# Memorandum

Date: October 19, 2015

From: AECOM

To: Charlotte Area Transit System (CATS)

Re: **Metrolina Transit Model Mode Choice Calibration and Validation**

# Introduction

As part of the Modeling Task Order contract, AECOM has been asked by CATS to calibrate the Metrolina mode choice model using the 2013 on-board transit survey. This report documents the work done by AECOM as part of mode choice calibration and validation.

The 2013 On-Board survey and calibration targets are discussed. The pre-calibration mode choice results are presented to set the basis for the calibration process. The transfer of mode choice model from the current *AEMS* to the new *ModeChoice* platform is discussed. The motivation to remove the choice rider setup in mode choice and the resulting model improvements are presented. The 2013 mode choice results using the calibrated model are presented. Validation of the calibrated model to 2010 conditions is discussed.

# 2013 Transit Survey

In Fall 2013, CATS conducted an on-board survey of passengers of the Charlotte Area Transit System (CATS) bus and rail service as part of the “Before” conditions prior to the construction of the LYNX Blue Line Extension (LYNX BLE) Northeast Corridor Light Rail Project. The full survey is a questionnaire intended to capture the characteristics of travel, including route, direction, time, origin, and destination, as well as access/egress modes, trip purpose, and other respondent demographics.

Automatic Passenger Count (APC) data for 23 weekdays in the month of October 2013 were used to develop survey expansion control totals for station/route segment level boarding and alighting by two time periods (peak and off-peak) direction of travel (inbound and outbound). The three datasets from the survey data collection - On-to-Off survey, Full survey, and PNR counts – along with the control totals established from October 2013 APC data were used in the Survey Expansion process. The survey expansion methodology is documented in the memo titled *CATS 2013 Transit Survey Expansion Methodology.*

The transit survey was analyzed for “Before” conditions prior to the construction of the LYNX Blue Line Extension (LYNX BLE) Northeast Corridor Light Rail Project. The analysis was documented in two memos titled *CATS 2013 Transit Survey Analysis* and *Transit Survey Summary and Analysis Report.*

# Mode Choice Calibration Targets

Mode Choice calibration targets were developed from the survey expansion process. The targets are tabulated in Table 1 by trip purpose, rider’s household income, transit mode of access and CBD/non-CBD market segments in production-attraction (PA) format.

The trips are segmented into Home-Based-Work (HBW), Home-Based-University (HBU), Home-Based-Other (HBO) and Non-Home-Based (NHB) purposes. The four income groups are defined based on the household income in 2013 as follows:

* Income 1: Less than $16,000
* Income 2: $16,000 to $ 34,000
* Income 3: $34,000 to $60,000
* Income 4: Greater than $60,000

The HBW is the dominant trip purpose both for rail and bus riders with over 55% of rail riders using transit for HBW trips. Income 1 and 2 riders make up 63% of total transit riders.

About 29 percent of system wide trips are attracted to the CBD and about 41 percent of rail trips are attracted to the CBD. The Income-4 group (high income) riders show a greater share of trips attracted to the CBD. The peak period accounts for more than half of system wide trips both for rail and for bus only modes.

Table . 2013 Mode Choice Calibration Targets by CBD/Non-CBD Market Segments

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **CBD Peak** | | | **Non-CBD Peak** | | | **CBD Off-Peak** | | | **Non-CBD Off-Peak** | | | **Total** | | | **TOTAL** |
| **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** |
| HBW - Inc 1 | 351 | 82 | 23 | 1,624 | 6 | 44 | 245 | 4 | 3 | 1,520 | 15 | 10 | 3,740 | 106 | 80 | 3,927 |
| HBW - Inc 2 | 396 | 137 | 34 | 3,418 | 138 | 107 | 377 | 101 | 11 | 2,514 | 53 | 55 | 6,705 | 429 | 207 | 7,341 |
| HBW - Inc 3 | 565 | 871 | 37 | 1,557 | 111 | 108 | 292 | 175 | 0 | 1,273 | 36 | 34 | 3,688 | 1,192 | 179 | 5,059 |
| HBW - Inc 4 | 901 | 3,669 | 267 | 701 | 312 | 104 | 201 | 530 | 29 | 422 | 41 | 4 | 2,225 | 4,552 | 405 | 7,181 |
| HBW - All | 2,213 | 4,759 | 361 | 7,300 | 568 | 364 | 1,115 | 809 | 43 | 5,730 | 144 | 104 | 16,357 | 6,279 | 871 | 23,508 |
| HBO - Inc 1 | 457 | 0 | 4 | 2,252 | 21 | 21 | 783 | 24 | 0 | 3,696 | 45 | 55 | 7,189 | 90 | 81 | 7,360 |
| HBO - Inc 2 | 318 | 42 | 20 | 2,126 | 12 | 101 | 610 | 29 | 25 | 3,089 | 10 | 17 | 6,143 | 93 | 162 | 6,399 |
| HBO - Inc 3 | 160 | 103 | 0 | 767 | 75 | 14 | 117 | 82 | 0 | 964 | 41 | 6 | 2,008 | 300 | 20 | 2,328 |
| HBO - Inc 4 | 90 | 108 | 0 | 320 | 91 | 10 | 61 | 191 | 0 | 422 | 30 | 9 | 892 | 421 | 19 | 1,332 |
| HBO - All | 1,025 | 253 | 24 | 5,465 | 200 | 146 | 1,571 | 326 | 25 | 8,172 | 126 | 87 | 16,232 | 904 | 282 | 17,418 |
| HBU | 9 | 0 | 0 | 1,164 | 215 | 79 | 0 | 5 | 0 | 1,278 | 142 | 112 | 2,451 | 362 | 191 | 3,003 |
| NHB | 290 | 58 | 13 | 1,723 | 31 | 64 | 407 | 58 | 3 | 2,631 | 13 | 46 | 5,052 | 161 | 126 | 5,338 |
| **Total** | **3,536** | **5,071** | **397** | **15,651** | **1,013** | **652** | **3,093** | **1,198** | **71** | **17,812** | **425** | **349** | **40,092** | **7,706** | **1,469** | **49,267** |

# Transit Model Update to the Latest Version

As AECOM initiated the calibration effort, the following model files were provided:

1. Latest transit model installation CD
2. 2013 inputs to Metrolina transit model: person trip tables, auto skims, roadway network, transit route system and zone system
3. Above model inputs for the year 2010

Since the last transmittal of transit model to Charlotte DOT, AECOM modified transit setup to deal with Commuter rail. The changes made are as follows:

* Added a check box in transit preparation and skimming steps to flag that Commuter Rail path needs to be separately evaluated.
* If the check box is checked (value =1), then the model builds a third pair of premium only paths that exclude Commuter Rail from the available modes.
* The third set of premium only paths without Commuter Rail mode are used by the non-work trip purposes (HBO and NHB) for Choice Set 2 (the choice riders).
* This is done to reflect the fact that Commuter Rail is not really a mode of choice for non-work related trips due to infrequent service and longer station spacing. If Commuter rail service was provided at good frequency all day (similar to urban rail like LRT / BRT / Streetcar), then the Choice Set 2 riders might consider this as a viable Premium Choice for non-work trips. Since the Red Line (North Commuter Rail) is primarily a peak direction service, allowing non-work Choice Set 2 trips to see Commuter Rail only path resulted in higher than expected share. By specifically building third set of skims, we reduce this share. If in the future it is desired to model Commuter rail frequency similar to urban rail, then un-checking of this option will achieve that goal (i.e. Commuter Rail Only path will be seen for non-work trips by Choice Set 2 riders). The Choice Set 1 riders see commuter rail path for all trip purposes.
* The operation statistics parameters were updated to 2011 observed numbers in preparation for the BLE FFGA submission. AECOM updated this macro and CDOT did not have a copy of the same
* Enhancements were made to boarding summary macro to summarize station boarding by access mode.

The above changes have been applied to the Metrolina model that was transmitted to AECOM for the current model calibration effort. With these updates, both versions of models are now consistent.

The following additional changes are made to both the 2010 and 2013 model inputs:

### Highway network

* The loaded highway network has one link (ID 9217) with missing attributes (such as area type, speed, model, travel times etc.).The required fields were manually computed.
* The BRT\_Flag value was null for new links that were added to the network

It may be desirable to add a step in the transit create network step that fill some of these required fields with a default value (e.g. default value for BRT\_Flag is zero, for Mode is 10). If some of the computed values like area type is found to be null, the process should display an error message and quit.

### Transit network

Couple of transit routes in Kannapolis had two stops on same route tagged to same node id. TransCAD doesn’t accept this and there is no easy way to catch this error except for inspecting the log file. These routes were fixed.

### TAZ\_AREATP.ASC

This ascii text file is used by the mode choice model for determining if the zone is a CBD zone or not and if the parking cost needs to be inflated. The *AEMS* mode choice program expects this file to be fixed column width of five (5). The output created by the Metrolina model had a fixed width that was eight characters long. As a result of this, the mode choice model would assign a default value of one (1) for all zones. In Metrolina model, a flag value of one means non-CBD attraction. As a result of this all zones were assigned to Non-CBD market segment. This may be the primary reason why the runs made at CDOT resulted in very low transit market share as the CBD market was underrepresented. It is suggested that the macro/program that outputs this file be updated to enforce the column width of size five (5) and if possible sorted by zone number. For the current model run the file was manually edited to match the expected format.

### Mode Choice control files

The Home Based Other control files (peak Choice Set 2 and Off-peak Choice Set 1 and 2) in the CDOT version of the model were from an older model version. The rest of the purposes were identical to AECOM’s version. This may have been a copy-paste error. The control files were updated to match the current version of model at AECOM.

Additionally, the mode choice control files still had 12068 as hard coded zone limit. This was updated to 12085.

After making all of the above changes, the transit model was successfully run for 2010 (with Commuter Rail Flag turned on as default). The transit boardings were similar for CATS service to what was provided for the 2009 calibration. The rail boardings are lower than observed, but overall boardings are close to observed. The Kannapolis and Gaston bus boardings look very different between the two models. The network coding needs to be reviewed in order to ensure that the networks are properly represented.

# Pre-Calibration Mode Choice

Prior to calibrating the mode choice model using the 2013 transit survey, the model was run using 2013 inputs, with the below changes made to transit routes:

1. Changes to routes 20 and 65X based on discussion from CATS
2. Change to route ID 2454 to avoid passing through centroid connector.

