TAHOE REGIONAL PLANNING AGENCY

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STAFF REPORT

Date: September 25, 2020

To: Transportation Technical Advisory Committee (TTAC)

From: TRPA Staff

Subject: Vehicle Miles Traveled (VMT) Threshold Update Baseline

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Summary:
The VMT threshold update and the project level assessment approach have been referred to the TTAC for review and recommendations (or recommendations with modifications) to the Regional Plan Implementation Committee. On October 5th, the TTAC will review and be asked to provide guidance on the proposed approach to estimating the Region's population for the updating of the VMT threshold standard.

Recommendation and Requested Action:
The TTAC is asked to provide a recommendation, or recommendation with modifications, on the proposed approach to establishing a population baseline for VMT threshold standard.

1. Baseline Population

   Description: The population size that will serve as the basis for establishment of the threshold standard.

   Recommendation: Use a consensus-based estimate of the baseline population derived from the Tahoe Effective Population Model and a "big-data" based approach. Continue to refine the parameters used in the Tahoe Effective Population Model and explore "big-data" based estimation approaches.

Background:
The Regional Plan Implementation Committee (RPIC) directed staff to update the VMT threshold standard to address concerns related to GHG reduction, mobility, and reducing reliance on the automobile at its July 2020 meeting. RPIC's guidance included that staff develop an efficiency-based metric for establishment of the VMT threshold standard because it accomplishes two things: first, it better aligns with factors that can be planned and managed by TRPA and meaningful differences in the

regional land use and the transportation system; and second, it affords consistency with California state policy with respect to VMT and GHG.

Standard development and TTAC feedback are divided into a three-step process; 1) Establish a VMT baseline, 2) Establish the population baseline, 3) Target setting and implementation. At the August meeting of the TTAC, the TTAC considered and endorsed the use of the three-year annual average daily VMT for establishment of the threshold standard baseline. VMT for baseline establishment and standard evaluation would be sourced from two non-proprietary data sources, to allow any stakeholder to calculate attainment status of the threshold at any time. The October 5th meeting of the TTAC will focus on the second step of the process, estimation of the population baseline.

While planning and evaluation often rely on estimates of the resident population of the region, in regions with large variations in seasonal population, or high visitation rates, resident population estimates provide only a partial picture of the number of the people that are in or traveling around the region. Tahoe's resident population has never exceeded 65,000 people, but the number of people in Tahoe on peak days has been estimated to exceed 200,000. For the standard to accurately reflect the overall efficiency of the transportation system, it must account for all travelers in the Region, including residents, commuters, and anyone else traveling in the Region. The total number of people in a region at a specific time is also referred to as the effective population (Campanelli et al. 2017; Morrison et al. 2020).

The effective population of the Tahoe region includes residents, visitors, and commuters. Attachment A details the Tahoe Effective Population Model (TEPM), which estimates the average annual daily population of the Tahoe Region using a variety of available datasets, in conjunction with assumptions and parameters derived from various surveys and studies. The model's framework is derived from the approach used to estimate the population in the Tahoe Travel Demand Model. Staff is currently working with the Tahoe Science Advisory Council to refine the model and associated input parameters.

The recommendation also includes continued exploration of "big data" based approaches to estimate the region's effective population. Like the approach to estimating total VMT in the Region, a "big data" based estimate could be combined with a TEPM-based estimate to provide a consensus estimate of the average daily effective population of the Region.

<u>Contact Information:</u>
For questions regarding the threshold update process, please contact Dan Segan, Principal Natural Resource Analyst, at dsegan@trpa.org or (775) 589-5233.

<u>Attachments:</u>

A: VMT Threshold Update: Effective Population Report

TAHOE REGIONAL PLANNING AGENCY

Threshold Update

VMT THRESHOLD UPDATE: EFFECTIVE POPULATION ESTIMATE

SEPTEMBER 25, 2020

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INTRODUCTION

This report is part of the larger workplan to review and update the threshold standards to ensure they are grounded in the best science. The report focuses on the Vehicle Miles Traveled (VMT) standard and addressing issues related to updating that standard from one rooted in concerns about nitrogen loading to the lake, to one designed to promote mobility, reduce dependence on the private automobile, and support the attainment of the GHG reductions goals of California and Nevada.

