Tahoe Metropolitan Planning Organization

P.O. Box 5310
128 Market Street
Stateline, Nevada 89449
(775) 588-4547 ◆ Fax (775) 588-4527

MEMORANDUM

DATE: October 14, 2011

TO: Mary Nichols, Chairman, California Air Resources Board (ARB)

FROM: Tahoe Metropolitan Planning Organization (TMPO)

RE: Methodology for estimating greenhouse gas emissions reductions from the Sustainable Communities Strategy for the Lake Tahoe Region

---

Overview

This memorandum describes the draft methodology for calculating greenhouse gas emissions per capita for the Lake Tahoe region. This information is provided in accordance with California's Senate Bill 375 (SB 375), the Sustainable Communities and Climate Protection Act of 2008. The methodology utilizes three tools or components:

- Lake Tahoe's Activity-Based Transportation Model
- The Trip Reduction Impact Analysis Tool (TRIA), a post-processor spreadsheet model
- Calculation of the share of vehicle miles traveled (VMT) attributable to the California portion of the Lake Tahoe region; and modeling greenhouse gas estimates using ARB's EMFAC2007 model

Background

Since the development of the bi-state Tahoe Regional Planning Compact (Public Law 96-551) in 1969, planning efforts in the Lake Tahoe Basin have engaged citizens in creating a vision for the future of Tahoe that will balance preservation of its natural beauty with its economic viability. A significant part of this vision is a reduction in dependence on automobiles as the primary means of transportation, in order to reduce the impacts on the environment and on the built form.

Recently, mitigation of climate change impacts has emerged as a high priority for all communities in California. SB 375 requires regional metropolitan planning organizations (MPOs) to focus regional land use and transportation policies to reduce greenhouse gas emissions (GHG) in order to meet targets established by the California Air Resources Board's Regional Technical Advisory Committee (RTAC). SB 375 calls for each MPO to develop a Sustainable Communities Strategy (SCS) with its Regional Transportation Plan, identifying how regional GHG will be reduced to meet the regional targets.

Tahoe Regional Planning Agency (TRPA) and TMPO Planning Responsibilities

TRPA operates under the authority of the bi-state Tahoe Regional Planning Compact (Public Law 96-551) between the states of California and Nevada and is required to regulate transportation and land use. TRPA also serves as the Tahoe Metropolitan Planning Organization (TMPO) for the Basin and in this role is responsible for development of the region's long-range transportation plan to meet state and federal requirements. Because of these requirements, TRPA is involved in several on-going planning processes related to transportation, land use, and the environment, including:

- Achieving the Environmental Thresholds of the bi-state Compact;
- The 20-year update of the TRPA Regional Plan, anticipated to be complete in December 2012;
- Regularly updating the Regional Transportation Plan (RTP) (per California and federal law);
- Creating the region's Sustainable Communities Strategy (SCS) under California state law.

As the primary authority regulating land use in the Lake Tahoe basin, TRPA is responsible for developing a land use plan that, when integrated with transportation and housing strategies, supports the goals of SB 375. The Sustainable Communities Strategy must rely on the transportation strategies of the RTP and the land use strategies of the Regional Plan to meet the Lake Tahoe GHG targets.

Under California's SB 575, the Tahoe Basin has the ability to use its Regional Plan as its Sustainable Communities Strategy if it meets the requirements of SB 375. The Lake Tahoe Regional Transportation Plan must be updated no later than November 2, 2012, to avoid a lapse in its conformity determination. As this date is prior to the anticipated approval of the 20-year update of the TRPA Regional Plan, the RTP will include a stand-alone Sustainable Communities Strategy chapter. When the TRPA Regional Plan is approved, the RTP will be amended to reference the approved Regional Plan.