The mode choice model was transferred from *AEMS* (based in FORTRAN) to the new *ModeChoice* program based in C#. The results from *AEMS* were replicated using the new *ModeChoice* program.

The pre-calibration 2013 mode choice model with the new *ModeChoice* program performs as shown in Table 2 and Table 3. The pre-calibration model over-represents walk access transit trips to non-CBD and under-represents walk access transit trips to CBD. KNR trips are significantly over-represented. Rail-related trips are significantly under-represented, while daily bus-only trips are over-represented by about 6,000.

Table . 2013 Pre-Calibration Mode Choice model Results by CBD/Non-CBD Market Segments

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **CBD Peak** | | | **Non-CBD Peak** | | | **CBD Off-Peak** | | | **Non-CBD Off-Peak** | | | **Total** | | | **TOTAL** |
| **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** |
| HBW - Inc 1 | 239 | 5 | 4 | 1,912 | 22 | 48 | 157 | 2 | 4 | 2,246 | 6 | 59 | 4,553 | 35 | 116 | 4,704 |
| HBW - Inc 2 | 230 | 66 | 49 | 2,005 | 21 | 82 | 149 | 13 | 1 | 2,082 | 37 | 62 | 4,467 | 137 | 195 | 4,799 |
| HBW - Inc 3 | 190 | 427 | 47 | 812 | 72 | 68 | 109 | 47 | 17 | 668 | 71 | 53 | 1,778 | 617 | 184 | 2,580 |
| HBW - Inc 4 | 877 | 4,773 | 297 | 402 | 387 | 127 | 162 | 574 | 26 | 267 | 59 | 56 | 1,708 | 5,793 | 506 | 8,007 |
| HBW - All | 1,536 | 5,271 | 398 | 5,130 | 502 | 325 | 578 | 636 | 48 | 5,264 | 173 | 231 | 12,507 | 6,581 | 1,001 | 20,089 |
| HBO - Inc 1 | 264 | 1 | 3 | 5,397 | 2 | 100 | 384 | 2 | 15 | 8,336 | 26 | 208 | 14,380 | 31 | 326 | 14,737 |
| HBO - Inc 2 | 91 | 5 | 19 | 2,161 | 7 | 60 | 237 | 18 | 21 | 3,335 | 26 | 126 | 5,823 | 55 | 226 | 6,104 |
| HBO - Inc 3 | 38 | 32 | 2 | 822 | 27 | 53 | 153 | 5 | 4 | 1,065 | 11 | 145 | 2,078 | 76 | 204 | 2,357 |
| HBO - Inc 4 | 24 | 109 | 8 | 252 | 41 | 30 | 209 | 40 | 21 | 528 | 16 | 114 | 1,013 | 206 | 172 | 1,391 |
| HBO - All | 417 | 147 | 31 | 8,631 | 76 | 243 | 983 | 66 | 60 | 13,263 | 79 | 593 | 23,294 | 367 | 927 | 24,589 |
| HBU | 0 | 0 | 0 | 2,079 | 193 | 342 | 0 | 0 | 0 | 880 | 56 | 113 | 2,959 | 249 | 455 | 3,663 |
| NHB | 80 | 191 | 38 | 869 | 114 | 104 | 216 | 331 | 39 | 2,034 | 90 | 185 | 3,199 | 726 | 368 | 4,292 |
| **Total** | **2,032** | **5,609** | **467** | **16,710** | **885** | **1,014** | **1,777** | **1,032** | **147** | **21,440** | **398** | **1,122** | **41,959** | **7,923** | **2,750** | **52,632** |
| **Survey** | **3,536** | **5,071** | **397** | **15,651** | **1,013** | **652** | **3,093** | **1,198** | **71** | **17,812** | **425** | **349** | **40,092** | **7,706** | **1,469** | **49,267** |
| **Difference** | **-1,504** | **538** | **70** | **1,059** | **-128** | **362** | **-1,316** | **-166** | **76** | **3,629** | **-27** | **773** | **1,867** | **217** | **1,281** | **3,365** |

Table . 2013 Pre-Calibration Mode Choice Model Results by Bus/Rail Paths

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Path | | Transit Linked Trips | | |
| Survey | Model | % Diff |
| Peak Walk | Rail Only | 1,588 | 951 | -40% |
| Rail Bus | 3,199 | 2,333 | -27% |
| Bus Only | 14,400 | 15,457 | 7% |
| Total | 19,187 | 18,742 | -2% |
| Peak PNR | Rail Only | 3,460 | 3,041 | -12% |
| Rail Bus | 79 | 198 | 149% |
| Bus Only | 2,544 | 3,255 | 28% |
| Total | 6,084 | 6,494 | 7% |
| Peak KNR | Rail Only | 158 | 280 | 77% |
| Rail Bus | 125 | 96 | -23% |
| Bus Only | 766 | 1,105 | 44% |
| Total | 1,049 | 1,480 | 41% |
| Off-Peak Walk | Rail Only | 1,748 | 1,768 | 1% |
| Rail Bus | 3,084 | 2,135 | -31% |
| Bus Only | 16,073 | 19,315 | 20% |
| Total | 20,905 | 23,217 | 11% |
| Off-Peak PNR | Rail Only | 1,186 | 1,102 | -7% |
| Rail Bus | 99 | 61 | -38% |
| Bus Only | 337 | 266 | -21% |
| Total | 1,622 | 1,429 | -12% |
| Off-Peak KNR | Rail Only | 66 | 403 | 512% |
| Rail Bus | 100 | 72 | -28% |
| Bus Only | 254 | 794 | 213% |
| Total | 420 | 1,269 | 202% |
| TOTAL | Rail Only | 8,206 | 7,546 | -8% |
| Rail Bus | 6,687 | 4,894 | -27% |
| Bus Only | 34,374 | 40,191 | 17% |
| **Total** | **49,267** | **52,631** | **7%** |

# Initial Mode Choice Calibration

Initially, the mode choice calibration focused on calibrating the income-based constants for the various purposes and peak/off-peak periods. The primary objective was to reduce bus-only trips and increase rail-related trips. The income-based constants for bus and rail (same constants were used for bus and rail modes) by the three modes of access (walk, drive and dropoff) were modified for the different purpose-income market segments. The modified constants vary in a reasonable way across income groups and modes of access. The bus-only trips and overall transit trips get closer to the targets, but the rail-related trips are still lower than targets. The reason is that the model shows about 4,500 fewer rail-only trips than the target, most of which are by walk and drive access.

Other options were tested to bring the model trips by rail-only and rail-bus path types closer to observed data. The proportion of transit riders who are choice riders (those who would only consider rail mode to make a transit trip, i.e. those who do not prefer to use bus to make a trip). The proportion of HBW peak trips belong to INCOME 1 and 2 categories who are choice riders was increased. This change to the model resulted in a slightly higher number of rail-only trips and slightly lower number of rail-bus trips. Since the impact of change to choice rider set was not significant, this option was not pursued. The choice rider setup was not changed and is as shown below in Table 4.

Table . Choice Set Factors - Proportion of trip table considered for choice set 1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Trip Purpose** | Income 1 | Income 2 | Income 3 | Income 4 |  | |  | |
| HBW Peak | 100% | 100% | 75% | 75% |  | |  | |
| HBW Off-Peak | 100% | 56% | 45% | 40% |  | |  | |
| HBO Peak | 100% | 65% | 36% | 20% |  | |  | |
| HBO Off-Peak | 100% | 50% | 36% | 25% |  | |  | |
| NHB Peak\*\* | 65% |  |  |  |  | |  | |
| NHB Off-Peak\*\* | 50% |  |  |  |  | |  | |
| HBU Peak\*\* | 57% |  |  |  |  | |  | |
| HBU Off-Peak\*\* | 65% |  |  |  |  | |  | |
| *\*\* NHB and HBU Purpose trip tables are not stratified by income group* | | | | | |  | |  | |
| ***Note: The residual person trips are considered for choice set 2 (Premium Only Transit as choice)*** | | | | | |  | |  | |

The overall system transit ridership is unchanged between spring 2009 and spring 2013 surveys. However, the spring 2013 survey shows lower transit linked trips when compared with spring 2009. This is due to higher transfer rate obtained from spring 2013 survey. This does not necessarily mean that between 2009 and 2013 the CATS riders need to make more number of transfers. This increase in transfer rate may be due to better reporting of transfer in the new data collection format. In order to reflect this behavior in the model, parameters related to transfers were modified. Also, initial wait time for rail was lowered to increase the model’s representation of rail ridership. Transit path building parameters were modified as below.

* The weight for initial wait time for LRT mode is reduced from 1.5 to 1.0. The change is reflected in mode choice by changing the coefficient for initial wait time from 1.5\*VOT to 1.0\*VOT. The absolute value of the coefficient depends on the trip purpose since VOT in the model varies by trip purpose.
* The weight for LRT transfer wait time is reduced from 2.0 to 1.5. The change is reflected in mode choice by changing the coefficient for initial wait time from 2.0\*VOT to 1.5\*VOT.
* Penalty to transfer to LRT is changed from 2 to 0 minutes for drive access trips during the peak period. Penalty to transfer among various bus modes is changed from 2 to 6 minutes for walk access trips during the peak period. This is done to reflect higher amount of observed activity on rail-related travel than the model represents.

The mode choice results by purpose, income, geographic markets and time periods are shown in Table 5 and Table 6. The mode choice results for 2013 were reasonably close to the targets.

