Flagstaff Metropolitan Planning Organization (FMPO) Peer Review

November 2015

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Flagstaff Metropolitan Planning Organization (FMPO)

Peer Review

Original: **September 2015**

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16. Abstract This report details the proceedings of a peer review of the Flagstaff Metropolitan Planning Organization (FMPO) transportation model. The peer review was intended to assess the FMPO Regional Travel Model and enhance the role of the model in the Traffic Impact Analysis (TIA) Process.		

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1.0 Introduction

1.1 Disclaimer

The views expressed in this document do not represent the opinions of FHWA and do not constitute an endorsement, recommendation or specification by FHWA. The document is based solely on the discussions that took place before and during the peer review sessions and supporting technical documentation provided by Flagstaff Metropolitan Planning Organization (FMPO).

1.2 Acknowledgements

The FHWA would like to acknowledge the peer review members for volunteering their time to participate in this peer review. Panel members include:

- Paul Basha - City of Scottsdale, Arizona
- Mei Ingram – Triangle Regional Model Service Bureau (TRMSB/ITRE/NCSU)
- Alan Horowitz (panel chair) – University of Wisconsin-Milwaukee
- Sean McAtee – Cambridge Systematics

Additional biographical information of each peer review panel member is located in Appendix C.

1.3 Report Purpose

This peer review was supported by the Travel Model Improvement Program (TMIP), sponsored by FHWA. TMIP sponsors peer reviews in order that planning agencies can receive guidance from and ask questions of officials from other planning agencies across the nation. The peer review process is specifically aimed at providing feedback to agencies on travel modeling endeavors.

The primary objective of the FMPO peer review was to assess the FMPO Regional Travel Model and enhance the role of the model in the Traffic Impact Analysis (TIA) Process.

The peer review panel convened for two half-day sessions (9/13/15 – 9/14/15). During that time, FMPO presented background information on their model and TIA process as well as new ideas for the panel to consider. The panel discussed these items and offered a series of formal recommendations to FMPO.

1.4 Report Organization

The remainder of this report is organized into the following sections.

- *Overview of the Flagstaff Metropolitan Planning Organization (FMPO)* – This section highlights the responsibilities of the agency as well as some key characteristics of the greater Flagstaff region.

- *Flagstaff Metropolitan Planning Organization (FMPO)Model Overview* – This section discusses FMPO’s existing model and the agency's goals for the current peer review.

- *Peer Review Discussion* – This section details the key discussions of the peer review with FMPO over the course of the peer review meeting as well as the pre-meeting discussion via email.

- *Peer Review Recommendations* – This section highlights the official recommendations made by the peer review panel. Some of the key discussion points are revisited here, but some new details are also added.

Four appendices are also included.

- *Appendix A* – List of Peer Review Panel Participants
- *Appendix B* – Peer Review Meeting Agenda
- *Appendix C* – Peer Review Panel Member Biographies
- *Appendix D* – List of Documentation Provided to Panel Members by FMPO

2.0 Overview of Flagstaff Metropolitan Planning Organization (FMPO)

2.1 FMPO Responsibilities

The Flagstaff Metropolitan Planning Organization (FMPO) is the federally designated MPO for the Flagstaff region of Arizona. The FMPO is involved in all levels of regional transportation planning and serves as de facto transportation planning staff for the City of Flagstaff and to a lesser degree Coconino County. The Flagstaff metropolitan area is entirely within Coconino County, and is the only concentrated population center in Coconino County. The FMPO has federally mandated responsibility for planning, programming, and budgeting of transportation improvements in the region with a population of about 85,000 residents.

2.2 Regional Characteristics

The Flagstaff Metropolitan area is known for its high quality of life and a strong sense of place with breathtaking landscapes and a strong outdoor ethic. It is a hub of commercial, cultural and educational activity for much of Northern Arizona. It is home to Northern Arizona University (NAU) with 20,000 students. At 7,000' and summer temperatures in the low 80's it is also a strong tourist draw for the Phoenix metro area when temperatures climb above 110. The Flagstaff region enjoys a great urban trail system, is nationally recognized as a walkable and bike friendly city and in 2013 the American Public Transportation Association (APTA) named the region's transit service the best in the country. The radial road network, however, is seriously constrained. Interstates 40 and 17 and the BSNF transcontinental railroad pose serious barriers to connectivity as does the large land mass of the university. Terrain and the open space values that come with it, including mountains, steep hills and deep washes, makes new facilities politically and financially challenging. Figure 2-1 shows the FMPO regional boundary with the national monuments highlighted in bright green. Development patterns make widening roads very expensive.

Growth is relatively slow, less than 2% per year. However, the remaining growth areas are relatively large, dispersed, and on the periphery of the urbanized area. With the constrained, radial system described above this can result in the capacity improvements triggered by any one development to be cost prohibitive. Not surprisingly, developers and the community alike want traffic congestion well-managed, to see a shift to other modes, and see costs contained.

Continued population growth, expanding university enrollment and growing tourism demand in recent decades have resulted in a heavily congested transportation network with sections on the main corridor into town exceeding a volume to capacity ratio of 1. Figure 2-2 shows the modeled daily congestion on the FMPO network and Table 2-1 shows the level of service thresholds related to the network displays. Policymakers realize the need for innovative solutions to create a diverse, multi-modal network, and to enhance the regional travel model's capabilities to analyze today's complex transportation policies. Policymakers and staff also recognize that private development must play a larger role in delivering those multimodal improvements especially in light of the difficulties facing expansion of the roadway network. Achieving this in a strong property rights state like Arizona requires a defensible process including appropriate use of the regional transportation model.