The Vision: Reducing Greenhouse Gases in the Tahoe Basin

Through an extensive public planning process to update the TRPA's Regional Plan, the residents of the Lake Tahoe region have put forth a shared transportation vision for a sustainable community which integrates transportation, land use, and economic development:

> *In 2030, the Tahoe Basin will have a diversity of transportation options that enhance the travel experience and lower environmental impacts. The highways transform into pedestrian-friendly main streets connecting vibrant communities and neighborhoods. Residents and visitors choose a variety of travel modes from walking, biking, alternative fuel buses/shuttles and regular ferry service.*

This vision is reflected in subsequent planning processes such as the 2008 Regional Transportation Plan (*Mobility 2030)*, which articulates a clear preference for:

> …*walkable, mixed-use town centers functioning as public gathering places and served by reliable and convenient public transit [and] streets that encourage biking and walking as much as driving.*

A central goal of both the Regional Transportation Plan and TRPA Regional Plan updates is to develop the necessary land use and transportation projects, policies, and programs to achieve this vision. The sections below describe a methodology for estimating the greenhouse gas impacts of the integrated strategy package.

<u>Component 1: The Lake Tahoe Transportation Model</u>

The Lake Tahoe Transportation Model is the primary tool used to calculate the VMT and GHG impacts of the existing and proposed land use pattern, the existing and proposed street network, and the basic transit network. Progressively sophisticated versions of the transportation model have been in use in the Lake Tahoe basin since 1981, when the first model was used to develop an environmental threshold goal for VMT for the region. The TRPA and the TMPO now use an activity-based model, which is described in more detail below. As part of the RTP update the TMPO used outside peer review to validate the model. The memo describing the results of this model validation is included as an attachment to this document.

In 2005, as part of the Regional Plan Update process, the TRPA invested in its most recent update to the travel-forecasting model, using the TransCAD platform. The previous model was a 3-step trip-based model developed in the 1980's, originally developed in Tranplan. The TransCAD activity-based model introduced several improvements over the previous model, including the ability to associate non-home-based trips with their producing household and associated socio-demographic variables. Another strength of Tahoe's activity-based model is the ability of a traveler to make trip substitution decisions along the 'trip chain', by eliminating a trip or changing the destination or time that a trip begins. Each "decision" is encapsulated within a separate model and therefore a household is able to dynamically adjust across models. In a trip-based model, if a traveler is faced with congestion during mode choice, then their only choice is to change modes. In the activity-based model, that same traveler could choose to leave at a different time period for a work trip, or choose a different destination for a discretionary trip.

The Tahoe model consists of an activity-based resident model and an activity-based visitor model. Because the number of resident households, employment locations, person activities, and the resident/visitor mix are potentially very different in the region during the summer versus the winter, socio-economic data has been developed for the two seasons. Thus, the user may choose to model an average summer weekday or an average winter weekday, with yearly travel being the sum of the seasonal travel.

For the SCS analysis, the Tahoe model is used to run the land-use scenario or scenarios proposed in the Regional Plan Update. Once the model run is complete, the resulting trip table is used as an input to the remaining two components of the GHG analysis.

Component 2: The Trip Reduction Impact Analysis (TRIA) Tool

The TMPO developed the Trip Reduction Impact Analysis (TRIA) model to evaluate the trip reduction impacts of various transportation policies and programs under consideration as part of the Sustainable Communities effort. While the Tahoe Transportation Model is robust, it cannot capture more nuanced strategies that can have a significant effect on travel demand such as parking policies, employer-trip reduction incentive programs, or construction of new bike trails and sidewalks. The purpose of the TRIA model is to provide planning-level, order-of-magnitude, comparative estimates of the quantitative impacts on auto trips, vehicle miles traveled and greenhouse gas emissions of the continuation of existing policies and programs compared to the impacts of implementing new policies and programs in the areas of transit service expansion, bicycling and walking, and transportation demand management.

Assumed Implementation Timing for SCS Policies

In developing the model, the TMPO used existing data sources and the TRPA model forecasts to estimate the time at which various policies will be implemented. For example, for the modes where population growth is built into the model, such as bicycling, walking and transit, the population forecasts from the TRPA regional model were used.

Figure 1 shows assumptions regarding implementation timing for the various policies, programs, and projects under consideration in the SCS plan.

