metro analytics

# TECHNICAL MEMORANDUM

TO: Brian Gibson, Executive Director, St. Cloud Area Planning Organization

FROM: Rob Schiffer, National Practice Leader, Travel Demand Forecasting

DATE: September 25, 2020

SUBJECT: St. Cloud APO Model Improvements Task 1: Zones and Districts

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This Draft Technical Memorandum outlines recommendations on traffic analysis zones (TAZs) and districts for an update of the St. Cloud Area Planning Organization (APO) travel demand model. Discussions are divided into the following topics:

- Task 1 Scope of Work
- Review of existing zone system
- Recommended TAZ changes
- Recommended districts and TAZ numbering scheme

This draft tech memo will be updated to reflect all comments received from APO staff. A separate tech memo will be provided on socioeconomic data, reflecting recommendations recently provided to APO staff.

## Task 1 Scope of Work

The Consultant shall review the current Travel Analysis Zone (TAZ) structure of the model and make one or more recommendations for adding TAZs to help reduce error and inaccuracies resulting from the current TAZ structure. The Consultant shall also create districts comprised of sets of TAZs for analyzing district-level jobs/housing balance and traffic flows. TAZs and Districts will be renumbered using a telescopic numbering system such that TAZs and Districts will be logically grouped together in spreadsheet format.

## Review of Existing Zone System

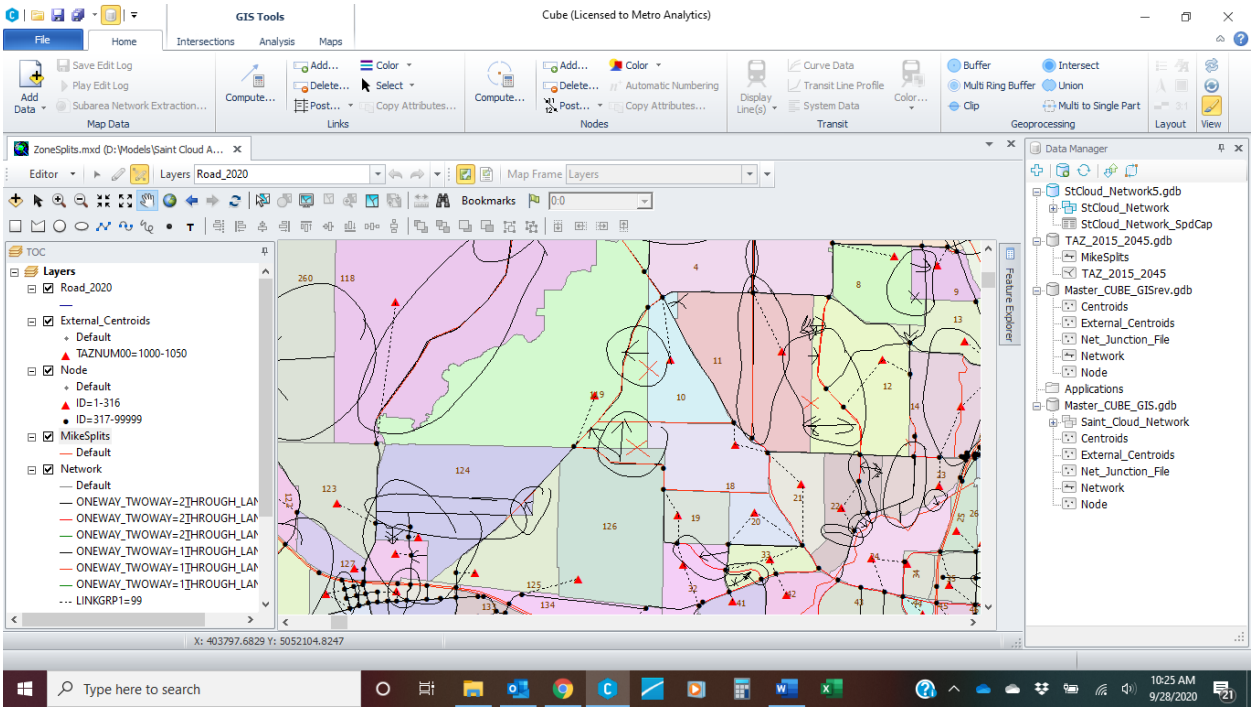
Consultant staff reviewed the existing St. Cloud APO 262-zone system through use of Google Map satellite imagery; a GIS overlay of the Cube base year model network, TAZ system, Districts, street alignments, and urban boundary maps; and a spreadsheet template designed to track the review of each TAZ, along with comments on recommended zone splits and boundary shifts. The spreadsheet template is depicted in an Appendix at the tail end of this technical memorandum.

## Recommended TAZ changes

Out of 262 existing internal TAZs, 130 zone splits and boundary changes are recommended, with a few zones identified for upwards of three splits each. This zone-by-zone review focused on identifying zone boundaries that do not follow major roadways or waterways, as well as zones with irregular shapes and zones that split major land uses such as college campuses. A number of zone boundaries appear to follow jurisdictional boundaries instead of nearby

streets, leading to small slivers of a few TAZs that have been flagged for modification. In addition to providing comments within the spreadsheet template, lines are drawn on the Cube/TAZ overlay for additional clarity. Figure 1 depicts a portion of the St. Cloud model network with the TAZs overlaid as a representative example of how recommended zone splits and boundary shifts are depicted.

**Figure 1. St. Cloud Zone/Network Overlay Example**

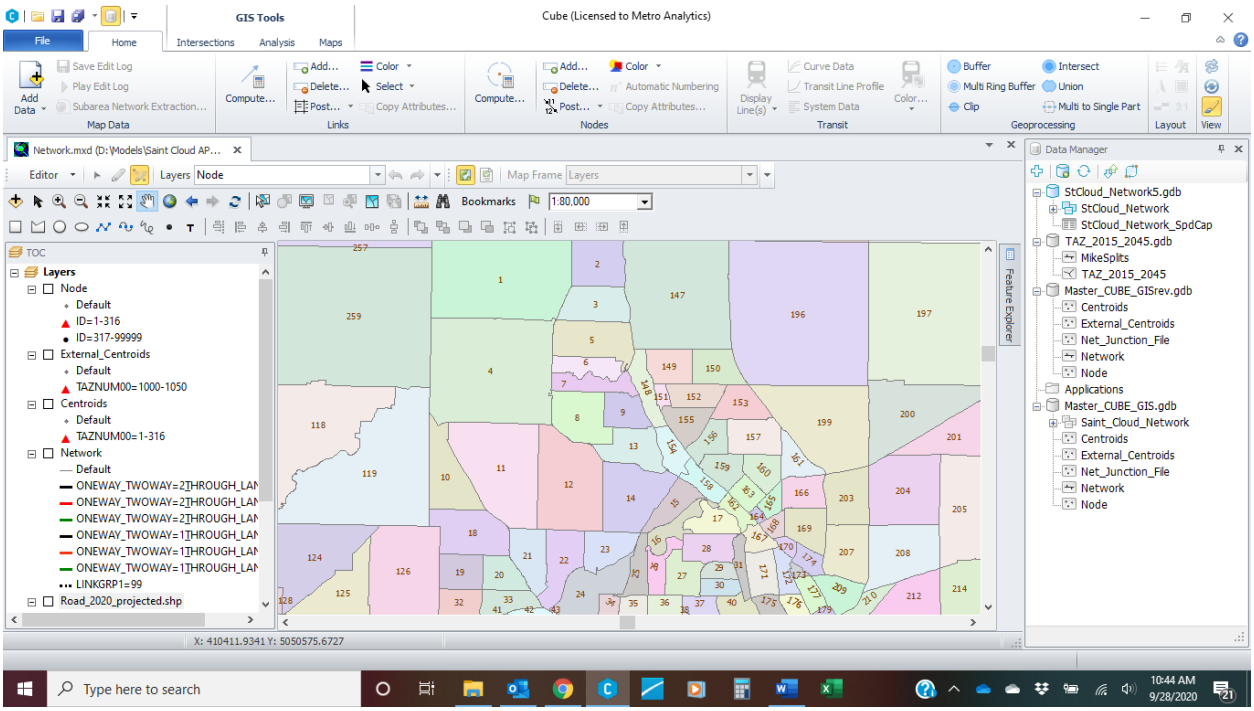



While some zone splits and boundary shifts are a higher priority than others, APO staff indicated a desire to include all of these recommendations at this time, rather than saving some of these for a future point in time.

## Recommended districts and TAZ numbering scheme

The existing St. Cloud travel demand model uses a simple numbering scheme for its zone system. Zone numbering appears to have started generally in the northwestern portions of the APO study area, moving west to east. When reaching the Mississippi River, the numbering shifts southward and again moves west to east in the same pattern. After reaching the southern boundary of the original APO study area, the zone numbering restarts in peripheral areas surrounding the original boundary, but within the current APO boundary including the east side of the Mississippi River. Figure 2 provides a visual example of the current numbering scheme.

**Figure 2. Existing St. Cloud Zone Numbering Example**




The scope of work for this project includes implementing a multi-tiered zone structure. This multi-tiered approach is a data management technique that creates districts with numbering in a "telescoping" fashion (e.g., zones 1-25 = district 1, zones 26-50 = district 2, etc.). Figure 3 provides a generic example of telescoping district and zone numbers.

**Figure 3. Example of District and Zone Numbering**

**District Numbering**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | | | | | 2 | | | | | | 5 | | | | | 6 | | | |
| 2 | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | |
| 6 | 3 | | | | | 4 | | | | | | 7 | | | | | 8 | | | |
| 7 | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | |
| 11 | 9 | | | | | 10 | | | | | | 13 | | | | | 14 | | | |
| 12 | | | | | | | | | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | | | | | | | | |
| 16 | 11 | | | | | 12 | | | | | | 15 | | | | | 16 | | | |
| 17 | | | | | | | | | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | | |

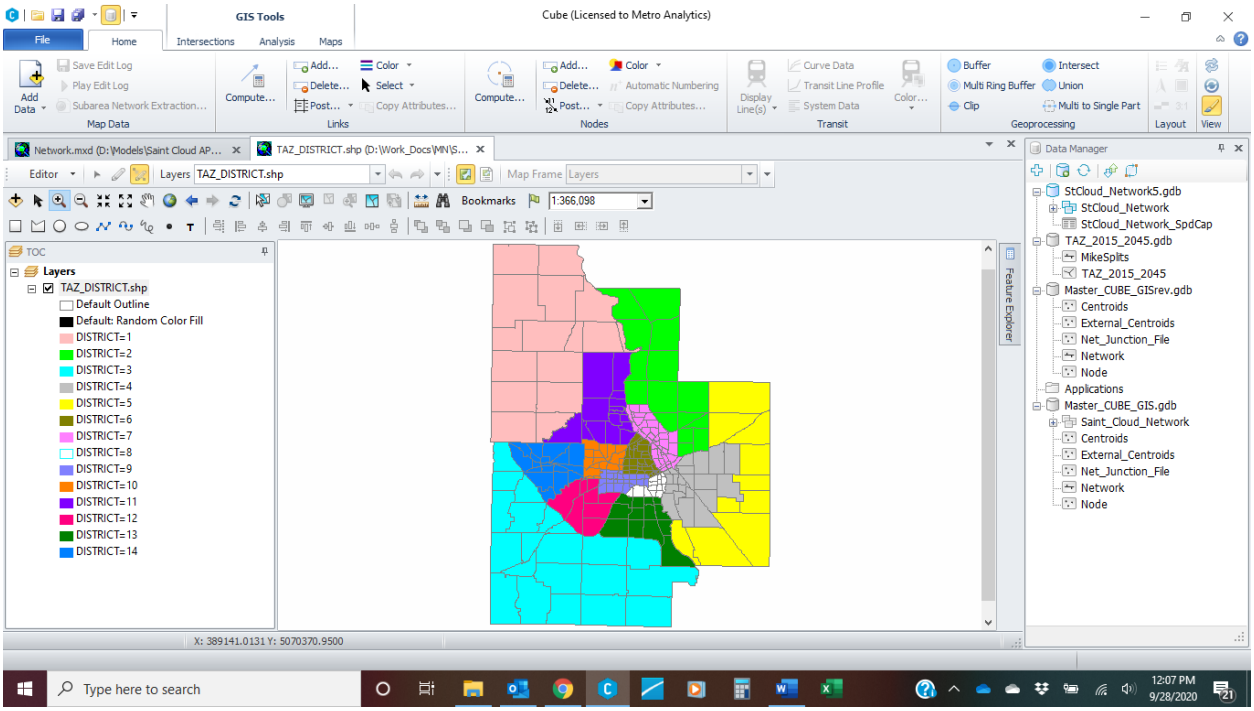
**TAZ numbering**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 3 | 4 | 5 | 26 | 27 | 28 | 29 | 30 | 101 | 102 | 103 | 104 | 105 | 126 | 127 | 128 | 129 | 130 |
| 2 | 6 | 7 | 8 | 9 | 10 | 31 | 32 | 33 | 34 | 35 | 106 | 107 | 108 | 109 | 110 | 131 | 132 | 133 | 134 | 135 |
| 3 | 11 | 12 | 13 | 14 | 15 | 36 | 37 | 38 | 39 | 40 | 111 | 112 | 113 | 114 | 115 | 136 | 137 | 138 | 139 | 140 |
| 4 | 16 | 17 | 18 | 19 | 20 | 41 | 42 | 43 | 44 | 45 | 116 | 117 | 118 | 119 | 120 | 141 | 142 | 143 | 144 | 145 |
| 5 | 21 | 22 | 23 | 24 | 25 | 46 | 47 | 48 | 49 | 50 | 121 | 122 | 123 | 124 | 125 | 146 | 147 | 148 | 149 | 150 |
| 6 | 51 | 52 | 53 | 54 | 55 | 76 | 77 | 78 | 79 | 80 | 151 | 152 | 153 | 154 | 155 | 176 | 177 | 178 | 179 | 180 |
| 7 | 56 | 57 | 58 | 59 | 60 | 81 | 82 | 83 | 84 | 85 | 156 | 157 | 158 | 159 | 160 | 181 | 182 | 183 | 184 | 185 |
| 8 | 61 | 62 | 63 | 64 | 65 | 86 | 87 | 88 | 89 | 90 | 161 | 162 | 163 | 164 | 165 | 186 | 187 | 188 | 189 | 190 |
| 9 | 66 | 67 | 68 | 69 | 70 | 91 | 92 | 93 | 94 | 95 | 166 | 167 | 168 | 169 | 170 | 191 | 192 | 193 | 194 | 195 |
| 10 | 71 | 72 | 73 | 74 | 75 | 96 | 97 | 98 | 99 | 100 | 171 | 172 | 173 | 174 | 175 | 196 | 197 | 198 | 199 | 200 |
| 11 | 201 | 202 | 203 | 204 | 205 | 226 | 227 | 228 | 229 | 230 | 301 | 302 | 303 | 304 | 305 | 326 | 327 | 328 | 329 | 330 |
| 12 | 206 | 207 | 208 | 209 | 210 | 231 | 232 | 233 | 234 | 235 | 306 | 307 | 308 | 309 | 310 | 331 | 332 | 333 | 334 | 335 |
| 13 | 211 | 212 | 213 | 214 | 215 | 236 | 237 | 238 | 239 | 240 | 311 | 312 | 313 | 314 | 315 | 336 | 337 | 338 | 339 | 340 |
| 14 | 216 | 217 | 218 | 219 | 220 | 241 | 242 | 243 | 244 | 245 | 316 | 317 | 318 | 319 | 320 | 341 | 342 | 343 | 344 | 345 |
| 15 | 221 | 222 | 223 | 224 | 225 | 246 | 247 | 248 | 249 | 250 | 321 | 322 | 323 | 324 | 325 | 346 | 347 | 348 | 349 | 350 |
| 16 | 251 | 252 | 253 | 254 | 255 | 276 | 277 | 278 | 279 | 280 | 351 | 352 | 353 | 354 | 355 | 376 | 377 | 378 | 379 | 380 |
| 17 | 256 | 257 | 258 | 259 | 260 | 281 | 282 | 283 | 284 | 285 | 356 | 357 | 358 | 359 | 360 | 381 | 382 | 383 | 384 | 385 |
| 18 | 261 | 262 | 263 | 264 | 265 | 286 | 287 | 288 | 289 | 290 | 361 | 362 | 363 | 364 | 365 | 386 | 387 | 388 | 389 | 390 |
| 19 | 266 | 267 | 268 | 269 | 270 | 291 | 292 | 293 | 294 | 295 | 366 | 367 | 368 | 369 | 370 | 391 | 392 | 393 | 394 | 395 |
| 20 | 271 | 272 | 273 | 274 | 275 | 296 | 297 | 298 | 299 | 300 | 371 | 372 | 373 | 374 | 375 | 396 | 397 | 398 | 399 | 400 |

In larger models, it might make sense to nest small districts within medium districts and medium districts within larger districts. In the case of St. Cloud, only one set of districts is

recommended at this time, consistent with districts used in reporting for the previous travel demand model. While zones are being renumbered consecutively within each district, old zone numbers are also being maintained within the database for future comparative analysis. Figure 4 depicts the districts to be used in numbering zones for the updated St. Cloud model.