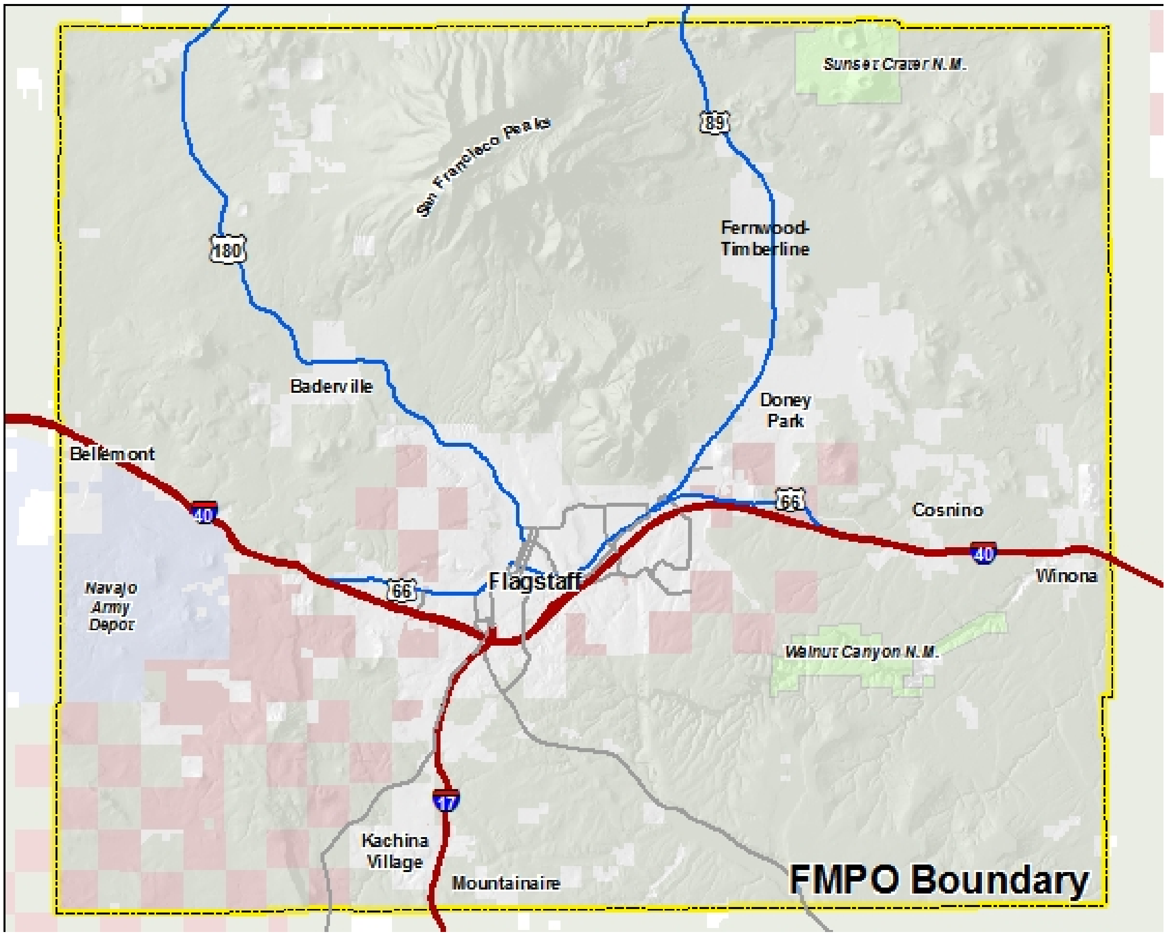

Figure 2-1: FMPO Geography

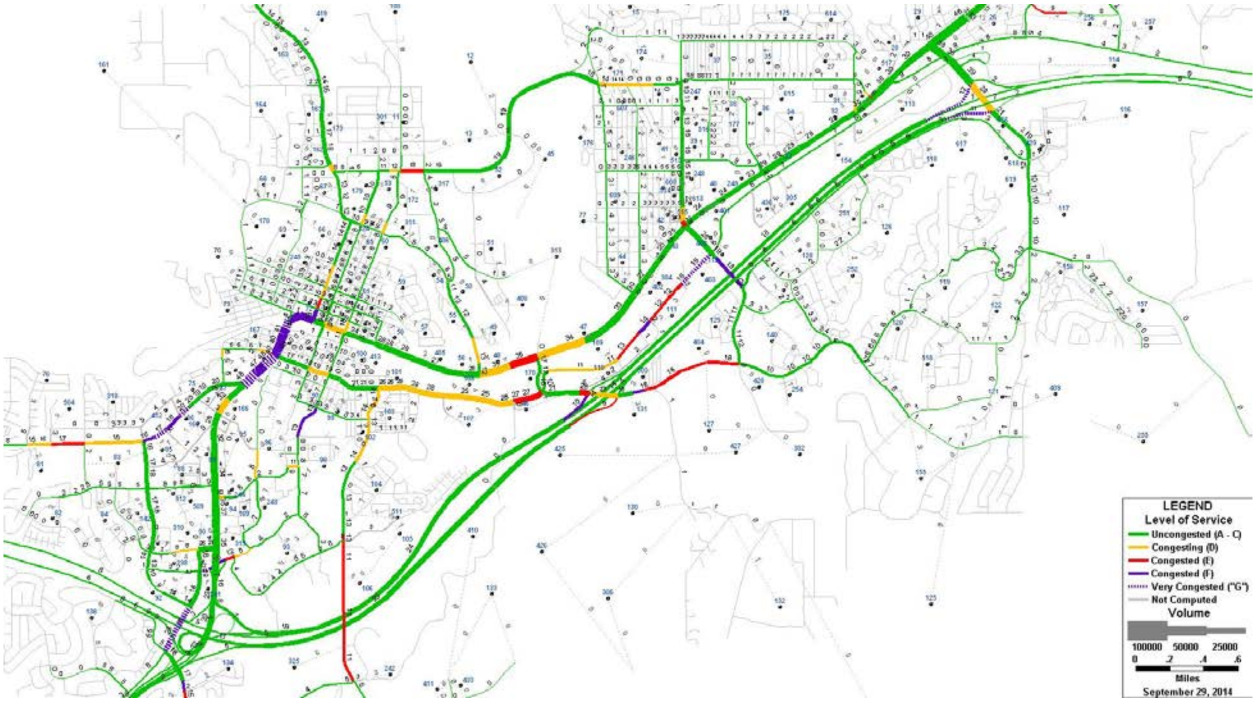

Figure 2-2: Daily Congestion on FMPO Network

Table 2-1: Level of Service Volume/Capacity Thresholds

Level of Service Cut Points						
FT	A	B	C	D	E	F
Freeway	0.31	0.50	0.71	0.87	1.00	1.11
Major Arterial	0.51	0.67	0.79	0.90	1.00	1.11
Minor Arterial	0.51	0.67	0.79	0.90	1.00	1.11
Major Collector	0.51	0.67	0.79	0.90	1.00	1.11
Minor Collector	0.51	0.67	0.79	0.90	1.00	1.11
Ramp	0.51	0.67	0.79	0.90	1.00	1.11
Fwy / Fwy Ramp	0.31	0.50	0.71	0.87	1.00	1.11

3.0 Flagstaff Metropolitan Planning Organization (FMPO) Model Overview

3.1 Model Background and Status

To conduct quantitative assessments of the regional transportation system, FMPO employs a traditional 4-step trip-based modeling framework in TransCAD. The modeling area consists of 340 TAZ over 525 square miles with 8 external stations. FMPO's current TransCAD setup was first developed in 1997 to aid the drafting of Arizona's first regional land use and transportation plan. The update in 2007 introduced a "3-D" process to estimate demand for pedestrian, bicycle and transit trips based on the trip density of each traffic analysis zone (TAZ), the balance of home-based-work productions versus attractions or diversity of each TAZ, and the design of each TAZ based on the quality of the respective modal facilities. The current TransCAD model was updated in 2013.

This is a traditional 4-step trip-based model producing 24-hour estimates that calibrate to a percent root mean square error (RMSE) of 18%. Though transit trips (estimated at 3% of total personal trips) are not currently assigned, demand between districts of aggregated TAZs showed strong correlation to an on-board origin-destination survey conducted by the transit agency. Overall mode share for pedestrian, bicycles and transit compare well to data gathered in two trip diary surveys (2006 and 2012).

There are five primary trip purposes: home-based work, home-based university, home-based shopping, home-based other, and non-home-based. There are no truck trip purposes. Trip production is based on dwelling unit type (5 types) and trip attraction is based on land use type (60 types) and is not stratified. External trip data are usually obtained from the Arizona DOT Statewide Traffic Model. PM peak period trips are estimated but an extensive calibration effort has not been made.

All steps, provided here in order, are activated with a GISDK scripted interface within the TransCAD environment. Separate model runs may be made for development phasing, development build out, and horizon-year, to name a few.

The model process is summarized below:

- Land Use: TAZ-level future land use data are created by a hands-on land use allocation model that considers regional population control total checked with historical land use growth patterns, local planning knowledge of upcoming developments, housing start data from local jurisdictions, and square feet of non-residential data from the assessor's office.
- Build Networks: in this stage, the link capacities and travel times are set and the highway skims are generated.
- Trip Generation: trip generation is based on rates from the Institute of Transportation Engineers Trip Generation Manual (ITE rates). Some of the ITE rates are modified by FMPO. Housing types (single family detached, single family attached, multifamily, manufactured homes) serve as proxy for income and have distinct trip rates. Trips are balanced to productions with the exception of university trips which are balanced to attractions based on university enrollment. The ITE trip rates produce vehicle trips. The model has been run with a vacancy rate applied to schools, hotels, 2nd homes, and

areas known to have high levels of seasonal business to generate summer and fall scenarios.