Figure 1 Assumed Implementation Timing for SCS Policies

Vehicle Trip Reduction Strategy	Implementation Year	
	2020	2035
Parking Management		
Adjust parking requirements and implement shared parking	100%	100%
Transportation Demand Management		
Expand existing employer vehicle trip reduction program requirements	100%	100%
Transit Service and Facilities[1]		
Intra-regional transit capital projects (Lake Tahoe ferry service)	100%	100%
Transit operational changes	Please see footnote #3	100%
Real-time arrival information at transit stops, online, and/or via web-enabled mobile devices.	100%	100%
Bike and Pedestrian Facilities		
Complete regional network of bike facilities (includes expanded bike parking)	40%	100%
Complete regional network of pedestrian facilities	40%	100%
Snow removal on important bike and ped routes	100%	100%

TRIA Methodology

The TRIA model provides a way to make order-of-magnitude comparisons between different policy alternatives and their effect on auto trips, vehicle miles traveled (VMT), and greenhouse gas emissions. Using the tool allows the TRPA and the TMPO to develop a package of policies tailored to the Tahoe area that will help the region meet the greenhouse gas emissions reduction targets set by the California Air Resources Board under California's Senate Bill 375.

As far as possible, the model is based on current conditions in the Tahoe basin, or existing forecasts developed locally. The impact of individual policies was estimated based on a review

[1] Assumes that all transit strategies will be fully implemented by 2020, with the exception of:

- Half-hour service on North Shore (year round, all day)
- Extend North Shore service (year round, until 10 pm, CA only)

of the available literature and studies of places where these policies have already been implemented. Where research showed that a policy might vary in effectiveness the more conservative approach was chosen, so as not to overstate the trip reduction potential.

The methodology for developing the TRIA spreadsheet centered on estimating the number of trips that could be transferred from single occupant vehicles (SOV) to other modes through a combination of policy changes, programs, infrastructure investment and incentives. The TRIA model is built up around analysis of the main modes of transportation and analysis of how the land use changes and transportation policies proposed in the Regional Plan alternatives impact these modes. The main categories considered in the model are:

- Bicycling and walking
- Public transit
- Transportation Demand Management measures
- Parking policy changes
- Single Occupant Vehicle (SOV) travel

The model is structured in such a way as to estimate the potential growth for each mode, for example the potential for new transit riders who were previously SOV drivers, and to take this growth as reductions in SOV trips.

The estimates of vehicle trip reductions that could likely be achieved with implementation of the proposed transportation policies and programs were drawn from a library of best practice case studies as well as a literature review. Wherever possible, the estimates were based on quantitative data (empirically derived or modeled). Where available, data from the TRPA Regional Model or ARB models were used. When appropriate, professional judgment was used to refine the estimates for the proposed policy alternatives, based on our experience in developing, analyzing, and implementing vehicle trip reduction strategies. At every step, the TMPO strove to find the right balance between making conservative assumptions and analysis in order to avoid overstating potential benefits, while at the same time avoiding the inverse error of being overly conservative—and thereby understating potential benefits.

The TRIA tool is intended to be a direct plug-in to the regional traffic model in that it provides percentage vehicle trip reductions based on the vehicle trip reduction strategies under consideration. These trip reduction percentages are directly linked to the regional traffic model as described in the last section of this document.

Cumulative Effect

While the effect of each policy was analyzed individually, the cumulative effect of these policies was also estimated based on the understanding that all selected policies would eventually be implemented.

The cumulative effect of these policies cannot simply be the sum of individual effects. The impact of some policies depends on the origin and destination – for example whether they affect trips that start in Tahoe but end outside the region, or if the entire trip takes place within the Tahoe Basin. Other policies may be mutually exclusive – i.e. the measures could not reasonably be implemented at the same time.

Where there are several trip reduction measures that are not mutually exclusive, the total cumulative trip reduction does not equal Measure A + Measure B. Once Measure A has been applied, the Measure B will then apply to a base that has already been reduced by the measure A. For example, if two trip reduction measures would each give a 10% trip reduction, the total cumulative reduction is not 20%. Rather, it would be equal to 100% - (90%*90%) = 19%.

Model Analysis by Mode

Bike and Pedestrian Facilities

The TRIA model for bicycle and pedestrian trips was developed based on the TMPO's Bicycle Trail User Model (available at www.tahoempo.org). The TRIA model incorporates the winter plowing scenario from this model as an alternative. In addition to the projections for new bicycle and pedestrian trips which replace existing SOV trips for existing Tahoe residents, the TRIA model incorporates population growth by adding new bicycle and pedestrian trips from new projected residents based on the TRPA Regional Plan population forecasts.