**Figure 4. Existing St. Cloud Districts for Zone Renumbering**




## Next Steps

Work continues with editing the previous model zone map to incorporate recommended zone splits and boundary changes. A revised zone shape file will subsequently be delivered to APO staff. The Appendix to this memorandum depicts original Consultant recommendations, comments received from APO staff, and final comments from Consultant staff to confirm edits made to the zone system. Red text indicates where changes were made to the original set of Consultant recommended TAZ splits and boundary shifts. This included locations that were originally tagged for future implementation but are now being addressed in conjunction with the original higher priority changes.

# Appendix: Spreadsheet Template for Zone Checking and Recommended Changes

| Zone | Recommend Split/Shift? | No. of Splits/Shifts | Changes | APO Comments | Rob |
|---|---|---|---|---|---|
| 1 | yes | 3 | split zone along 35th Street North | Yes. But also, there are plans for 15th Street North to be a future collector. Extend a line from 15th St. North and split there as well. | added 15 St. N extension split and along 19th Ave N |
| 2 | yes | 1 | split zone along 27th Street North | Yes | ok |
| 3 | no | 0 | | | |
| 4 | yes | 1 | split zone along 1st St. N, 19th Ave. N and 2.5 St. N | Yes to 19th Ave split; Yes to 2-1/2 St split; but also split at river instead of 1st St | moved 1st St split to Watab River |
| 5 | no | 0 | | | |
| 6 | no | 0 | | | |
| 7 | no | 0 | | | |
| 8 | yes | 2 | would be ideal if boundary followed 4th Ave. S | Yes, but also suggest splitting zone as shown in graphic "8" attached to email. | would prefer splits along roadways but OK |
| 9 | no | 0 | | | |
| 10 | yes | 1 | would be ideal to shift boundary to CR 133 | Yes, but also shift that weird NE corner to follow CR-4 | marked accordingly |
| 11 | yes | 1 | split zone along 19th Ave. S | yes | ok |
| 12 | yes | 1 | would be best if boundary followed Pine Cone Rd. | yes | ok |
| 13 | yes | 1 | would be ideal if boundary followed 4th Ave. S | yes | ok |
| 14 | maybe | 0 | consider split along Connecticut Ave. S | not reviewed by APO but OK with Rob | Mike's red markup |
| 15 | yes | 1 | would be ideal if boundary followed Riverside Dr. | yes | ok |
| 16 | no | 0 | | | |
| 17 | no | 0 | | | |
| 18 | no | 0 | | | |
| 19 | no | 0 | | | |
| 20 | no | 0 | | | |
| 21 | no | 0 | | | |
| 22 | yes | 2 | would be ideal if boundary followed Pine Cone Rd. | We propose a series of changes to 22 and 23 - please see attached image "21-22-23"... includes following Sauk River for lower boundary | marked accordingly |
| 23 | yes | 1 | split zone along CR 134; possibly shift boundary at 22 | (see note above) | marked accordingly |
| 24 | no | 0 | | | |
| 25 | no | 0 | | | |
| 26 | no | 0 | | | |
| 27 | no | 0 | | | |
| 28 | no | 0 | | | |
| 29 | yes | 1 | split zone along 9th Ave. N | yes | ok |
| 30 | yes | 1 | split zone along 9th Ave. N | yes | ok |
| 31 | yes | 1 | split zone along 17th Street North; elongated zone | yes | ok |
| 32 | yes | 1 | would be ideal if boundary followed Westwood Pwy | yes | ok |
| 33 | yes | 1 | would be ideal if boundary followed Westwood Pwy | yes, split such that the Cypress Court Apartments and Westwood Parkway Estates are in their own TAZ | split instead of shift in markup |
| 34 | no | 0 | | | |
| 35 | no | 0 | | | |
| 36 | yes | 1 | split zone along 10th Street North | yes | ok |
| 37 | no | 0 | | | |
| 38 | no | 0 | | | |
| 39 | no | 0 | | | |
| 40 | yes | 3 | split zone along 10th St. N and 9th Ave. N (4 zones) | yes to split along 9th Ave N.; instead of splitting at 10th St N, suggest 11th St N | line actually does show split along 11th St N |
| 41 | no | 0 | | | |
| 42 | no | 0 | | | |
| 43 | no | 0 | | | |
| 44 | no | 0 | | | |
| 45 | no | 0 | | | |
| 46 | no | 0 | | | |
| 47 | no | 0 | | | |
| 48 | yes | 1 | split zone along 16th Ave. N; isolate residential | yes | ok |
| 49 | no | 0 | | | |
| 50 | yes | 1 | consider shifting boundary with zone 134 to CR 134 | yes | ok |
| 51 | no | 0 | | | |
| 52 | no | 0 | | | |
| 53 | no | 0 | | | |
| 54 | no | 0 | | | |
| 55 | no | 0 | | | |
| 56 | no | 0 | | | |
| 57 | no | 0 | | | |
| 58 | no | 0 | | | |
| 59 | no | 0 | | | |
| 60 | yes | 1 | split along 6th Avenue N | suggest splitting along railroad instead | moved split to RR line |
| 61 | no | 0 | | | |
| 62 | no | 0 | | | |
| 63 | no | 0 | | | |
| 64 | yes | 1 | split along 29th Avenue N | yes | ok |
| 65 | no | 0 | | | |
| 66 | yes | 1 | split along W. St. Germain St. | yes | ok |
| 67 | yes | 1 | split along W. St. Germain St. | yes | ok |
| 68 | yes | 1 | split along W. St. Germain St. and 10th Ave. N. | yes | ok |
| 69 | yes | 1 | split zone along 1st/2nd Street N/shift W to 10th Ave | yes | ok |
| 70 | yes | 1 | split along 8th Avenue N and possibly 6th Avenue N | suggest considering 7th Ave N and 5th Ave N instead | used 6th & 8th Aves |

| Zone | Recommend Split/Shift? | No. of Splits/Shifts | Changes | APO Comments | Rob |
|---|---|---|---|---|---|
| 71 | yes | 1 | split along W. St. Germain St. | yes | ok |
| 72 | no | 0 | | | |
| 73 | no | 0 | | | |
| 74 | no | 0 | | | |
| 75 | no | 0 | | | |
| 76 | yes | 1 | split along 6th Avenue N | yes | ok |
| 77 | no | 0 | | | |
| 78 | no | 0 | | | |
| 79 | no | 0 | | | |
| 80 | yes | 1 | split along 33rd Avenue N | 33rd Ave N is already a boundary; plus split at 29th Ave | yes, I marked at 29th Ave |
| 81 | no | 0 | | | |
| 82 | yes | 1 | split along Cooper Ave. S/University Dr. S | yes | ok |
| 83 | yes | 1 | shift southern boundary up to 7th Street S | yes | ok |
| 84 | yes | 1 | split zone along 4th Street South/add 4th to network | yes, but also suggest shifting southern boundary to 7th | yes, I marked at 7th Ave |
| 85 | no | 0 | | | |
| 86 | yes | 1 | shift no. bound. up to 7th St. S/so. bound. to Univ. S. | yes | ok |
| 87 | yes | 1 | shift northern boundary down to 7th Street S | yes | ok |
| 88 | no | 0 | | | |
| 89 | yes | 1 | shift western boundary inward to 28th Avenue S | yes | ok |
| 90 | no | 0 | | | |
| 91 | yes | 1 | split along Sundial Drive | yes | ok |
| 92 | no | 0 | | | |
| 93 | no | 0 | | | |
| 94 | no | 0 | | | |
| 95 | no | 0 | | | |
| 96 | maybe | 0 | consider splitting along 17th St. S | not reviewed by APO but OK with Rob | inserted Mike's red markup |
| 97 | yes | 1 | split along Traverse Road | yes | ok |
| 98 | yes | 1 | shift northern boundary to University Dr. S | yes | ok |
| 99 | no | 0 | | | |
| 100 | no | 0 | | | |
| 101 | no | 0 | | | |
| 102 | no | 0 | | | |
| 103 | yes | 1 | split along 2nd Avenue S | yes | ok |
| 104 | yes | 1 | split along W. St. Germain St. | yes | ok |
| 105 | no | 0 | | | |
| 106 | no | 0 | | | |
| 107 | yes | 1 | split along Clearwater Rd. | yes | ok |
| 108 | no | 0 | | | |
| 109 | yes | 1 | split along W. St. Germain St. | yes | ok |
| 110 | no | 0 | | | |
| 111 | yes | 1 | would be ideal to split along Southway/Sunridge Drs. | yes on Sunridge; but instead of Southway, split at creek (i.e., north-south gap between residential developments ) | shifted from Southway to creek in markup |
| 112 | yes | 1 | split along Clearwater Rd. | yes | ok |
| 113 | yes | 2 | would be ideal to split along Graniteview Rd. | yes | ok |
| 114 | yes | 1 | split along CR 74 | yes | ok |
| 115 | no | 0 | | | |
| 116 | no | 0 | | | |
| 117 | no | 0 | | | |
| 118 | yes | 1 | would be ideal to split along CR 2 | yes | ok |
| 119 | yes | 1 | would be ideal to shift boundary to CR 133 | yes, but also shift northern boundary to CR 4 | ok |
| 120 | no | 0 | | | |
| 121 | yes | 1 | possibly split along CR 2 | yes | ok |
| 122 | no | 0 | | | |
| 123 | no | 0 | | | |
| 124 | yes | 1 | ideal to shift boundary to Northland/Jasmine | yes to Northland Drive as border ; instead of Jasmine, City has plans for a "northern corridor" (arterial) lining up approximately with 315th Street - suggest that as northern border. | marked accordingly |
| 125 | no | 0 | | | |
| 126 | no | 0 | | | |
| 127 | no | 0 | | | |
| 128 | yes | 1 | ideal to shift boundary to Northland/Jasmine | yes to Northland Drive as border ; instead of Jasmine, City has plans for a "northern corridor" (arterial) lining up approximately with 315th Street - suggest that as northern border. | marked accordingly |
| 129 | yes | 1 | possibly split along 2nd Ave NW | yes | ok |
| 130 | yes | 1 | split along 4th Ave NE | yes | ok |
| 131 | yes | 1 | shift south bound. to incl. entire St. Benedict campus | yes | ok |
| 132 | no | 0 | | | |
| 133 | no | 0 | | | |
| 134 | yes | 1 | consider shifting boundary with zone 50 to CR 134 | yes | ok |
| 135 | no | 0 | | | |
| 136 | no | 0 | | | |
| 137 | yes | 1 | shift north bound. to incl. entire St. Benedict campus | yes; also suggest spliting along College Ave | ok |
| 138 | no | 0 | | | |
| 139 | no | 0 | | | |
| 140 | no | 0 | | | |

| Zone | Recommend Split/Shift? | No. of Splits/Shifts | Changes | APO Comments | Rob |
|---|---|---|---|---|---|
| 141 | yes | 1 | split along Bel Clare Dr/Indigo Rd/86th Ave | yes | ok |
| 142 | yes | 1 | consider splitting along CR 160 | yes | ok |
| 143 | yes | 1 | consider splitting along CR 139 | yes | ok |
| 144 | no | 0 | | | |
| 145 | no | 0 | | | |
| 146 | maybe | 0 | consider split along Bel Clare Drive | not reviewed by APO but OK with Rob | inserted Mike's red markup |
| 147 | yes | 1 | split along 1st Ave NE, or RR line | yes, split at Benton Drive (1st Ave NE) | marked accordingly |
| 148 | no | 0 | rather odd zone comprising river and dam... land use? | there use to be a papermill there, but it burned down; city has redevelopment plans; leave as is | ok |
| 149 | no | 0 | | | |
| 150 | no | 0 | | | |
| 151 | no | 0 | | | |
| 152 | no | 0 | | | |
| 153 | unlikely | 0 | only if US10/SR15/CR29 triangle is developable | leave as is | ok |
| 154 | no | 0 | | | |
| 155 | no | 0 | | | |
| 156 | no | 0 | | | |
| 157 | yes | 1 | split along 9th Ave N | yes, but also suggest splitting along Prairie Lane Park (the long, wet green space west of 9th Ave between houses | used instead of 9th Avenue in markup |
| 158 | no | 0 | | | |
| 159 | yes | 1 | split along 4th Ave N | yes | ok |
| 160 | yes | 1 | split along 9th Ave N | yes | ok |
| 161 | no | 0 | | | |
| 162 | yes | 1 | consider splitting along CR 33/N Benton Dr | yes, but also move southern boundary to bridge | marked accordingly |
| 163 | no | 0 | | | |
| 164 | yes | 1 | | | extend to river, per 162 |
| 165 | yes | 1 | split along 6th Ave N | yes, but also move western boundary to follow Summit Ave | marked accordingly |
| 166 | no | 0 | | | |
| 167 | no | 0 | | | |
| 168 | maybe | 0 | consider shifting zone 168/170 boundary to 5th St. S | boundary is already there | my bad... oops/unmarked it |
| 169 | no | 0 | | | |
| 170 | maybe | 0 | consider shifting zone 168/170 boundary to 5th St. S | boundary is already there | my bad... oops/unmarked it |
| 171 | maybe | 0 | consider split along River/Broadway Avenues | No | ok |
| 172 | yes | 1 | consider split along 12th St. S | yes | ok |
| 173 | no | 0 | | | |
| 174 | no | 0 | | | |
| 175 | yes | 1 | consider shifting zone 175/176 boundary to Wilson Av | yes | ok |
| 176 | yes | 1 | consider shifting zone 175/176 boundary to Wilson Av | yes | ok |
| 177 | no | 0 | | | |
| 178 | yes | 1 | consider split along Wilson Ave. | yes | ok |
| 179 | no | 0 | | | |
| 180 | yes | 1 | consider split along Wilson Ave. | yes | ok |
| 181 | no | 0 | | | |
| 182 | yes | 1 | consider split along Wilson Ave. | yes, plus move southern boundary to 7th Street | marked accordingly |
| 183 | no | 0 | | | |
| 184 | yes | 1 | consider split along 13th St SE | yes | ok |
| 185 | yes | 1 | split along RR line | yes | ok |
| 186 | yes | 1 | split along RR line | yes | ok |
| 187 | yes | 1 | split along 9th Ave SE | yes | ok |
| 188 | no | 0 | | | |
| 189 | maybe | 0 | consider split on Minnesota Blvd if development poss | No, leave as is | crossed off |
| 190 | yes | 1 | split along 15th Ave SE; consider border shift with 192 | yes to split along 15th Ave SE; also move border to include all residential in one TAZ - either 190 or 192 | marked accordingly |
| 191 | no | 0 | ...but it is rather enlongated zone | | |
| 192 | maybe | 0 | consider ceding portion inside City limits to zone 190 | move border with 190 to include all residential in one TAZ - either 190 or 192 | marked accordingly |
| 193 | no | 0 | unless there's future development potential here | | |
| 194 | maybe | 0 | consider splitting along 49th St. SE | not reviewed by APO but OK with Rob | inserted Mike's red markup |
| 195 | yes | 1 | split along 57th/60th St SE/CR 7 | yes | ok |
| 196 | yes | 1 | consider split on CR 57 if development potential | yes | ok |
| 197 | yes | 1 | consider split on CR 15 if development potential | yes | ok |
| 198 | yes | 1 | split along Golden Spike Road | yes | ok |
| 199 | yes | 1 | split along 10th Ave. NE | yes | ok |
| 200 | yes | 1 | consider split on 25th Ave NE if development poss | yes | ok |
| 201 | no | 0 | | | |
| 202 | maybe | 0 | consider relocating 202/206 boundary to SR 23 | existing border follows an abandoned rail line that they are trying to turn into a regional bike path. Suggested keeping the eastern boundary as it, but spliting TAZ 206 at SR-23 | marked accordingly |
| 203 | no | 0 | | | |
| 204 | no | 0 | | | |
| 205 | yes | 1 | split along 15th St NE | yes | ok |
| 206 | yes | 1 | consider relocating 202/206 boundary to SR 23 | no, but do suggested splitting at SR-23 | marked accordingly |
| 207 | yes | ***2*** | split along 10th St NE and split along 10th Ave NE | yes to both | ok |
| 208 | yes | 2 | split along 10th St NE; consider along Mayhew Lake too | yes to both | ok |
| 209 | no | 0 | | | |
| 210 | no | 0 | consider E/W split if development potential | No | ok |