Table . 2013 Mode Choice by Income and Trip Purpose with Calibrated Constants and Modified PathBuilding Parameters

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **CBD Peak** | | | **Non-CBD Peak** | | | **CBD Off-Peak** | | | **Non-CBD Off-Peak** | | | **Total** | | | **TOTAL** |
| **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** |
| HBW - Inc 1 | 292 | 36 | 2 | 1,815 | 24 | 52 | 211 | 2 | 2 | 1,868 | 7 | 77 | 4,186 | 70 | 133 | 4,389 |
| HBW - Inc 2 | 262 | 173 | 35 | 3,407 | 20 | 65 | 279 | 19 | 1 | 2,337 | 38 | 60 | 6,284 | 250 | 161 | 6,695 |
| HBW - Inc 3 | 477 | 537 | 27 | 1,960 | 64 | 70 | 214 | 78 | 10 | 1,129 | 66 | 43 | 3,780 | 745 | 150 | 4,675 |
| HBW - Inc 4 | 1,010 | 4,200 | 225 | 563 | 365 | 95 | 184 | 492 | 28 | 349 | 62 | 56 | 2,106 | 5,118 | 404 | 7,628 |
| HBW - All | 2,041 | 4,947 | 288 | 7,745 | 473 | 283 | 887 | 590 | 41 | 5,683 | 173 | 236 | 16,356 | 6,183 | 848 | 23,387 |
| HBO - Inc 1 | 497 | 1 | 2 | 2,377 | 2 | 152 | 475 | 2 | 13 | 4,501 | 36 | 167 | 7,849 | 40 | 333 | 8,223 |
| HBO - Inc 2 | 284 | 3 | 12 | 2,132 | 7 | 62 | 289 | 17 | 20 | 3,132 | 28 | 102 | 5,837 | 55 | 195 | 6,087 |
| HBO - Inc 3 | 87 | 40 | 1 | 683 | 39 | 57 | 138 | 6 | 4 | 809 | 13 | 126 | 1,717 | 98 | 187 | 2,002 |
| HBO - Inc 4 | 68 | 106 | 7 | 323 | 41 | 29 | 133 | 45 | 24 | 448 | 17 | 96 | 971 | 210 | 155 | 1,336 |
| HBO - All | 936 | 151 | 21 | 5,515 | 90 | 299 | 1,034 | 70 | 60 | 8,889 | 94 | 491 | 16,374 | 404 | 871 | 17,649 |
| HBU | 0 | 0 | 0 | 1,555 | 241 | 290 | 0 | 0 | 0 | 1,247 | 72 | 80 | 2,802 | 313 | 370 | 3,485 |
| NHB | 208 | 167 | 33 | 1,855 | 101 | 84 | 283 | 342 | 39 | 2,506 | 94 | 93 | 4,852 | 704 | 250 | 5,806 |
| **Total** | **3,185** | **5,265** | **343** | **16,669** | **904** | **957** | **2,205** | **1,002** | **139** | **18,326** | **432** | **900** | **40,384** | **7,603** | **2,339** | **50,326** |
| **Survey** | **3,536** | **5,071** | **397** | **15,651** | **1,013** | **652** | **3,093** | **1,198** | **71** | **17,812** | **425** | **349** | **40,092** | **7,706** | **1,469** | **49,267** |
| **Difference** | **-352** | **194** | **-55** | **1,018** | **-109** | **305** | **-888** | **-196** | **68** | **514** | **8** | **552** | **292** | **-103** | **870** | **1,059** |

Table . 2013 Mode Choice Model by Bus/Rail Paths with Calibrated Constants and Modified PathBuilding Parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Path | | Transit Linked Trips | | |
| Survey | Model | % Diff |
| Peak Walk | Rail Only | 1,588 | 1,276 | -20% |
| Rail Bus | 3,199 | 3,857 | 21% |
| Bus Only | 14,400 | 14,721 | 2% |
| Total | 19,187 | 19,854 | 3% |
| Peak PNR | Rail Only | 3,460 | 2,880 | -17% |
| Rail Bus | 79 | 317 | 300% |
| Bus Only | 2,544 | 2,972 | 17% |
| Total | 6,084 | 6,169 | 1% |
| Peak KNR | Rail Only | 158 | 250 | 58% |
| Rail Bus | 125 | 146 | 17% |
| Bus Only | 766 | 903 | 18% |
| Total | 1,049 | 1,299 | 24% |
| Off-Peak Walk | Rail Only | 1,748 | 1,915 | 10% |
| Rail Bus | 3,084 | 2,704 | -12% |
| Bus Only | 16,073 | 15,912 | -1% |
| Total | 20,905 | 20,531 | -2% |
| Off-Peak PNR | Rail Only | 1,186 | 1,098 | -7% |
| Rail Bus | 99 | 80 | -19% |
| Bus Only | 337 | 257 | -24% |
| Total | 1,622 | 1,434 | -12% |
| Off-Peak KNR | Rail Only | 66 | 351 | 433% |
| Rail Bus | 100 | 76 | -24% |
| Bus Only | 254 | 612 | 141% |
| Total | 420 | 1,040 | 148% |
| TOTAL | Rail Only | 8,206 | 7,770 | -5% |
| Rail Bus | 6,687 | 7,181 | 7% |
| Bus Only | 34,374 | 35,376 | 3% |
| **Total** | **49,267** | **50,327** | **2%** |

The above calibrated model was applied to 2010. The mode choice results for 2010 with the above calibration changes are shown in Table 7 and Table 8. The 2010 mode choice results show fewer transit trips than observed in the 2009 survey.

Table . 2010 Mode Choice by Income and Trip Purpose with Calibrated Constants and Modified PathBuilding Parameters

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **CBD Peak** | | | **Non-CBD Peak** | | | **CBD Off-Peak** | | | **Non-CBD Off-Peak** | | | **Total** | | | **TOTAL** |
| **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** |
| HBW - Inc 1 | 270 | 34 | 2 | 1,677 | 23 | 49 | 194 | 2 | 2 | 1,682 | 6 | 69 | 3,824 | 64 | 122 | 4,010 |
| HBW - Inc 2 | 235 | 172 | 33 | 3,131 | 18 | 62 | 252 | 18 | 0 | 2,078 | 35 | 55 | 5,696 | 244 | 151 | 6,091 |
| HBW - Inc 3 | 428 | 524 | 26 | 1,791 | 61 | 68 | 187 | 75 | 9 | 983 | 63 | 39 | 3,389 | 723 | 141 | 4,253 |
| HBW - Inc 4 | 965 | 4,005 | 224 | 497 | 314 | 86 | 170 | 466 | 27 | 292 | 53 | 48 | 1,924 | 4,836 | 384 | 7,145 |
| HBW - All | 1,899 | 4,734 | 285 | 7,096 | 415 | 266 | 803 | 561 | 38 | 5,035 | 157 | 210 | 14,832 | 5,867 | 799 | 21,498 |
| HBO - Inc 1 | 476 | 1 | 2 | 2,186 | 2 | 139 | 442 | 2 | 12 | 4,065 | 33 | 148 | 7,169 | 37 | 300 | 7,505 |
| HBO - Inc 2 | 268 | 3 | 11 | 1,927 | 6 | 56 | 264 | 16 | 19 | 2,758 | 25 | 89 | 5,218 | 50 | 175 | 5,443 |
| HBO - Inc 3 | 82 | 38 | 1 | 612 | 35 | 52 | 126 | 5 | 4 | 706 | 11 | 110 | 1,525 | 90 | 166 | 1,781 |
| HBO - Inc 4 | 64 | 99 | 7 | 286 | 36 | 26 | 123 | 42 | 23 | 386 | 15 | 83 | 859 | 192 | 138 | 1,190 |
| HBO - All | 890 | 141 | 21 | 5,011 | 79 | 273 | 955 | 65 | 57 | 7,916 | 84 | 430 | 14,771 | 369 | 779 | 15,920 |
| HBU | 0 | 0 | 0 | 1,409 | 222 | 279 | 0 | 0 | 0 | 1,140 | 72 | 73 | 2,549 | 294 | 352 | 3,195 |
| NHB | 190 | 159 | 32 | 1,638 | 91 | 76 | 258 | 326 | 37 | 2,187 | 87 | 82 | 4,275 | 664 | 227 | 5,166 |
| **Total** | **2,979** | **5,034** | **337** | **15,154** | **808** | **893** | **2,016** | **952** | **132** | **16,278** | **401** | **795** | **36,426** | **7,195** | **2,157** | **45,778** |
| **Survey** | **3,371** | **7,141** | **692** | **12,973** | **803** | **852** | **2,502** | **1,654** | **168** | **18,049** | **342** | **1,012** | **36,896** | **9,940** | **2,725** | **49,561** |
| **Difference** | **-392** | **-2,107** | **-355** | **2,180** | **5** | **41** | **-486** | **-702** | **-37** | **-1,771** | **58** | **-217** | **-470** | **-2,745** | **-568** | **-3,783** |

Table . 2010 Mode Choice Model by Bus/Rail Paths with Calibrated Constants and Modified PathBuilding Parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Path | | Transit Linked Trips | | |
| Survey | Model | % Diff |
| Peak Walk | Rail Only | 970 | 972 | 0% |
| Rail Bus | 2,329 | 3,126 | 34% |
| Bus Only | 13,045 | 14,035 | 8% |
| Total | 16,344 | 18,133 | 11% |
| Peak PNR | Rail Only | 4,060 | 2,648 | -35% |
| Rail Bus | 141 | 246 | 75% |
| Bus Only | 3,743 | 2,949 | -21% |
| Total | 7,944 | 5,843 | -26% |
| Peak KNR | Rail Only | 270 | 230 | -15% |
| Rail Bus | 197 | 129 | -34% |
| Bus Only | 1,078 | 872 | -19% |
| Total | 1,545 | 1,230 | -20% |
| Off-Peak Walk | Rail Only | 1,619 | 1,673 | 3% |
| Rail Bus | 2,765 | 2,484 | -10% |
| Bus Only | 16,167 | 14,136 | -13% |
| Total | 20,551 | 18,293 | -11% |
| Off-Peak PNR | Rail Only | 1,514 | 1,024 | -32% |
| Rail Bus | 81 | 70 | -14% |
| Bus Only | 401 | 259 | -35% |
| Total | 1,996 | 1,352 | -32% |
| Off-Peak KNR | Rail Only | 152 | 351 | 433% |
| Rail Bus | 210 | 76 | -24% |
| Bus Only | 819 | 612 | 141% |
| Total | 1,181 | 1,040 | 148% |
| TOTAL | Rail Only | 8,585 | 6,871 | -20% |
| Rail Bus | 5,722 | 6,131 | 7% |
| Bus Only | 35,253 | 32,777 | -7% |
| **Total** | **49,560** | **45,778** | **-8%** |

# New Mode Choice Calibration

AECOM attempted a new mode choice calibration using the updated auto-calibration features of the *ModeChoice* program. The primary objectives of this calibration effort are two-fold:

* Make the mode choice model more flexible to modeling year and hence more flexible to socio-economic and transit network characteristics. This can help improve 2010 model validation.
* Make the mode choice model more acceptable to FTA since a preference for not using the choice rider setup has been expressed by the FTA staff

A few features of the new mode choice calibration setup are discussed below.