Transit Services and Facilities

The transit portion of the TRIA model is based on ridership projections from the Tahoe Area Regional Transit Systems Plan Study (2005), and the Tahoe Interregional/Intraregional Transit Study (2006), both prepared by the Tahoe Regional Planning Agency. These new services were too small to be captured by the model, and therefore are analyzed as part of the TRIA. The ridership projections were grouped into service improvements and capital projects. For example, adding a public bus service between the Reno Airport, Truckee and Tahoe was included as a service improvement, since the capital investment is low and the change could be implemented by an existing company, potentially as a modification to existing services. Conversely, the Lake Tahoe Waterborne Transit project, which would see ferry service between South and North Lake Tahoe, was included as a capital project, because it would require a significant investment of public funds in infrastructure in order to be realized.

Starting with the ridership projections provided in the studies, the TRIA model assumes that 95% of the projected ridership would come from existing SOV trips[2]. Further, TRIA includes 100% of the ridership on transit routes that would be fully within California, two-thirds of ridership on routes that operated regionally, and none of ridership from routes entirely in Nevada.

Where transit alternatives were obviously mutually exclusive, only the project with the highest projected ridership was included. Otherwise, all projects were included and assumed not to affect the ridership of other services.

Transportation Demand Management (TDM) Measures

The TRIA model primarily compares the effect of improving the compliance rate of existing TDM ordinances through improved enforcement. The model assumes that compliance rates for small companies will achieve the target compliance rate of 75% (up from 30%), medium companies will achieve 90% (up from 50%) and large companies will achieve 100% compliance (up from 80%).

Parking Management

Where available, the parking calculations in the TRIA model are based on observed parking occupancy statistics and estimates of the total parking supply provided by existing studies. Where occupancy and turnover data was not available, trip generation rates were based on data from Trip Generation, 8th Edition[3].

Using data on the existing trip generation rates and number of spaces, TRIA estimates the total number of trips. Assuming no changes to trip generation rates or parking regulations, the future baseline amount of parking was estimated, and hence the future number of trips. TRIA then analyzes the effects of proposed changes to parking requirements on the total amount of parking available under different growth scenarios embodied in the TRPA Regional Plan Update, and hence on the number of trips. Comparing these to the baseline "status quo" scenario yields the percentage reductions that can be expected from the proposed changes to parking requirements.

Single Occupant Vehicle Travel

The TRIA model bases single occupant vehicle miles on the TRPA regional traffic model. The projected future vehicle trips are derived from vehicle miles traveled, and are used unmodified as the "status quo" scenario to which all the trip reduction measures were applied and compared.

[2] This is due to the nature of the service changes, which are either inter-regional, or late-night services which are unlikely to attract users from modes other than a private vehicle.

[3] Trip Generation, 8th Edition, Institute of Transportation Engineers (2008)

Component 3: Calculating VMT and Greenhouse Gas emissions

Because the Tahoe Transportation Model spans both California and Nevada in its region-wide VMT calculations, it is necessary to develop a methodology for splitting out the VMT attributable to the California portion of the basin. In addition, in accordance with the RTAC protocol for accounting for half of the VMT of all trips with an origin or destination outside the region, and none of the VMT for trips that cross through the region without stopping, additional post-processing of the Transportation Model results is necessary. This section explains how the TRIA is integrated into the model results, and how total VMT and GHG emissions for the California portion of the region are calculated.

The TMPO developed an "accounting-based" approach to improve the accuracy of VMT estimates in the Tahoe Basin. As described below, this approach accounts for every vehicle trip in the TRPA model. By doing so, it does not have to rely on any interim assumptions, and produces accurate VMT estimates that can be readily reviewed/confirmed by others.

VMT Calculation for 2005 TRPA Travel Demand Model

This section outlines the process the TMPO undertook to calculate VMT for 2005 conditions. A similar approach is taken for the 2010, 2020, and 2035 models. As noted in previous work products, VMT is estimated for a peak summer weekday.

Step 1: Obtain Daily Trip Table

The daily trip table is a large matrix displaying the total number of vehicle trips on a daily basis that travel from one particular traffic analysis zone (TAZ) to another. Trip tables also include the number of trips that remain internal to a particular TAZ and trips that have an origin or destination to an external gateway. Below is an illustration of TRPA's trip table.