The Bi-State Compact instructs the Tahoe Regional Planning Agency (TRPA) to develop a transportation plan for the Region with two goals: first, to reduce dependency on the automobile, and second, to reduce air pollution from motor vehicles (Public Law 96-551, 96th Congress 1980). As a result of increasingly stringent federal and state tail pipe emissions standards, vehicles today are far cleaner than they were when the Bi-State Compact was amended 40 years ago. Because of those improvements, air quality in Tahoe today is generally good, and nitrogen emissions today are well below the emissions reduction goal established in 1981.

The Regional Plan Implementation Committee (RPIC) directed staff to update the VMT threshold standard to address concerns related to GHG reduction, mobility, and to reduce reliance on the automobile at its July 2020 meeting. RPIC's guidance included that staff develop an efficiency-based metric for establishment of the VMT threshold standard because it accomplishes two things: first, it better aligns with factors that can be planned and managed by TRPA and meaningful differences in the regional land use and the transportation system; and second, it affords consistency with California state policy with respect to VMT and GHG.

Standard development and TTAC feedback are divided into a three-step process; 1) Establish a VMT baseline, 2) Establish the population baseline, 3) Target setting and implementation. At the August meeting of the TTAC, the TTAC considered and endorsed the use of the three-year annual average daily VMT for establishment of the threshold standard baseline. VMT for baseline establishment and standard evaluation would be sourced from two non-proprietary data sources, to allow any stakeholder to calculate attainment status of the threshold at any time. This report informs the second step of the three-step process, the establishment of a population baseline to inform update of the threshold standard. To accurately reflect the overall efficiency of the land-use and transportation system, all

travelers must be accounted for. Accounting for all travelers means the inclusion of visitors, residents, commuters, and anyone else traveling in the Region. The report details options for estimating the effective population of the Tahoe region at any point in time.

SUMMARY OF RECOMMENDATIONS

Description: The population size that will serve as the basis for establishment of the threshold standard.

Recommendation: Use a consensus-based estimate of the baseline population derived from the Tahoe Effective Population Model and a "big-data" based approach. Continue to refine the parameters used in the Tahoe Effective Population Model and explore "big-data" based estimation approaches.

EFFECTIVE POPULATION

The *effective population* refers to the number of individuals in an area at a specific time (Campanelli et al. 2017; Morrison et al. 2020). While regional and infrastructure planning often relies on the estimates of the resident population of a region, in regions with large variations in seasonal population, the residential population estimates provide only a partial picture of the actual number people that are in or traveling around the region.

Tahoe's regional resident population has never exceeded 65,000 people, according to the U.S. Census, but the number of people in the Tahoe Region on peak days has been estimated to exceed 200,000. The effective population of the Tahoe Region includes residents, visitors (including day, overnight, second homeowners and their guests), and commuting workers. Formal estimates are available for some of these populations, while others, such as the number of day visitors are more challenging to develop. The approaches outlined below are alternative methodologies to estimate these individual populations and to aggregate the average daily effective population of the Tahoe Region.

ESTIMATION WITH "BIG DATA"

"Big Data" refers to the information sourced from connected vehicle technology, GPS data, smart phone applications and cell phone connections. Big data sources have been increasingly applied to address a

variety of persistent information gaps across a variety of disciplines. TRPA is currently exploring potential data from several vendors to estimate the effective population size using big data.

For example, several vendors including UberMedia, Entrada Insights, and Arrivalist aggregate multiple sources of geolocation data to assess trends in visitation. UberMedia is one of the largest aggregators of mobile device data. UberMedia aggregates anonymized mobile location data from over 55 million devices daily. Similarly, Arrivalist provides market intelligence and insights into consumer behavior, competitive share, media effectiveness, and market trends using mobile device data. Entrada Insights leverages a platform approach to integrating data from multiple sources (including UberMedia) into one tool. The Lake Tahoe Visitors' Authority recently selected Entrada as for their tourism analysis platform. Other associations on the North Shore use the Arrivalist platform for their market intelligence. TRPA staff are discussing potential data sharing agreements with our regional travel partners, exploring direct contracts with big data firms, or conducting one-off analyses to access this data.

