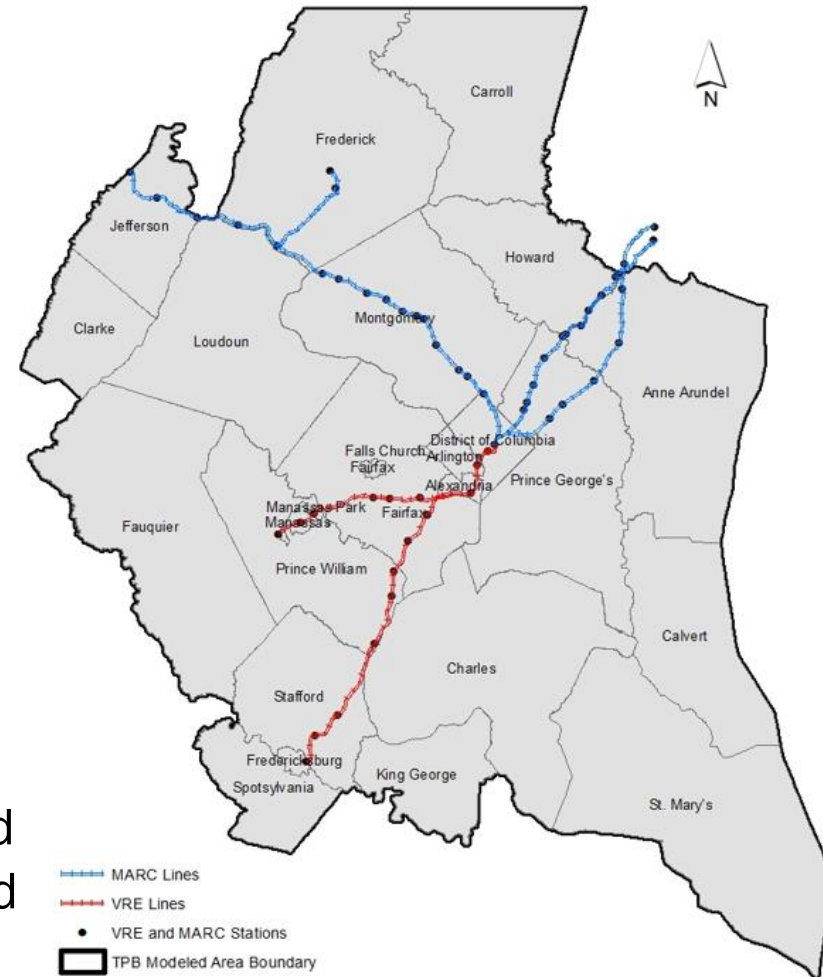
Introduction

- Underestimation of commuter rail ridership has recently caught the attention of TFS: 2014 model validation in March noted a 40% underestimation (32,000 simulated vs. 55,000 reported boardings).
- Underestimation issue has long been noted by TPB staff:
 - Persistent in prior and current versions of the Version 2.3 models as well as in the developmental Version 2.5 Model.
 - Not a top priority in past model validation efforts due to the relatively small market share of commuter rail.
- TPB staff have been trying to identify possible causes to the underestimation and to improve the simulation of commuter rail ridership.
- While prior investigations were focused on estimated travel from the model, a recent investigation revealed an inconsistency related to the observed data used for commuter rail ridership validation.