*Choice Riders*

* The pre-defined set of choice riders does not need to be specified. As a result, population in all income categories and trip purposes has access to bus and rail paths.

*Mode Constants*

* The income-based mode-specific constants are specified at all levels of the nested model, unlike the current setup where the constants are mostly specified for only the lowest level modes.
* The income-based mode-specific constants can be constrained from being extreme values by specifying lower and higher limits as inputs to the auto-calibration process.
* The constants for bus and rail modes are allowed to be different. In the FY’13 model with choice riders, bus and rail constants were kept the same (the reasoning was that the distinction between the bus and rail modes was made through choice riders, and hence no further distinction is made by varying the constants between the modes).

*Mode Bias*

* A mode bias value can be specified by mode, income, purpose and market segment. The mode bias is added to the mode utility before its exponential is added to the mode constant.
* A lower preference for bus-related travel by higher income population can now be modeled through bias factors that are specified for lower nest modes.
* Mode bias values can also act as an auto availability constraint for lower income households
* Mode bias values are specified manually as input to model autocalibration or application.

*AutoCalibration*

* The income-based mode-specific constants are determined by the auto-calibration process by combining them with the bias factors that are manually specified.
* The primary input to the auto-calibration process is the targets by mode, income, purpose, market segment and time period.
* In cases where surveyed trips were 0, the target was set as 1. The exception was HBU transit trips for CBD market, in which case the targets were set as 0 trips.

A user guide document for the *ModeChoice* program was provided to Charlotte DOT.

As mentioned above, with the new mode choice model, mode bias values can be specified in addition to mode-based constants. The bias values used to calibrate the mode choice model are as shown in   
Table 9.

Table . New Mode Choice Model Bias Values

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Non-CBD PEAK** | **Auto** | | | **Bus-Only** | | | **Rail-Related** | | |
| SOV | HOV2 | HOV3+ | Walk | PNR | KNR | Walk | PNR | KNR |
| HBW - Inc 1 | -0.5 | -0.5 | -0.5 |  |  |  |  |  |  |
| HBW - Inc 2 | -0.5 | -0.5 | -0.5 |  |  |  |  |  |  |
| HBW - Inc 3 |  |  |  |  |  |  |  |  |  |
| HBW - Inc 4 |  |  |  |  |  |  |  |  |  |
| HBO - Inc 1 | -0.5 | -0.5 | -0.5 |  |  |  |  |  |  |
| HBO - Inc 2 | -0.5 | -0.5 | -0.5 |  |  |  |  |  |  |
| HBO - Inc 3 |  |  |  |  |  |  |  |  |  |
| HBO - Inc 4 |  |  |  |  |  |  |  |  |  |
| HBU |  |  |  |  |  |  |  |  |  |
| NHB |  |  |  |  | -2 | -2 |  | -2 | -2 |
| **CBD PEAK** | **Auto** | | | **Bus-Only** | | | **Rail-Related** | | |
| SOV | HOV2 | HOV3+ | Walk | PNR | KNR | Walk | PNR | KNR |
| HBW - Inc 1 | -3 | -2 | -1 |  |  |  |  |  |  |
| HBW - Inc 2 | -3 | -2 | -1 |  |  |  |  |  |  |
| HBW - Inc 3 | -3 | -2 | -1 |  |  |  |  |  |  |
| HBW - Inc 4 |  |  |  | -1 | 1 |  | 1 | 1 |  |
| HBO - Inc 1 | -1 | -1 | -1 |  |  |  |  |  |  |
| HBO - Inc 2 | -1 | -1 | -1 |  |  |  |  |  |  |
| HBO - Inc 3 |  |  |  |  |  |  |  |  |  |
| HBO - Inc 4 |  |  |  |  |  |  |  |  |  |
| HBU |  |  |  |  |  |  |  |  |  |
| NHB |  |  |  |  | -2 | -2 |  | -2 | -2 |
| **Non-CBD OFFPEAK** | **Auto** | | | **Bus-Only** | | | **Rail-Related** | | |
| SOV | HOV2 | HOV3+ | Walk | PNR | KNR | Walk | PNR | KNR |
| HBW - Inc 1 | -1 | -1 | -1 |  |  |  |  |  |  |
| HBW - Inc 2 | -1 | -1 | -1 |  |  |  |  |  |  |
| HBW - Inc 3 |  |  |  |  |  |  |  |  |  |
| HBW - Inc 4 |  |  |  |  |  |  |  |  |  |
| HBO - Inc 1 | -0.25 | -0.25 | -0.25 |  |  |  |  |  |  |
| HBO - Inc 2 | -0.25 | -0.25 | -0.25 |  |  |  |  |  |  |
| HBO - Inc 3 |  |  |  |  |  |  |  |  |  |
| HBO - Inc 4 |  |  |  |  |  |  |  |  |  |
| HBU |  |  |  |  |  |  |  |  |  |
| NHB |  |  |  | 1.75 | -3 | -3 | 3 | -3 | -3 |
| **CBD OFFPEAK** | **Auto** | | | **Bus-Only** | | | **Rail-Related** | | |
| SOV | HOV2 | HOV3+ | Walk | PNR | KNR | Walk | PNR | KNR |
| HBW - Inc 1 | -4 | -3 | -2 |  |  |  |  |  |  |
| HBW - Inc 2 | -4 | -3 | -2 |  |  |  | 0.5 | 0.5 |  |
| HBW - Inc 3 |  |  |  |  |  |  | 1 | 0.5 |  |
| HBW - Inc 4 |  |  |  |  |  |  | 1.5 | 0.5 |  |
| HBO - Inc 1 | -0.5 | -0.5 | -0.5 |  |  |  |  |  |  |
| HBO - Inc 2 | -0.5 | -0.5 | -0.5 |  |  |  |  |  |  |
| HBO - Inc 3 |  |  |  |  |  |  |  |  |  |
| HBO - Inc 4 |  |  |  |  |  |  |  |  |  |
| HBU |  |  |  |  |  |  |  |  |  |
| NHB |  |  |  | 2 | -2 | -2 | 3 | 0 | 0 |

The new calibration process uses constants that are in a similar range as the FY’13 model. The bias values can be used appropriately to control the range of constants

The changes to path building parameters made as part of the initial model calibration (discussed in Section 6) were included in the new calibration.

The results of the new mode choice calibration setup for 2013 are presented in Table 10 and Table 11. The 2013 mode choice results using the new calibration setup are reasonably close to targets as was possible with the previous mode choice setup with choice riders and manual calibration of constants.

Table . 2013 Mode Choice by Income and Trip Purpose with New Mode Choice Calibration

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **CBD Peak** | | | **Non-CBD Peak** | | | **CBD Off-Peak** | | | **Non-CBD Off-Peak** | | | **Total** | | | **TOTAL** |
| **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** |
| HBW - Inc 1 | 346 | 82 | 25 | 1,623 | 22 | 45 | 217 | 19 | 10 | 1,512 | 15 | 15 | 3,698 | 138 | 94 | 3,930 |
| HBW - Inc 2 | 398 | 141 | 34 | 3,440 | 138 | 108 | 351 | 104 | 34 | 2,514 | 53 | 56 | 6,703 | 436 | 232 | 7,370 |
| HBW - Inc 3 | 566 | 879 | 40 | 1,559 | 112 | 108 | 238 | 161 | 3 | 1,340 | 41 | 34 | 3,702 | 1,193 | 184 | 5,079 |
| HBW - Inc 4 | 945 | 3,782 | 279 | 697 | 314 | 106 | 215 | 571 | 29 | 423 | 41 | 5 | 2,279 | 4,708 | 419 | 7,406 |
| HBW - All | 2,254 | 4,884 | 378 | 7,318 | 585 | 367 | 1,020 | 855 | 75 | 5,789 | 150 | 110 | 16,382 | 6,474 | 929 | 23,785 |
| HBO - Inc 1 | 465 | 2 | 5 | 2,253 | 21 | 22 | 768 | 27 | 19 | 3,700 | 44 | 54 | 7,186 | 94 | 100 | 7,380 |
| HBO - Inc 2 | 321 | 46 | 21 | 2,128 | 12 | 102 | 614 | 34 | 24 | 3,093 | 10 | 18 | 6,155 | 103 | 165 | 6,422 |
| HBO - Inc 3 | 156 | 111 | 2 | 768 | 76 | 13 | 113 | 92 | 2 | 965 | 40 | 7 | 2,001 | 319 | 24 | 2,345 |
| HBO - Inc 4 | 89 | 113 | 2 | 321 | 91 | 11 | 56 | 209 | 2 | 423 | 31 | 10 | 888 | 444 | 25 | 1,357 |
| HBO - All | 1,031 | 272 | 30 | 5,469 | 200 | 148 | 1,550 | 363 | 47 | 8,180 | 125 | 89 | 16,230 | 960 | 314 | 17,504 |
| HBU | 0 | 0 | 0 | 1,166 | 215 | 78 | 0 | 0 | 0 | 1,282 | 142 | 113 | 2,448 | 357 | 191 | 2,995 |
| NHB | 289 | 61 | 14 | 1,728 | 32 | 66 | 475 | 125 | 32 | 3,623 | 35 | 289 | 6,115 | 253 | 401 | 6,769 |
| **Total** | **3,574** | **5,217** | **421** | **15,682** | **1,032** | **658** | **3,045** | **1,342** | **155** | **18,873** | **452** | **601** | **41,174** | **8,044** | **1,835** | **51,053** |
| **Survey** | **3,536** | **5,071** | **397** | **15,651** | **1,013** | **652** | **3,093** | **1,198** | **71** | **17,812** | **425** | **349** | **40,092** | **7,706** | **1,469** | **49,267** |
| **Difference** | **47** | **146** | **24** | **31** | **19** | **6** | **-48** | **145** | **84** | **1,061** | **28** | **252** | **1,091** | **338** | **366** | **1,795** |

Table . 2013 Mode Choice Model by Bus/Rail Paths with New Mode Choice Calibration