| Zone | Recommend Split/Shift? | No. of Splits/Shifts | Changes | APO Comments | Rob |
|---|---|---|---|---|---|
| 211 | no | 0 | | | |
| 212 | no | 0 | consider E/W split if development potential | No | ok |
| 213 | no | 0 | consider E/W split if development potential | No | ok |
| 214 | no | 0 | | | |
| 215 | yes | 1 | split along SR 23 | yes | ok |
| 216 | yes | 1 | split along SR 23 | yes | ok |
| 217 | yes | 1 | consider split along 1st St. NE westward | yes | marked accordingly |
| 218 | yes | 1 | consider split along 12th St. SE | yes | marked accordingly |
| 219 | yes | 1 | consider shifting TAZ 219/222 boundary to 12th St SE | yes | marked accordingly |
| 220 | yes | 1 | consider shifting TAZ 220/221 boundary to 55th Ave SE | yes | marked accordingly |
| 221 | yes | 1 | consider shifting TAZ 220/221 boundary to 55th Ave SE | yes | marked accordingly |
| 222 | yes | 1 | consider shifting TAZ 219/222 boundary to 12th St SE | yes | marked accordingly |
| 223 | yes | 1 | consider split on 45th Ave SE or 222/223 bound shift | yes to boundary shift to 45th Ave | marked accordingly |
| 224 | yes | ***2*** | split along 27th St NE and split along CR 78 | yes | ok |
| 225 | yes | 1 | split along 60th Ave SE | yes | ok |
| 226 | no | 0 | | | |
| 227 | no | 0 | | | |
| 228 | yes | 1 | consider split along Lake Rd. | yes | marked accordingly |
| 229 | yes | 1 | consider split along CR 8 | yes | marked accordingly |
| 230 | yes | 1 | consider split along CR 140 | yes | marked accordingly |
| 231 | yes | 1 | ideal to split along Grand Lake Rd/205th St | yes | marked accordingly |
| 232 | yes | 1 | ideal to split along 88th Ave/220th St | yes | marked accordingly |
| 233 | yes | 1 | consider split along CR 141 | yes | marked accordingly |
| 234 | yes | 1 | consider split along 95th Ave/Tallow Rd | yes | marked accordingly |
| 235 | no | 0 | | | |
| 236 | no | 0 | | | |
| 237 | yes | 1 | split along 390th St/very elongated zone | yes | ok |
| 238 | yes | 1 | consider splits along CR 55 and 105th St NW | yes | marked accordingly |
| 239 | no | 0 | | | |
| 240 | no | 0 | | | |
| 241 | maybe | 0 | consider split along 115th Ave NW | not reviewed by APO but OK with Rob | inserted Mike's red markup |
| 242 | no | 0 | | | |
| 243 | yes | 1 | split along NE River Rd | yes | ok |
| 244 | no | 0 | | | |
| 245 | yes | 1 | consider split along CR 118/85th Ave NW | yes | prior street name wrong |
| 246 | yes | 1 | consider split along 230th St; shift 246/255 boundary | yes, plus shift western boundary to SR-15 | marked accordingly |
| 247 | yes | 1 | large zone bisected by network links... no good options | Split at CR1 | now it's elongated |
| 248 | no | 0 | | | |
| 249 | no | 0 | consider splitting along CR 57 | not reviewed by APO but OK with Rob | inserted Mike's red markup |
| 250 | no | 0 | | | |
| 251 | no | 0 | | | |
| 252 | yes | 1 | split along I-94 | yes | ok |
| 253 | yes | ***3*** | splits along I-94 and CR 7 (perhaps CR 44 to the south) | yes to all three | CR 44 markup added |
| 254 | yes | 1 | consider split or boundary shift along CR 115 | Split along CR 115 | marked accordingly |
| 255 | yes | 1 | consider split or boundary shift along CR 141 | Split along CR 141, plus shift western boundary to SR-15 | marked accordingly |
| 256 | maybe | 0 | consider shifting 256/257 boundary to CR 4 | not reviewed by APO but OK with Rob | inserted Mike's red markup |
| 257 | yes | 1 | split along CR 2 | yes | ok |
| 258 | no | 0 | consider boundary shifts to CR 4 and Quail Rd | not reviewed by APO but OK with Rob | inserted Mike's red markup |
| 259 | yes | 1 | split along CR 2 | yes | ok |
| 260 | maybe | 0 | consider split along I-94 and adding Old Rd to network | shift southern boundary to I-94; shift eastern boundary to CR 3 | marked accordingly |
| 261 | maybe | 0 | consider split along 250th St | yes, plus shift western boundary to SR-15 | marked accordingly |

metro analytics

# TECHNICAL MEMORANDUM

TO: Brian Gibson, Executive Director, St. Cloud Area Planning Organization

FROM: Rob Schiffer, National Practice Leader, Travel Demand Forecasting

DATE: October 1, 2020

SUBJECT: St. Cloud APO Model Improvements Task 2: External Trips

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This Draft Technical Memorandum describes StreetLight InSight data analysis of external trips and subsequent steps in updating external trips for the St. Cloud Area Planning Organization (APO) travel demand model. Discussions are divided into the following topics:

- Task 2 Scope of Work
- StreetLight InSight analysis of external trips
- Adjustment of StreetLight InSight to traffic counts
- Instructions on updating external trips in Cube
- Next steps

This draft tech memo will be updated to reflect all comments received from APO staff. A separate tech memo will be provided on trip generation, reflecting recommendations on trip purpose allocations for internal-external trips and potential file format changes.

## Task 2 Scope of Work

The Consultant shall use Streetlight Data, already purchased by the APO, to analyze external trip-making characteristics. Task 2 Deliverable:

1) A technical memo recommending changes to external stations, counts, and/or trip tables and step-by-step instructions on how APO staff would incorporate the recommendations into the model files

## StreetLight InSight Analysis of External Trips

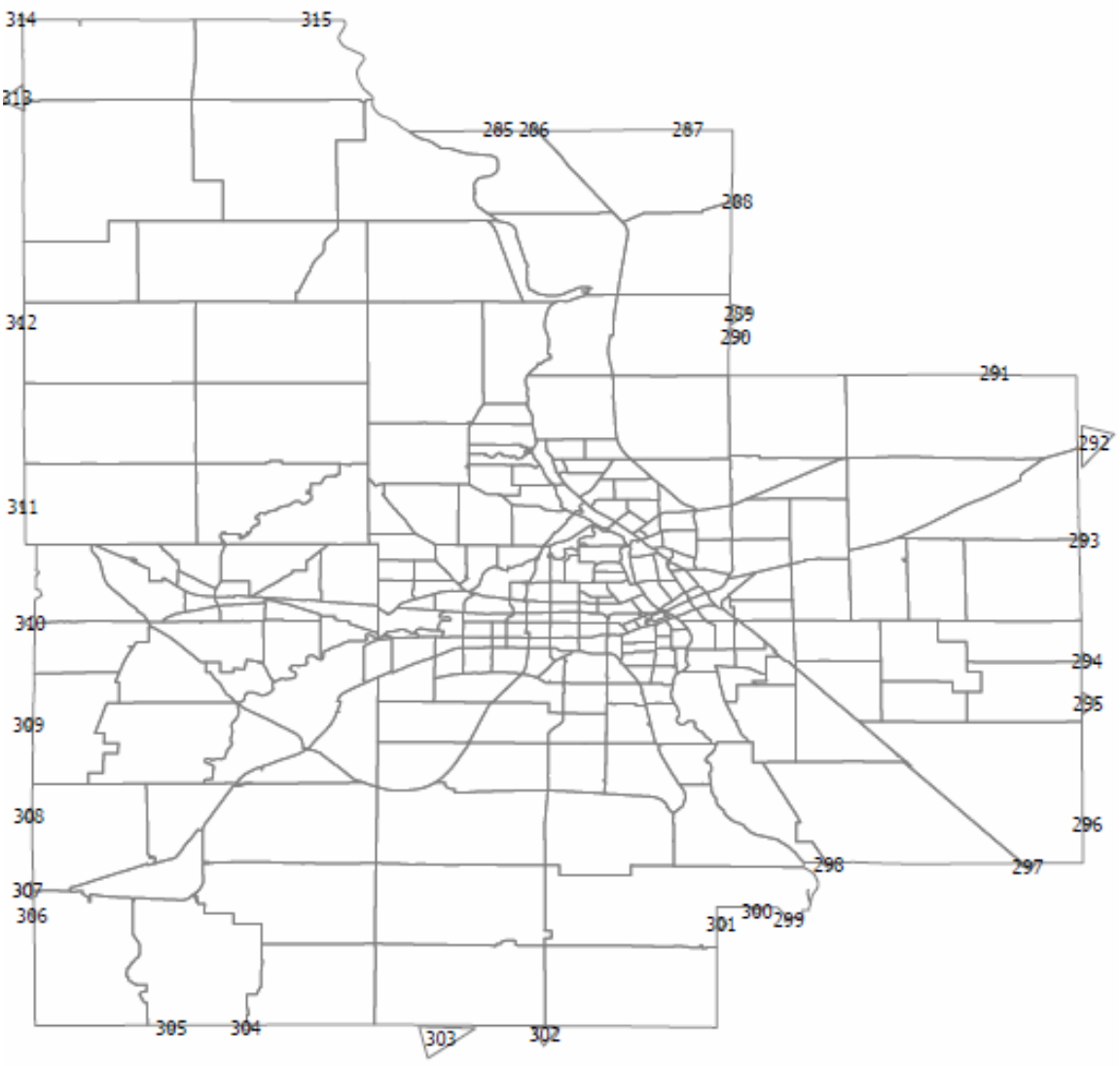
It is not clear how recently (if ever) an external travel survey was conducted for the St. Cloud model. Such surveys were historically conducted using roadside interviewers positioned at each roadway segment crossing the model study area boundary and asking questions about the origin and destination (O/D) locations of the trip being intercepted by the interviewer. Over the years, technology has resulted in more efficient methods to obtain information on the origin and destination of external trips. In particular, over the past decade, the use of big data from cellular and other global positioning system (GPS) devices has become the preferred method for obtaining this information.

The Minnesota Department of Transportation (MnDOT) has a license for unlimited use of StreetLight InSight data for trip origin and destination analyses. StreetLight InSight uses data from GPS devices and location-based services (LBS), along with a series of algorithms and validation techniques, to estimate O/D patterns across the U.S. The StreetLight InSight online

dashboard enables the user to either use pre-set geographies or create/upload traffic analysis zones (TAZs) for summarizing average daily travel patterns, which can be selected for specific months, years, days of the week, and time periods of the day. Data for all months and days of the week for the year 2016 were used for the analyses described in this memorandum. These data were the closest available to the current model base year of 2015.

Consultant staff were granted access to the MnDOT StreetLight InSight dashboard to analyze O/D travel patterns for the St. Cloud APO region. While the MnDOT dashboard already included the existing St. Cloud APO internal TAZ system, it did not include any zones for analyzing "pass through trips" that begin and/or end outside the APO study area. Thus, the first step was to delineate pass through zones for each external TAZ in the APO model. Pass through zones must be tightly focused on the corridor being analyzed in order to limit the tagging of GPS devices to the roadway of interest. Figure 1 depicts external "pass through" zones created using the StreetLight InSight dashboard for the St. Cloud APO region.

**Table 1. StreetLight InSight External Pass Through Zones for the St. Cloud APO Region**



Using the StreetLight InSight dashboard, all trips passing through these external zones were tagged and identified as either internal-external (those with only one trip end outside the APO study area) or external-external (those with both trip ends outside the APO study area). This enabled computing the percentage split between IE (internal-external) and EE (external-external) trips. After determining the percent of EE trips, EE origins and destinations were further analyzed to determine the proportion of EE trips at each external zone passing through other external zones.

Table 1 is a listing of each APO external zone with 2016 StreetLight InSight volumes and the split of trips between IE and EE trip purposes. Red text is used to indicate external zones with the highest percentages of EE trips with comments indicating why higher EE percentages are justified. Not surprisingly, the four external zones with the highest StreetLight volume (I-94 east and west plus US 10 north and south) also exhibit a high percentage of through trips. Other locations with somewhat higher EE trip percentages are located at model boundary "corners," whereby a right or left turn at the next intersection might result in a through trip.

**Table 1. Internal-External/External-External Splits from StreetLight InSight Analysis**

| Origin Zone ID | Origin Zone Name | Ext Total | EE Sum | EE Pct | IE Sum | IE Pct | Comments |
|---|---|---|---|---|---|---|---|
| 285 | CR 55 North | 409 | 116 | 28% | 293 | 72% | model boundary corner |
| 286 | US 10 N | 11,109 | 4,047 | 36% | 7,062 | 64% | multi-lane US highway |
| 287 | 15th Ave N | 39 | 19 | 49% | 20 | 51% | model boundary corner |
| 288 | Little Rock Rd NE | 206 | 90 | 44% | 116 | 56% | model boundary corner |
| 289 | Mayhew Lake Rd. NE | 266 | 69 | 26% | 197 | 74% | near model boundary corner |
| 290 | 65th St. NE | 576 | 130 | 23% | 446 | 77% | |
| 291 | Golden Spike Rd NE | 512 | 43 | 8% | 469 | 92% | |
| 292 | SR 23 NE | 3,400 | 269 | 8% | 3,131 | 92% | |
| 293 | SR 95 E | 1,613 | 259 | 16% | 1,354 | 84% | |
| 294 | CR 62/17th St. SE | 77 | 11 | 14% | 66 | 86% | |
| 295 | CR 3/27th St SE | 426 | 38 | 9% | 388 | 91% | |
| 296 | 57th St. NE | 515 | 33 | 6% | 482 | 94% | |
| 297 | US 10 S | 7,950 | 2,484 | 31% | 5,466 | 69% | multi-lane US highway |
| 298 | River Rd SE | 718 | 30 | 4% | 688 | 96% | |
| 299 | Opportunity Dr. | 1,038 | 196 | 19% | 842 | 81% | |
| 300 | I-94 E | 13,973 | 4,066 | 29% | 9,907 | 71% | Interstate highway |
| 301 | CR 44 | 966 | 141 | 15% | 825 | 85% | |
| 302 | CR 7 | 546 | 54 | 10% | 492 | 90% | |
| 303 | SR 15 S/CR 142 S | 2,742 | 431 | 16% | 2,311 | 84% | |
| 304 | CR 141 S | 348 | 66 | 19% | 282 | 81% | |
| 305 | CR 8 S | 305 | 26 | 9% | 279 | 91% | |
| 306 | CR 140 W | 81 | 4 | 5% | 77 | 95% | |
| 307 | SR 23 SW | 6,990 | 1,457 | 21% | 5,533 | 79% | |
| 308 | CR 2 SW | 1,803 | 229 | 13% | 1,574 | 87% | |
| 309 | CR 160 W | 252 | 47 | 19% | 205 | 81% | |
| 310 | CR 51 W | 741 | 108 | 15% | 633 | 85% | |
| 311 | I-94 West | 12,157 | 2,877 | 24% | 9,280 | 76% | Interstate highway |
| 312 | CR 155 | 1,565 | 804 | 51% | 761 | 49% | near model boundary corner |
| 313 | CR 17 | 2,253 | 1,408 | 62% | 845 | 38% | model boundary corner |
| 314 | 130th Ave at 450th St. | 356 | 293 | 82% | 63 | 18% | model boundary corner |
| 315 | Great River Rd (CR 21) | 689 | 444 | 64% | 245 | 36% | model boundary corner |
| 316 | 125th St. NW River Crossing | 3,777 | 1,630 | 43% | 2,147 | 57% | model boundary corner |
| | | 78,398 | 21,919 | 28% | 56,479 | 72% | |

StreetLight InSight was also used to estimate the proportion of EE trips at each external zone that pass through each other external zone. This information is used to form the basis of an updated EE trip table. Table 2 depicts external origin zones (i) as the rows and destination zones (j) as columns, along with the percent of trips from each origin zone to each destination zone (e.g., 28 percent of EE trips from zone 285 are destined for zone 297 while 72 percent are destined for zone 316) in the cells of the matrix. Once again, the four external zones with the greatest EE trip interchanges are highlighted. Zonal interchanges with less than 20 EE trips are depicted as zero, as such numbers are smaller than the error margin found in most models.