- Trip Distribution: trip distribution is done using a purpose-specific gravity model and generates a trip length frequency report.
- Mode Split: The vehicle trips are first expanded to represent person trips. Occupancy factors by trip type from the Regional Trip Diary Survey are used together with a general expansion factor. The share of non-auto trips is derived by a process that considers the density, diversity, distance (3-D) as well as the non-auto levels of service and proximity to NAU. The mode split process first splits transit trips from the set of person trips and next splits the bike trips from the remaining person trips. The non-auto trips are removed from the trip table before assignment.
- Traffic Assignment – Auto Only: The remaining person trips are factored to vehicle trips and assigned to the network using stochastic user equilibrium (SUE).

3.2 Planned Model Updates

The next version of the model currently under development will have a planning horizon to year 2040 as interpolated from a build out model. Planned improvements include more quantitative methods for assigning pedestrian, bicycle and transit level of service to each TAZ and bicycle trips assigned based on a “bicycle comfort index.”

3.3 Model Applications

The FMPO model is used primarily by FMPO to prepare the LRTP and all financially constrained projects are included in the model network. The model is used by consultants for specific traffic impact analyses (TIA) and has been included to some extent in the new statewide model.

The FMPO model outputs are used in ranking projects in the Transportation Improvement Program (TIP). Forty percent of the project score depends on the model output.

3.4 FMPO’s Goals for the Current Peer Review

Prior to the peer review meeting, FMPO identified several areas for which they wanted the peer review panel to comment and make recommendations. The areas and specific questions are detailed below:

- An objective assessment of the FMPO’s existing travel demand forecasting framework;
- Industry standard procedures and best practices for conducting a TIA and a comparison to the City of Flagstaff TIA procedures;
- Within the context of an acceptable TIA procedure the best practices or means to determine the following and the appropriate use of a regional model for each (with feedback specific to the FMPO regional model, desired):
    - Trip generation – Compare and contrast trip rates within the model versus trips rates used at the site development scale (typically ITE Trip Generation Rates).
    - Trip distribution – Compare and contrast model generated project trip distributions based on constrained and unconstrained networks versus

engineering judgment distributions. Discuss the methodology for estimating background traffic within a model versus the use of one or more growth factors.

  - Background traffic – Discuss and define the purpose of background traffic, its estimation and its role in determining the impacts assigned to the proposed project.
  - Mode share – Compare and contrast the effectiveness of a regional transportation model versus other methods such as ITE for determining mode splits for a proposed development.
  - Pass-by and Internal Capture trips – Compare and contrast how pass-by and internal capture trips are represented, if at all, within a regional model to standard ITE practice.
  - Proportional share – what are effective and equitable means of calculating proportional share for improvements related to all modes? What is the role a regional model can play in identifying these?
- Relevant to each stage in the modeling process the agency would benefit from the panel addressing the following questions:
  - What are the best ways to apply the different stages of the modeling process to the different expectations out of the TIA process?
  - Where are there limitations in the use of the model and how are these best explained to and mitigated by the local jurisdiction and development applicant?
  - When there are known errors in the model (i.e., under or over estimates) how are these best explained and mitigated?
  - How do other MPO's officially approve of their model performance and how do their member agencies adopt it for their use?
  - What are the range of model runs (i.e., with and without the project, current and future case, phases of the project, build out, etc.) needed to most effectively answer questions of trip generation, distribution, assignment and proportional share?
  - Do agencies use a different process for regional plan amendments vs. zoning cases?
  - Are there agencies that have pre-application processes in place and how well do those work?
  - Examples of concept planning using the regional model to explore capacity issues, constraints and network opportunities.
  - Examples of detailed capacity analysis of roadways and intersections by the agencies on a regular basis whereby that information is a "given" for the applicant.
  - Examples of detailed master plans for roadways and intersections where the level and types of improvements are pre-determined.
  - What are reasonable expectations of the development community to mitigate impacts across a broad geographic area when costs or agency practice prohibit or strongly inhibit addition of capacity in the immediate proximity of the development?

- How can the model assist in identifying potential improvements and their relative effectiveness?
- Are there any agencies that actively test the accuracy of their TIA post-development?

4.0 Peer Review Discussion

Three presentations were given prior to the official peer review meeting to give the audience more information about the Traffic Impact Analysis process and the FMPO regional travel demand model as well as to highlight a Concurrency Districts approach done in Bellingham, WA. The presentations given were the following:

- Concurrency Districts, Chris Comeau, Bellingham, WA
- Traffic Impact Analysis 101, Paul Basha, Scottsdale, AZ
- The FMPO Transportation Model, David Wessel, Flagstaff MPO

The official peer review began with an overview of the FMPO TIA process and regional model and proceeded with a more in-depth discussion of aspects of the model and TIA process. A theme through the peer review is how the regional model could be used to further the TIA process and what improvements need to be made in the model itself, the model validation, and application to support the TIA process. This section presents first the assessment of model components in their order of execution, followed by model calibration and maintenance recommendations. The TIA process and model relationships are described after the model assessment.

4.1 Trip Generation

The FMPO model implements modified ITE vehicle trip rates applied to land-use data from the assessor's office to generate trip productions and attractions. This approach provides a more straightforward connection between trip productions and land use policy questions, such as floor area ratio and second home regulations. On the attraction side, the trips rates vary based on commercial tenant so variations between a restaurant, convenience store, and clothing store are all represented.

Forecasts are developed through scenario workshops that produce build out scenarios. Horizon year control totals are set by state projections. The scenarios are then disaggregated to TAZs.

The ITE rates are vehicle trips, and so the generated trips must be expanded to person trips using average vehicle occupancies by trip purpose. FMPO specifically requested comments on their trip generation process including whether to segment trip generation rates further to use more of the 60 land uses available in the ITE manual. Acknowledged risks of this approach are the dependency on the assessors data collection and categorization methodology, the complex forecast process, and the lack of cross-classification.

Several panelists raised concerns that this approach is unconventional and may be problematic when developing forecasts. The base year dataset can be well constructed because the information is readily available, but it is not clear how an objective forecast method can be applied. Whereas, the use of employment and demographics for trip attractions is time honored and those traditional methods are compatible with economic and land-use forecasting methodologies.

A panelist acknowledged that using ITE vehicle trip production rates are more straightforward because household and employment data do not need to be collected and forecast, but questioned the implied assumption of uniform travel behavior among all households with the same dwelling unit type. Testing this assumption would require an analysis of travel behavior pattern differences by different household types (if not also person types) using the household travel survey to see if there are statistically significant differences. For example, families within a "single-family house" can be different sizes and have different number of workers, vehicles, and incomes. There is also demonstrated value in segmented trip rates by vehicles and income for later steps of the model process, particularly distribution and mode choice. A panelist also mentioned that replacing the dwelling unit type based trip production with a cross-classified approach may help with some of the assignment issues where volume is high in one area and low in another.

Using employee-based attraction rates is more typical and also may be worth considering for the FMPO. Several panel members' past experiences have shown that there are a number of technical issues that may be encountered when using ITE trip generation rates to build up trip attractions. A panelist emphasized, and the panel agreed, that using employee-based trip rates from ITE are better than square footage based trip rates because they seem to have a smaller standard deviation.