In 30 days of sample data provided by UberMedia there was a daily average of 10,000 unique mobile devices in the Tahoe Region during August and September of 2020. UberMedia estimates that its platform covers between 5% and 8% of the total population of the United States. Extrapolating from the 10,000 observed devices during the study period would result in an estimated overall daily average effective population of between 125,000-200,000 individuals during this period. The estimates also include peak daily number of unique devices of 14,000 and a minimum number of devices of 6,000.

Table 1: Example estimate of Effective Population using "Big Data"

Unique Device IDs	Low Estimate of Effective Population	High Estimate of Effective Population
6,000 (low observation)	75,000	120,000
10,000 (average)	125,000	200,000
14,000 (peak observation)	175,000	280,000

TAHOE EFFECTIVE POPULATION MODEL (TEPM)

The Tahoe Effective Population Model (TEPM) is an approach to estimating the annual average daily effective population of the Tahoe Region using a variety of available datasets, in conjunction with information about travel and visitation behavior of residents and visitors derived from surveys and studies. The approach is implemented in two primary steps, first estimation of the overnight population of the region, and second estimation of the population entering the region during the day (Figure 1).

Total Effective Population of the Tahoe Region:

(1) Effective Population = Residents + Overnight Visitors + Day Visitors + Commuters

The TEPM takes an additive approach to estimating the total effective population by first estimating the size of contributing sub-populations. The sub-populations considered include, residents, visitors, and commuters. The size of individual sub-populations is then summed to arrive at the effective population. To estimate each individual sub-population, the TEPM approach is adapted from the conceptual framework used by the Tahoe Travel Demand Model. The overnight population is estimated using data on the number of residents of the region, and information on the number of visitors at overnight accommodations in the region (including hotels/motels, campgrounds, and short-term rentals). The population entering the region is estimating by balancing the total entry traffic volumes in the region with the known populations and travel behaviors of the sub-populations.

The conceptual approach can be applied at a variety of time scales ranging from a single day to the annual estimates. Application of the approach should acknowledge that the uncertainty in the estimate of the individual parameters of the model increases with narrowing of the estimation window. That is, annual average estimates are likely to be more accurate than estimates for an individual day.