**Table 2. Proportionate Distribution of StreetLight External-External Trips**

| | 20+ Trips | CR 55 N | US 10 N | 15th Av N | Lit Rock | May hew | 65th St NE | Gold Spik | SR 23N | SR 95E | CR 62 | CR 3 | 57th St NE | US 10 S | Riv. RdSE | Opp Dr. | I-94 E | CR 44 | CR 7 | SR 15 S | CR 141S | CR 8 S | CR 140 | SR 23W | CR 2 SW | CR 160 | CR 51W | I-94 W | CR 155 | CR 17 | 130 Ave | CR 21 | 125 St N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 | 300 | 301 | 302 | 303 | 304 | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 313 | 314 | 315 | 316 |
| CR 55N | 285 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.72 |
| US 10N | 286 | 0 | 0 | 0 | 0.01 | 0 | 0.01 | 0 | 0.01 | 0.02 | 0 | 0 | 0.01 | 0.58 | 0 | 0 | 0.06 | 0 | 0 | 0.03 | 0 | 0 | 0 | 0.01 | 0 | 0 | 0 | 0 | 0 | 0.03 | 0 | 0.04 | 0.18 |
| 15th Av | 287 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| LittleR | 288 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mayhew | 289 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 65thNE | 290 | 0 | 0.41 | 0.59 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| GoldSp | 291 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SR 23N | 292 | 0 | 0.11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.14 | 0 | 0 | 0 | 0.31 | 0 | 0 | 0 | 0.44 | 0 | 0 | 0 | 0 | 0 |
| SR 95E | 293 | 0 | 0.41 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.17 | 0 | 0 | 0 | 0.42 | 0 | 0 | 0 | 0 | 0 |
| CR 62 | 294 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 3 | 295 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 57th Av | 296 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| US 10S | 297 | 0 | 0.94 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.01 | 0 | 0 | 0 | 0 | 0.01 |
| RivRdSE | 298 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Opp Dr | 299 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.39 | 0.61 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| I-94 E | 300 | 0 | 0.05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.02 | 0 | 0 | 0 | 0 | 0 | 0.01 | 0 | 0 | 0 | 0.26 | 0 | 0 | 0.01 | 0.63 | 0.02 | 0.01 | 0 | 0 | 0 |
| CR 44 | 301 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.36 | 0 | 0 | 0 | 0.64 | 0 | 0 | 0 | 0 | 0 |
| CR 7 | 302 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SR 15 S | 303 | 0 | 0.36 | 0 | 0 | 0 | 0 | 0 | 0.11 | 0.07 | 0 | 0 | 0 | 0 | 0 | 0 | 0.12 | 0 | 0 | 0 | 0 | 0 | 0 | 0.09 | 0 | 0 | 0 | 0.25 | 0 | 0 | 0 | 0 | 0 |
| CR 141 | 304 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 8 S | 305 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.31 | 0 | 0 | 0.69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 140 | 306 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SR 23W | 307 | 0 | 0.03 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.03 | 0 | 0 | 0 | 0 | 0 | 0.02 | 0.72 | 0.02 | 0 | 0.02 | 0 | 0.06 | 0 | 0 | 0.03 | 0 | 0 | 0.02 | 0 | 0 | 0 | 0 | 0 |
| CR 2 SW | 308 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.23 | 0 | 0 | 0 | 0 | 0 | 0 | 0.15 | 0 | 0 | 0 | 0.14 | 0.19 | 0.12 | 0 | 0 | 0.17 |
| CR 160 | 309 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 51W | 310 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.47 | 0 | 0 | 0 | 0 | 0 |
| I-94 W | 311 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.02 | 0.02 | 0 | 0 | 0 | 0.01 | 0 | 0.03 | 0.86 | 0.01 | 0 | 0.03 | 0 | 0 | 0 | 0 | 0.01 | 0 | 0.01 | 0 | 0 | 0 | 0 | 0 | 0 |
| CR 155 | 312 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.07 | 0 | 0 | 0 | 0 | 0.76 | 0.06 | 0 | 0.05 |
| CR 17 | 313 | 0 | 0.14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.02 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.03 | 0 | 0 | 0 | 0.44 | 0 | 0.08 | 0 | 0.29 |
| 130 Av | 314 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.29 | 0.58 | 0 | 0 | 0.13 |
| CR 21 | 315 | 0 | 0.43 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.57 |
| 125 St | 316 | 0.05 | 0.52 | 0.02 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0 | 0 | 0 | 0.02 | 0.2 | 0 | 0.14 | 0 |

## Adjustment of StreetLight Insight to Traffic Counts

While StreetLight InSight uses algorithms to approximate actual traffic counts, it is best to use StreetLight data for proportionate estimates and then apply these proportions to documented traffic counts for analysis of pass through trips. In other words, StreetLight can provide the percent IE/EE split at each external zone, along with the proportion of EE trips distributed to other external zones, while these percentages and proportions are then applied to actual traffic counts to estimate base year numbers for use in a model.

Thus, the next step in the analysis was to apply StreetLight derived IE/EE splits to year 2015 traffic counts found in the existing 2015 base year APO model. Table 2 provides base year 2015 internal-external and external-external trips after adjusting StreetLight trips for consistency with available 2015 daily traffic counts, along with a series of other intermediate and comparative numbers. A similar procedure would be used in developing a model for a new base year by inserting traffic counts for that year (e.g., 2020) in place of 2015. Unfortunately, the impacts of COVID-19 on travel patterns throughout much of 2020 will make it difficult to rely on traffic counts taken during this time as these are not likely representative of typical conditions.

Table 3 depicts baseline 2015 external trips after applying the percent IE/EE splits from StreetLight InSight to 2015 traffic counts, along with assignment volumes available from the APO travel demand model. It is important to understand the information included in Table 3, so a numbered series of footnotes are included below to describe the contents of each column.

**Table 3. Updated Baseline 2015 External Trips**

| External Zone | Location | 2015 SE Data AADT[1] | 2015 Volume[2] | Percent IE[3] | New % IE[4] | %IE Diff[5] | 2015 Count[6] | Volume/ Count[7] | New SE IE AADT[8] | New EE Totals[9] | New EE Directional[10] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 285 | CR 55N | 365 | 370 | 99% | 72% | -27% | 365 | 1.01 | 261 | 104 | 52 |
| 286 | US 10N | 19,937 | 24,080 | 83% | 64% | -19% | 23,900 | 1.01 | 15,193 | 8,707 | 4,353 |
| 287 | 15th Av | 510 | 516 | 99% | 51% | -48% | 510 | 1.01 | 262 | 248 | 124 |
| 288 | LittleR | 420 | 425 | 99% | 56% | -43% | 420 | 1.01 | 237 | 183 | 92 |
| 289 | Mayhew | 1,009 | 1,211 | 83% | 74% | -9% | 1,200 | 1.01 | 889 | 311 | 156 |
| 290 | 65thNE | 1,650 | 1,668 | 99% | 77% | -21% | - | - | - | - | - |
| 291 | GoldSp | 2,041 | 2,172 | 94% | 92% | -2% | 2,150 | 1.01 | 1,969 | 181 | 90 |
| 292 | SR 23N | 7,497 | 8,479 | 88% | 92% | 4% | 8,400 | 1.01 | 7,735 | 665 | 332 |
| 293 | SR 95E | 5,089 | 5,355 | 95% | 84% | -11% | 5,300 | 1.01 | 4,449 | 851 | 426 |
| 294 | CR 62 | 630 | 638 | 99% | 86% | -13% | 630 | 1.01 | 540 | 90 | 45 |
| 295 | CR 3 | 1,281 | 1,314 | 97% | 91% | -6% | 1,300 | 1.01 | 1,184 | 116 | 58 |
| 296 | 57th Av | 2,125 | 2,173 | 98% | 94% | -4% | 2,150 | 1.01 | 2,012 | 138 | 69 |
| 297 | US 10S | 23,141 | 23,527 | 98% | 69% | -30% | 23,300 | 1.01 | 16,020 | 7,280 | 3,640 |
| 298 | RivRdSE | 2,231 | 2,274 | 98% | 96% | -2% | 2,250 | 1.01 | 2,156 | 94 | 47 |
| 299 | Opp Dr | 2,712 | 2,823 | 96% | 81% | -15% | - | - | - | - | - |
| **300** | **I-94 E** | **29,306** | **41,940** | **70%** | 71% | 1% | 45,500 | **0.92** | 32,260 | 13,240 | 6,620 |
| 301 | CR 44 | 1,374 | 1,513 | 91% | 85% | -5% | 1,500 | 1.01 | 1,281 | 219 | 109 |
| 302 | CR 7 | 1,830 | 1,867 | 98% | 90% | -8% | 1,850 | 1.01 | 1,667 | 183 | 91 |
| 303 | SR 15 S | 4,627 | 6,444 | 72% | 84% | 12% | 6,980 | 0.92 | 5,883 | 1,097 | 549 |
| 304 | CR 141 | 641 | 667 | 96% | 81% | -15% | 660 | 1.01 | 535 | 125 | 63 |
| 305 | CR 8 S | 1,450 | 1,461 | 99% | 91% | -8% | 1,450 | 1.01 | 1,326 | 124 | 62 |
| 306 | CR 140 | 160 | 162 | 99% | 95% | -4% | 160 | 1.01 | 152 | 8 | 4 |
| 307 | SR 23W | 16,031 | 16,402 | 98% | 79% | -19% | 16,300 | 1.01 | 12,902 | 3,398 | 1,699 |
| 308 | CR 2 SW | 3,515 | 3,575 | 98% | 87% | -11% | - | - | - | - | - |
| 309 | CR 160 | 617 | 626 | 99% | 81% | -17% | 620 | 1.01 | 504 | 116 | 58 |
| **310** | **CR 51W** | **899** | **1,559** | **58%** | 85% | 28% | 1,550 | 1.01 | 1,324 | 226 | 113 |
| **311** | **I-94 W** | **24,070** | **36,715** | **66%** | 76% | 11% | 36,500 | 1.01 | 27,862 | 8,638 | 4,319 |
| 312 | CR 155 | 1,830 | 1,838 | 100% | 49% | -51% | - | - | - | - | - |
| 313 | CR 17 | 3,820 | 3,817 | 100% | 38% | -63% | - | - | - | - | - |
| 314 | 130 Av | 803 | 851 | 94% | 18% | -77% | 850 | 1.00 | 150 | 700 | 350 |
| 315 | CR 21 | 905 | 1,104 | 82% | 36% | -46% | 1,100 | 1.00 | 391 | 709 | 354 |
| 316 | 125 St | 5,000 | 5,013 | 100% | 57% | -43% | 5,000 | 1.00 | 2,842 | 2,158 | 1,079 |
| Totals | | 167,516 | 202,579 | | | | 191,895 | 1.06 | 141,988 | 49,907 | 24,953 |

1 Internal-External AADT found in SE data file (representing IE trips only)
2 Base year 2015 assignment volume (including EE and IE)
3 2015 "IE AADT"/2015 Assignment Volume (1 over 2)
4 Percent IE trips according to 2016 StreetLight InSight analysis
5 Difference between StreetLight percent IE and 2015 base year model
6 2015 traffic count in existing model network (some missing from network need filling in)
7 Existing model volume-over-count ratios at external links
8 Updated 2015 AADT volume for SE data file (assuming 2015 count applied to StreetLight IE percent split)
9 Updated 2015 EE total by zone (assuming 2015 count)
10 Updated 2015 EE directional total by zone (assuming 50% ij and 50% ji)

## Instructions on Updating External Trips in Cube

The highlighted numbers from Table 3 in the column titled "New SE IE AADT" should replace current numbers in the last column ("ADT") of the base year socioeconomic data file titled "TAZ_Updated_EIIE.dbf", consistent with the current trip generation model structure. As will be described in a subsequent tech memo on trip generation, the current APO model assumes a percentage of these IE trips are apportioned to each internal trip purpose in the model (home-based work, home-based other, and nonhome-based).

During the 2020 model validation, consideration might be given to assigning all or a percentage of IE trips to a separate IE purpose, distinguished by a unique set of distribution factors (e.g., friction factors) that differ from those applied to internal model study area trip purposes. It is also possible that a different file structure and/or contents might be recommended as part of the 2020 model update. A review of the current model did identify that some external zones are connected directly to network intersections by centroid connectors and thus do not include traffic counts for validation purposes. These missing 2015 counts must be located to compute updated "ADT" values for the socioeconomic data file.

Additionally, the updated 2015 external-external trip estimates depicted with red text below in Table 4 should replace numbers found in the current "2015EE.DAT" file.