Another value of the employee-based attraction rates is that the attractions can be segmented by worker's earning so that high-earning employment is associated with high-income households. This is particularly important in regions with greater income disparity than the Flagstaff region. This would require additional data collection by the FMPO and translation of employment types into income categories, for which there are methods readily available. A panelist explained the method from the Triangle Regional Model as follows:

- Use a cross-classified trip production that distinguishes households by income (or number of cars available/owned) and the household size. The workers' earning level is used in the Triangle Regional Model Version 6 and a few other MPO models, but the panel does not recommended that for FMPO.
- If the FMPO household travel survey does not collect earning info, an adhoc imputation approach can be used to estimate earning categories based on other household worker information, such as employer industry, worker's occupation, education level, years of work, etc. and total household income. This process was done for the North Carolina Triangle 2006 household travel survey.
- To generate a worker's earning based attraction rate, job location employees by census industry and earning group information from the CTPP-Part 2-Table A202205C (TAZ level) table can be utilized to derive the percent of high or low earning employees within each Industry. The threshold between high and low earnings will need to be defined, the Triagle Regional Model used $2010 earning of $50K. Another resource for resident worker distributions by industry and earning are the American Community Survey (CTPP) – Part 1 data at the TAZ level.

The FMPO expressed concerns that there would be an inconsistency and/or incompatibility between a regional model using cross-classified household data and a TIA process using land use data. Several panelists asserted that this is not an incompatibility and that, moreover, the cross-classified household data are especially relevant for in-fill developments. An affordable housing infill development containing a higher percentage of low income household is an example where the expected travel behavior differs from the region average.

Audience members familiar with the Arizona TIA process agreed that there is no incompatibility between using socio-economic data within the regional model and ITE rates based on land-use for the TIA process. However, the audience emphasized the need for good communication between the data set managers to avoid inconsistencies.

4.1.1 University Trips

University trips are generated through the same process as the other trip purposes. University students represent a large percentage of the overall Flagstaff population, and university students have different travel behavior, particularly around transit usage and non-motorized modes. These factors led the panel to recommend that FMPO collect or borrow university special generator data to better capture the large population of university students in the region. A panelist recommended that FMPO review the trip rates and study results from the NCDOT University Student Travel Survey and Modeling research project. Off-campus student address data often have quality issues because of the confusion between residence while attending school and permanent residence, e.g. parent's residence. But, FMPO should try to make use of off-campus student housing data within the model.

4.1.2 School (K-12) Trips

The model currently accounts for K-12 school trips as part of the Home-Based Other trip purpose. Implementing a separate Home-Based School trip purpose will require identifying the school locations with enrollment and forecasting future K-12 school locations. School bus trips are typically not included in a regional travel demand model with static assignment, but charter schools in Flagstaff have contracted with Northern Arizona Intergovernmental Public Transit Authority (NAIPTA) to use public transit service for school trips. The importance for transit led at least one panelist to recommend that FMPO add a home-based school trip purpose.

4.1.3 Freight

The current model does not include a freight or truck component. Trucks on non-interstate roadways in the Flagstaff region repersent less than 5% of all traffic and traffic on many roadways is less than 2% truck. The method defined in the Quick Response Freight Manual (QRFM) is straightforward and appropriate for regions this size. Calibrating the model would require expanding the number of vehicle class count locations. The panel recommended that FMPO implement a QRFM model.

4.1.4 Seasonality

University and tourist activity create seasonal traffic patterns for Flagstaff, although the similar location of both student housing and hotels means that the traffic levels are fairly similar across seasons with the fall season being slightly busier. FMPO has developed methods by which vacancy rates can be applied to represent different seasons. The rates were developed using census data and adjusted by utility and postal delivery records along with informal observations. The vacancy rates are generally not applied in forecast years. A panelist questioned the use of a consistent rate across all TAZs because vacation homes, hotels, and student housing are not uniformly distributed across the region.

The panel concluded that, given that traffic is higher during the school year, only a fall model is necessary to be maintained. The other advantage of modeling the fall season is that spring travel should be similar so a fall model actually represents half the year. If FMPO should maintain a summer model, the panel supported the use of vacancy rates to account for the smaller student population and recommended that a visitor-specific generation be included.

4.2 Trip Distribution

The FMPO model currently uses a gravity model to distribute trips. The panel noted that a destination choice model incorporates more flexibility into the model, but that it is not necessary for a region this size.

4.3 Time of Day

The FMPO model produces both a 24 hour and PM peak hour assignment results. However, the PM peak hour assignment has not been used much lately and was calibrated only using broad percent RMSE measures during the last model update. The 24 hour assignment is used for long range planning as well as to supply growth rates to the TIA process for large development projects that will roll out over several years. The TIA process, however, is for the peak design hour, but the growth rates based on daily travel patterns are being used from the regional model. FMPO requested advice from the panel as to how they should expand their peak hour assignments.

In a pre-meeting email, a panelist argued that no forecast should use a time interval for traffic assignment larger than 1 hour. 24 hour forecasts are not reliable and peak-period forecasts, while they might calibrate well, will not be properly sensitive to delays. Furthermore, traffic engineers have never defined 24-hour capacity. Capacity in the Highway Capacity Manual (HCM) is defined for 15 minutes, which can be extended to a full hour with the PHF (peak hour factor). Whereas any 24-hour capacity numbers are less justifiable. Regional models with static assignment, however, should not be run with shorter than one hour periods because a key assumption of the static assignment process is that all trips loaded onto the network will complete within the time period.

Another panelist noted that the model run times are so short that it would not delay the process to implement more time periods.

The panel expressed concern about the disconnect between the 24 hour model assignment and peak design hour for the TIA process and strongly recommended replacing 24-hour model with a series of shorter traffic assignment procedures that would sum to a 24-hour total. For example, there could be two peak hours (AM and PM), a midday period if necessary and the remaining off-peak periods assigned as a single block. The peak hour assignments are most important to support the TIA process.

Time of day factors can be asserted, but the assignment results will need to be validated against hourly count data. Time of day factors could be derived from the household survey and/or from neighboring regional models. A panelist noted that different time of day factors should be developed for auto and truck traffic as heavy trucks will avoid traveling during congested times.

4.4 External Trips

The model currently segments External-Internal, and Internal-External trips into three trip purposes. This allows the distribution to be sensitive to trip purposes. External-External, External-Internal, and Internal-External model trips are based on an intercept survey from the 1980s combined with a hotel and truck stop survey done in 1998. Since then, FMPO has used growth factoring and comparisons with the Arizona statewide model. In the pre-meeting discussions, a panelist recommended a cordon survey to improve the external trip data.

The panel recommended that FMPO continue the practice of segmented external trips through model updates. FMPO should also continue to work with Arizona Department of Transportation (ADOT) to improve data available through the statewide model.

4.5 Mode Choice

The FMPO model does segment transit person trips using the "3-D" method, but does not use a typical logit mode choice model structure with sensitivities to path skim times. The process uses qualitative measures of level of service for walk modes, a transit level of service based on the proximity to bus stops and frequency of service, and a bike comfort index that considers the distance, bike lane connectivity, and intersections. This non-traditional method of mode split was implemented in the FMPO model based on guidance from their model development consultants.

The panel recommended that FMPO implement a more traditional logit-based mode choice model within the overall model stream as shown in Figure 4-1. FMPO could use asserted parameters based on FTA guidance and make this a straightforward process. There would need to be coding of the transit route system and non-motorized networks. Some of the existing level of service measures that FMPO has developed, such as the Bike Comfort Index (BCI) that accounts for traffic speed and volume, bike lanes and trails, and lane widths, can and should be included in the non-auto utility functions.