	1	2	3	4	5	6	7	9	10	11	12	13	[illegible]
1	69.00	23.00	11.00	30.00	24.00	21.00	30.00	1.00	2.00	0.00	0.00	0.00	0.
2	36.00	60.00	15.00	17.00	36.00	28.00	28.00	16.00	41.00	16.00	14.00	24.00	4.
3	0.00	8.00	44.00	1.00	4.00	3.00	0.00	13.00	49.00	20.00	9.00	18.00	2.
4	26.00	23.00	10.00	7.00	28.00	23.00	28.00	1.00	1.00	2.00	0.00	1.00	0.
5	25.00	19.00	9.00	34.00	10.00	29.00	29.00	0.00	6.00	3.00	1.00	1.00	0.
6	30.00	29.00	16.00	26.00	14.00	33.00	29.00	0.00	0.00	0.00	0.00	0.00	0.
7	44.00	27.00	11.00	28.00	24.00	22.00	81.00	0.00	1.00	0.00	0.00	0.00	0.
9	1.00	9.00	12.00	0.00	1.00	0.00	0.00	4.00	9.00	4.00	2.00	9.00	2.
10	1.00	8.00	9.00	0.00	1.00	0.00	2.00	6.00	8.00	1.00	7.00	8.00	2.
11	0.00	5.00	8.00	1.00	0.00	0.00	0.00	5.00	2.00	2.00	2.00	3.00	1.
12	3.00	19.00	13.00	0.00	0.00	1.00	0.00	12.00	18.00	3.00	20.00	15.00	5.
13	1.00	12.00	13.00	2.00	2.00	1.00	0.00	7.00	14.00	3.00	9.00	7.00	3.
14	0.00	8.00	5.00	0.00	2.00	1.00	1.00	3.00	4.00	1.00	6.00	6.00	0.
15	1.00	3.00	6.00	2.00	1.00	0.00	0.00	1.00	3.00	0.00	3.00	2.00	0.

Step 2: Apply TRIA Adjustments

The TRIA spreadsheet is a tool which quantifies the trip reduction benefits of various transportation programs and policies that are part of the SCS. Since the traffic model is not capable of modeling changes in behavior due to these strategies (e.g., employer shuttles, parking management, subsidized transit, etc), it was necessary to model these behavior changes through 'post-processing' of the trip table. Specifically, trips were reduced in accordance with the TRIA percentages in those TAZs where travel behavior would be affected by these strategies.

Step 3: Estimate Distance of Trips

A distance-skim matrix is used to estimate the travel distance between all TAZs within a model. It is a matrix of identical size to a trip table, but whose contents are expressed as miles versus vehicle trips.

Step 4: Calculate Zone-to-Zone VMT

The TransCAD software program allows for matrix multiplication. The TRIA-adjusted trip table in Step 2 is multiplied by the distance skim in Step 3 to yield a new matrix whose content is VMT (i.e., number of daily trips multiplied by distance) between all zones in the model.

Step 5: Aggregate Zones into Districts

The TRPA model contains 289 TAZs, of which 184 represent land uses on the California side of the Tahoe Basin and 105 represent land uses on the Nevada side of the Tahoe Basin and external gateways.

Step 6: Apply RTAC's VMT Calculation Methodology

The Regional Targets Advisory Committee (RTAC) established under SB 375 recommends the following accounting of various trip types for VMT purposes:

- Include 100% of internal-internal (I-I) trips
- Exclude external-external (X-X) trips
- Count 50% of internal-external (I-X) and external-internal (X-I) trips[4]

Since the SB 375 evaluation is for the California side of the Tahoe Basin, I-I trips are those that begin and end in this area. An example of an I-X trip is a trip from Meyers, CA to Incline Village, NV. An example of an X-X trip is a trip from Echo Summit, CA to Incline Village, NV.

[4] TMPO has decided that only the portion of the I-X and X-I trip occurring within the Tahoe Basin would be counted because accurate estimates of trip lengths outside the basin would be difficult to develop.

The zone-to-zone VMT matrix from Step 4 was manipulated based on the aggregation of zones in Step 5 and the above VMT calculation methodology.

The results of this six-step process yield the VMT for the California side of the Tahoe Basin using the RTAC-recommended calculation method.