**Table 4. Updated Baseline 2015 External-External Trips**

| i> | 20+ Trips | CR 55 N | US 10 N | 15th Av N | Lit Rock | May hew | 65th St NE | Gold Spik | SR 23N | SR 95E | CR 62 | CR 3 | 57th St NE | US 10 S | Riv. RdSE | Opp Dr. | I-94 E | CR 44 | CR 7 | SR 15 S | CR 141S | CR 8 S | CR 140 | SR 23W | CR 2 SW | CR 160 | CR 51W | I-94 W | CR 155 | CR 17 | 130 Ave | CR 21 | 125 St N | Directional EE Trips ij | Total EE Trips ij+ji | Enter Red Values into 2015EE.DAT | %Diff |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| j: | | 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 | 300 | 301 | 302 | 303 | 304 | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 313 | 314 | 315 | 316 | | | Total Diff | % Diff |
| CR 55N | 285 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 37 | 52 | 103 | 0 | 0% |
| US 10N | 286 | 0 | 0 | 0 | 48 | 0 | 55 | 0 | 23 | 104 | 0 | 0 | 40 | 2536 | 0 | 0 | 248 | 0 | 0 | 116 | 0 | 0 | 0 | 56 | 0 | 0 | 0 | 0 | 0 | 151 | 0 | 176 | 800 | 4,353 | 9,368 | (662) | -7% |
| 15th Av | 287 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | 17 | 232 | 1394% |
| LittleR | 288 | 0 | 92 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 92 | 140 | 43 | 31% |
| Mayhew | 289 | 0 | 0 | 0 | 0 | 0 | 156 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 156 | 156 | 156 | 100% |
| 65thNE | 290 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | 211 | (211) | -100% |
| GoldSp | 291 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 90 | 90 | 90 | 100% |
| SR 23N | 292 | 0 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 48 | 0 | 0 | 0 | 103 | 0 | 0 | 0 | 145 | 0 | 0 | 0 | 0 | 0 | 332 | 686 | (21) | -3% |
| SR 95E | 293 | 0 | 173 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 73 | 0 | 0 | 0 | 179 | 0 | 0 | 0 | 0 | 0 | 426 | 722 | 129 | 18% |
| CR 62 | 294 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - | 90 | *0%* |
| CR 3 | 295 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - | 116 | *0%* |
| 57th Av | 296 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | 40 | 98 | 248% |
| US 10S | 297 | 0 | 3430 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 132 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 0 | 0 | 0 | 0 | 40 | 3,640 | 6,362 | 918 | 14% |
| RivRdSE | 298 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - | 94 | *0%* |
| Opp Dr | 299 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | 156 | (156) | -100% |
| I-94 E | 300 | 0 | 319 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 124 | 0 | 0 | 0 | 0 | 0 | 70 | 0 | 0 | 0 | 1706 | 0 | 0 | 49 | 4182 | 105 | 65 | 0 | 0 | 0 | 6,620 | 12,113 | 1,127 | 9% |
| CR 44 | 301 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 | 0 | 0 | 0 | 70 | 0 | 0 | 0 | 0 | 0 | 109 | 181 | 38 | 21% |
| CR 7 | 302 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - | 183 | *0%* |
| SR 15 S | 303 | 0 | 197 | 0 | 0 | 0 | 0 | 0 | 63 | 39 | 0 | 0 | 0 | 0 | 0 | 0 | 66 | 0 | 0 | 0 | 0 | 0 | 0 | 47 | 0 | 0 | 0 | 137 | 0 | 0 | 0 | 0 | 0 | 549 | 962 | 135 | 14% |
| CR 141 | 304 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 63 | 82 | 43 | 53% |
| CR 8 S | 305 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 0 | 0 | 42 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 62 | 220 | (96) | -44% |
| CR 140 | 306 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - | 8 | *0%* |
| SR 23W | 307 | 0 | 58 | 0 | 0 | 0 | 0 | 0 | 92 | 47 | 0 | 0 | 0 | 0 | 0 | 42 | 1220 | 30 | 0 | 31 | 0 | 96 | 0 | 0 | 53 | 0 | 0 | 29 | 0 | 0 | 0 | 0 | 0 | 1,699 | 3,766 | (368) | -10% |
| CR 2 SW | 308 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | 151 | (151) | -100% |
| CR 160 | 309 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 58 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 58 | 58 | 58 | 100% |
| CR 51W | 310 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 53 | 0 | 0 | 0 | 0 | 0 | 113 | 198 | 28 | 14% |
| I-94 W | 311 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 85 | 105 | 0 | 0 | 0 | 33 | 0 | 113 | 3709 | 42 | 0 | 149 | 0 | 0 | 0 | 0 | 47 | 0 | 36 | 0 | 0 | 0 | 0 | 0 | 0 | 4,319 | 9,153 | (515) | -6% |
| CR 155 | 312 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | 234 | (234) | -100% |
| CR 17 | 313 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | 629 | (629) | *0%* |
| 130 Av | 314 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 102 | 203 | 0 | 0 | 45 | 350 | 350 | 350 | 100% |
| CR 21 | 315 | 0 | 151 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 204 | 354 | 681 | 28 | 4% |
| 125 St | 316 | 51 | 558 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 51 | 0 | 0 | 0 | 26 | 211 | 0 | 150 | 0 | 1,079 | 2,204 | (46) | -2% |

## Next Steps

APO staff will edit the files "TAZ_Updated_EIIE.dbf" and "2015EE.DAT" with the updated 2015 numbers provided in this memo for the purposes of model testing. At some point, these 2015 numbers will be adjusted to reflect new base year traffic counts for 2020 or 2021, though it is possible that new data formats will ultimately be recommended for the 2020 APO model. The StreetLight InSight analysis described in this tech memo could also be updated for a new base year; however, the year 2020 is in too much flux to be considered as average conditions.

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# TECHNICAL MEMORANDUM

TO: Brian Gibson, Executive Director, St. Cloud Area Planning Organization

FROM: Rob Schiffer, National Practice Leader, Travel Demand Forecasting

DATE: September 29, 2020

SUBJECT: St. Cloud APO Model Improvements Task 3: Socioeconomic Data

---

This Draft Technical Memorandum outlines recommendations on replacement socioeconomic attributes and reasonableness ranges for data checking as part of an update to the St. Cloud Area Planning Organization (APO) travel demand model. Discussions are divided into the following topics:

- Task 3 Scope of Work
- Recommended replacement socioeconomic attributes
- Reasonableness ranges for data checking
- Next steps

This draft tech memo will be updated to reflect all comments received from APO staff. A separate tech memo will be provided on trip generation, reflecting recommendations on trip production and attraction rates as well as trip rates for special generators.

## Task 3 Scope of Work

The Consultant shall review the current land-use categories and how each is used in the Trip Generation step, and, if appropriate, make one or more recommendations for changes. The Consultant shall also develop one or more automated checking tools for both TAZs and Districts that include:

- Zones with no socio-economic data
- Zones that are not connected to the network
- Persons per household ratios
- Household density and population density
- Student to service employment ratios
- Employment per acre ratios (on commercial acres only)
- District population and employment totals and growth over base
- District-level jobs and household balance
    - The Consultant shall measure the jobs and households balance by district for the base year to establish a high-low range of “normal” existing conditions.

## Recommended Replacement Socioeconomic Attributes

The current St. Cloud trip generation model relies heavily on the use of vehicle trip rates from the Institute of Transportation Engineers’ (ITE) Trip Generation Handbook. Hence, the land use and socioeconomic data used in the current model are consistent with variables used in ITE trip

generation equations. While the ITE Trip Generation approach is standard practice for Traffic Impact Studies, it is a rather unconventional and limiting approach for regional travel demand modeling. This topic will be discussed in greater detail in a future Technical Memorandum on Trip Generation but key limitations with the ITE approach are as follows:

- ITE variables are generally too numerous and specific for regional analyses
- ITE variables are difficult to forecast
- ITE trip rates are mostly in vehicle equivalents whereas most travel demand models generate person trips that are later converted to vehicle trips during mode choice

Table 1 provides a comparison between existing demographic variables and those recommended for the next St. Cloud APO model. Each of these attributes is described further in the text below the table.

**Table 1. Conversion of St. Cloud Travel Demand Model Land Use Categories**

| # | Socioeonomic/Land Use Categories | Current Model Units | Abbreviation | Proposed Model Units | Sources | Employees per SF avg. |
|---|---|---|---|---|---|---|
| 1 | Single Family Residential | Dwelling Units | SFR | Households | Census, CTPP, permit records | n/a |
| 2 | Medium/High Density Residential | Dwelling Units | MHR | merge with #1 | merge with #1 | n/a |
| 3 | Office | 1,000 Square Feet | OFFICE | Office Employment | InfoGroup | 150 to 300 |
| 4 | Industry | 1,000 Square Feet | IND | Industrial Employment | InfoGroup | 500 to 1,000 |
| 5 | Low Industry | 1,000 Square Feet | LIND | merge with #4 | merge with #4 | merge with #4 |
| 6 | Low Retail | 1,000 Square Feet | LRET | Retail Employment | InfoGroup | 300 to 700 |
| 7 | Medium Retail | 1,000 Square Feet | MedRET | merge with #6 | merge with #6 | merge with #6 |
| 8 | High Retail | 1,000 Square Feet | HighRET | merge with #6 | merge with #6 | merge with #6 |
| 9 | Hotel/Motel | Rooms | HOT | Rooms | direct contact-new properties | n/a |
| 10 | School | Enrollment | SCH | Enrollment | School Boards | n/a |
| 11 | Parks | Acres | PARK | *consider replacing with special generators* | | n/a |
| 12 | Hospital | Beds | HOSP | *consider replacing with special generators* | | n/a |
| 13 | College | Students | COLL | Students | Universities | n/a |
| 14 | Existing Traffic Count | Vehicles per Day | ADT | *consider alternate format for external trip control totals* | | n/a |

While dwelling units (DUs) are usually synonymous with households (HHs), the latter has become a more customary attribute, with most transferable trip rate parameters reflecting the number of HHs. More important than whether these HHs are single- or multi-family (as in the current model) is their composition by attributes such as HH income, HH size, autos/HH, and workers/HH. Most trip generation models cross classify HH trip rates by 1-3 of these attributes. While ITE data indicate a significant difference in trip-making characteristics between single- and multi-family units, percent auto availability and income quartiles provide an even greater level of differentiation in trip rates with a broader range of household categories.

As an example, using household characteristics in place of dwelling unit type, the new model would differentiate between the trip-making characteristics of a low-income neighborhood that primarily dwells in multi-family HHs vs. a neighborhood of wealthy, large single-family homes, on the basis of HH income rather than SF vs. MF DUs. Many models assume that the same base year proportionate HH characteristics exist into the future (i.e., assuming the same distribution by income, etc.) unless trends show that the nature of these areas will be shifting dramatically in the future. One forecasting option is to identify a TAZ in the base year that is similar to what another zone is expected to be like in the future and applying those base HH distributions to

the evolving zone in the future. It should be noted that auto availability, etc. is often only available at a higher level of geography than HHs and thus several adjacent zones might use the same distribution patterns of HHs by size, workers, autos, and/or income.

Final recommendations on supplemental HH characteristics will be outlined in the forthcoming trip generation tech memo. Table 2 provides examples of how these characteristics could potentially be divided up. More advanced models alternately include an auto availability model that forecasts auto availability by zone based on income and other related attributes.

**Table 2. New Recommended Socioeconomic Data Categories**

| Name | Use | Sources |
|---|---|---|
| Population | persons per HHs | Census, CTPP |
| Auto Availability | % 0, 1, 2, 3+ autos/HH | Census, CTPP |
| HH Income | % HHs by income quartile | Census, CTPP |
| No. of Workers | % 0, 1, 2+ workers/HH | Census, CTPP |

APO staff are presently estimating zonal employment using proprietary data from InfoGroup, thus replacing the use of commercial square footage in the new trip generation model. While it is true that trip attraction rates per employee differ significantly for a corner convenience store vs. a big box retail operation, retail stores are trip attracters rather than trip producers. The relative attractiveness of differing retail land uses will now be determined by the number of employees in the TAZ, and it is much easier to back check employment numbers during a model validation/calibration process than to check/confirm building square footage. Employment is also easier to forecast than building square footage since there are many government agencies and private sector companies tracking employment at the county level.

Hotel/motel rooms and student enrollment should continue to be maintained as in the current model, although related trip rates will change to reflect standard practices and transferable trip rates. Since employment is already a trip attraction attribute, hotel/motel rooms should be used to generate trip productions as a household surrogate for out-of-town travelers.

It is recommended that park acreage and hospital beds be replaced with special generators, but only where needed. Employment estimates should be used to attract trips to hospitals with special generator adjustments added only as needed. Parks are tricky because they generally have few employees. If a park is part of a larger zone, the hope would be that other uses in the TAZ would compensate for a portion of the recreational trips; however, if a park is located in its own zone, special generators might be the only option, perhaps using the MnDOT StreetLight InSight data shared license to estimate person trip activity at these locations.

Decisions on the need for special generators should be based on model performance. Model validation typically starts without any special generators with these incrementally added if roadways surrounding a major land use are under-assigning trips. There is no specific threshold for imposing the use of special generators; however, special generators are usually only applied to unique land uses such as major regional malls, colleges/universities, military bases, regional parks, and sometimes hospitals. If needed to improve model accuracy, Crossroads Center, St. Cloud State University, St. Cloud Hospital, St. Cloud VA Health Care, and College of St. Benedict

have the potential to be special generators. The primary reason to minimize special generators is because then their trip activity needs to be forecasted, which is more complicated than simply forecasting employment numbers.

## Reasonableness Ranges for Data Checking

The resulting updated trip generation model will include a series of accuracy/quality control checks on the socioeconomic data. Table 3 includes a set of preliminary reasonableness ranges to flag potential data errors, along with data sources used to identify these ranges. The 2017 National Household Travel Survey (NHTS) is cited for three of these ratios. The National Center for Education Statistics (NCES) publishes ratios on students to service employment.

Employment to population was derived from the Florida DOT's FSUTMS Model Calibration and Validation Standards. Typical households per square mile comes from a study of 1990, 2000, and 2010 Census Tract data. The Brookings Institute cites less than 5,000 employees per square mile as typical in most metropolitan areas, with "only a handful of other metros" having more than 20,000 employees per square mile. EPA's EnviroAtlas states that "an employment to housing ratio in the range of 0.75 to 1.5 is considered beneficial for reducing vehicle miles traveled" while the publication Urban Studies indicates "only when the jobs−housing ratio is less than 1.2 or larger than 2.8 do VMT vary noticeably as the jobs−housing ratio changes."

**Table 3. Proposed Acceptable Socioeconomic Data Ratios**

| Acceptable Socioeconomic Data Ratios | | |
|---|---|---|
| **Name** | **Acceptable Range** | **Sources** |
| Persons per HH | 2.55 (2.42 Midwest) | NHTS 2017 |
| Student to service emp | 31.9 U.S. (43.2 MN) | NCES |
| Employment/Pop Ratio | 0.35 to 0.75 | FSUTMS Val |
| Workers/HH | 1.33 (1.29 Midwest) | NHTS 2017 |
| Autos/HH | 1.88 (1.96 Midwest) | NHTS 2017 |
| HHs per square mile | 1.02 to 2,213=suburban | jedkolko.com |
| | <1.02-rural;>2,213=urban | |
| employment/sq. mile | <5,000 in most MSAs | Brookings Inst |
| Jobs/housing balance | 0.75 to 1.5 (desirable) | EnviroAtlas |
| | 1.2 to 2.8(min VMT impact) | Urban Studies |

## Next Steps

As noted earlier, APO staff have initiated development of base year employment estimates using proprietary data from InfoGroup. The APO plans on developing a base year 2020 travel demand model that makes use of these employment estimates in conjunction with Census 2020 data and results from a planned household travel survey. Delays with the 2020 Census, due to COVID19, will impact the startup of this model development effort. COVID19 might also delay the household travel survey, as travel patterns remain in flux. In the meantime, interim APO estimates of base year socioeconomic data and transferable model parameters and other assumptions will suffice for testing of the recommended trip generation model structure.

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# TECHNICAL MEMORANDUM

TO: Brian Gibson, Executive Director, St. Cloud Area Planning Organization

FROM: Rob Schiffer, National Practice Leader, Travel Demand Forecasting

DATE: October 16, 2020

SUBJECT: St. Cloud APO Model Improvements Task 4: Highway Network

---

This Draft Technical Memorandum describes the St. Cloud Area Planning Organization (APO) travel demand model highway network database and efforts aimed at updating this information. Discussions are divided into the following topics:

- Task 4 Scope of Work
- Recommended revisions to network
- Pre-processing algorithms
- Free-flow speeds and capacities
- Next steps

This draft tech memo will be updated to reflect all comments received from APO staff.

## Task 4 Scope of Work

The Consultant shall review the APO's true-shape link network and, if appropriate, recommend revisions to the network and/or link attributes.

The Consultant shall also develop pre-processing algorithms Cube scripts to automatically detect many common coding errors. Errors will result in a red-flag popup box indicating that an error has been detected.

The Consultant shall also develop and insert into the travel demand model a free-flow speed estimator based on the roadway functional classification, number of lanes, area type, intersection control type, and posted speed limit. Task 4 Deliverables:

1) A technical memo recommending revisions to the roadway network and link attributes;
2) Pre-processing algorithms to catch network coding errors; and
3) Rule-based establishment of free-flow speeds and capacities.

## Recommended Revisions to Network

The most recent available APO model documentation is a 17-page memorandum titled *Travel Demand Model Update* and dated January 3, 2019. This memorandum was preceded by a report titled *St. Cloud APO Catalog Model User's Guide,* dated February 2013. Surprisingly, neither of these documents define unloaded network attributes in the St. Cloud travel demand model. The highway network was transformed from a Cube .NET format to a Cube geodatabase during the 2015 base year model update and recently updated by APO staff.