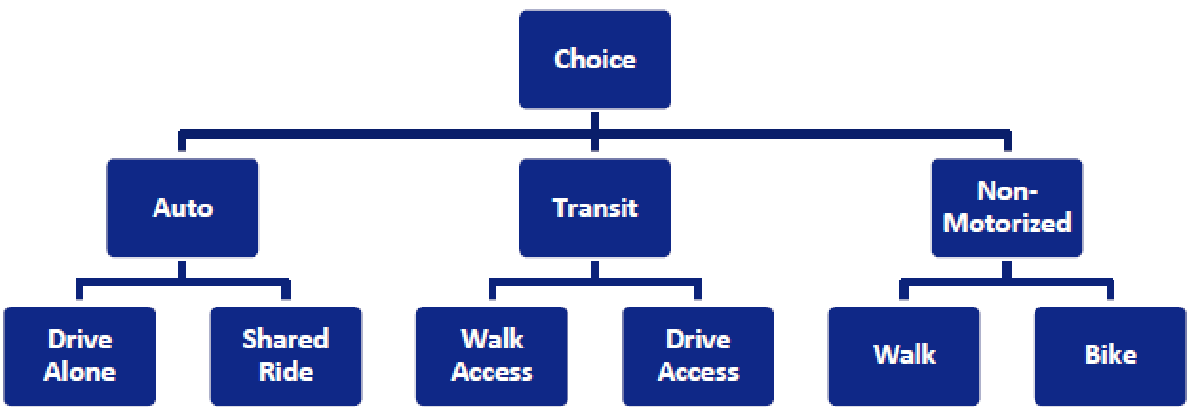

Figure 4-1: Traditional Mode Choice Nest Formulation

4.6 Networks and Assignment

The network contains daily and peak hour link capacities by functional class and area type derived from the Highway Capacity Manual. There are manually coded intersection delays, particularly at the railroad crossing which runs through the center of town and is heavily used by freight trains and a daily Amtrak service. A panelist commented that the link capacity numbers appeared to be on the high end and expressed concern that local trips on major arterials and interstates tend to reduce capacities. Free flow speeds are based on posted speed limits, which a panelist pointed out do not necessarily represent the actual travel speed of drivers.

The FMPO defines area type by staff judgment. Area type is currently used in the model to determine link capacity and out of vehicle times (terminal times). In other regions, area type is based on a household and/or employment density within a zone, but this requires manual smoothing to avoid big changes in area types due to urban parks, for example. The panel recommended that FMPO continue their current practice of coding area types using staff judgment.

4.6.1 Highway Assignment

Assignment runs with the current model produce volume to capacity ratios above 1.0 for certain links. The panel advised FMPO to be cautious of links with V/C ratios significantly higher than 1.0. Links with v/c ratios over about 1.2 indicate a model scenario where demand is much higher than supply and the model results may not be valid.

The panel recommended that FMPO implement an assignment process that utilizes an intersection delay function. The intersection delay function dynamically adds delay to paths through intersections based on the signal timing. This will improve the model's usefulness in the TIA process, which is more dependent on turning movements at intersections and corridor-level volumes. The panel noted that the railroad crossings will require special tuning to account for the perceived delay that may be substantially higher than the actual delay.

4.6.2 Transit

The Flagstaff region has a small but heavily used bus network that serves both choice and captive riders with about half of the ridership related to NAU. The transit agency has received a Small Starts FTA grant for a BRT-light route through campus and is planning a second grant application for a BRT route.

The FMPO model does not currently include a transit network for skimming or assignment. As discussed in the Mode Choice section above, transit trips are removed from the set of person trips before highway assignment using level of service measures based on proximity and frequency of service. Transit is validated by comparing district-district flows to the observed boardings.

The panel concluded that the NAIPTA Mountain Line transit service is small enough such that coding the existing service into a transit network for skimming and assignment would be manageable. Forecast year transit will need to be represented as well, similar to the forecast highway network. The transit network skims would be used in mode choice, as described above, and the transit trips from mode choice could then be assigned to this network.

The modeled transit boardings will be easier for FMPO to validate than the current method of area to area mode shares. The validated results will be much more useful to NAIPTA for route-level planning and future FTA grant applications for BRT service.

4.6.1 Dynamic Traffic Assignment

The use of Dynamic Traffic Assignment (DTA) for the FMPO model was discussed and dismissed prior to the peer review. As a panelist explained via email, Flagstaff is most likely not big enough or busy enough to justify DTA on its technical merits. A good substitute for DTA, which is feasible for a city the size of Flagstaff, will be to implement node delays at signalized and stop-controlled intersections and run one-hour assignments in the congested times as was recommended in the Time of Day and Highway Assignment sections.

4.6.2 Zonal Structure

The FMPO model consists of 340 traffic analysis zones although zones are sometimes subdivided in the TIA process. Smaller zones can be useful to analyze pedestrian and bicycle travel, but additional zones increases computational intensity. The run time of the current model is very short so that is not a concern, but panelists concluded that the number of zones was appropriate for a region this size.

4.7 Speed Feedback

The FMPO model does not implement a speed-feedback loop whereby congested travel times and distances are used to redistribute trips. Adding a speed-feedback loop will cause average trip lengths to be shorter because congested travel times are longer than free flow travel times so the friction factor curve will resolve to closer zones. This will typically result in lower vehicle miles traveled (VMT) in the forecast year and the reduction or elimination of links with high volume to capacity rations. However, it is much more behaviorally sound to include congested travel times in the distribution model, particularly for the peak travel times.

The panel strongly recommended that FMPO implement a speed feedback model, particularly with the peak travel periods. The panel recommended that a composite impedance that considers both distance and time be used in distributions and potentially in assignment. Including distance as an impedance measure will mitigate the reduction in VMT under speed feedback iterations.

4.8 Calibration and Validation

4.8.1 Data Collection

The panel recommended that data collection be focused in the fall to be consistent with the recommendation that FMPO calibrate and maintain a fall season model, as discussed in the Trip Generation section above. The panel also recommended that FMPO conduct year round counts at 10-12 locations to gain more insight into seasonal traffic variations.

FMPO conducts a household survey every six years, which the panel supported and recommended that the survey results be incorporated into more aspects of the model validation. As a complement to the household survey, a panelist recommended that FMPO conduct a transit on-board survey to collect better mode share data and estimate intra-zonal transit trips.

FMPO requested more information about collecting data on non-motorized modes. One panelist noted that their region uses volunteers to conduct manual counts along bike paths. Another panelist provided the following references for more information on non-motorized data collection:

- Informational webinar about North Carolina Department of Transportation's Non-Motorized Volume Data Program (www.itre.ncsu.edu/Public/bikepedtrn.html) that covers the following topics:
    - Why Count Bicyclists and Pedestrians?
    - Current State of Practice
    - Site Selection Process
    - Local Agency Partnerships and Participation
    - Data Monitoring, Maintenance, and Management
    - Programmatic Next Steps
- The Traffic Monitoring Guide, which includes guidance, standards, procedures, and equipment used to count and monitor traffic, including (in Chapter 4) bike and pedestrian counts www.fhwa.dot.gov/policyinformation/tmguide/; and

- NCHRP report 797 guidebook on collecting bike and pedestrian counts onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_797.pdf

4.8.2 Model Calibration and Validation

In general, the panel recommended that FMPO invest more time on calibration of the demand models.

For trip generation, the household survey can be used to validate district level trip generation by purpose. Trip generation can also be submitted to reasonableness checks as identified in NCHRP-716 and the TMIP Model Validation and Reasonableness Checking Manual.

The panel recommended that the household survey and Census Transportation Planning Products (CTPP) Journey to Work data be used to calibrate trip length frequencies and district to district flows where the districts are a small number of key travel areas. Suggested measures include average trip length and the coincidence ratio[1], which compares how well the distribution shape fits. It is also important to validate that the trips are being distributed between the right locations. Although there are insufficient data to analyze flows at a zonal level, the FMPO could aggregate to the district level, using professional judgment to identify key areas and validate the district to district flows in the model. District to district flows differ from screenlines in that they can be used to identify flows from areas that are not adjacent.