Greenhouse Gas Emission Estimation

The California Air Resources Board released a memo dated July 2011, called "*Description of Methodology for ARB Staff Review of Greenhouse Gas Reductions from Sustainable Communities Strategies (SCS) Pursuant to SB 375.*" Regarding modeling greenhouse gas emissions from VMT estimates, this methodology directs MPOs to use EMFAC2007 for both 2005 estimates and 2020 and 2035 estimates. ARB's methodology document states:

> *"The EMission FACtors (EMFAC) model is a California specific computer model that calculates daily emissions of air pollutants from all on-road motor vehicles including passenger cars, trucks, and buses for calendar years 1970 to 2040. The model, developed by ARB, estimates emissions using vehicle activity provided by regional planning organizations and emission rates developed from testing of in-use vehicles. In addition to statewide emissions, the model can also estimate emissions at the county, air district, and air basin levels. The current EMFAC2007 model estimates exhaust and evaporative hydrocarbons, carbon monoxide, oxides of nitrogen, particulate matter, oxides of sulfur, methane, and carbon dioxide (CO2) emissions."*

After calculating the VMT attributable to the California side of the Tahoe Basin in accordance with RTAC procedures, the TMPO will use this VMT as an input to EMFAC. The resulting GHG emissions are then divided by the 2005, 2025, and 2035 residential populations to obtain GHG emissions per capita.

Attachments:

Validation of TRPA Base Year (2010) Travel Demand Model

FEHR PEERS

MEMORANDUM

Date: September 20, 2011

To: Keith Norberg & Karen Fink – TRPA
Curtis Alling & Sydney Coatsworth – Ascent Environmental

From: John Gard – Fehr & Peers

Subject: Validation of TRPA Base Year (2010) Travel Demand Model

RS11-2895

The *2010 RTP Guidelines* published by the California Transportation Commission specify that travel demand models used as part of the development of a Regional Transportation Plan should undergo static and dynamic validation tests to assess their ability to accurately predict travel behavior. The following describes the purpose of these tests:

- ❖ Static Validation – compares the model's prediction of traffic volumes against existing traffic counts.
- ❖ Dynamic Validation – evaluates the model's response to changes in land use and transportation system assumptions.

Static Validation

The *2010 RTP Guidelines* reference the following list of possible validation measures (as originally specified in the *Travel Forecasting Guidelines*, Caltrans, 1992):

- Volume-to-Count Ratio – Divides the model volume by the actual traffic count for individual roadways through the model.
- Percent of Links Within Caltrans Deviation Allowance – Calculated as the difference between the model and actual traffic count divided by the actual traffic count. Result is then evaluated against prescribed deviation thresholds.
- Correlation Coefficient – estimates the correlation (strength and direction of the linear relationship) between the actual traffic counts and the estimated volumes from the model.
- Percent Root Mean Square Error (%RMSE) – is the square root of the model volume minus the actual count squared divided by the number of counts. It is a measure similar to standard deviation in that it assesses the accuracy of the entire model.

TRPA staff established 24 roadway segments for use in the validation tests. Attachment A displays the peak summer month weekday Annual Daily Traffic (ADT) for each segment along with the estimated traffic volume from the base year TRPA traffic model.

The 24 roadway segments cover both the California and Nevada sides of the Tahoe Basin. Among these segments are the seven gateways that provide access to the Tahoe Basin. Unlike "trip-based models" that use fixed volume factors at gateways, "activity-based" models (like TRPAs) estimate traffic entering/exiting at gateways. Accordingly, these links were included in the validation tests.

Table 1 displays the results of the static validation tests including the applicable criteria for acceptance. As shown, the TRPA base year travel demand model passes all three validation tests that have measurable acceptance criteria.

Table 1 – Static Validation Test Results

Validation Test	Criteria for Acceptance	TRPA Model Result
Volume-to-Count Ratio	Not Defined	Gateways: 0.98 Model-Wide: 1.07
Percent of Links Within Allowable Deviation	≥ 75%	75.0%
Correlation Coefficient	≥ 0.88	0.93
Percent Root Mean Squared Error (%RMSE)	≤ 40%	23%

Sources of validation tests and acceptance criteria are *2010 RTP Guidelines* and Travel Forecasting Guidelines, Caltrans, 1992.