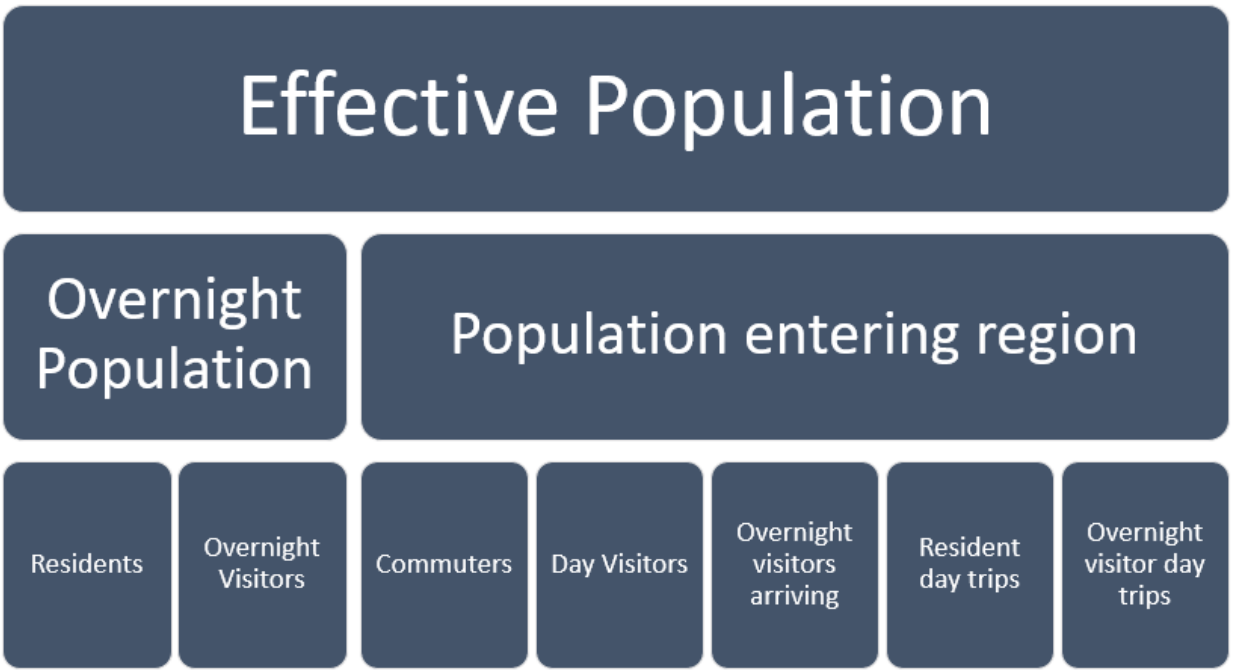


Figure 1: Sub-populations of Tahoe's Effective Population

Overnight Population

Resident Population - The resident population is derived directly from data provided by US Census. The US Census Bureau provides a complete estimate every 10 years through the decennial census, and annual estimates every year as part of the American Community Survey (ACS).

Overnight Visitors – The overnight visitor population is comprised of three different sub-populations, 1) visitors staying at accommodations that collect Transient Occupancy Tax (TOT), 2) visitors staying in campgrounds, and 3) visitors staying in residences where TOT is not collected. The size of each is estimated independently as described below.

1) *Overnight Visitors Paying TOT* – The population of overnight visitors staying in accommodations that collect TOT, including casinos, hotels, motels and resorts, as well as short-term vacation rentals (STRs), can be estimated using information sourced from local jurisdiction's TOT collection reports or data from third party vendors that aggregate the information. TOT reports include both the dollar value collected and the number of nights in which accommodation were occupied. This data reflects the number of hotel/motel/casino/STR units that are rented in the region on an annual basis.

2) *Overnight Visitors at Campgrounds* – Overnight visitors who at campgrounds within the region. Campground occupancy is reported separately and added to produce the total number of occupied "units" in the Region.
3) *Overnight Visitors in Accommodations where TOT is not collected.* The number of residences *where TOT is not collected* is estimated using data from the US Census American Community Survey (ACS), which identifies the number of "vacant" housing units in the region occupied for "Seasonal/Recreational/Occasional" purposes. Such visitors may include second home owners, guests staying with friends, or seasonal renters (i.e., anyone who has a primary residence outside of the region). Because this category ostensibly includes some short-term rentals (STR), which are included in the above overnight visitor estimate, the known STR units are subtracted from this category. With the remaining units, an estimated annual occupancy is assigned to determine the number of second home units that are occupied on an average day. Lastly, similar to the overnight visitor estimate, the approach relies on a suite of parameters related to visitor behavior, including the average number of vehicles per unit, length of stay, and vehicle occupancy to reach the final population estimate.

Overnight Visitors in Accommodations where TOT is not collected:

(1) Number of Seasonal Residential Units = Total residential units – Units occupied by residents – Number of STRs – Vacant Units

(2) Overnight Seasonal Visitors = Number of Seasonal Residential Units * % occupied * Individuals per unit

After estimating the number of occupied units of each type, the number of visitors at each type is calculated by using an estimate of the average party size staying at each accommodation type.

Overnight Visitors in the Region:

(1) Number overnight visitors = Number of Occupied Units * Average Party Size

Population entering the region

The population entering the region during a day consists of six sub-populations: 1) non-resident incoming commuters, 2) resident outgoing commuters, 3) day visitors, 4) overnight visitors arriving, 5) resident day trips and 6) overnight visitors making day trips to destinations outside the region and returning for their overnight stay. Estimation of the total number of cars entering the region on a daily basis is considered the most reliable variable of the equation to estimate the population entering the

> **(1) Total Entry Trips =** Day Visitors + Incoming commuters (Non-residents who work inside) + Outgoing commuters (Residents who work outside) + Overnight Visitors Arriving + Overnight Visitor Discretionary trips + Resident Discretionary Trips

region on a day, and is used as a limiting factor to balance the individual sub-population sizes. That is, if there are 30,000 trips entering the region on an average day, the total number of trips of the contributing subpopulation trips cannot exceed 30,000. Because sub-population sizes are balanced against observed traffic counts, augmentation of the size of a sub-population reduces the size another sub-population in the traveling into the region. This means that if traffic counts stay constant, and the number of commuters increases, there needs to be an equal size reduction in trips made by the other sub-populations.