For assignment, the panel suggested that the FMPO continue their robust count collection and enhance it with vehicle class counts to validate the truck model, but that the average annual weekday count (AAWDT) be used rather than average annual daily count (AADT), which include weekend data. The count data are currently used to validate overall model VMT as well as several screen-lines. FMPO expressed concern that some minor screen line locations are not supported by counts. A panelist advised that the FMPO review the reasoning for each screen lin. If the screen line represents a major or key flow in the region, it should be counted and the counts should be complete. The panelist explained that the best practice is to also count traffic on roadways across the screen line that are not part of the model network. But, screen lines do not need to be maintained for their own sake. Some panelists thought that a major corridor link level validation is also necessary, given that the region is dominated by a single corridor and divided by the railroad and interstate.

FMPO reported cases of over/under issues in the highway assignment where volume is too high in one area but too low in another. A panelist suggested that FMPO use ‘select link’ type analyses to gain insight into the origin and destination of trips through the problem areas.

In addition to the count data, travel times are also important for assignment validation of peak periods. The panel recommended that HERE and/or INRIX data be used to validated travel times. Travel times should be validated by facility type and volume group and may be used to calibrate the volume-delay function.

FMPO had incorporated the maximum desirable deviation curve in the validation report, although it was not used as a primary determinant of model validation. Panelists agreed that the maximum desirable deviation curve is an antiquated measure and should not be used in validation.

[1] For a full description of coincidence ratios, please see section 8 of the Quick Response Freight Manual: http://www.ops.fhwa.dot.gov/freight/publications/qrfm2/sect08.htm

Finally, validation standards from states such as Ohio, Michigan, and Florida should be reviewed for guidance as to the specific validation measures and for ideas on best ways to organize validation tables, graphics and reports.

4.9 Model Update Schedule

The typical MPO procedure calls for a model update for each transportation plan, which occurs every five years in Flagstaff. FMPO currently updates the model networks and inputs on a three year cycle and would like to systematically incorporate information from the assessor's office and TIA process enhancements into the model. On average, there is one major project per year that requires changes to the model inputs to support a TIA process.

A new development may be completed within the three year model update cycle and the panel expressed concern that this presents the opportunity for TIAs to be conducted with obsolete versions of the model. To support the TIA process and other local uses, the panel recommended that the network of existing and committed projects be updated on an annual basis. The land use dataset should also be updated on an annual basis. FMPO may explore more frequent updates as new projects are funded or implement an Existing and Under-Construction dataset to represent multi-year developments.

FMPO requested guidance on how the regional model could be officially approved for use by member agencies. A panelist offered the following opinion:

> Approaches vary widely by jurisdiction. One of the most effective methods I have seen is creation of a committee that participates in model update and development processes. The committee will usually meet 3-4 times over the course of a model update. An example meeting list might include:
>
> 1. Travel Modeling 101 – An introduction since members may not be familiar with modeling.
>
> 2. Data Requests – A process in which members help provide and review data to be used in the model update. This can include counts, socio-economic data, and transportation networks.
>
> 3. Preliminary Results – The committee reviews preliminary results and begins to understand the model calibration and validation process.
>
> 4. Final Results – The committee sees final results and example products such as congestion maps and regional trip patterns. Often paired with something like "Travel model Dos and Don'ts."
>
> Results of this process include a broader understanding of the model's purpose and better review by a more varied audience. Example committee names include "Model Development Team," "Model Validation Task Force," or "Model Improvement Team."

4.10 Interim Year Forecasts

The model currently consists of a base year and 20 year forecast year. The panel agreed with the planned development of 10-year interim forecasts (e.g., 2020, 2030, and 2040). The panel advised to also consider 5-year increments to avoid the need to interpolate over long periods of time. Where interpolation is appropriate, the process should be applied to model inputs (i.e., socio-economic/land use data), not outputs. Very short term forecasts (e.g., 3-5 years) may be done with simple growth forecasting.

Panelists cautioned against running model forecasts with a no-build network as it may be stressing the assignment procedure beyond its applicability. Forecasts should be run with a fiscally constrained development pattern and perhaps include projects that are beyond the Existing and Committed list but are reasonably affordable.

4.11 Model Use for TIA

There was a robust discussion about working with the model outputs to support the TIA process. The implications for the model structure are discussed in the previous sections and recommended model applications are discussed below.

Currently, the model is used in TIA studies to baseline background traffic and derive growth factors in the forecast year. The panel concluded that the model can be used in other aspects of the TIA process, given that certain enhancements are made to the model to ensure better results.

4.11.1 Model Administration with TIA process

The audience emphasized the need for a clear process. Audience members with experience developing TIAs cited experiences where the unknown time to complete model runs and additional processing were onerous for a development project. The panel agreed with a threshold of 100 trips per hour as a prerequisite for involving the regional model in the TIA process.

4.11.2 TIA process trip generation

The TIA process uses trip rates from the ITE manual to derive the number of vehicle trips generated by a particular development. A panelist explained the method for how the ITE manual rates are developed and distinguished between averaging across the rates and recalculating the average rate using the total land use and trips, which is effectively a weighted average. Different ranges of square footage require different approaches, i.e. plotted points in adtion to the convetional average rate or fitted curve rate, to determining an appropriate trip rate.

Another key concern with the TIA process around the adjustment of generated trips is handling mixed used developments. A panelist and audience members agreed that the term “mixed use” has been misapplied to developments that do not truly reduce trips outside of the development. The Trip Generation Handbook, 3rd Edtion provides clear guidance on the definition of mixed-sue developments. A well-designed regional travel model with cross-classified household or person-based trip rates is well suited to forecast background traffic growth, particularly in-fill type travel that is not well represented by ITE rates.

4.11.3 Post Processing Model Outputs for TIA inputs

The TIA process uses a fairly low level of information (e.g. link volumes and turning movements) while a regional model is primarily calibrated at the corridor, screen-line, and regional volume level. So great caution should be exercised before using these outputs from the regional travel demand model. Panelists recommended a careful validation beyond what is currently being conducted and, even with the additional effort, still concluded that post-processing and refinement of the output is necessary. Moreover, the TIA may require splitting of model zones and/or adding links to zoom in on a smaller area. Therefore, the regional model results cannot be used directly, but the indirect applications still need to be carefully calibrated.

NCHRP-255 / NCHRP-765 define a standard method for intersection and link volume post-processing. For example, link volumes can be adjusted using difference method according to the ratio or average volume and iterative proportional fitting (IPF) applied to the turning movements to fit the adjusted link volumes. The panel recommended that FMPO follow a process similar to that recommended in NCHRP-765.

4.11.4 Radius of Impact

The model can be useful to identify the radius of impact for a development project. Rather than placing a simple radius around the development project, there may be intersections farther away that are more adversely impacted than closer intersections not on a key link for the particular development. For example, a development that will house university students would impact the intersections between the development and university to a greater degree than intersections between the development and downtown.

Thresholds that define a significant impact, constraints on the total intersections to be considered and the minimum development size need to be defined. Example thresholds are:

- Minimum 100 vehicle trips per hour generated by the new development;
- Between four and ten intersections will be analyzed;
- Significantly impacted intersections are those where:
    - Intersection delay is increased by more than X% (this would be a direct model output with an intersection delay-based assignment or could be post processed);
    - Volume to capacity ratio on intersection approaches increase by more than X%;
    - Volume increases by more than X vehicles.

