Transportation Model Methods and Needs Evaluation

The purpose of this evaluation is to identify a restructured process to realistically update and maintain existing and future transportation models.

All primary model methods and inputs required to develop traffic forecasts are individually assessed and subsequently used to identify transportation needs and projects. This document attempts to answer questions regarding the how and when of data collection, calibration, analysis and distribution.

1) MODEL PURPOSE

The Quick Response System II (QRS II) travel demand forecasting model is used to project future traffic volumes on the roadway network as well as determine traffic growth. The results are used to assess transportation needs.

The model may also be used, when appropriate and upon request, to determine potential shifts in travel based on major adjustments to the roadway network (such as roadway additions, closures or connections) or major adjustments to demographics.

2) MODEL DATA

In addition to model data input described in this evaluation, the model uses various default factors based on national data sets to perform the required calculations. BMPO staff typically does not make adjustments to these factors unless an important reason appears to do so. If adjustments are made, they will be documented with an explanation of the need.

A) Roadway Network

The model is developed to provide a scaled representation of the roadway network. Roadway network data presented in this evaluation will be updated periodically when changes have been identified. Also, the entities responsible for management of the data will be requested annually to provide an update and verify any changes already implemented.

Lane Geometry / Cross Sections

The cross section of most freeways, highways, arterials and collectors are reflected. Local streets are generally not modeled.

Current - Any additions, deletions, realignments or other modifications presently planned to be implemented to the existing roadway and intersection lane geometry / cross sections (for collector and higher classified roadways) are required.

Future – Information regarding potential lane geometry / cross sections for possible future roadways and intersections will be requested from the entities responsible for project development.

Intersection Traffic Control—Signs

The model selects the best trip route based primarily on travel time. Thus, stop and yield signs that impede travel time are reflected in the model.

Current - Locations of new or removed stop and yield signs presently planned to be implemented are required.

Future - As applicable, information regarding proposed locations of future signs will be requested from the entities and/or the locations may be determined by potential need based on roadway function and uninterrupted travel patterns.

Intersection Traffic Control—Traffic Signal / Phases

Traffic signals also impede travel time and are represented in the model.

Current - Locations of new or removed traffic signals presently planned to be implemented are required in addition to the number of phases for new signals or adjustments to existing signals.

Future – Information regarding locations of future traffic signals will be requested from the entities and/or be determined based on potential need projected traffic volumes generated by the model. The number of signal phases will also be assumed based on projected traffic volumes.

B) Roadway Characteristics

The model includes intangible characteristics of the roadway network. These characteristics are important to determine trip assignment and travel patterns. Roadway characteristics will be updated periodically as changes are identified or warranted. As appropriate, the entities will be requested to provide an update and verify any implemented changes.

Functional Classification

Roadway functional classifications provide information regarding roadway type such as length, spacing, access and speeds. Typical functional classes used in QRS II are: freeway, expressway, major arterial, minor arterial, collector, local and other.

Current – Roadway functional classifications are determined from the Federal Highway Administration (FHWA) approved ten-year BMPO and Bonneville County Functional Classification Maps.

Future - Roadway functional classifications are determined from the Long Range Roadway Functional Classification map found in the BMPO Long Range Transportation Plan which should be consistent with local comprehensive plans. Any modifications to these roadway functional classifications are required.

Speed

Model travel patterns are heavily dictated by travel times. Thus, link speeds are an essential model input.

Current – Locations and changes made to posted speed limits are required.

Future - Speeds for proposed future roadways will be determined by functional classification as follows:

Collector (Rural) – 50 mph*
Collector (Urban) – 30 mph
Minor Arterial (Urban) – 35 mph
Principal Arterial (Urban) – 40 mph

Posted speed limits are initially used in the model as representative of typical free-flow link speed, but they may be adjusted during the calibration process to better represent actual speeds. Currently, it is cost prohibitive to gather actual roadway speeds.

*Technically, the metropolitan planning area should be a representation of what the urbanized area will look like in 20-25 years. Therefore, all roadways should correspond with urban functional classifications. However, because other factors are used to establish metropolitan planning area boundaries, growth projections will be used to determine if a roadway outside the existing urbanized area will continue to function more as a rural collector.