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Path | | Transit Linked Trips | | |
| Survey | Model | % Diff |
| Peak Walk | Rail Only | 1,588 | 989 | -38% |
| Rail Bus | 3,199 | 3,774 | 18% |
| Bus Only | 14,400 | 14,494 | 1% |
| Total | 19,187 | 19,256 | 0% |
| Peak PNR | Rail Only | 3,460 | 3,146 | -9% |
| Rail Bus | 79 | 461 | 481% |
| Bus Only | 2,544 | 2,642 | 4% |
| Total | 6,084 | 6,249 | 3% |
| Peak KNR | Rail Only | 158 | 122 | -23% |
| Rail Bus | 125 | 193 | 55% |
| Bus Only | 766 | 764 | 0% |
| Total | 1,049 | 1,079 | 3% |
| Off-Peak Walk | Rail Only | 1,748 | 1,407 | -19% |
| Rail Bus | 3,084 | 3,741 | 21% |
| Bus Only | 16,073 | 16,770 | 4% |
| Total | 20,905 | 21,918 | 5% |
| Off-Peak PNR | Rail Only | 1,186 | 1,236 | 4% |
| Rail Bus | 99 | 143 | 44% |
| Bus Only | 337 | 415 | 23% |
| Total | 1,622 | 1,795 | 11% |
| Off-Peak KNR | Rail Only | 66 | 113 | 72% |
| Rail Bus | 100 | 88 | -12% |
| Bus Only | 254 | 555 | 119% |
| Total | 420 | 756 | 80% |
| TOTAL | Rail Only | 8,206 | 7,013 | -15% |
| Rail Bus | 6,687 | 8,400 | 26% |
| Bus Only | 34,374 | 35,641 | 4% |
| **Total** | **49,267** | **51,053** | **4%** |

With the new calibrated mode choice, the resulting boardings at the rail stations are compared against boardings from the on-board survey. They comparison is shown in Table 12 and Table 13. Boardings for all of the station groups match well with observed boardings. The boardings at the 7th St Station are lower in the model compared to observed boardings. This may be due to the additional walk access provided to CTC station in the model network. The station access can be adjusted if a better match for the 7th St Station is desired. The total modeled boardings at the CBD stations match well with observed boardings.

Table . Metrolina 2013 South LRT Boardings by Time of Day

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 2013 Model | | | 2013 On-Board Survey | | |
| Station Name | Peak | Off-Peak | Daily | Peak | Off-Peak | Daily |
| 7th St Station | 145 | 107 | 252 | 493 | 413 | 905 |
| CTC | 2,230 | 1,593 | 3,823 | 1,985 | 1,817 | 3,801 |
| 3rd St Station | 748 | 336 | 1,084 | 758 | 348 | 1,106 |
| Stonewall Station | 322 | 162 | 484 | 237 | 116 | 354 |
| **CBD Stations** | **3,445** | **2,198** | **5,643** | **3,472** | **2,694** | **6,166** |
| Carson Station | 118 | 124 | 243 | 153 | 141 | 294 |
| Bland | 248 | 242 | 490 | 203 | 194 | 397 |
| East-West Station | 284 | 289 | 573 | 364 | 370 | 734 |
| New Bern Station | 292 | 323 | 615 | 295 | 273 | 568 |
| **Southend Stations** | **942** | **979** | **1,921** | **1,015** | **978** | **1,993** |
| ScaleybarkSt | 354 | 322 | 676 | 538 | 400 | 938 |
| Woodlawn Station | 420 | 415 | 835 | 364 | 352 | 716 |
| Tyvola Station | 530 | 502 | 1,032 | 535 | 393 | 928 |
| Archdale Station | 231 | 232 | 463 | 412 | 376 | 788 |
| Arrowood Station | 571 | 699 | 1,269 | 692 | 650 | 1,342 |
| SharonWest | 760 | 515 | 1,276 | 764 | 423 | 1,188 |
| S I-485 | 1,124 | 618 | 1,742 | 1,482 | 626 | 2,109 |
| **PNR Stations** | **3,991** | **3,304** | **7,294** | **4,788** | **3,221** | **8,009** |
| **Total** | **8,378** | **6,481** | **14,859** | **9,275** | **6,893** | **16,168** |

Table . Metrolina 2013 South LRT Boardings by Mode of Access

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2013 Model | | | | | 2013 On-Board Survey | | | | | PNR Capacity |
| StaName | Direct Drive | Direct Walk | Bus Access | Direct Dropoff | Total | Direct Drive | Direct Walk | Bus Access | Direct Dropoff | Total |
| 7th St Station | 0 | 232 | 17 | 3 | 252 | 0 | 592 | 248 | 49 | 889 |  |
| CTC | 0 | 1,528 | 2,250 | 45 | 3,823 | 0 | 1,539 | 2,226 | 22 | 3,787 |  |
| 3rd St Station | 0 | 967 | 100 | 17 | 1,084 | 0 | 950 | 148 | 7 | 1,105 |  |
| Stonewall Station | 0 | 412 | 65 | 7 | 484 | 0 | 305 | 26 | 20 | 351 |  |
| **CBD Stations** | **0** | **3,139** | **2,432** | **71** | **5,643** | **0** | **3,386** | **2,648** | **98** | **6,132** |  |
| Carson Station | 0 | 212 | 27 | 3 | 243 | 0 | 236 | 59 | 0 | 295 |  |
| Bland | 0 | 312 | 170 | 8 | 490 | 0 | 334 | 25 | 5 | 364 |  |
| East-West Station | 0 | 467 | 94 | 13 | 573 | 0 | 478 | 223 | 15 | 716 |  |
| New Bern Station | 0 | 544 | 60 | 11 | 615 | 0 | 508 | 22 | 37 | 567 |  |
| **Southend Stations** | **0** | **1,536** | **351** | **35** | **1,921** | **0** | **1,556** | **329** | **57** | **1,942** |  |
| ScaleybarkSt | 274 | 300 | 49 | 53 | 676 | 257 | 402 | 186 | 92 | 937 | 315 |
| Woodlawn Station | 244 | 418 | 134 | 40 | 835 | 178 | 339 | 139 | 61 | 717 | 382 |
| Tyvola Station | 142 | 389 | 478 | 23 | 1,032 | 316 | 467 | 141 | 5 | 929 | 465 |
| Archdale Station | 1 | 380 | 64 | 19 | 463 | 33 | 524 | 210 | 20 | 787 | 432 |
| Arrowood Station | 157 | 314 | 787 | 11 | 1,269 | 273 | 377 | 689 | 4 | 1,343 | 289 |
| SharonWest | 284 | 392 | 572 | 28 | 1,276 | 368 | 374 | 397 | 49 | 1,188 | 188 |
| S I-485 | 1,202 | 176 | 344 | 20 | 1,742 | 1,112 | 343 | 602 | 52 | 2,109 | 1,294 |
| **PNR Stations** | **2,303** | **2,368** | **2,428** | **195** | **7,294** | **2,537** | **2,826** | **2,364** | **283** | **8,010** | **3,365** |
| **Total** | **2,303** | **7,043** | **5,211** | **301** | **14,859** | **2,537** | **7,768** | **5,341** | **438** | **16,084\*** |  |

\* - The total is not 16,168 due to PNR boardings reported for non-PNR stations

# New Mode Choice Validation

The calibrated new mode choice model was applied to 2010 conditions. The pre-calibration 2010 mode choice model performs as shown in Table 14 and Table 15. The mode choice results for 2010 with the calibrated model are shown below in Table 16 and Table 17.

Table . 2010 Pre-Calibration Mode Choice model Results by CBD/Non-CBD Market Segments

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **CBD Peak** | | | **Non-CBD Peak** | | | **CBD Off-Peak** | | | **Non-CBD Off-Peak** | | | **Total** | | | **TOTAL** |
| **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** |
| HBW - Inc 1 | 221 | 4 | 4 | 1,791 | 19 | 46 | 142 | 2 | 4 | 2,028 | 6 | 52 | 4,182 | 31 | 106 | 4,319 |
| HBW - Inc 2 | 209 | 65 | 48 | 1,863 | 20 | 78 | 132 | 13 | 1 | 1,842 | 34 | 57 | 4,046 | 131 | 183 | 4,360 |
| HBW - Inc 3 | 169 | 415 | 45 | 751 | 69 | 64 | 95 | 45 | 15 | 578 | 68 | 47 | 1,593 | 596 | 171 | 2,360 |
| HBW - Inc 4 | 842 | 4,557 | 295 | 359 | 328 | 114 | 150 | 544 | 25 | 223 | 51 | 48 | 1,574 | 5,479 | 481 | 7,534 |
| HBW - All | 1,440 | 5,041 | 392 | 4,765 | 435 | 301 | 518 | 603 | 45 | 4,671 | 159 | 204 | 11,394 | 6,238 | 940 | 18,572 |
| HBO - Inc 1 | 253 | 1 | 3 | 5,009 | 1 | 91 | 357 | 2 | 14 | 7,533 | 24 | 184 | 13,152 | 28 | 291 | 13,471 |
| HBO - Inc 2 | 86 | 4 | 18 | 1,972 | 6 | 55 | 217 | 16 | 20 | 2,932 | 23 | 110 | 5,206 | 50 | 202 | 5,457 |
| HBO - Inc 3 | 36 | 30 | 1 | 743 | 24 | 48 | 141 | 5 | 3 | 928 | 10 | 127 | 1,847 | 69 | 180 | 2,096 |
| HBO - Inc 4 | 23 | 102 | 7 | 224 | 35 | 27 | 196 | 38 | 20 | 454 | 14 | 99 | 898 | 189 | 152 | 1,239 |
| HBO - All | 398 | 137 | 30 | 7,948 | 66 | 220 | 910 | 61 | 56 | 11,846 | 71 | 519 | 21,103 | 335 | 825 | 22,264 |
| HBU | 0 | 0 | 0 | 1,917 | 182 | 334 | 0 | 0 | 0 | 801 | 56 | 103 | 2,718 | 238 | 437 | 3,393 |
| NHB | 74 | 183 | 36 | 777 | 101 | 93 | 198 | 315 | 38 | 1,772 | 84 | 163 | 2,821 | 683 | 330 | 3,834 |
| **Total** | **1,912** | **5,361** | **458** | **15,406** | **784** | **948** | **1,627** | **980** | **139** | **19,091** | **369** | **989** | **38,036** | **7,494** | **2,533** | **48,063** |
| **Survey** | **3,371** | **7,141** | **692** | **12,973** | **803** | **852** | **2,502** | **1,654** | **168** | **18,049** | **342** | **1,012** | **36,896** | **9,940** | **2,725** | **49,561** |
| **Difference** | **-1,460** | **-1,780** | **-234** | **2,433** | **-19** | **95** | **-876** | **-674** | **-30** | **1,042** | **27** | **-24** | **1,140** | **-2,446** | **-192** | **-1,498** |