The model's estimate of daily traffic entering/exiting the Tahoe Basin gateways is within two percent of the actual traffic count. On a model-wide basis, estimated traffic volumes exceed actual counts by about seven percent. These levels of variation are considered acceptable given that they are within typical model error tolerances and daily traffic levels can fluctuate by two to five percent.

In summary, this evaluation has found that the TRPA base year travel demand model satisfies the static validation tests described in the *2010 RTP Guidelines*.

Dynamic Validation

We worked with TRPA staff to develop a series of model runs that assess how the model responds to land use changes, both within and outside of pedestrian-transit oriented development (PTOD) areas. The following eight tests were performed:

Residential Evaluations

- Test #1 – Double number of dwelling units in TAZs 205 & 206 (PTOD area)
- Test #2 – Add 500 dwelling units in TAZ 251 (non-PTOD area)
- Test #3 – Reduce number of dwelling units in TAZs 189 & 190 by 50% (PTOD area)
- Test #4 – Subtract 500 dwelling units from TAZ 12 (non-PTOD area)

Non-Residential Evaluations

- Test #5 – Add 1,000 employees each to TAZs 295 & 297 (PTOD area)
- Test #6 – Double employment in TAZ 62 (non-PTOD area)
- Test #7 – Subtract 1,000 employees from TAZs 200 & 202 (PTOD area)
- Test #8 – Subtract 400 employees from TAZ 181 (non-PTOD area)

For each test, the TRPA base year travel demand model was modified, rerun, and then compared to the base case scenario. Tables 2a and 2b display the comparison results for the residential and non-residential evaluations, respectively.

Table 2a – Dynamic Validation Test Results for Residential Land Use Changes

Test	Dwelling Unit Change	Model-Wide Performance Measures		
		Change in Vehicle Trips	Added Trips ÷ New DUs	Change in VMT
#1: Additional Units in PTOD area	+ 566	+3,648	6.4	- 4,648
#2: Additional Units in non-PTOD area	+ 500	+ 1,946	3.9	+23,414
#3: Reduced Units in PTOD area	- 668	- 7,238	- 10.8	- 38,460
#4: Reduced Units in non-PTOD area	- 500	- 3,422	- 6.8	- 10,063
Source: Output from TRPA base year travel demand model.				

The results in Table 2a appear reasonable as evidenced by the following:

- ✓ The addition of new dwelling units causes a net increase in model-wide vehicle trips, whereas a reduction in units causes a decrease in vehicle trips.
- ✓ The number of new daily trips per unit ranges from 4 to 11, with lower trip rates in non-PTOD areas (i.e., reasonable given more secondary homes and trip chaining in non-PTOD areas).
- ✓ The geographic location of new units may help explain the difference in VMT between Tests #1 and #2. In Test #1, the additional units are added in Kingsbury, which is adjacent to various complementary land uses. In contrast, the new units in Test #2 are located north of Glenbrook in a sparsely developed area (i.e., much longer travel distances to amenities).

Table 2b – Dynamic Validation Test Results for Non-Residential Land Use Changes

Test	Employment Change	Model-Wide Performance Measures		
		Change in Vehicle Trips	Added Trips ÷ New Emps	Change in VMT
#5: Additional Employees in PTOD area	+ 2,000	+7,650	3.8	+ 65,647
#6: Additional Employees in non-PTOD area	+ 674	+ 3,654	5.4	+ 14,076
#7: Reduced Employees in PTOD area	- 2,000	- 9,442	- 4.7	- 10,833
#8: Reduced Employees in non-PTOD area	- 400	- 1,956	- 4.9	- 16,462
Source: Output from TRPA base year travel demand model.				

The results in Table 2b are also reasonable as evidenced by the following:

- ✓ The addition of new employees causes a net increase in model-wide vehicle trips and VMT, whereas a reduction in employees causes a decrease.
- ✓ The number of new daily trips per employee ranges from 3.8 to 5.4, which indicates that the model is stable.