Capacity

The capacity of a roadway segment is the maximum number of vehicles that can cross an imaginary line in the roadway over a specified amount of time. When a roadway segment nears capacity, congestion occurs and travel time is increased, therefore trips may be diverted elsewhere.

Current and Future - The capacity of a roadway lane is established based on the *Highway Capacity Manual (HCM)* as 1800 passenger cars per hour (pcph) and 2000 pcph for freeways and expressways. The appropriate capacity will be added for any new lane additions.

<u>Cycle Lengths</u>

Cycle length is the length of time it takes for a traffic signal to run through all phases for all legs of an intersection.

<u>Current and Future</u> - In the past, cycle lengths were gathered from timing plans or observation. However, with modern actuated signals, the cycle length will vary from cycle to cycle, based on traffic demand. Due to the complexity of establishing appropriate cycle lengths at actuated signals, cycle lengths for all existing and future traffic signals will be based on the following: 2 phases = 60 seconds, 3 to 4 phases = 90 seconds and 5 to 6 phases = 120 seconds.

<u>Heavy Vehicle Proportion</u>

Heavy vehicle proportion is the percentage of daily trips made by heavy vehicles on a roadway segment.

<u>Current and Future</u> - With the exception of I-15 and US-20, a default of six percent is used for all principal arterials and two percent is used for all other roadways to reflect the proportion of overall traffic considered to be heavy vehicles. Every five years, BMPO staff will request an update from ITD for heavy vehicle proportion on I-15 and US-20. For all other roadways, BMPO staff will continue to use the default unless it is deemed necessary to make a change.

<u>Progression</u>

How well traffic flows along a roadway corridor relative to traffic signals is called progression.

<u>Current and Future</u> – Progression is estimated on a scale of one to six with one being very poor (a dense platoon of vehicle arriving at the start of red) and six being excellent (a dense platoon of vehicles arriving at the start of green). Currently, a progression of three (random arrivals), which is average, is used for most roadways. However, adjustments can and have been made based on knowledge of roadway characteristics that impact flow such as coordinated traffic signal timing, number of access points, on street parking, etc. During model calibration, BMPO staff will determine on a case by case basis the need to make adjustments.

C) Socio-Economics

Socio-economic data is required by small geographic areas called traffic analysis zones (TAZs). Socio-economic data establishes the trip generation or number of trips assigned to the roadway network. The number of trips produced by households is estimated primarily on either income or the number of vehicles per household. Higher income levels and number of vehicles produce a higher number of trips. Secondarily, trip production is also affected by household size (number of persons per household). The number of trips attracted by employees depends on the type of employment.

Socio-economic forecasts are updated every five years with a short range forecast of approximately ten years and a long range forecast of approximately twenty years.

Households and Employment

All occupied dwelling units are considered households. Employment is all full-time and part-time employees working in the non-retail, retail and service industries.

Current – Building permits are gathered monthly from the local jurisdictions. The process for incorporating the building permit data for model needs is described in the Socio-Economic Estimates document. Every ten years, the household data is re-adjusted to match U.S. Census Bureau data. During calibration, which is every five years, employment data is re-adjusted with data from the Labor Department.

Future – The method to obtain demographic forecasts is and will continue to be described in the published document that presents the future household and employment data.

Household and employment estimates are updated annually for two reasons: 1) to be readily available for input to update the calibrated model to a current year and, 2) to track and assess the validity of socio-economic forecasts.

Income or Vehicles per Household

The aggregate income for an area divided by the number of households provides an average household income.

Current and Future – Household income and the average number of vehicles per household for each TAZ are extracted from U.S. Census Bureau data and updated every ten years. Household income is adjusted using the consumer price index to a common dollar value related to the year the production rate table is based upon. During model calibration, trip productions based on income and vehicles per household are compared and the more representative method is used until the next model calibration. Currently, income is used to estimate trips.

If, at anytime during a ten-year period, the number of dwellings increases by fifty percent within a TAZ, the new residential development will be evaluated to determine if it is dissimilar to the existing development. If it is determined to be dissimilar, then the income, vehicles per household and household size for the TAZ will be adjusted using data from other TAZs with similar characteristics.