Again, these were offered as example thresholds and constraints and they should be defined based on the FMPO staff judgment.

4.11.5 TIA and Model Interaction

As discussed in the Seasonality and Count Data section, a fall model is sufficient for the FMPO's needs. If the agency were to maintain a summer model, for example to test a proposed development consisting primarily of hotels or summer homes that would have peak travel during the summer, the panel recommended that a hotel-based trip purpose be added to the model. Visitor travel is not well represented by the standard purposes that are currently in the model.

4.11.6 Background Traffic / Proportional Share Calculations

A major concern raised by the FMPO and their consultants is how to assess the proportional share of new developments. The concern stems from the situation where developments are not restricted while there is ample capacity in the network, but if the available capacity is limited, developments end up with the burden of substantial improvements even though they would represent a minority of the total traffic. This is an issue for urban developments because it discourages infill type development and promotes development in outlying areas, i.e. sprawl, which results in increased congestion (real or perceived) in outlying areas and on critical connections to outlying areas. Sprawl also increases the potential of early developments providing no transportation improvements, and later developments required to provide substantial improvements.

Allocation of proportional share responsibilities to developers is primarily a political issue, but the regional model can be used to assess impacts based on the proportion of existing capacity used by the new development. The process would be to run the model with and without each development and compare the base and/or forecast year assignment results. Some other tools that can be used are a comparison of delays to examine where the impact is on roads and intersections that are near capacity. A select link/zone analysis can also be used identify critical points in the network.

An audience member explained that many cities in Arizona have an impact fee program that takes effect even if the degradation in level of service does not exceed any threshold. A key aspect of the impact fee program is that the growth rate is clearly defined and agreed upon because developers need to be able to determine in advance what the potential impact fee might be.

4.11.7 Non-Auto

Flagstaff has a high non-auto mode share because of the large university population and dense, walkable downtown. Pedestrian traffic is at a level where it is creating congestion to key roadways during the pedestrian crossing cycle. Several of the bus lines are over capacity. Therefore, the impact of new developments analyzed needs to be more than just the vehicle trips generated.

A panelist noted in a pre-meeting email that the margin of error in transit trip prediction is greater than the predicted volume, particularly for smaller regions such as the FMPO planning area. Therefore sensitivity tests should be run to produce a range of non-auto results from the model. The sensitivity tests should be constructed to determine the magnitude of error on the transit predictions that results in a different conclusion of transportation network improvements. For example, what is the possibility that the development will create severely crowded buses?

The panelist went on to explain that, in terms of auto trip reduction, there should be robustness thresholds that the transit system meets to justify any reduction. For example: an auto trip reduction greater than one percent can only be justified by bus stops or stations within one-quarter mile of a development, with service frequencies of 15 minutes or less, direct connections to destinations, and travel times less than 50% greater than private vehicle. The transit system must have characteristics that would compel choice riders to regularly utilize that system if they worked, lived, shopped, or recreated in the proposed development.

The entire panel acknowledged these threshold recommendations and proposed the following method to use the model to support the non-auto process. First, deficiencies by mode would be identified as part of an off-model process. Next, the model would be used to identify development traffic interacting with areas where deficiencies have been noted. Model tools to support this analysis are the select zone analysis and examining proximity in the network. Implementation of a transit network for skimming and assignment is particularly important to make the model useful for non-auto analyses.

A presentation of a concurrency district analysis process in Bellingham, WA referenced during the peer review calls for looking at network “completeness” rather than the level of service range. The panel agreed that this process would be appropriate for Flagstaff given the connectivity issues caused by the railroad and interstate. This type of approach would be complementary to the model results and help balance the risk of using model predictions with known large error terms.

5.0 Peer Review Panel Recommendations

This section summarizes the recommendations of the panel.

5.1 Model Assessment

There were several aspects of the FMPO modeling and planning process that the panel approved of; however, the panel concluded that the model required extensive changes to be brought up to the state of the practice and to be useful in the TIA process. The panel recommendations were made with a particular mind to achieving the following goals expressed by FMPO during the peer review meeting:

- Model that employs best practice approaches;
- A model that can be used to support the TIA process;
- Consideration for non-auto modes (transit, bike, pedestrian); and
- Solid forecast capabilities.

The following sections summarize the panel recommendations from the previous section by priority. Priority was determined according to the relative effort and benefit of each item. In addition to the recommendations listed below, the panel recommended that FMPO review published guidelines, such as NCHRP Report 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design, and peer models like Parkersburg, WV-OH for examples of solid, four-step models that are feasible for FMPO to implement and maintain and are appropriate to support project-level travel forecasting. The panel emphasized that regional models are not appropriate for direct project-level forecast use and that operational model should be used instead. Moreover, in order for regional model outputs to be used as reference, the model must be well validated and the outputs used used with great caution.

5.1.1 High Priority Model Improvements

The high-priority model suggestions include fairly extensive changes throughout all components of the model. Given that FMPO has only one full-time modeler on staff, the panel assumed that consulting resources would be used to complete the recommendations. The estimated cost of such a model update would be about $80-120K and take about one year.

- Produce trips using cross-classified person trip generation rates based on socio-economic data.
- Implement a truck model based on the Quick Response Freight Manual.
- Replace the 24-hour model with a series of shorter traffic assignment procedures that include one-hour assignment periods during congested times.
- Implement a more traditional logit-based mode choice model using transferred/asserted parameters.
- Implement an assignment process that utilizes an intersection delay function.
- Create a transit network for skimming and assignment.
- Implement a speed-feedback loop whereby the congested travel times and distances are used to redistribute trips.
- Calibrate the model to represent the fall travel season.
- Collect counts on a monthly basis at 10-12 locations to confirm fall travel season peak assumption and gain more insight into seasonal traffic variations.

- Improve the validation process, specifically:
  - Calibrate trip distribution using measures that examine the trip length frequency curve (e.g. coincidence ratio);
  - Examine flows between key sub-areas of the network;
  - Utilize HERE and/or INRIX travel time data; and
  - Follow the example of states such as Ohio, Michigan and Florida for guidance on measures and reports.
- Develop forecast years with 10 year intervals through 2040.

5.1.2 Medium Priority Model Improvements

The medium priority improvements suggested are those that the panel would like to see implemented, but are not as critical for FMPO's needs.

- Home-Based School Trip Purpose: Identify K-12 school locations and enrollment and add a home-based school purpose to the model, especially considering that some charter schools use the public transit system as the school bus.
- Trip Attractions: Convert the current approach from using ITE trip rates to a more traditional employment based attraction rates by employment type. Alternatively, the ITE employment based trip rates may be used, which is an improvement over the land use square footage rates.
- University Trip Special Generator: FMPO should collect or borrow university special generator data to better capture the large population of university students in the region.
- Update networks and inputs on an annual basis.
- Develop forecast years with 5-year intervals.

5.1.1 Low Priority Model Improvements

Low priority model improvements are included as things that FMPO should keep in mind through future model development.

- External trips should continue to be derived from the statewide model and a cordon survey taken to validate the statewide model and improve the trip purpose splits for external travel.
- Develop a summer travel season model that includes a hotel-based trip purpose.

5.2 Model Integration with the TIA Process

The model recommendations above were made with the intention of making the model outputs more suited to use in a TIA process. This section summarizes the post-processing and ways to utilize the model outputs in a TIA.

5.2.1 Post Processing

- Follow the method defined in NCHRP-765 for intersection and link volume post-processing.

5.2.2 Model uses in TIA

- Use the model to inform the radius of impact determination and identify significantly impacted intersections.
- Identify model volumes using select link analysis to calculate proportional share from new developments.
- Observe mode shares by zone to support non-auto analyses and examine travel through areas of the network with identified deficiencies.