Table . 2010 Pre-Calibration Mode Choice Model Results by Bus/Rail Paths

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Path | | Transit Linked Trips | | |
| Survey | Model | % Diff |
| Peak Walk | Rail Only | 970 | 739 | -24% |
| Rail Bus | 2,329 | 2,269 | -3% |
| Bus Only | 13,045 | 14,310 | 10% |
| Total | 16,344 | 17,318 | 6% |
| Peak PNR | Rail Only | 4,060 | 2,752 | -32% |
| Rail Bus | 141 | 176 | 25% |
| Bus Only | 3,743 | 3,217 | -14% |
| Total | 7,944 | 6,145 | -23% |
| Peak KNR | Rail Only | 270 | 257 | -5% |
| Rail Bus | 197 | 97 | -50% |
| Bus Only | 1,078 | 1,051 | -2% |
| Total | 1,545 | 1,405 | -9% |
| Off-Peak Walk | Rail Only | 1,619 | 1,548 | -4% |
| Rail Bus | 2,765 | 2,017 | -27% |
| Bus Only | 16,167 | 17,153 | 6% |
| Total | 20,551 | 20,718 | 1% |
| Off-Peak PNR | Rail Only | 1,514 | 1,028 | -32% |
| Rail Bus | 81 | 53 | -35% |
| Bus Only | 401 | 268 | -33% |
| Total | 1,996 | 1,349 | -32% |
| Off-Peak KNR | Rail Only | 152 | 163 | 7% |
| Rail Bus | 210 | 74 | -65% |
| Bus Only | 819 | 682 | -17% |
| Total | 1,181 | 919 | -22% |
| TOTAL | Rail Only | 8,585 | 6,695 | -22% |
| Rail Bus | 5,722 | 4,687 | -18% |
| Bus Only | 35,253 | 36,681 | 4% |
| **Total** | **49,560** | **48,063** | **-3%** |

Table . 2010 Mode Choice by Income and Trip Purpose with New Mode Choice Calibration

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **CBD Peak** | | | **Non-CBD Peak** | | | **CBD Off-Peak** | | | **Non-CBD Off-Peak** | | | **Total** | | | **TOTAL** |
| **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** | **Walk** | **PNR** | **KNR** |
| HBW - Inc 1 | 322 | 75 | 26 | 1,524 | 21 | 41 | 200 | 17 | 10 | 1,359 | 14 | 13 | 3,404 | 126 | 91 | 3,621 |
| HBW - Inc 2 | 360 | 135 | 33 | 3,210 | 131 | 102 | 316 | 100 | 32 | 2,218 | 51 | 53 | 6,103 | 417 | 219 | 6,739 |
| HBW - Inc 3 | 502 | 852 | 39 | 1,449 | 107 | 103 | 206 | 153 | 2 | 1,160 | 39 | 30 | 3,318 | 1,151 | 174 | 4,643 |
| HBW - Inc 4 | 900 | 3,587 | 281 | 626 | 269 | 96 | 193 | 542 | 28 | 356 | 36 | 4 | 2,075 | 4,435 | 408 | 6,917 |
| HBW - All | 2,084 | 4,649 | 378 | 6,809 | 528 | 342 | 915 | 812 | 71 | 5,093 | 139 | 100 | 14,900 | 6,128 | 891 | 21,919 |
| HBO - Inc 1 | 440 | 2 | 5 | 2,097 | 20 | 20 | 709 | 24 | 18 | 3,341 | 41 | 49 | 6,587 | 87 | 91 | 6,765 |
| HBO - Inc 2 | 297 | 42 | 20 | 1,955 | 11 | 94 | 558 | 31 | 23 | 2,738 | 9 | 17 | 5,547 | 93 | 155 | 5,795 |
| HBO - Inc 3 | 145 | 102 | 2 | 704 | 71 | 12 | 103 | 85 | 2 | 851 | 37 | 7 | 1,803 | 295 | 23 | 2,121 |
| HBO - Inc 4 | 79 | 105 | 2 | 292 | 82 | 10 | 49 | 197 | 2 | 374 | 28 | 9 | 793 | 412 | 23 | 1,228 |
| HBO - All | 961 | 251 | 29 | 5,048 | 184 | 137 | 1,419 | 336 | 45 | 7,303 | 116 | 81 | 14,730 | 887 | 292 | 15,909 |
| HBU | 0 | 0 | 0 | 1,096 | 175 | 70 | 0 | 0 | 0 | 1,172 | 142 | 102 | 2,267 | 317 | 171 | 2,756 |
| NHB | 264 | 58 | 13 | 1,559 | 29 | 59 | 434 | 119 | 31 | 3,169 | 34 | 247 | 5,427 | 240 | 351 | 6,017 |
| **Total** | **3,309** | **4,958** | **421** | **14,511** | **916** | **608** | **2,768** | **1,267** | **147** | **16,737** | **431** | **530** | **37,324** | **7,572** | **1,705** | **46,602** |
| **Survey** | **3,371** | **7,141** | **692** | **12,973** | **803** | **852** | **2,502** | **1,654** | **168** | **18,049** | **342** | **1,012** | **36,896** | **9,940** | **2,725** | **49,561** |
| **Difference** | **-62** | **-2,183** | **-271** | **1,537** | **113** | **-245** | **266** | **-387** | **-22** | **-1,313** | **89** | **-482** | **428** | **-2,368** | **-1,020** | **-2,959** |

Table . 2010 Mode Choice Model by Bus/Rail Paths with New Mode Choice Calibration

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Path | | Transit Linked Trips | | |
| Survey | Model | % Diff |
| Peak Walk | Rail Only | 970 | 723 | -25% |
| Rail Bus | 2,329 | 3,657 | 57% |
| Bus Only | 13,045 | 13,439 | 3% |
| Total | 16,344 | 17,820 | 9% |
| Peak PNR | Rail Only | 4,060 | 2,840 | -30% |
| Rail Bus | 141 | 401 | 186% |
| Bus Only | 3,743 | 2,633 | -30% |
| Total | 7,944 | 5,874 | -26% |
| Peak KNR | Rail Only | 270 | 109 | -60% |
| Rail Bus | 197 | 182 | -8% |
| Bus Only | 1,078 | 738 | -32% |
| Total | 1,545 | 1,028 | -33% |
| Off-Peak Walk | Rail Only | 1,619 | 1,247 | -23% |
| Rail Bus | 2,765 | 3,420 | 24% |
| Bus Only | 16,167 | 14,838 | -8% |
| Total | 20,551 | 19,505 | -5% |
| Off-Peak PNR | Rail Only | 1,514 | 1,152 | -24% |
| Rail Bus | 81 | 131 | 61% |
| Bus Only | 401 | 416 | 4% |
| Total | 1,996 | 1,698 | -15% |
| Off-Peak KNR | Rail Only | 152 | 109 | -29% |
| Rail Bus | 210 | 88 | -58% |
| Bus Only | 819 | 480 | -41% |
| Total | 1,181 | 677 | -43% |
| TOTAL | Rail Only | 8,585 | 6,179 | -28% |
| Rail Bus | 5,722 | 7,879 | 38% |
| Bus Only | 35,253 | 32,544 | -8% |
| **Total** | **49,560** | **46,602** | **-6%** |

As seen above, the 2010 mode choice results are considerably lower than targets based on 2009 survey. The modeled daily PNR access trips to CBD are lower than targets by about 2,500. The modeled dropoff to transit (KNR) trips are lower than observed by about 1,000. The walk access trips to non-CBD are lower in the off-peak period and higher in the peak, effectively cancelling out the difference. The model simulates fewer rail-only trips and more rail-bus trips than observed in the 2009 survey, with the net effect of simulating almost the same number of rail-related trips as observed. Bus trips are under-represented by about 2,700 in the model.

The reasons for lower number of linked transit trips in 2010 using the 2013 calibrated model were explored. Some findings are discussed below.

The primary reason for lower 2010 transit trips is that the modeled person trip demand grew by 3 to 6% depending on the market segment. However, if we compare 2009 and 2013 on-board surveys, transit trip making for certain market segments declined. This is particularly true of walk access transit for work trips made by INCOME1 households and drive access transit for work trips made by INCOME4 households. The lower transit trips for these two market segments account for most of the deficit in transit trips in the 2010 model. A decrease in transit trip making from 2010 to 2013 is unlikely to be simulated by the model with similar land use, an increased person trip demand, and similar or better transit service.

The person trips in 2010 and 2013 are compared in Table 18 below. As can be seen, person trips increase for all market segments from 2010 to 2013.