Special Generators

Special generators with separate trip generation data are calculated and incorporated into the model for those land uses that generate trips not normally captured by the number of employees. Special generators may include land uses such as schools, airports, government and religious facilities. For example, rather than use employees, the number of students attending a particular school might be used or the number of scheduled flights at the airport might be used, etc.

Current and Future - Commonly acceptable sources such as the ITE "Trip Generation" Manual are used to determine the number of trips generated by the special generator. Trips are appropriately converted to person trips based on trip purposes.

It is extremely difficult to project where special generators will be located in the future. BMPO staff will work with the appropriate entities in order to make qualified assumptions regarding locations and characteristics.

BMPO staff will determine on a case by case basis the need for special generators and the data required to best reflect the trip generation.

D) Traffic

Traffic data is required to validate the model, establish the number of trips entering and leaving the area, and establish a base to develop traffic forecasts.

Average Daily Traffic Counts

Average Daily Traffic (ADT) counts represent the amount of traffic on a roadway segment during a normal day of the year.

Current - Traffic count locations are strategically located to provide a solid base to calibrate the model. Locations are needed throughout the modeled area, representative of all functional classes of roadways. Since traffic counts are used in traffic forecasting and ultimately in determining capacity needs, the count locations correlate with that need. Traffic counts are taken at external station locations and used to calculate person trips by trip purpose.

The Traffic Count Program document outlines the methods used to obtain traffic counts and identifies the count locations. The program is re-evaluated periodically to determine if it meets the needs of the traffic model.

Base Volumes

Base volumes consist of trips made through the area without stopping.

Current and Future - Base volumes are estimated every five years by calculation from the total trips on the highways, mainline volumes and entering and existing volumes. Distribution of base volumes is also calculated where I-15 and US-20 merge.

External Stations

External stations are located on the fringe of the transportation model and identify the number of trips entering and leaving the area from outside the area.

Current - External station data is updated in conjunction with traffic count updates. Traffic counts are divided into trip purpose i.e. home based work, home based non-work and non-home based work. The information is then converted to person trips. The percent of average daily person trips by purpose correlate with guidelines provided in "NCHRP Report 365, Travel Estimation Techniques for Urban Planning".

Future - Adjust the existing Average Daily Traffic counts by a percentage based upon the demographic growth projections. Apply the same methodology used to determine the current trips.

At some point in the future, a comprehensive travel survey of area residents may be performed in order to obtain more accurate origin-destination data and journey-to-work data. Currently, such a survey is cost prohibitive.

3) NETWORK CALIBRATION

Approximately every five years the model will be calibrated with updated roadway network data and characteristics.

The model attempts to accurately represent overall traffic volumes region-wide and on roads grouped by roadway functional classifications. This is accomplished by comparing the sum of all available traffic counts on roadway segments to the sum of the model generated volumes. This process is repeated and broken down by roadway functional classifications. A target is established for the region and by functional classification that requires the actual counts and model generated volumes be within a designated range of acceptability.

For example, the target is to have actual counts and model generated volumes for major arterials be within 10 percent. Therefore, if the sum of the actual counts on all major arterials is 1,290,000 and the sum of the model generated volumes is 1,350,000, the target would be met as the totals are within 5 percent.

In addition to the process described above, actual counts for roadway segments are compared to model generated volumes for links which represent the roadway segments. The number of link volumes within a certain percentage (based on traffic volume range) of the actual counts are tallied and compared with the total number of links assessed.

For example, if 72 links are assessed and 60 link volumes are within 25 percent (based on traffic volume range of 10,000 to 25,000 ADT) of the actual counts and 12 link volumes are not, then 83 percent of the links are on target.

Once all targets have been met, the model is determined to be acceptable and calibrated.

Note: If warranted BMPO may elect to use a different vehicle occupancy rate than the default used in the model.

4) TRAFFIC FORECASTS and CAPACITY ANALYSIS

Short and long range traffic forecasts will be performed using the calibrated model as a beginning base. Capacity analysis will also be performed using the results of the calibrated model and the short and long range traffic forecasts.

It is likely the model will not be accurate enough in every location to reliably calculate Level of Service (LOS) directly from the output or model generated volumes. Therefore, some types of adjustments are generally warranted.