Table 1 is a listing of network attributes in the current network, along with our understanding of their definitions and notations on how these attributes are used in the model. As indicated in this table, there are several network attributes in the existing network that might no longer be needed, along with others that should be added or repurposed. Metro Analytics staff have already added the directional number of lanes (DIRLANES) based on existing attributes THROUGH_LA and ONEWAY_TWO. It might also be desirable to include a flag for Uninterrupted Flow Arterials. Two more attributes will be added to the network (SCREENLINE and DIVIDED). Table 2 provides a set of new repurposed area type codes for the model update.

**Table 1. St. Cloud APO Model Network Attributes**

| Attribute Name[1] | Minimum Value | Maximum Value | Attribute Definition[2] | Observations | Recommended Changes to Attribute |
|---|---|---|---|---|---|
| AX/BX | 391987 | 391959.53 | X-Coordinate | | |
| AY/BY | 5063559 | 5061153.2 | Y-Coordinate | | |
| A | 1 | 7275 | ANODE | | |
| B | 1 | 7275 | BNODE | | |
| OBJECTID | 0 | 1918 | LINK ID | | |
| SPEED | 0 | 70 | Posted Speed | | |
| MODELED | 0 | 2 | Flag for model inclusion | codes 0, 1, and 2 undefined | |
| ENABLED | 0 | 1 | Flag for model enabling | codes 0, 1, and 2 undefined | |
| CONTROL | 0 | 4 | Unknown | | |
| DIRECTION | 0 | 8 | Unknown | | |
| CITY | 0 | 16 | Unknown | what are the 16 codes? | |
| FUNC_CLASS | 0 | 11 | Federal Functional Classification | appears to be consistent | no changes necessary |
| AREA_TYPE | 0 | 2 | Surrounding Land Use Character | 0=centroids; 1=urban core; 2=other | see Table 2 recommendations |
| NAME | 10th Ave N | Westwood | Roadway Name | no comment | new links will need corrections |
| LAND_USE | 0 | 0 | Unknown | | replace with new area types |
| LINKGRP1 | 0 | 99 | Old TRANPLAN attribute | unclear how/if still used | confirm relevance |
| FMTRUCKCNT | 0 | 3250 | Truck Count | unclear what FM means | replace with 2020 truck counts |
| ADT_2015 | 0 | 23600 | 2015 Average Daily Traffic Count | no comment | replace with 2020 ADT counts |
| SHAPE_LENG | 0 | 8189.3213 | Link length in feet(?) | unclear how/if still used | distance computed in model run |
| COUNTY | 0 | 3 | County Identifier | 1=Stearns;2=Benton;3=Sherburne | no changes necessary |
| ALT_NAME | 10th Ave N | Wilson Ave | Alternate Roadway Name | no comment | up to APO on usefulness to keep |
| OWNERSHIP | 0 | 12 | Unknown | lots of categories | up to APO on usefulness to keep |
| THROUGH_LA | 0 | 4 | Number of through lanes | lanes per direction is preferable | remove/replace with DIRLANES |
| CHECKED | 0 | 1 | Unknown | perhaps for error checking? | up to APO on usefulness to keep |
| ONEWAY_TWO | 1 | 2 | One-Way/Two-Way Flag | 1=oneway link; 2=two way link | no changes necessary |
| DIRLANES | 0 | 4 | Directional number of lanes | best for capacity calculation | Metro added this attribute |
| SCREENLINE | 0 | 99 | Screenline link | needed to volume-over-count | Metro will add this attribute |
| DIVIDED | 0 | 1 | Presence of median | needed for capacity calculation | Metro will add this attribute |

[1]Excludes _R attributes (reverse direction) and temporary attributes

[2]Based on general modeling knowledge, field inventory, and Google Map satellite view

**Table 2. Recommended St. Cloud APO Area Types**

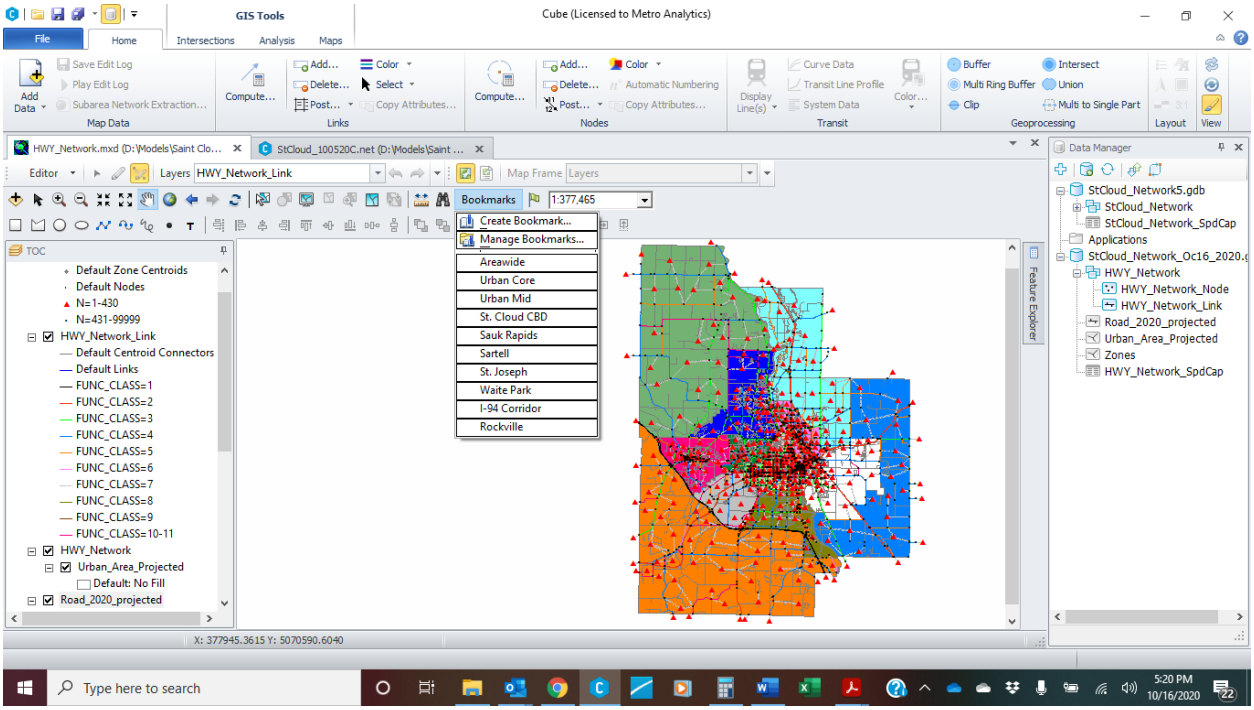
| Code | Name | Definition |
|---|---|---|
| 1 | CBD | Central Business District |
| 2 | CBD Fringe | Mixed Use Adjacent to CBD |
| 3 | Residential | Predominantly Residential Area |
| 4 | OBD | Outlying Business District (suburban commercial) |
| 5 | Transitioning | Ex-Urban (urbanizing over next 20 years) |
| 6 | Rural | Areas beyond urban transitioning boundary |

Metro Analytics staff relocated all previously coded centroids and connectors for consistency with recommended and approved zone splits. New centroids and connectors were also added for new zones and locations where zone access was missing. Some roadway links bordering newly split zones were also added to the network. These edits were made by exporting the network shape file to a Cube .NET file and using Cube Base for network editing. Care was taken to minimize link splits so as to not disrupt the true shape network display. Once these edits were complete, the network was imported to an updated geodatabase that includes the following GIS layers:

- Highway network link
- Highway network node
- Urban area boundary
- 2020 street network (all roads)
- Traffic analysis zones (TAZs)

Color line posting was added to the geodatabase for centroids, network lanes, functional classification, and area type as well as fill colors in the TAZ shape file to depict transportation analysis districts (aggregations of TAZs). Bookmarks were added so that model users can easily move from one view to another for the purposes of editing and printing. Figure 1 depicts the geodatabase for the St. Cloud APO model, including network links by functional class, nodes by centroid, TAZs by District, and a pull-down of bookmarks saved in the geodatabase .MXD file.

**Figure 1. Highway Network for the St. Cloud APO Region**




The network geodatabase received from APO staff had a minimal number of nodes and also had issues related to ANODE/BNODE sequencing. Nodes must be properly and strategically

located in the model network for Cube to build travel time paths (skims) between zones and load trips to the network. Since Metro Analytics staff minimized link splits when incorporating new centroid connectors, some connectors are not ideally located. All new centroid nodes are numbered between 262 and 376, with the latter representing the new maximum internal zone number. External zones have also been renumbered, from the previous range of 285-316 to an updated range of 400-430, as noted in the Task 2 Technical Memorandum. New non-centroid network nodes are generally numbered in the 7000+ series.

It is recommended that additional editing of centroid connectors be completed using Cube during subsequent 2020 validation efforts. The network must NOT be edited using ArcGIS as this causes inconsistencies with sequencing of ANODE/BNODE information that is vital to the use of Cube networks for network skimming and trip assignment.

Table 3 depicts our understanding of functional classification codes used in the APO model. Codes 1-5 follow standard FHWA functional classifications, but the remainder do not.

**Table 3. St. Cloud APO Functional Classification Codes**

| Code | Functional Classification |
|---|---|
| 1 | Interstate Highways |
| 2 | Other Freeways & Expressways |
| 3 | Other Principal Arterials |
| 4 | Minor Arterials |
| 5 | Collectors |
| 6 | not used |
| 7 | Centroid Connectors |
| 8 | On-Ramps |
| 9 | Off-Ramps |
| 10 | not used |
| 11 | Local Streets (?) |

## Pre-processing Algorithms

The purpose of pre-processing algorithms is to flag potential syntax errors in the highway network coding. Cube scripting in the current APO model will be modified to include the following error checks:

- Allowable values for coding of FUNC_CLASS, AREA_TYPE, and DIRLANES
- If SCREENLINE>0 link must include a traffic count (ADT)
- If FMTRUCKCNT>0 link must also include ADT>0
- If FUNC_CLASS<3, DIRLANES>1
- If FUNC_CLASS<4 and FUNC_CLASS=8-9 must be coded with ONEWAY_TWO=1
- If FUNC_CLASS<3 no adjacent links with FUNC_CLASS<8 or FUNC_CLASS>9
- If ANODE or BNODE=1-430, FUNC_CLASS=7 (Centroid Connectors)
- Flag unconnected zone centroids

The updated color, plot, and post settings in the MXD file should also assist in quality control of the model network.

## Free-flow Speeds and Capacities

The most recent 2015 APO model appears to have speeds and capacities assigned directly to each link in the highway network. The previous capacity attribute (CAPACITY_yy) was not carried over to the updated network geodatabase, as evidenced by the network attribute listing provided earlier in Table 1. The previous free-flow speed (FF_SPEED) attribute has been replaced with SPEED, which appears to represent posted speed. While it is good practice to include posted speed in the model network, adjustment of speeds is often a key component of model validation, best addressed via a lookup table.

The preferred approach in most travel demand models is to use lookup tables for capacities and free-flow speed adjustments. Lookup tables simplify the assignment of capacities and speed adjustments to a single table based on key network characteristics that directly impact travel flow. Once the table is populated, the focus of quality control is on network characteristics such as functional classification (or facility type), area type, number of lanes, one-way/two-way status and presence of a median, which are easy to view by color in Cube Base.

Several states have developed standard speed and capacity lookup tables to be used in MPO travel demand models. Florida was the first state in the U.S. to implement a standard set of speeds and capacities for its travel demand modeling and systems planning efforts. Florida's *QUALITY/LEVEL OF SERVICE HANDBOOK* has gone through many revisions over the years, consistent with changes to the Transportation Research Board's *Highway Capacity Manual*. The FDOT 2020 Q/LOS Handbook provides "service volumes" for each LOS category, with LOS E service volumes representing "absolute capacity".

Extensive model testing by the author of this memorandum has shown that trip diversion begins prior to a roadway achieving absolute capacity, generally around LOS C or D. One approach to addressing this issue is to implement variable UROAD factors in the highway assignment model, as is done in Florida, since the differences between LOS C, D, and E vary by roadway type. With this approach, UROAD factors are applied to absolute capacities in the lookup table to achieve "practical capacity," or the point at which trip diversion begins. The need for UROAD factors in conjunction with updated BPR (Bureau of Public Roads) curves can be addressed during the 2020 model validation process. Another potential attribute called CONFAC can be used to toggle between daily and peak period capacity values in the model.

Table 4 provides a suggested starting point for daily capacity values in the updated APO model. Peak hour model capacities will be a percent of daily values, based on available information on regional peak period traffic characteristics. The values listed in this table were derived from standard service volume tables found in the FDOT 2020 Q/LOS Handbook Appendix. Q/LOS adjustment factors were used for medians, one-way vs. two-way, non-state roadways (collectors and local streets), etc. Some confirmation or clarification might still be needed on the definition of functional classification categories in the model. Functional class categories

could be switched to a series of facility types that could include categories with and without signals, etc.

**Table 4. Proposed St. Cloud APO Daily Capacities**

| | Highway Network Characteristics Relevant to Capacities | | | | | Daily Capacities by Area Type | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | Functional Classification | Posted Speed | Uninterrupted or Signalized | No. of Lanes | Divided vs. Undivided | CBD | CBD Fringe | Suburban Residential | Suburban OBD | Transitioning (Ex-Urban) | Rural (Undeveloped) |
| 1-2 | Interstate Highways and | All | Uninterrupted | 4 | Divided | 87,300 | 87,300 | 85,400 | 85,400 | 72,600 | 63,200 |
| | Other Freeways | All | Uninterrupted | 6 | Divided | 131,200 | 131,200 | 128,100 | 128,100 | 108,900 | 94,800 |
| 3-4 | Other Principal Arterials and Minor Arterials | 50 MPH+ | Uninterrupted Flow | 2 | Divided | n/a | n/a | 34,230 | n/a | 33,180 | 29,925 |
| | | | | 4 | Divided | | | 75,300 | | 71,700 | 62,700 |
| | | | | 6 | Divided | | | 113,100 | | 107,400 | 94,200 |
| | | | | 2 | Undivided | | | 32,600 | | 31,600 | 28,500 |
| | | | | 4 | Undivided | | | 71,535 | | 68,115 | 59,565 |
| | | | | 6 | Undivided | | | 107,445 | | 102,030 | 89,490 |
| 3-4 | Other Principal Arterials and Minor Arterials | 40 MPH+ | Signalized | 2 | Divided | 18,585 | 18,585 | 18,585 | 18,585 | 17,010 | 14,910 |
| | | | | 4 | Divided | 39,800 | 39,800 | 39,800 | 39,800 | 35,500 | 30,400 |
| | | | | 6 | Divided | 59,900 | 59,900 | 59,900 | 59,900 | 53,500 | 45,800 |
| | | | | 2 | Undivided | 17,700 | 17,700 | 17,700 | 17,700 | 16,200 | 14,200 |
| | | | | 4 | Undivided | 37,810 | 37,810 | 37,810 | 37,810 | 33,725 | 28,880 |
| | | | | 6 | Undivided | 56,905 | 56,905 | 56,905 | 56,905 | 50,825 | 43,510 |
| 3-4 | Other Principal Arterials and Minor Arterials | 35 MPH- | Signalized | 2 | Divided | 16,380 | 16,380 | 16,380 | 16,380 | 14,910 | n/a |
| | | | | 4 | Divided | 33,800 | 33,800 | 33,800 | 33,800 | 31,600 | |
| | | | | 6 | Divided | 50,900 | 50,900 | 50,900 | 50,900 | 47,600 | |
| | | | | 2 | Undivided | 15,600 | 15,600 | 15,600 | 15,600 | 14,200 | |
| | | | | 4 | Undivided | 32,110 | 32,110 | 32,110 | 32,110 | 30,020 | |
| | | | | 6 | Undivided | 48,355 | 48,355 | 48,355 | 48,355 | 45,220 | |
| 5 | Collectors | | | 2 | Divided | 14,742 | 14,742 | 14,742 | 14,742 | 13,419 | 13,419 |
| | | All | All | 4 | Divided | 30,420 | 30,420 | 30,420 | 30,420 | 28,440 | 27,360 |
| | | | | 2 | Undivided | 14,040 | 14,040 | 14,040 | 14,040 | 12,780 | - |
| | | | | 4 | Undivided | 28,899 | 28,899 | 28,899 | 28,899 | 27,018 | - |
| 6 | not used | | | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| 7 | Centroid Connectors | | | 2 | All | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 |
| 8 | On-Ramps | | Uninterrupted | 1 | All | 20,538 | 20,538 | 20,538 | 20,538 | 19,908 | 17,955 |
| 9 | Off-Ramps | | Signalized | 1 | All | 9,828 | 9,828 | 9,828 | 9,828 | 8,946 | 8,946 |
| 10 | not used | | | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| 11 | Local Streets (?) | | | 2 | All | 14,040 | 14,040 | 14,040 | 14,040 | 12,780 | - |

## Next Steps

Recommendations in this memorandum will be used for scripting updated Cube/Voyager network and assignment modules, in conjunction with comments received from APO staff. Additional network editing will be needed during the 2020 model validation effort, as noted elsewhere in this memorandum. Volume/delay functions related to the capacity values in this tech memo will be addressed as part of Task 8, Trip Assignment.