Table . 2010 and 2013 Person Trips in the Regional Model

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Modeled 2010 Person Trips** | | | | | | | |
| **Purpose** | **CBD Peak** | **Non-CBD Peak** | **Peak** | **CBD**  **Off-Peak** | **Non-CBD Off-Peak** | **Off-Peak** | **TOTAL** |
|
| HBW - Inc 1 | 552 | 25,735 | 26,287 | 312 | 14,564 | 14,877 | 41,164 |
| HBW - Inc 2 | 1,290 | 61,130 | 62,420 | 730 | 34,595 | 35,325 | 97,745 |
| HBW - Inc 3 | 3,166 | 148,898 | 152,064 | 1,792 | 84,265 | 86,057 | 238,121 |
| HBW - Inc 4 | 33,911 | 448,906 | 482,817 | 19,191 | 254,047 | 273,239 | 756,056 |
| HBW - All | 38,919 | 684,670 | 723,589 | 22,025 | 387,472 | 409,497 | 1,133,086 |
| HBO - Inc 1 | 1,871 | 171,777 | 173,647 | 2,322 | 214,136 | 216,458 | 390,105 |
| HBO - Inc 2 | 2,868 | 266,424 | 269,292 | 3,591 | 334,154 | 337,745 | 607,037 |
| HBO - Inc 3 | 3,625 | 351,313 | 354,938 | 4,537 | 440,803 | 445,339 | 800,277 |
| HBO - Inc 4 | 10,549 | 1,017,493 | 1,028,042 | 13,363 | 1,294,670 | 1,308,033 | 2,336,075 |
| HBO - All | 18,913 | 1,807,007 | 1,825,919 | 23,812 | 2,283,763 | 2,307,575 | 4,133,494 |
| HBU | 0 | 51,969 | 51,969 | 0 | 21,683 | 21,683 | 73,653 |
| NHB | 11,686 | 675,466 | 687,152 | 26,616 | 1,274,090 | 1,300,706 | 1,987,858 |
| **TOTAL** | **69,517** | **3,219,112** | **3,288,629** | **72,453** | **3,967,009** | **4,039,461** | **7,328,091** |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Modeled 2013 Person Trips** | | | | | | | | |  |
| **Purpose** | **CBD Peak** | **Non-CBD Peak** | **Peak** | **CBD**  **Off-Peak** | **Non-CBD Off-Peak** | **Off-Peak** | **TOTAL** |
| HBW - Inc 1 | 581 | 27,245 | 27,826 | 329 | 15,419 | 15,747 | 43,573 |
| HBW - Inc 2 | 1,354 | 64,406 | 65,760 | 766 | 36,449 | 37,215 | 102,975 |
| HBW - Inc 3 | 3,313 | 156,638 | 159,951 | 1,875 | 88,645 | 90,520 | 250,471 |
| HBW - Inc 4 | 34,790 | 474,648 | 509,438 | 19,688 | 268,615 | 288,304 | 797,742 |
| HBW - All | 40,037 | 722,937 | 762,974 | 22,658 | 409,128 | 431,786 | 1,194,760 |
| HBO - Inc 1 | 1,940 | 180,488 | 182,428 | 2,419 | 225,054 | 227,473 | 409,900 |
| HBO - Inc 2 | 2,982 | 280,779 | 283,761 | 3,749 | 352,200 | 355,950 | 639,711 |
| HBO - Inc 3 | 3,753 | 369,145 | 372,898 | 4,718 | 463,193 | 467,911 | 840,809 |
| HBO - Inc 4 | 10,958 | 1,068,651 | 1,079,609 | 13,922 | 1,359,810 | 1,373,731 | 2,453,341 |
| HBO - All | 19,634 | 1,899,063 | 1,918,696 | 24,808 | 2,400,257 | 2,425,064 | 4,343,761 |
| HBU | 0 | 54,187 | 54,187 | 0 | 22,609 | 22,609 | 76,796 |
| NHB | 12,283 | 711,390 | 723,674 | 27,938 | 1,341,370 | 1,369,308 | 2,092,982 |
| **TOTAL** | **71,954** | **3,387,577** | **3,459,531** | **75,404** | **4,173,364** | **4,248,768** | **7,708,299** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Modeled 2013 Person Trips minus 2010 Person Trips** | | | | |  | |  | | |  | |  |
| **Purpose** | **CBD Peak** | **Non-CBD Peak** | **Peak** | **CBD**  **Off-Peak** | | **Non-CBD Off-Peak** | | **Off-Peak** | **TOTAL** | |
|
| HBW - Inc 1 | 29 | 1,510 | 1,538 | 16 | | 854 | | 871 | 2,409 | |
| HBW - Inc 2 | 64 | 3,276 | 3,340 | 36 | | 1,854 | | 1,890 | 5,230 | |
| HBW - Inc 3 | 147 | 7,739 | 7,886 | 83 | | 4,380 | | 4,463 | 12,349 | |
| HBW - Inc 4 | 879 | 25,742 | 26,621 | 497 | | 14,568 | | 15,065 | 41,686 | |
| HBW - All | 1,118 | 38,267 | 39,385 | 633 | | 21,656 | | 22,289 | 61,675 | |
| HBO - Inc 1 | 69 | 8,711 | 8,780 | 97 | | 10,917 | | 11,015 | 19,795 | |
| HBO - Inc 2 | 114 | 14,355 | 14,469 | 159 | | 18,046 | | 18,205 | 32,674 | |
| HBO - Inc 3 | 128 | 17,832 | 17,960 | 181 | | 22,390 | | 22,571 | 40,531 | |
| HBO - Inc 4 | 409 | 51,158 | 51,568 | 559 | | 65,139 | | 65,698 | 117,266 | |
| HBO - All | 721 | 92,056 | 92,777 | 996 | | 116,493 | | 117,489 | 210,266 | |
| HBU | 0 | 2,218 | 2,218 | 0 | | 925 | | 925 | 3,143 | |
| NHB | 598 | 35,924 | 36,521 | 1,322 | | 67,280 | | 68,602 | 105,124 | |
| **TOTAL** | **2,437** | **168,465** | **170,902** | **2,951** | | **206,355** | | **209,306** | **380,208** | |

Another reason for lower transit trips in the 2010 model compared to the 2009 survey may be due to some questionable patterns in the 2009 survey. A couple of such patterns are:

* Some of the reported drive access transit trips in the 2009 survey had CBD zones as productions
* A higher than reasonable number of INCOME1 walk access trips and INCOME4 drive access trips

The observed and surveyed trips for the INCOME1 walk access trips and INCOME4 drive access trips were examined to review the difference in modeled transit trips between 2010 and 2013. These trips are shown at a district level in Table 19 and Table 20 below. A schematic of the districts used to aggregate model and survey trips is shown in Figure 1. A few observations are listed below.

* A significantly higher number of HBW INCOME1 walk to transit trips are observed in the 2009 survey compared to 2013 survey in the CBD, Non-Corridor Core and Mid-South districts. Most of the difference between 2010 modeled and observed trips is in these districts.
* A significantly higher number of HBW INCOME4 drive to transit trips to CBD are observed in the 2009 survey compared to 2013 survey. These trips are produced in the Outer South, Non Corridor Core and Rest of the Region districts.

Table . 2010 and 2013 Modeled and Observed Home-Based Work INCOME1 Walk to Transit Trips

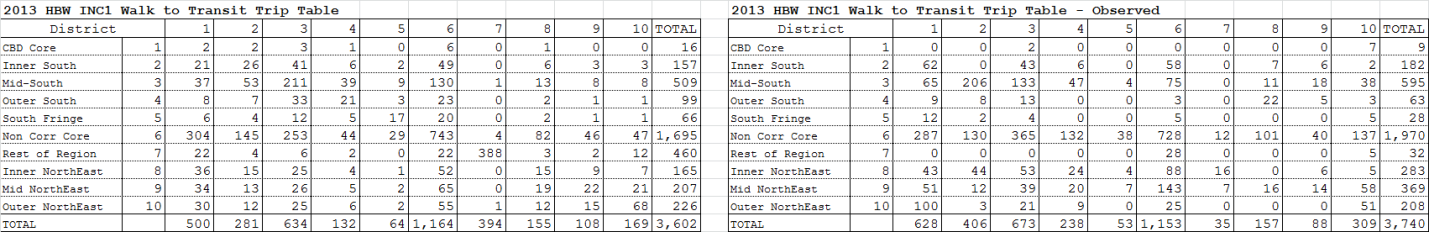
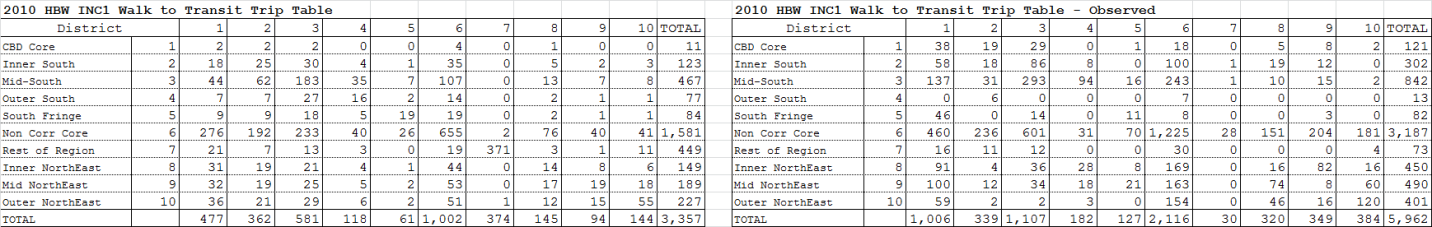


Table . 2010 and 2013 Modeled and Observed Home-Based Work INCOME4 Drive to Transit Trips