The overall approach involves using the best available data on known population sizes and movements. The approach first allocates trips to known parties and the remaining trips are then allocated to day trips into the region, which are considered the least well-known variable.

> **Overnight Visitors Arriving:**
>
> **(1) Overnight Visitor Entering** = (Number Overnight Units Occupied / Length of Stay) * Party Size
>
> **(2) Overnight Visitors Cars** = Overnight Visitors Entering / Visitors Per Car

Overnight Visitors Arriving- The number of occupied units (paying TOT, not paying TOT, and campgrounds) is used in conjunction with assumptions about the average number of individuals per unit. The total number of occupied units is divided by the average length of stay to arrive at the number of overnight visitor parties arriving or leaving on an average day. The number of visitor parties is then multiplied by average party size for accommodation units to estimate the total number of individuals

entering the Region. Finally, the number of individuals entering is dividing by the average vehicle occupancy for entry trips to estimate the number of overnight visitor entry car trips.

Commuters – The commuter population can be directly estimated from data provided by several US Census data programs such as Census Transportation Planning Products (CTPP) and Longitudinal Employer-Household Dynamics (LEHD), or through the use of Streetlight data. Two regional reports, one for the north shore and one for the south shore also estimate the number of commuters (TTCF 2016; Sullivan et al. 2019).

Day Visitors – The population of day visitors is estimated using observed entry traffic volumes, in conjunction with assumptions about vehicle occupancy. The number of vehicles that enter the region on a given day are composed of day visitors, commuters traveling to their job inside the region, residents returning from their commute outside of the region, thru visitors, and overnight visitors/second home owners traveling to their lodging destination. The TEPM approach apportions the total entry vehicles to each of these party types using information from several data sources including StreetLight Data, as well as assumptions about the average length of overnight visitor stay. In the end, the number of day visitor vehicle entry trips are estimated, and a vehicle occupancy assumption is applied to conclude the total day visitor population.

(1) **Day visitation trips** = Total Entry Trips – Overnight Entry Trips – Commute Entry Trips – Discretionary Entry Trips

(2) **Day visitors** = Day visitation trips X vehicle occupancy

PARAMETER SENSITIVITY

Total effective population estimation using the TEPM is sensitive to number of parameters, but three are identified below because of their significant impact and relatively high levels of uncertainty in the associated estimates of the parameter value. Clearly, factors like the resident population, number of overnight visitors, and entry station volumes significantly impact the effective population estimates, but relatively reliable datasets are available from which these parameters can be derived. The three variables identified below both influence the overall estimate and have uncertainty associated with each.

The total effective population estimate is constrained by the observed number of entry trips into the region, a zero-sum exercise to attribute trips to trip party. The first, vehicle occupancy is likely highly intuitive, the more individuals in each vehicle, the more people there will be in the region for any given volume of vehicles. The later to relate to the composition of entry trips, and relative proportion of those trips that taken by visitors. Using the consensus estimate for average daily trip volume into the region in 2018 (explained in detail in the background data section), this means population estimate is sensitive to the how the 29,000 entry trips are allocated to different party types. Identifying the proportion of the 29,000 vehicle trips that are taken by residents and commuters impacts the total effective population because it constrains the number of trips available for people day tripping into the region.

1. Vehicle Occupancy

Vehicle occupancy refers to the number of individuals in each car. Because the TEPM approach is constrained by the total number of trips into the region, the wider the range of estimates for vehicle occupancy for each trip entering the region, the more variable the effective population of the region is likely to be. Vehicle occupancy for commuter trips into the Region is generally thought to be at or just above one person per vehicle (TTD 2017; Sullivan et al. 2019). Changes in vehicle occupancy for visitors has a significant effect on the total effective population in the region. For example, an increase of 0.25 persons in the number of passengers per visitor vehicle increases the effective population by ~10,000 people.