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# TECHNICAL MEMORANDUM

TO: Brian Gibson, Executive Director, St. Cloud Area Planning Organization

FROM: Rob Schiffer, National Practice Leader, Travel Demand Forecasting

DATE: October 20, 2020

SUBJECT: St. Cloud APO Model Improvements Task 5: Trip Generation

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This Draft Technical Memorandum describes an updated trip generation process for the St. Cloud Area Planning Organization (APO) travel demand model. Discussions are divided into the following topics:

- Task 5 Scope of Work
- Trip purpose structure
- Trip production and attraction rates
- College and University trips
- Next steps

This draft tech memo will be updated to reflect all comments received from APO staff. The Task 3 Technical Memorandum provides additional guidance on socioeconomic data and special generators.

## Task 5 Scope of Work

The Consultant shall develop and implement in the travel demand model files a home-based-school trip purpose.

The Consultant shall make a recommendation for updates to the trip production and attraction rates within the model.

The Consultant shall also use readily available Streetlight Data to develop home-based college trip tables by time of day. Task 5 Deliverables:

1) A technical memo with proposed sources and changes to trip rates and special generators and step-by-step instructions on how APO staff can incorporate those changes into the travel demand model files; and

2) Creation of college trip tables using Streetlight Data and modification of the travel demand model process files to include this special trip generation table for college students

## Trip Purpose Structure

The current St. Cloud APO trip generation model calculates trip productions and attractions in vehicular equivalents for three trip purposes for both internal and external traffic analysis zones (TAZs). Most MPO model instead generate person trips and include a separate trip purpose for internal-external trips. The three trip purposes used in the current model are as follows:

1. Home-based work (HBW)
2. Home-based other (HBO)
3. Nonhome-based (NHB)

The current 2015 APO model does not separate out home-based school trips by purpose but rather includes these under the home-based other purposes, using data on the student enrollment. The APO desires to separate out home-based school as a separate trip purpose, as is done in many MPO models. The updated trip generation model would then split the current home-based other trip purpose into two new purposes: home-based nonwork (HBNW) and home-based school (HBSC).

It is also recommended that two additional trip purposes be added to the model, consistent with most MPO models: truck trips and internal-external trips. With an ever-increasing emphasis on freight planning, having a separate truck trip purpose will enable the APO to monitor truck travel, such as truck trip generators and major truck routes. Validation of truck trips will require that truck counts be added to the Cube highway network. Some models differentiate between light-duty, medium-duty and/or heavy-duty trucks; however, validating such a differentiation would require truck counts by vehicle class. Furthermore, freight and non-freight goods can be transported by a wide range of vehicle types so, absent a wealth of truck data, a single truck trip purpose should suffice at this point in time for the APO model.

Internal-external trips are those with one trip end inside the MPO model area and one trip end outside the MPO model area. Some MPO models differentiate between internal-external (IE) and external-internal (EI) trips but since trip ends are balanced during trip generation, it seems sufficient to have a single trip purpose to cover flows between internal and external zones. With the introduction of a separate internal-external purpose, it might be desirable during model validation to implement special generators or demographic data to attract work trips to external zones, if there are a large number of work trips attracted to areas outside the APO. Conversely, the advantage of a separate IE purpose is the ability to better control the number of trips at each external zone without impacting the attraction of trips to work, etc. locations inside the model study area.

Table 1 is a listing of trip purposes recommended for the new APO trip generation model. It is worth noting that truck trips are generally a subset of nonhome-based trips.

**Table 1. St. Cloud APO Recommended 2020 Trip Purposes**

| **Trip Purposes** | |
|---|---|
| **Existing** | **Recommended** |
| Home-Based Work | Home-Based Work |
| Home-Based Other | Home-Based Nonwork |
| | Home-Based School |
| Nonhome-Based | Nonhome-Based |
| | Trucks |
| N/A | Internal-External |

## Trip Production and Attraction Rates

The St. Cloud APO has funded a household travel survey that should serve as the primary source for trip rates used in the updated 2020 base year trip generation model. In the meantime, trip production and attraction rates can be borrowed from *NCHRP 716 – Travel Demand Forecasting: Parameters and Techniques*. NCHRP 716 was published in 2012, with trip rates and other transferable parameters calculated using the 2009 National Household Travel Survey (NHTS). Tables 2 through 5 provide recommended interim trip production rates for the HBW, HBNW, HBSC, and NHB purposes, respectively.

**Table 2. St. Cloud APO Recommended Interim Trip Production Rates: Home-Based Work**

| Autos per HH | Persons per Household | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5+ |
| 0 | 0.2 | 0.7 | 1.0 | 1.0 | 1.0 |
| 1 | 0.6 | 0.8 | 1.2 | 1.7 | 1.5 |
| 2 | 0.7 | 1.3 | 2.0 | 2.0 | 2.3 |
| 3+ | 0.9 | 1.4 | 2.6 | 2.9 | 3.3 |

**Table 3. St. Cloud APO Recommended Interim Trip Production Rates: Home-Based Nonwork**

| Autos per HH | Persons per Household | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5+ |
| 0 | 1.2 | 3.0 | 4.5 | 6.8 | 8.1 |
| 1 | 1.9 | 3.5 | 6.2 | 8.0 | 8.1 |
| 2 | 2.0 | 3.6 | 6.2 | 8.0 | 9.9 |
| 3+ | 2.0 | 3.6 | 6.2 | 8.0 | 11.6 |

**Table 4. St. Cloud APO Recommended Interim Trip Production Rates: Home-Based School**

| Autos per HH | Persons per Household | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5+ |
| 0 | - | 0.1 | 0.8 | 1.5 | 1.6 |
| 1 | - | 0.1 | 0.8 | 1.6 | 2.4 |
| 2 | - | 0.1 | 0.8 | 1.7 | 2.6 |
| 3+ | - | 0.1 | 0.8 | 1.8 | 2.7 |

**Table 5. St. Cloud APO Recommended Interim Trip Production Rates: Nonhome-Based**

| Autos per HH | Persons per Household | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5+ |
| 0 | 0.7 | 1.7 | 2.0 | 3.7 | 3.9 |
| 1 | 1.4 | 2.3 | 3.5 | 3.9 | 3.9 |
| 2 | 1.6 | 2.6 | 3.9 | 5.5 | 5.6 |
| 3+ | 1.6 | 2.7 | 4.5 | 5.8 | 7.1 |

NCHRP 716 also provides ranges for trip attraction rates, excerpts of which are depicted in Table 6. These trip attraction rates are only a starting point for adjustment during model validation to achieve a better balance between trip productions and attractions. Truck trip rates, as indicated in particular, vary widely based on the industrial mix within a given region.

**Table 6. St. Cloud APO Recommended Interim Trip Attraction Rates**

| | Trip Attraction Rates by SE Data Attributes | | | | | |
|---|---|---|---|---|---|---|
| | | School | Employment | | | |
| Trip Purpose | Households | Enrollment | Basic | Retail | Service | Total |
| Home-Based Work | - | - | - | - | - | 1.2 |
| Home-Based Nonwork | 1.2-2.4 | - | 0.2-0.7 | 7.7-8.4 | 0.7-3.5 | - |
| Home-Based School | - | 1.1-1.4 | - | - | - | - |
| Nonhome-Based | 0.6-1.4 | - | 0.5 | 4.7-6.9 | 0.9-1.4 | - |
| Trucks | 0.0283-0.163 | - | 0.0118-10.88 | 0.009-0.0744 | 0.008-0.038 | - |

## College and University Trips

The existing St. Cloud APO travel demand model treats colleges and universities as a separate land use/socioeconomic category. The current model essentially takes the student enrollment at each campus and multiplies that by a vehicle trip rate of 2.37 and then apportions trips to productions and attractions by the three trip purposes. Staff provided base year 2015 and 2020 student enrollment at each college and university campus in the region depicted in Table 7.

**Table 7. St. Cloud APO University and College Enrollment**

| APO TAZ | | | School Year | | Student Enrollment | | |
|---|---|---|---|---|---|---|---|
| 2015 | 2020 | Institution | 2015 | 2020 | 2015 | 2020 | Address |
| 88 | 232 | St. Cloud State University | Fall 2015 | Fall 2019 | *16,096* | *12,608* | 720 4th Ave S, St Cloud, MN 56301 |
| 29 | 142 | St. Cloud Technical Community College | Fall 2015 | Fall 2018 | *4,701* | *5,624* | 1540 Northway Dr, St Cloud, MN 56303 |
| 92 | 272 | Rasmussen College | Fall 2017 | Fall 2017 | *542* | *542* | 226 Park Avenue South, St. Cloud, Minnesota 56301 |
| 131 | 369 | College of St. Benedict | Fall 2015 | Fall 2019 | *1,943* | *1,782* | 37 S. College Avenue, St. Joseph, MN 56321 |
| near 120 | near 51 | St. John's University* | Fall 2015 | Fall 2019 | *1,874* | *1,777* | 2850 Abbey Plaza, Collegeville, MN 56321 |
| 14 | 320 | College of St. Scholastica | Fall 2017 | Fall 2017 | *160* | *160* | 137 23rd St S, Sartell, MN 56377 |
| 84 | 229 | Model College of Hair Design | Fall 2015 | Fall 2017 | *57* | *105* | 8th Ave S, St Cloud, MN 56301 |
| 92 | 272 | Moler Barber School | Fall 2015 | Fall 2017 | *130* | *26* | 200 Waite Ave S #220, St Cloud, MN 56301 |
| | | *Not in planning area | Total Enrollment: | | 25,503 | 22,624 | |

APO staff would like to replace the current process with a pre-defined matrix of trips with origins and destinations at each significant campus location. in our opinion, the only campus locations that merit such special treatment would be the following:

- St. Cloud State University
- St. Cloud Technical Community College
- College of St. Benedict

StreetLight InSight data were used by Metro Analytics to develop a matrix of trips between each of the above campus locations and the remaining zones within the APO region. While St. John's University is a similar sized, self-contained campus similar to St. Benedict, it is located just outside the MPO area. During validation of the 2020 model, decisions can be reached on whether or not the St. John's campus or any of the remaining colleges should be added to the model in a similar manner.

The resulting matrices from StreetLight InSight analysis are too large to include as tables in this memo. Table 8 provides a few statistics for each of the three campus locations noted above. It is surprising to see numbers of trips being so similar at all three colleges considering the differences in enrollment and mission. The number of trips per student is very low at less than 1.0 for each location. Metro Analytics staff manually created zones for each campus location and has inquired with StreetLight staff as to the similarity of these numbers.

**Table 8. St. Cloud APO University and College Trips**

| APO TAZ | | | Number of Trips | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2015 | 2020 | Institution | All Zones | Intra-Campus | Internal Zones | Percent Internal | Enrollment | Trips/ Student |
| 88 | 232 | St. Cloud State University | 4,496 | 86 | 3,848 | 86% | *12,608* | *0.36* |
| 29 | 142 | St. Cloud Technical Community College | 1,603 | 3 | 1,307 | 82% | *1,782* | *0.90* |
| 131 | 369 | College of St. Benedict | 4,795 | 372 | 2,940 | 61% | *5,624* | *0.85* |

## Next Steps

Recommendations in this memorandum will be used for scripting and file formatting in the updated Cube/Voyager model. Trip production and attraction rates provided in this Technical Memorandum should be considered “interim” until which time an updated regional household travel survey is completed. Consideration could be given to using trip rates from 2017 NHTS for the Midwest Region, as computed for and used in the Iowa Statewide Model (iTRAM), as an alternative to those provided from NCHRP 716. The only hesitation in documenting these for this tech memo was the lack of a specific home-based school trip purpose in the iTRAM.

It is anticipated that StreetLight InSight will be responsive to our inquiry on initial findings on the numbers of college campus trips and that adjustments to these results will be forthcoming. Once a reasonable number of trips per campus is achieved, resulting .CSV files from StreetLight InSight can easily be translated into trip matrices for each campus location.

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# TECHNICAL MEMORANDUM

TO: Brian Gibson, Executive Director, St. Cloud Area Planning Organization

FROM: Rob Schiffer, National Practice Leader, Travel Demand Forecasting

DATE: October 26, 2020

SUBJECT: St. Cloud APO Model Improvements Task 6: Trip Distribution

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This Draft Technical Memorandum describes an updated trip distribution process for the St. Cloud Area Planning Organization (APO) travel demand model. Discussions are divided into the following topics:

- Task 6 Scope of Work
- Data analyses
- Friction factor and K-factor refinement
- Destination choice modeling
- Next steps

This draft tech memo will be updated to reflect all comments received from APO staff. The recent Task 5 Technical Memorandum provides additional guidance on the trip generation process that feeds trip distribution, including recommended trip purpose stratifications.

## Task 6 Scope of Work

The Consultant shall use Streetlight Data and 2016 Census Transportation Planning Products workflow data to aid in calibration and validation of the model results.

The Consultant shall review and refine friction factors as needed.

The Consultant shall explore the use of K-factors in specific locations and trip purposes to better calibrate the model but shall make every effort to keep K-factors to a minimum.

Task 6 Deliverable:

1) A written report summarizing the trip distribution methodology and modifications that were made to the model (if any).

## Data Analyses

Data analyses conducted for trip distribution included use of StreetLight InSight Data and 2016 Census Transportation Planning Products (CTPP) workflow data. Additional StreetLight analysis for the APO Model Update was described in the Task 2 Technical Memorandum on external trips and the Task 5 Technical Memorandum on Trip Generation. The former was focused on understanding the split of internal-external/external-external trips and the distribution of external-external trips between external zones while the latter was focused on understanding trip distribution patterns of trips to and from the area's college campuses. For Task 6, the focus of StreetLight InSight analysis is on identifying prominent zone-to-zone flows and generating a trip matrix in .CSV format. The .CSV file can be used to prepare a trip matrix in Cube format.

Table 1 is a listing of the top zone-to-zone travel movements in the St. Cloud metropolitan area. For each zone-to-zone interchange, an indication is provided on whether the trip is external-external (EE), internal-external (IE), or internal-internal (II). Where complimentary flows exist (i.e., same origin/destination pair in reverse direction) in the top 20, two-way totals are listed.