Appendix A List of Peer Review Panel Participants

This section lists all individuals who attended the meetings, including panel members, FMPO staff, and peer review support staff. The meeting was also available via live-streaming but the online attendees were not identified.

A.1 Peer Review Panel Members

Panel Member	Affiliation
Paul Basha	Scottsdale, Arizona
Mei Ingram	Triangle Regional Model Service Bureau (TRMSB/ITRE/NCSU)
Alan Horowitz (panel chair)	University of Wisconsin-Milwaukee
Sean McAtee	Cambridge Systematics

A.2 FMPO, City of Flagstaff, County/Federal, Transit Agency Staff

Name	Affiliation
David Wessel	Flagstaff Metropolitan Planning Organization (FMPO)
Martin Ince	Flagstaff Metropolitan Planning Organization (FMPO)
Jeff Bauman	City of Flagstaff
Stephanie Sarty	City of Flagstaff
Reid Miller	City of Flagstaff
Mark Sawyer	City of Flagstaff
Kevin Fincel	City of Flagstaff
Dan Folke	City of Flagstaff
Rick Barrett	City of Flagstaff
Nate Reisner	ADOT Flagstaff
Tim Dalegowski	Coconino County
Romare Truly	Federal Highway Administration (FHWA)
Erika Mazza	NAIPTA Mountain Line
Chris Comeau	City of Bellingham, Washington (via phone)

A.3 Agency Consultants

Name	Affiliation
Stephanie Watney	Snell & Wilmer LLP
Yung Koprowski	Lee Engineering
Andrew Smigielski	SWTE
Alejandro Angel	Psomas

A.4 TMIP Peer Review Support Staff

Name	Affiliation
Sarah Sun	Federal Highway Administration (FHWA)
Martin Milkovits	Cambridge Systematics

Appendix B Peer Review Panel Meeting Agenda

Monday, September 14, 2015

Welcome / Introductions / Meeting Purpose	1:00-1:15
Overview of TIA Process	1:15-1:30
Overview of the FMPO model	1:30-2:00
PANEL Q&A	2:00-2:10
Trip Generation & Distribution	2:10-2:25
Break	2:25-2:35
Background Traffic	2:35-3:35
PANEL Q&A	3:35-3:50
Mode share & Modal Distribution	3:50-4:30
PANEL Q&A	4:30-4:45
Recap & Next Day instructions	4:45-5:00

Tuesday, September 15, 2015

Mode Share (revisited)	8:00-8:15
PANEL Q&A	8:15-8:30
Proportional Share	8:30-9:30
PANEL Q&A	9:30-9:40
General wrap-up and follow-on questions	9:40-10:00
Break	10:00-10:15
Panelists executive session	10:15-12:00
Panelists presentation	12:00-1:00

Appendix C Peer Review Panel Biographies

C.1 Paul Basha, City of Scottsdale, Arizona

Paul Basha is currently the Transportation Director for the City of Scottsdale. He has more than 40 years of experience in traffic engineering and transportation planning. Approximately half of his career has been as a public servant and half as a traffic engineering consultant. Approximately 30 years has been in Arizona, 6 years in Washington State, and the remainder in Michigan and Chicago. He served on the Institute of Transportation Engineers Review Committee for the Trip Generation Handbook, 3rd Edition published in 2014; and serves on the similar committee for the Trip Generation Manual, 10th Edition, anticipated for publication in 2017. Mr. Basha has prepared more than 200 Traffic Impact Analyses and reviewed more than 50 Traffic Impact Analyses prepared by other traffic engineers.

C.2 Mei Ingram, Triangle Regional Model Service Bureau

Mei Z. Ingram is a senior research associate at the Triangle Regional Model Service Bureau, Institute for Transportation Research and Education, located at the North Carolina State University, Raleigh, North Carolina. Her key role is to develop and maintain the Triangle Regional Model and provide technical support to the stakeholders and other users.

Prior to her current position, Ms. Ingram worked for two years at NCDOT and eight years with the Parsons Transportation Group/Barton-Aschman. She has 20 years of experience in multimodal regional traffic demand model development and application for various urban sizes, travel behavior related survey design/analysis, air quality conformity study, regional economic development and socio-economic data forecast, and highway safety.

Ms. Ingram holds an MS in Economics from the University of North Carolina at Chapel Hill as well as an MA in Urban Studies from the University of Maryland at College Park and a BS in Physics from Beijing Normal University.

C.3 Alan Horowitz, University of Wisconsin-Milwaukee

Alan J. Horowitz is a transportation engineer and an urban planner. His research spans the areas of travel forecasting and traffic impacts. Since coming to the University of Wisconsin-Milwaukee in January 1979, Professor Horowitz has been continuing his research into values of time, and conducting new research about urban trip tours, land-use impact assessment, single-route ridership forecasting, trip assignment, subarea focusing, ride quality of highways, intermodal passenger transfer facilities, transportation benefits, freight planning, applications of GIS to transportation networks, hazardous materials routing, intelligent transportation systems, and travel forecasting. Dr. Horowitz is the author of the Quick Response System II travel forecasting software platform.

C.4 Sean McAtee, Cambridge Systematics

Sean McAtee is a Senior Associate of Cambridge Systematics with more than 10 years of experience in travel model development and application, including survey analysis, parameter estimation and calibration, systemwide model validation, and model implementation. Mr. McAtee has experience developing and applying travel models for states, MPOs, and cities of various sizes, including jurisdictions in Arizona, Arkansas, California, Colorado, Illinois, Iowa, Kansas, Mississippip, Michigan, Nebraska, New Mexico, and Texas. He has extensive experience in developing user interfaces and automating model processes via programming and scripting in languages such as Python, Visual Basic, GISDK, and various travel demand model software packages. He often provides assistance to agencies in their ongoing model maintenance, update, and application efforts.

Appendix D Documentation Provided to Panel Members by FMPO

1. Original TMIP Application
2. FMPO RTP Policy Document
3. Model Documentation
    a. FY 2015 Regional Transportation Model Base 2013 Calibration Report
    b. 3dBikeModel Flow.docx: A flow chart of the model files and how they are handled in the code
    c. Model Documentation
        i. Flagstaff bike mode 5-1-15.pptx
        ii. 2_3dMemo.pdf
        iii. Memo 3d mode v2b
        iv. Flagstaff Model Documentation
    d. Other documents
        i. Trip Generation Comparison.xlsx: compares model results to ITE
        ii. Future EE_IE.xlsx: EE and IE trip forecast procedure
        iii. FMPO indexFile.xlsx: Flow chart of future land use and interpolations
4. Calibration-Validation Materials
    a. Summary.htm: Model run report withperformance by facility type and area type
    b. Summary3d.txt and summary3dbike.txt: Comparison of the “3d” and “auto only” model.
    c. Bike Model vs. TDSurvey: Comparison of bike assignment model outputs to results from a trip diary survey in three areas of town: core, rest of the City, and Rest of the MPO
    d. Transit Calibration: 2012 comparison of transit demand between districts
5. TIA and TIA Model Procedures
    a. TIA rewrite_Draft Final: City’s pending update to the TIA process
    b. Modeling Procedures: Draft documentation of model uses in TIA process
    c. Policy Questions: Questions from FMPO and City staff to inform TIA process and model uses.
6. Model Files

NOTICE

Federal Highway Administration

U.S. Department of Transportation
Federal Highway Administration
Office of Planning, Environment, and Realty
1200 New Jersey Avenue, SE
Washington, DC 20590

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U.S. Department of Transportation
Federal Highway Administration