Methodology

In the past, model generated volumes were adjusted by approximately 20 percent if they were ten percent lower or ten percent higher than the actual counts. This method was applied to both current and future model generated volumes. However, it has been determined that a simplified and potentially more effective method is more appropriate.

For any model link where actual counts are available, the difference between the future year model volume and the current year model volume is added to the actual count.

For example, a link where the:

Future year model volume	= 25,300
(-)	
Current year model volume	= 14,600
Difference	= 10,700
(+)	
Actual Count	= 17,400
Adjusted future volume	= 28,100

If the difference results in a negative number, then BMPO staff will determine if the model assumptions are accurate and should be adjusted or if a decrease to the actual count is warranted.

For model links where counts are not available, the average adjusted growth factor for adjoining or nearby link(s) will be applied to the unadjusted future year model volume where no count exists.

For example:

Adjoining adjusted future volume	= 28,100
(/)	
Adjoining future year model volume	= 25,300
Average adjustment growth factor	= 1.11
(x)	
Future year model volume (where no count exists)	= 22,000
Adjusted future volume	= 24,400

Note: If there are adjoining adjusted future volumes on both sides of the future year model volume where no actual traffic count exists, the average of both adjusted future volumes may be used to determine the growth factor.

Capacity Assessment

The existing counts and adjusted future volumes will be assessed against capacity guidelines as described in Section 2 of this document. As with the past methodology, when the volume to capacity (v/c) ratio is between 70 and 80 percent, the roadway is identified as approaching capacity. When the v/c ratio is between 80 and 90 percent, the roadway is considered to be experiencing minor congestion. Between 90 and 100 percent, the roadway is identified as having major congestion. And when the v/c ratio exceeds 100 percent, the roadway is considered to be failing.

5) AERIALS

Aerial photos are used for accurate placement of the roadway network, trip generators and socio-economic data within the model. BMPO staff uses aerials purchased primarily by the City of Idaho Falls with limited support from BMPO. BMPO will continue to participate in the acquisition of updated aerial photos on an as needed basis.

6) DISTRIBUTION

Adjusted future volumes will be mapped and documented. Where applicable, adjusted future volumes will be shown with their associated actual counts.

Occasionally, traffic forecast data is requested for years that do not correlate with the future year model. If BMPO staff has not been authorized by the BMPO Policy Board to run additional future year models, only the available future year model data will be distributed. BMPO staff can provide insights regarding adjustments that might be appropriate if the future year model data is deemed to be inadequate to meet the purposes of a request.

BMPO Calibration Model Checklist

Data Needs	BMPO Action for Five Year Calibration	Done
Lane Geometry / Cross Sections	Verify existing data and make appropriate changes based on Transportation Model Methods and Needs Evaluation.	
Traffic Signs		
Traffic Signal / Phases		
Functional Classification		
Speed Limit		
Capacity	Update model capacity from lane geometry / cross sections data.	
Cycle Length	Cycle lengths will be determined based on traffic signal phase data.	
Heavy Vehicle Proportion	Request updated information for highways from ITD. For all other roadways, use default unless change is deemed necessary.	
Progression	Assess need to adjust average on a case by case basis.	
Dwelling Units	Input most current socio-economic data. Every ten years adjust data with U.S. Census Bureau data. Employment data is re-adjusted with Labor Department data.	
Employees		
Income / Vehicle Per Household	Input most current socio-economic data. Every ten years adjust data with U.S. Census data.	
Special Generator Trips	Verify and re-asses the special generators and trip generation assumptions. Determine the need for new special generators and apply appropriate assumptions.	
Average Daily Traffic Counts	Use the most current data.	
Base Volumes	Re-calculate base volumes based on latest highway traffic counts.	
External Trips	Update external trips data from most current traffic counts.	