**Table 1. St. Cloud APO Top 20 Origin-Destination Flows based on StreetLight Data**

| Rank | Origin Zone ID | Origin Zone Name | Destination Zone ID | Destination Zone Name | Average Daily O-D Traffic | OD+DO | EE | IE | II |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 300 | I-94 E | 311 | I-94 West | 2,464 | | X | | |
| 1B | 311 | I-94 West | 300 | I-94 E | 2,391 | 4,855 | X | | |
| 2 | 286 | US 10 N | 297 | US 10 S | 2,308 | | X | | |
| 2B | 297 | US 10 S | 286 | US 10 N | 2,237 | 4,589 | X | | |
| 3 | 311 | I-94 West | 131 | St. Benedict's | 1,894 | | | X | |
| 3B | 131 | St. Benedict's | 311 | I-94 West | 1,423 | 3,294 | | X | |
| 4 | 132 | St. Ben. East | 129 | St. Ben. North | 1,241 | | | | X |
| 5 | 242 | NE APO model | 286 | US 10 N | 1,180 | | | X | |
| 5B | 286 | US 10 N | 242 | NE APO model | 1,063 | 2,243 | | X | |
| 6 | 300 | I-94 E | 307 | SR 23 SW | 1,005 | | X | | |
| 4B | 129 | St. Ben. North | 132 | St. Ben. East | 1,003 | 2,244 | | | X |
| 6B | 307 | SR 23 SW | 300 | I-94 E | 982 | 1,987 | X | | |
| 7 | 253 | SE Stearns Co | 300 | I-94 E | 857 | | | X | |
| 8 | 300 | I-94 E | 252 | I-94/MN 75 Int | 818 | | | X | |
| 9 | 316 | 125th St. NW Ri | 286 | US 10 N | 805 | | X | | |
| 10 | 307 | SR 23 SW | 229 | Rockville | 785 | | | X | |
| 10B | 229 | Rockville | 307 | SR 23 SW | 770 | 1,555 | | X | |
| 9B | 286 | US 10 N | 316 | 125th St. NW R | 728 | 1,533 | X | | |
| 8B | 252 | I-94/MN 75 Int | 300 | I-94 E | 668 | 1,486 | | X | |
| 11 | 253 | SE Stearns Co | 252 | I-94/MN 75 Int | 667 | | | | X |
| 12 | 311 | I-94 West | 129 | St. Ben. North | 661 | | | X | |
| 13 | 313 | CR 17 | 312 | CR 155 | 598 | | X | | |
| 13B | 312 | CR 155 | 313 | CR 17 | 575 | 1,173 | X | | |
| 14 | 137 | St. Ben. South | 129 | St. Ben. North | 540 | | | | X |
| 15 | 62 | Crossroads Ctr | 77 | Kohls | 539 | | | | X |
| 16 | 62 | Crossroads Ctr | 79 | Walmart/Hinn | 515 | | | | X |
| 15B | 77 | Kohls | 62 | Crossroads Ctr | 511 | 1,050 | | | X |
| 17 | 253 | SE Stearns Co | 299 | Opportunity D | 501 | | | X | |
| 18 | 306 | CR 140 W | 306 | CR 140 W | 492 | | X | | |
| 7B | 300 | I-94 E | 253 | 253 | 485 | 1,342 | | X | |
| 19 | 62 | Crossroads Ctr | 15 | Sam's Club | 481 | | | | X |
| 20 | 76 | Home Depot | 62 | Crossroads Ctr | 481 | | | | X |
| 20B | 62 | Crossroads Ctr | 76 | Home Depot | 478 | 959 | | | X |

CTPP worker flows were used to identify home-based work distribution patterns between the three counties that comprise the APO model/study area. CTPP data are based on the American Community Survey (ACS), which has an insufficient sample size to analyze flows between MPO TAZs. Table 2 provides a summary of travel flows between these three counties, including the number of trips, the percentage of trips from each origin County and the percentage of trips to each destination county.

**Table 2. CTPP Worker Flows: St. Cloud APO Counties**

| ***Volumes*** | | **WORKPLACE (to)** | | | |
|---|---|---|---|---|---|
| **RESIDENCE (from)** | **Primary APO City** | **Benton County** | **Sherburne County** | **Stearns County** | **Totals** |
| **Benton County** | Sauk Rapids | 6,970 | 950 | 9,740 | 17,660 |
| **Sherburne County** | St. Cloud (E of River) | 1,295 | 14,285 | 4,840 | 20,420 |
| **Stearns County** | St. Cloud | 5,250 | 1,565 | 66,880 | 73,695 |
| **Totals** | | 13,515 | 16,800 | 81,460 | 111,775 |
| | | | | | |
| ***Percent to Origin*** | | **WORKPLACE (to)** | | | |
| **RESIDENCE (from)** | **Primary APO City** | **Benton County** | **Sherburne County** | **Stearns County** | **Totals** |
| **Benton County** | Sauk Rapids | 52% | 6% | 12% | 16% |
| **Sherburne County** | St. Cloud (E of River) | 10% | 85% | 6% | 18% |
| **Stearns County** | St. Cloud | 39% | 9% | 82% | 66% |
| | | 100% | 100% | 100% | 100% |
| | | | | | |
| ***Percent to Destination*** | | **WORKPLACE (to)** | | | |
| **RESIDENCE (from)** | **Primary APO City** | **Benton County** | **Sherburne County** | **Stearns County** | **Totals** |
| **Benton County** | Sauk Rapids | 39% | 5% | 55% | 100% |
| **Sherburne County** | St. Cloud (E of River) | 6% | 70% | 24% | 100% |
| **Stearns County** | St. Cloud | 7% | 2% | 91% | 100% |
| | | 12% | 15% | 73% | 100% |

Mean work trip lengths from CTPP were found to range between a low of 20.5 minutes (Stearns County 2006-2010) and a high of 32.3 minutes (Sherburne County 2012-2016). For some reason, 2012-2016 trip lengths were not available for Stearns County. Benton County work trip lengths are essentially midway between Sherburne and Stearns Counties.

## Friction Factor and K-factor Refinement

The current APO trip distribution model includes friction factors in a text file format for the existing three purpose gravity model. The source of these friction factor values is unknown. The traditional approach to estimating friction factors is to analyze MPO household travel survey data; however, since respondents often round off travel times in five minute increments, travel times are often attributed to estimates from a model network between the same TAZs geocoded for the traveler's origins and destinations. With the use of GPS in modern travel surveys, greater precision is achieved, both in terms of arrival and departure times and the addresses of origins and destinations. As noted in previous tech memos of this series, the APO intends to conduct an updated household travel survey in the near future that can be used for computing an initial set of friction factors by trip purpose, given a sufficient sample size.

CTPP provides estimates of average travel time for work trips; however, these estimates are not provided for every increment of travel time. As depicted in Table 3 below, CTPP minutes of

travel time to work are available only in 5- to 15-minute increments. StreetLight InSight similarly groups trip lengths into increments of 10 minutes and does not distinguish estimates by trip purpose. StreetLight InSight trips by increment of travel are found in Table 4. While friction factors could potentially be estimated using a combination of CTPP and StreetLight InSight, the "lumpy" nature of these trip travel time estimates would require assumptions for all gaps. Incidentally, according to StreetLight InSight, the 2016 split of trips by purpose is:

- HBW = 16.9 percent
- HBO = 39.3 percent
- NHB = 43.8 percent

**Table 3. St. Cloud APO 2016 CTPP Travel Time to Work**

| | Benton County | | Sherburne County | | Stearns County | | All APO Counties | |
|---|---|---|---|---|---|---|---|---|
| **Travel Time Increments** | **Number** | **Percent** | **Number** | **Percent** | **Number** | **Percent** | **Number** | **Percent** |
| Did not work at home: | 19,205 | | 45,540 | | 76,995 | | 141,740 | |
| Less than 5 minutes | 860 | 4.5% | 1,110 | 2.4% | 4,465 | 5.8% | 6,435 | 4.5% |
| 5 to 14 minutes | 5,880 | 30.6% | 7,940 | 17.4% | 27,715 | 36.0% | 41,535 | 29.3% |
| 15 to19 minutes | 3,615 | 18.8% | 5,020 | 11.0% | 14,810 | 19.2% | 23,445 | 16.5% |
| 20 to 29 minutes | 3,735 | 19.4% | 8,005 | 17.6% | 13,525 | 17.6% | 25,265 | 17.8% |
| 30 to 44 minutes | 2,875 | 15.0% | 10,415 | 22.9% | 9,340 | 12.1% | 22,630 | 16.0% |
| 45 to 59 minutes | 975 | 5.1% | 6,075 | 13.3% | 2990 | 3.9% | 10,040 | 7.1% |
| 60 to 74 minutes | 535 | 2.8% | 5,230 | 11.5% | 1,870 | 2.4% | 7,635 | 5.4% |
| 75 to 89 minutes | 210 | 1.1% | 485 | 1.1% | 725 | 0.9% | 1,420 | 1.0% |
| 90 minutes or more | 515 | 2.7% | 1,265 | 2.8% | 1,565 | 2.0% | 3,345 | 2.4% |
| | | 100.0% | | 100.0% | | 100.0% | | 100.0% |

**Table 4. St. Cloud APO 2016 StreetLight InSight Average Trip Lengths (All Purposes)**

| Minutes of Travel Time Increment | Percent of Trips by Increment |
|---|---|
| 0-10 | 14.5% |
| 10-20 | 35.4% |
| 20-30 | 22.8% |
| 30-40 | 11.8% |
| 40-50 | 6.3% |
| 50-60 | 3.5% |
| 60-70 | 2.0% |
| 70-80 | 1.2% |
| 80-90 | 0.8% |
| 90+ | 1.7% |
| Total | 100.0% |

It is anticipated that the next validation/calibration of the APO model will be completed for a base year of 2020, with efforts unlikely to proceed until after 2020 Census data and household travel survey data are available. Should these efforts need to start in advance of data availability, other options would be to use gamma functions from NCHRP 716 and NCHRP 735 temporarily or continue with existing model friction factors until local survey data are available. Existing friction factors or transferable gamma functions for home-based other trips can be duplicated for the new home-based school purpose for the time being.

It does not appear that K-factors are used in the present version of the APO model. Years of model guidance suggest that there is no need to start the next calibration process using K-factors. K-factors should only be used in a Gravity Model calibration once all other methods of model adjustment have been exhausted. A determination on the necessity of K-factors for work trips can be made by comparing the percentages in Table 2 against an aggregation of county-to-county model trips. County level K-factors should be simple enough to implement, adjust and maintain.

An alternate approach to correct for trip distribution anomalies is to implement bridge penalties in the network instead of using K-factors. River crossings are typically problematic in trip distribution and bridge locations are easy to isolate and identify. When considering bridge penalties, it should be understood that this will increase travel time estimates for trips impacted by the penalties. Also, it is recommended that, if bridge penalties are considered, application should be made to all bridges. Finally, when testing new bridge crossings, it is essential that comparable penalties be placed on future bridges as well as existing bridges.

## Destination Choice Modeling

While the St. Cloud APO currently uses a Gravity Model for trip distribution it is worth noting that a growing trend is to use destination choice as an alternative distribution process. Instead of friction factors and K-factors, destination choice models consist of utility equations that use alternative explanatory variables beyond just travel time impedance. Examples of destination choice variables include psychological barriers such as railroad and river crossings; development density; and alternate measures of accessibility. The pros and cons of destination choice should be discussed further at the start of the 2020 model calibration and validation effort.

## Next Steps

Tabular information from this memorandum can be used for validation and calibration of the next trip distribution model, along with data from the forthcoming household travel survey and the 2020 Census. Interim recommendations are also provided for use in advance of data availability. The most important next step in trip distribution is to conduct the household travel survey as this will serve as the primary source for developing and calibrating model parameters.

Unfortunately, until travel patterns return to normal from months of the COVID-19 pandemic, it could be challenging to mount a successful household travel survey. Of course, these same concerns apply to any traffic counts conducted during the year 2020 that will be used to validate a 2020 base year model. Should the schedule change for conducting a travel survey, sufficient interim recommendations are provided in this tech memo to move forward.

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## TECHNICAL MEMORANDUM

TO: Brian Gibson, Executive Director, St. Cloud Area Planning Organization

FROM: Rob Schiffer, National Practice Leader, Travel Demand Forecasting

DATE: October 29, 2020

SUBJECT: St. Cloud APO Model Improvements Task 7: Mode Choice/Auto Occupancy

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This brief memorandum describes a simplified mode choice process for the St. Cloud Area Planning Organization (APO) travel demand model. While there is no tech memo required for addressing transit in the model, I have prepared a table of relevant metrics and outlined a simple approach for incorporating mode choice and auto occupancy.

The text below comes from our contract scope.

***TASK 7: MODE CHOICE***

*The Consultant shall modify the travel demand model to easily report and export key inputs for off-model processes for estimating demand using transit and active transportation modes.*

*Task 7 Deliverable:*

*Modification of the travel demand model files so that the model generates person-trip tables and vehicles trip tables that will facilitate off-model assessment of transit and active transportation modes.*

Essentially, the proposed approach would do the following:

1. Compute percent transit trips by purpose based on transit access and zone activity flag
2. Prepare transit and auto person trip tables by purpose with zone-to-zone percent transit
3. Generate vehicle trip table by applying auto occupancy factors to auto person trip table
4. Merge person trip purposes, transpose, and balance origins and destinations
5. Truck and external trips will be maintained as separate trip purposes for trip assignment

The attached spreadsheet includes the following tables:

1. Assessment of transit accessibility by zone
2. Auto occupancy rates by trip purpose from several sources (start with 2017 NHTS)
3. CTPP work trip mode splits by APO County
4. Daily transit ridership by route, along with calculation of linked transit trip target

No transit trips would be allocated to zones without transit access (flag=0). Zones flagged with transit access (flag=1) would be assigned a minimal transit mode split (e.g., 1%) while zones with flag=2 would receive a slightly higher transit mode split (e.g., 2%). Since these are linked trips, transit access would be assessed at both origin and destination zone. So, if a zone-to-zone pair has transit access at only one end of the trip, the transit mode split would be zero. Testing of varying percentages can be used to achieve a target of 27,768 transit trips (2015).

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## TECHNICAL MEMORANDUM

TO: Brian Gibson, Executive Director, St. Cloud Area Planning Organization

FROM: Rob Schiffer, National Practice Leader, Travel Demand Forecasting

DATE: November 9, 2020

SUBJECT: St. Cloud APO Model Improvements Task 8: Trip Assignment

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This brief memorandum describes refinements to the trip assignment process for the St. Cloud Area Planning Organization (APO) travel demand model. While there is no tech memo required for addressing trip assignment in the model, I have prepared a set of draft recommendations and table of time-of-day statistics based on analysis of travel patterns using StreetLight InSight.

The text below comes from our contract scope.

***TASK 8: TRIP ASSIGNMENT***

*The Consultant shall discuss with APO staff the various options for adding peak period trip assignment and will implement the agreed-to option for peak period trip assignment in the travel demand model.*

*The Consultant shall also work with APO staff to evaluate the existing static equilibrium assignment and how it might be improved to account for queueing and traffic congestion in the trip assignment phase.*

*The Consultant shall also update the BPR curve to better estimate congested speeds by facility type in a peak-period framework. Task 8 Deliverable:*

*1) Updated traffic assignment that includes peak period assignment and improved volume/delay functions.*

While the above scope of services only calls for peak period trip assignments, most MPO models that go beyond a daily traffic assignment process divide the highway trip table into three to five time periods, load trips separately for these periods, and then add the resulting output volumes together for a set of daily numbers. StreetLight InSight provides trip activity data for five time periods. These time periods are noted below along with percent of APO trips.

1. Early AM (12am-6am): 3.5%
2. Peak AM (6am-10am): 18.1%
3. Mid-Day (10am-3pm): 33%
4. Peak PM (3pm-7pm): 31.9%
5. Late PM (7pm-12am): 13.5%

These time periods, definitions, and percentages are consistent with MPO models in the U.S., as is the merger of Early AM and Late PM periods as these hours generate relatively little traffic (17% in the case of the APO study area). Thus, it is recommended that the new St. Cloud APO model be structured with four time periods using the above percentages and Early AM and Late PM periods combined at 17 percent. A spreadsheet is attached with StreetLight computations.

It is not practical at this point in time to switch from a static traffic assignment process to a dynamic traffic assignment (DTA) algorithm. DTA adds a lot of overhead to the assignment process and only a relatively small number of MPOs have successfully implemented DTA into their standard modeling structures. DTA is best applied to severely congested corridors and subareas using microsimulation tools. It is anticipated that recommended refinements to a time-of-day assignment process will sufficiently account for peak period congestion.

We will institute a process with multiple BPR curves in the updated assignment process, consistent with other comparable models. The ability to disaggregate BPR curves by facility type will be included with alternate BPR alpha and beta values; however, initial BPR curves will only differentiate between limited access highways and at-grade roadways. Subsequent model validation efforts will assess the need for further disaggregation of BPR curves by taking, for example, the curves for all at-grade roadways and disaggregating these into separate values for arterials and collectors.