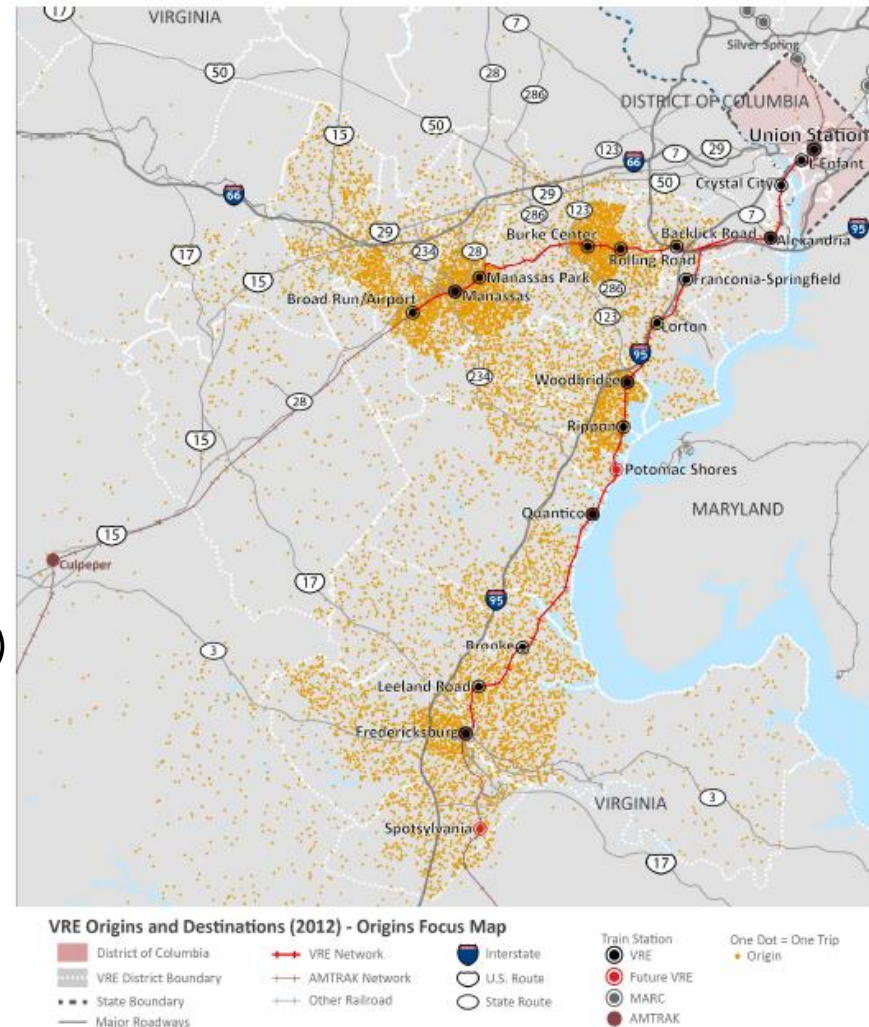
Investigation

- TPB's travel demand model does not simulate transit trips external to the modeled area, including Internal-to-External (I-E), External-to-Internal (E-I) and External-to-External (E-E) trips.
- Thus, mode choice model was calibrated to internal modal person trip targets and transit assignment subsequently simulates commuter rail boardings incurred by internal person trips only.
- However, system boardings reported by VRE and MARC include boardings incurred by external trips, which should be removed for internal ridership targets.



Investigation

- Identification of external trips relies on Transit On-Board Surveys (TOSs), which provide critical information on the origin and destination of commuter rail trips.
- When developing person trip targets for 2007 calibration, staff computed the percentages of external person trips for VRE and MARC based on TOSs:
 - VRE 2005 TOS: 6,405/13,074 (49%)
 - MTA 2007/2008 TOS: 11,651/26,451 (44%)
- VRE percentage of external trips is suspiciously high.



Source: Virginia Railway Express 2040 System Plan Study

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VRE Survey Data: Review

- Original 2005 VRE on-board survey data, consisting of 4,999 sample person trips (responses), identified home and work locations of these trips through ZIP Codes.
- After it was cleaned, expanded and adjusted (factored) to represent year-2007 conditions, the survey data contained 13,086 person trips.
- Data processing was performed by TPB staff in 2010 through a combination of SAS, ArcGIS, MS Access and MS Excel procedures.
- A recent review of the VRE data found two errors in data processing.



VRE Survey Data: Processing Error #1

Error:

- Prior data processing failed to identify trip records with invalid home/work ZIP Codes and subsequently labelled them as external trips.
 - ZIP Codes pointing to foreign countries or remote states that are impossible for VRE trips: “1”, “22322”, “40201”, etc.
 - ZIP Codes not existing in national ZIP Code database: “20231”, etc.

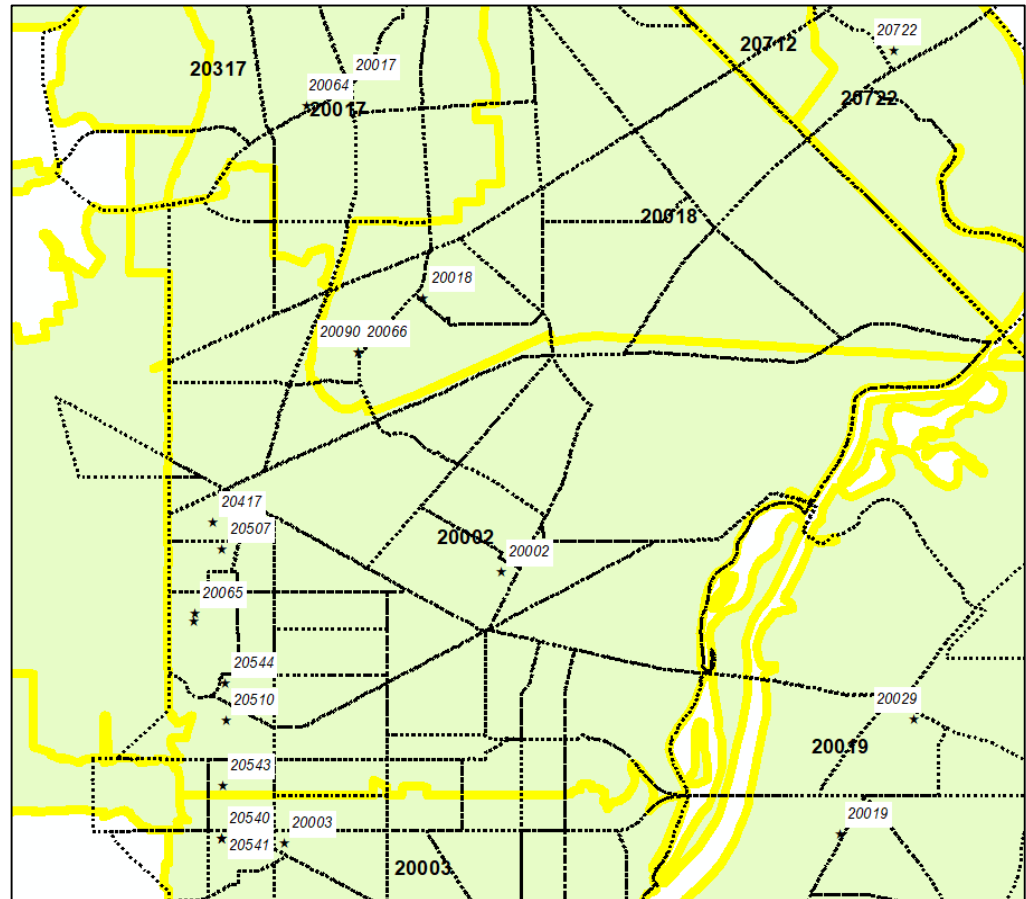
Fix:

- Trip records containing invalid ZIP Codes were removed.
- The updated data contained 4,723 sample person trips and 12,565 person trips after being cleaned, expanded and adjusted.
- The data was subsequently reweighted (factored) to match the original control total of 13,086.



VRE Survey Data: Processing Error #2

- To develop calibration targets, ZIP-Code-to-ZIP-Code trip records were disaggregated into TAZ-to-TAZ trips in ArcGIS based on area proration.
- First, a trip was tied to a ZIP Code polygon based on a matching between ZIP Code in the trip record and polygon key ZIP Code.
- Second, trips to or from a ZIP Code polygon were split into TAZ-based trips based on the area of each intersecting TAZ relative to that of the ZIP Code polygon.



VRE Survey Data: Processing Error #2

Error:

- Neglected the fact that key ZIP Codes contained in ZIP Code polygons represent only a subset of all existing ZIP Codes: ZIP Codes for some agencies, buildings or PO Boxes, which have unique ZIP Codes but do not have geographical boundaries are not included in ZIP Code polygons.
- Unable to match those ZIP Codes with any polygon key ZIP Code in this region, prior ZIP Code matching procedure erroneously labelled trips containing those ZIP Codes as external trips and excluded them from the VRE person trip calibration target.

Fix:

- Matched a ZIP Code in a trip record to a point in a ZIP Code point shape file that contains the complete set of existing ZIP Codes.
- Matched this trip to a ZIP Code polygon based on the geographic intersection of the ZIP Code point and the ZIP Code polygon.



VRE Survey Data: Updates to Targets

2007 Calibration Targets (Linked Trips):

- Following the fixes to the above two errors, only 1,336 out of the 13,086 VRE person trips (or 10%) in 2007 were identified as external trips.
- Excluding those external trips, the control total of the VRE person trip target for 2007 mode choice calibration became 11,750.

2014 Validation Targets (Unlinked Trips):

- As the survey provides no transfer information, it is assumed that one VRE trip incurred only one boarding to one train. Therefore, the percentage of VRE boardings incurred by external trips was also 10% in 2007.
- Until more recent survey data become available to the TPB, it is assumed that this percentage remained the same for 2014.
- Applying this percentage to total VRE system boardings (18,166) in 2014, the 2014 VRE ridership validation target was updated to 16,311.



MTA Survey Data: Review

- 2007 MARC data files extracted from the MTA TOS contained 1,714 sample MARC person trips which were expanded to 26,451 person trips.
- Trip records in this data were already cleaned and geocoded with X- and Y- coordinates of origins and destinations.
- A recent review of this data found no error in data processing.
- Using the transfer information in the survey data, TPB staff converted 26,451 MARC linked trips to 26,668 unlinked trips (boardings), and calculated that external trips (including I-E, E-E and E-I trips) accounted for 44% of total MARC boardings in 2007.
- Reasonableness of the E-I percentage (23%) was verified by an independent E-I percentage estimate (21.5%) that TPB staff developed based on MARC ridership information by station for August of 2017.



MARC Survey Data: Updates to Targets

2007 Calibration Targets (Linked Trips):

- No Update (control total remains to be 14,800).

2014 Validation Targets (Unlinked Trips):

- Until more recent survey data become available to the TPB, it is assumed that the 2007 percentage of external trips (44%) remained the same for 2014.
- Applying this percentage to total MARC system boardings (36,051) in 2014, the 2014 MARC ridership validation target was updated to 20,171.



Next Steps

- TPB staff are currently conducting a series of re-calibration and re-validation tests for the Version 2.3 Model using the updated commuter rail targets.
- In parallel, TPB staff are also testing Version 2.3 Model improvements, such as a fix to the external trip distribution model.
- In the end, TPB staff will conduct 2007 mode choice re-calibration for the Version 2.3 Model using:
 - Updated transit person trip targets, and
 - Updated auto person trip targets from a new 2007 model run that incorporates the above model improvements in testing.
- Using the re-calibrated model and updated 2014 commuter rail ridership targets, TPB staff will then conduct the 2014 model re-validation.



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