BMPO Annual Model Checklist

Data Needs	BMPO Action for Annual Update	Done
Lane Geometry / Cross Sections	Update as identified. Annually request verifications and update from entities responsible for data management.	
Traffic Signs		
Traffic Signal / Phases		
Functional Classification		
Speed Limit		
Capacity	Update model capacity from lane geometry / cross sections data.	
Cycle Length	Cycle lengths will be updated from any new traffic signal phase data.	
Heavy Vehicle Proportion	Maintain data from calibration.	
Progression	Assess need to adjust average on a case by case basis.	
Dwelling Units	Collect building permit data monthly and adapt data for model purposes and publish socio-economic data.	
Employees		
Income / Vehicle Per Household	Based on building permit data, assess the need to update income data by TAZ.	
Special Generator Trips	Contact appropriate entities regarding new special generators. Update data sets and apply most current trip generation assumptions. If trip generation assumptions have changed, apply to all like special generators.	
Average Daily Traffic Counts	Update traffic count data at specified locations that are older than three years.	
Base Volumes	Maintain data from calibration.	
External Trips	Update external trips data from most current traffic counts.	

BMPO Future Model Checklist

Data Needs	BMPO Action for Model Forecast Year	Done
Lane Geometry / Cross Sections	Contact entities responsible for project development and obtain proposed roadway network data and roadway characteristics or, based on model output and guidelines presented in this document, establish the data and characteristics and request entity approval.	
Traffic Signs		
Traffic Signal / Phases		
Functional Classification		
Speed Limit		
Capacity	Update model capacity from proposed lane geometry / cross sections.	
Cycle Length	Cycle lengths will be calculated from the traffic signal phases proposed or determined to be needed.	
Heavy Vehicle Proportion	Maintain data from calibration.	
Progression	Assess need to adjust average on a case by case basis.	
Dwelling Units	Develop long range socio-economic data.	
Employees		
Income / Vehicle Per Household	Use the most current data.	
Special Generator Trips	Assess the need for existing and future special generators. Contact appropriate entities for possible locations and updated data sets. Apply most current trip generation assumptions to the data sets.	
Average Daily Traffic Counts	Use the most current data.	
Base Volumes	Re-calculate base volumes based on latest highway traffic counts.	
External Trips	Adjust traffic counts and external trip data based on projected short and long range growth.	

Model Data Work Sheet for Verification

Lane Geometry / Cross Section

Roadway/Intersection Name:
Begin:
End:
Change:

Roadway/Intersection Name:
Begin:
End:
Change:

Roadway/Intersection Name:
Begin:
End:
Change:

Roadway/Intersection Name:
Begin:
End:
Change:

Traffic Signs (additions, deletions, modifications)

Location:
Change:

Location:
Change:

Location:
Change:

Location:
Change:

Traffic Signals (additions, deletions, modifications)

Location:
Signal Phases:
Change:

Location:
Signal Phases:
Change:

Location:
Signal Phases:
Change:

Location:
Signal Phases:
Change:

Functional Classification

Roadway Name:
Begin:
End:
Change:

Roadway Name:
Begin:
End:
Change:

Roadway Name:
Begin:
End:
Change:

Roadway Name:
Begin:
End:
Change:

Speed Limit

Roadway Name:
Begin:
End:
Change:

Roadway Name:
Begin:
End:
Change:

Roadway Name:
Begin:
End:
Change:

Roadway Name:
Begin:
End:
Change:

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Model Data Work Sheet for New Data

Lane Geometry / Cross Section

Roadway/Intersection Name:
Begin:
End:
Change:

Roadway/Intersection Name:
Begin:
End:
Change:

Roadway/Intersection Name:
Begin:
End:
Change:

Roadway/Intersection Name:
Begin:
End:
Change:

Traffic Signs (additions, deletions, modifications)

Location:
Change:

Location:
Change:

Location:
Change:

Location:
Change:

Traffic Signals (additions, deletions, modifications)

Location:
Signal Phases:
Change:

Location:
Signal Phases:
Change:

Location:
Signal Phases:
Change:

Location:
Signal Phases:
Change:

Functional Classification

Roadway Name:
Begin:
End:
Change:

Roadway Name:
Begin:
End:
Change:

Roadway Name:
Begin:
End:
Change:

Roadway Name:
Begin:
End:
Change:

Speed Limit

Roadway Name:
Begin:
End:
Change:

Roadway Name:
Begin:
End:
Change:

Roadway Name:
Begin:
End:
Change:

Roadway Name:
Begin:
End:
Change:

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