A comparison of Tests #5 and #7 shows substantially different VMT changes (+65,600 VMT for Test #5 vs. -10,800 VMT for Test #7) despite equivalent employment additions/reductions. The added employees were in Crystal Bay and the removed employees were in South Stateline. These locations have very different surrounding community characteristics, which influence travel behavior. South Stateline has many other amenities that could offset a loss of 2,000 employees. In contrast, the lack of population in the vicinity of Crystal Bay would suggest that the introduction of a substantial amount of new trip-attracting land uses would result in longer distance trips.

Given the relative lack of roadway capacity-expansions planned in the Tahoe Basin, it was not necessary to conduct any dynamic validation tests of roadway network changes.

In conclusion, this evaluation has determined that the TRPA model responds in a reasonable manner to changes in land use. Based on these tests, the model is capable of accurately estimating future travel demand associated with future land use assumptions for the basin.

TRPA Base Year (2010) Travel Demand Model - Static Validation Results

ID	Link ID	LOCATION	Daily Traffic Counts	Model	Model/ Count	Deviation	Maximum Deviation	Within Deviation	Model-Count	Difference Squared
1	6321	US 50 mp 70.62	17,000	15,910	0.94	0.06	0.30	YES	-1,090	1,188,100
2	6254	US 50 mp 71.48	17,200	15,990	0.93	0.07	0.30	YES	-1,210	1,464,100
3	14543	US 50 mp 75.45	39,500	32,690	0.83	0.17	0.23	YES	-6,810	46,376,100
4	5337	US 50 mp 76.41	37,500	40,160	1.07	0.07	0.24	YES	2,660	7,075,600
5	4949	US 50 mp 77.33	38,000	36,440	0.96	0.04	0.23	YES	-1,560	2,433,600
6	2730	US 50 mp 80.14	34,000	34,280	1.01	0.01	0.24	YES	280	78,400
7	551	US 50 ATR 0521109	33,300	35,600	1.07	0.07	0.24	YES	2,300	5,290,000
8	2649	US 50 sta 0041	27,000	33,530	1.24	0.24	0.26	YES	6,530	42,640,900
9	146	SR 28 sta 0035	7,200	16,890	2.35	1.35	0.42	NO	9,690	93,896,100
10	13237	SR 28 ATR 3122409	17,000	26,920	1.58	0.58	0.30	NO	9,920	98,406,400
11	13374	SR 28 mp 11.00	17,300	22,820	1.32	0.32	0.30	NO	5,520	30,470,400
12	8305	SR 28 mp 9.34	23,200	20,000	0.86	0.14	0.27	YES	-3,200	10,240,000
13	10239	SR 28 mp 1.85	13,700	17,630	1.29	0.29	0.32	YES	3,930	15,444,900
14	4077	SR 89 mp 19.54	6,000	9,150	1.53	0.53	0.44	NO	3,150	9,922,500
15	4929	SR 89 mp 11.69	6,400	10,090	1.58	0.58	0.44	NO	3,690	13,616,100
16	13490	SR 89 mp 8.67	14,800	14,950	1.01	0.01	0.31	YES	150	22,500
17	7573	SR 267 mp 9.28	13,300	11,210	0.84	0.16	0.32	YES	-2,090	4,368,100
18	14522	SR 89 MP 0.00 Alpine-El Dorado	3,000	3,020	1.01	0.01	0.60	YES	20	400
19	6499	US 50 MP 65.62 Echo Lake Road	15,100	9,200	0.61	0.39	0.31	NO	-5,900	34,810,000
20	4012	SR 207 ATR 0531509- sta 0024	14,000	17,960	1.28	0.28	0.31	YES	3,960	15,681,600
21	145	US 50 ATR 252125	14,900	14,060	0.94	0.06	0.31	YES	-840	705,600
22	14525	SR 431 sta 770	6,700	8,130	1.21	0.21	0.43	YES	1,430	2,044,900
23	14520	SR 267 MP 6.23 Martis Peak Rd	10,600	10,510	0.99	0.01	0.36	YES	-90	8,100
24	14521	SR 89 MP 13.72 Squaw Valley Rd	13,600	13,780	1.01	0.01	0.32	YES	180	32,400
			440,300	470,920						

Model/Count Ratio =	**1.07**	
Percent Within Caltrans Maximum Deviation =	**75%**	> 75%
Percent Root Mean Square Error =	**23%**	< 40%
Correlation Coefficient =	**0.93**	> 0.88