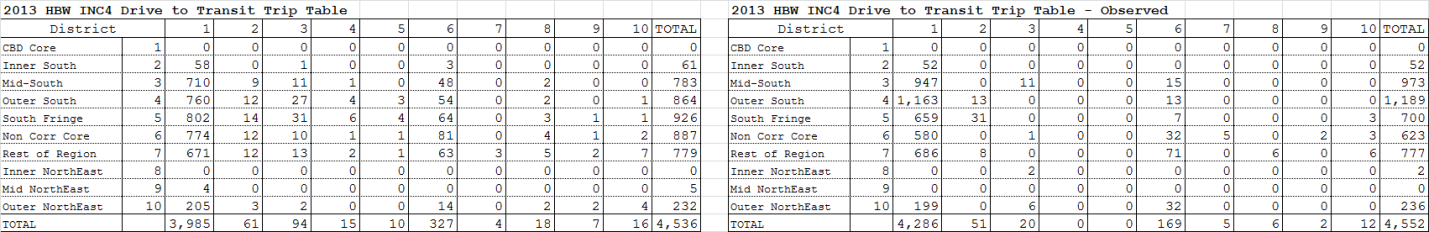
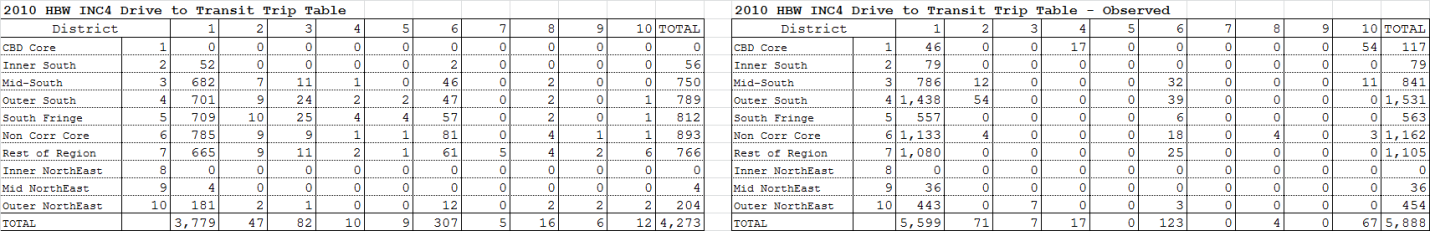
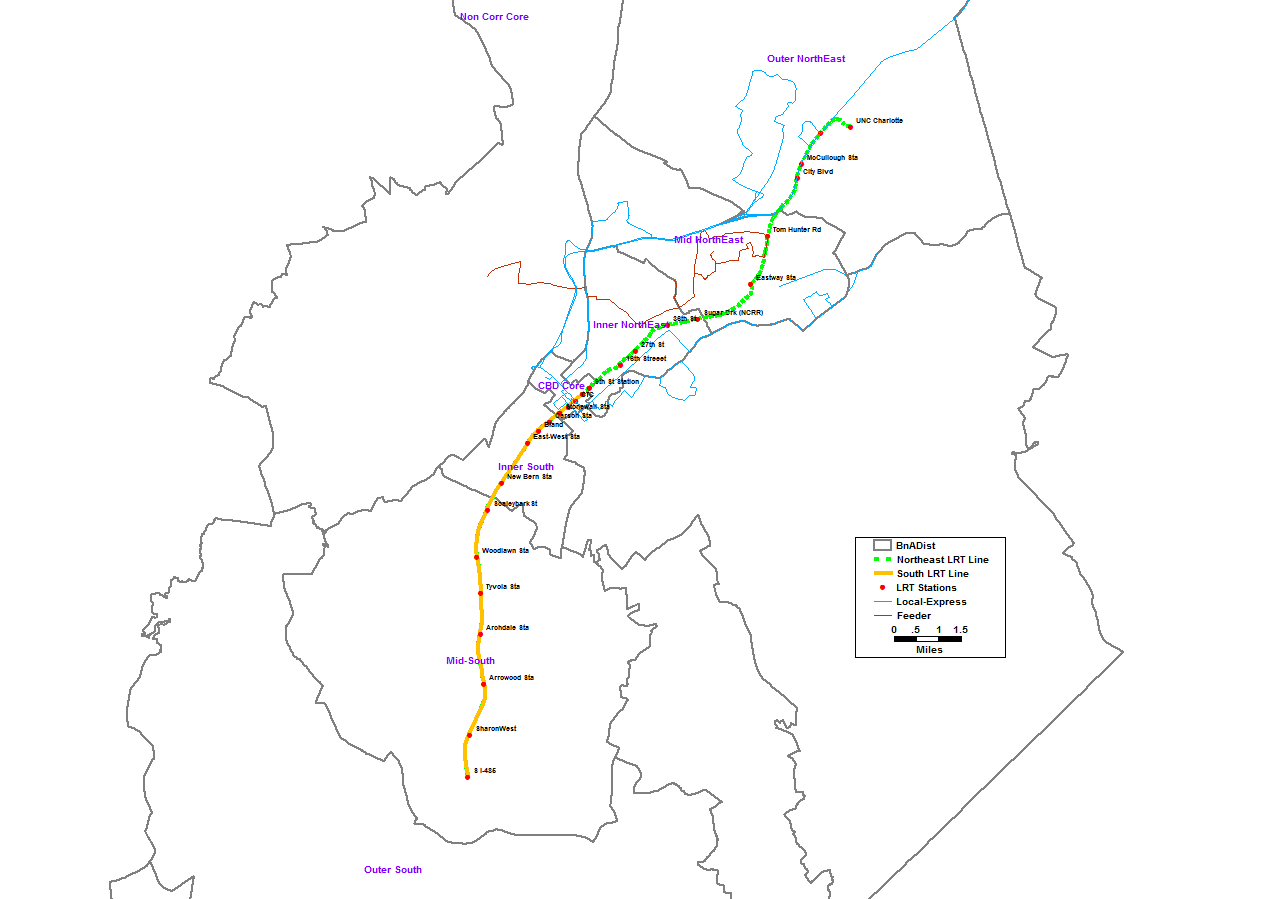


Figure . BnA Districts used to aggregate model and survey trips



The above discussion suggests that some of the differences between the 2009 and 2013 transit survey cannot be reconciled with the transit ridership behavior in the region. According to CATS, the 2013 transit survey is more reliable than the 2009 survey based on the way it was conducted and compiled. With this understanding, the difference between 2010 modeled transit demand and 2009 survey is acknowledged as acceptable.

With the new calibrated mode choice, the 2010 boardings at the rail stations are compared against the boardings from the on-board survey as shown below in Table 21 and Table 22. The total rail boardings are 5% lower than observed boardings from the 2009 Survey. As mentioned above, the rail-related trips in the 2010 model are only slightly lower than observed, though total daily transit trips are lower by about 3,000. Hence, the rail boardings are not significantly lower than observed. The CBD station boardings are 15% lower than observed. This is consistent with lower transit trips to CBD resulting from the mode choice. Most of the deficit in rail boardings is by drive access, which is due to fewer HBW INCOME4 drive access trips in the model compared to observed trips. Similar to the 2013 model, boardings at 7th/CTC stations can be further refined by adjusting the walk access connectors to the stations.

Table . Metrolina 2010 South LRT Boardings by Time of Day

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 2010 Model | | | 2009 On-Board Survey | | |
| Station Name | Peak | Off-Peak | Daily | Peak | Off-Peak | Daily |
| 7th St Station | 122 | 112 | 234 | 443 | 482 | 925 |
| CTC | 2,025 | 1,427 | 3,452 | 1,630 | 1,782 | 3,411 |
| 3rd St Station | 653 | 318 | 971 | 936 | 338 | 1,274 |
| Stonewall Station | 299 | 146 | 446 | 194 | 123 | 317 |
| **CBD Stations** | **3,099** | **2,003** | **5,102** | **3,202** | **2,724** | **5,926** |
| Carson Station | 55 | 111 | 166 | 109 | 125 | 233 |
| Bland | 143 | 183 | 326 | 112 | 143 | 254 |
| East-West Station | 460 | 365 | 824 | 244 | 328 | 572 |
| New Bern Station | 228 | 266 | 494 | 392 | 397 | 788 |
| **Southend Stations** | **885** | **925** | **1,810** | **855** | **992** | **1,847** |
| ScaleybarkSt | 357 | 366 | 722 | 219 | 284 | 503 |
| Woodlawn Station | 410 | 394 | 803 | 285 | 356 | 640 |
| Tyvola Station | 404 | 431 | 836 | 385 | 422 | 807 |
| Archdale Station | 256 | 244 | 500 | 274 | 345 | 618 |
| Arrowood Station | 581 | 627 | 1,209 | 506 | 594 | 1,099 |
| SharonWest | 730 | 502 | 1,232 | 461 | 386 | 847 |
| S I-485 | 1,080 | 556 | 1,636 | 1,390 | 900 | 2,289 |
| **PNR Stations** | **3,818** | **3,120** | **6,938** | **3,518** | **3,285** | **6,803** |
| **Total** | **7,802** | **6,048** | **13,850** | **7,575** | **7,001** | **14,575** |

Table . Metrolina 2010 South LRT Boardings by Mode of Access

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Station Name | 2010 Model | | | 2009 On-Board Survey | | | PNR Capacity | |
| PNR | Non-PNR | Total | PNR | Non-PNR | Total |  |
| 7th St Station | 0 | 234 | 234 | 0 | 1,030 | 1,030 |  |
| CTC | 0 | 3,452 | 3,452 | 0 | 3,389 | 3,389 |  |
| 3rd St Station | 0 | 971 | 971 | 0 | 1,182 | 1,182 |  |
| Stonewall Station | 0 | 446 | 446 | 0 | 217 | 217 |  |
| **CBD Stations** | **0** | **5,102** | **5,102** | **0** | **5,818** | **5,818** |  |
| Carson Station | 0 | 166 | 166 | 0 | 245 | 245 |  |
| Bland | 0 | 326 | 326 | 0 | 250 | 250 |  |
| East-West Station | 0 | 824 | 824 | 0 | 617 | 617 |  |
| New Bern Station | 0 | 494 | 494 | 0 | 830 | 830 |  |
| **Southend Stations** | **0** | **1,810** | **1,810** | **0** | **1,942** | **1,942** |  |
| ScaleybarkSt | 271 | 451 | 722 | 281 | 230 | 511 | 315 |
| Woodlawn Station | 230 | 573 | 803 | 292 | 334 | 626 | 382 |
| Tyvola Station | 150 | 686 | 836 | 212 | 613 | 825 | 465 |
| Archdale Station | 1 | 499 | 500 | 46 | 587 | 632 | 432 |
| Arrowood Station | 158 | 1,051 | 1,209 | 251 | 811 | 1,062 | 289 |
| SharonWest | 251 | 981 | 1,232 | 294 | 572 | 866 | 188 |
| S I-485 | 1,140 | 496 | 1,636 | 1,430 | 867 | 2,297 | 1,294 |
| **PNR Stations** | **2,202** | **4,736** | **6,938** | **2,805** | **4,014** | **6,818** | **3,365** |
| **Total** | **2,202** | **11,649** | **13,850** | **2,805** | **11,774** | **14,579** |  |

# Summary

The Metrolina mode choice model was calibrated using the 2013 on-board survey. In preparation for the calibration effort, calibration targets by market segments were developed from the expanded survey. Transit model changes related to commuter rail that were made since the last model transmittal to Charlotte DOT were incorporated before commencing with the calibration effort.

As part of the calibration effort, the mode choice model was migrated to a new program called *ModeChoice* from the current *AEMS.* The new mode choice model does not include the choice rider definition, thereby allowing all transit riders to choose between rail and bus modes for transit trips and not artificially restricting some (defined as choice riders) from choosing paths involving bus. The mode choice model constants were calibrated using auto-calibration (iterative calibration performed by the *ModeChoice* program) instead of manually adjusting the constants. The mode bias feature provides the flexibility to selectively incorporate user attributes or preferences without using significantly large constants.

The calibrated model was validated to the 2009 survey using 2010 model inputs. The differences between modeled and observed transit trips were partially attributed to inconsistencies between the 2009 and 2013 survey results. However, modeled rail boardings by station were reasonably close to 2009 survey boardings.