TRPA generally estimates 2.4 passengers per vehicle, based on numerous travel surveys. The 2017 Tahoe Transportation District Corridor Connection Plan estimated that both day and overnight visitor vehicle occupancy was 2.6 persons (TTD 2017), while other studies have estimated vehicle occupancy to be even higher. For example, Stantec reported that the SE Group estimated four passengers per vehicle (Mactutis & Albright 2016).

TRPA conducts two different types of travel survey, resident and visitor travel surveys, and mode share surveys. The resident and visitor travel surveys are more data intensive surveys that are used to parameterize the behavior or residents and visitors in the travel demand model. The most recent resident and visitor surveys were conducted in 2004 and 2005. Complete resident and visitor travel surveys are very expensive and time consuming to complete. Because of these cost considerations, and

the fact that travel behavior often changes slowly over time, many planning agencies complete them less frequently. The Sacramento Area Council of Governments completed new travel surveys in 2018, to update their prior surveys which were conducted in 2000 (SACOG 2019). Mode share intercept surveys are less intense that full travel surveys. Since 2004, TRPA has conducted alternating winter and summer surveys every two years to evaluate transportation mode performance and assess changes in travel behavior.

The average day visitor party size in the detailed winter visitor travel survey was 2.4, while travel party size of overnight visitors was 3.7 (NuStats 2004a). The survey noted large differences in overnight party size between the north and south shore, with visitors on the south shore staying more frequently in hotels and traveling in smaller parties (3.1) and visitors to the north shore being more likely to stay at private residences and travel in larger party sizes (3.9). The summer survey estimates slightly larger day visitor party size (2.8), and smaller long-term visitors party size 3.1 (NuStats 2004b).

In the 2018 summary mode share travel survey, TRPA estimated the vehicles entering the region had on average 3.02 passengers per vehicle. The 2014 summer survey didn't break out entering trips but suggested an average party size of 2.51, up from 2.25 in the 2010 summer survey, and 2.63 in the 2006 survey. Winter travel surveys have generally encountered smaller party sizes, ranging from 2.0 in 2016 to 2.2 in both the 2012 and 2008 surveys. Party size for trips entering the region was reported in 2012 and 2008 winter surveys was 3.0 and 3.1 respectively, consistent with the 2018 summer survey.

For parameter estimation it is critically important to be specific about which types of trips are included in the estimate of party size. As described above, estimates of party size for trips entirely contained within the region are generally smaller than the entry trip party size; the inclusion of commuters in the entry trip party size calculations result in a smaller overall party size on average.

2. Commuters

Commuters are defined as individuals that live in the region and commute out of the region for work, or individuals that live outside the region and commute into the region for work. Estimates of the number of commuters in the region vary greatly and range from about 3,500 a day to nearly 10,000 a day. Because the attribution of entry trips is a zero-sum exercise, if the number of annual average daily

commuters is on the higher end of the expected range, the number of day visitors would be reduced. And, because resident populations are already accounted for, the total effective population is also lower.

At the lower end of the spectrum for the number of commuters in the Region is the estimate of the 2017 corridor connection plan estimate of just under 2,000 incoming commuter trips a day (Albright 2016; TTD 2017). The estimate was develop by Stantec, who was engaged by the Tahoe Transportation District to analyze travel patterns in the region using anonymous cell phone data from AirSage (Albright 2016; TTD 2017). AirSage Analytics is a firm that specializes in processing anonymous cell phone to better understand movement in the transportation system. Using information about device home location, Stantec estimated that 6% of trips entering the region were commuter trips and that there were a total of 21.8 million vehicles trips into or out of the Region annually (TTD 2017). Using the assumption that half of the vehicle volume flows in each direction, there would be 10.9 million trips into the region annually, 29,863 daily, and 1,792 commuters daily.

For the 2018 base year analysis for TRPA's 2020 Regional Transportation Plan, and using travel survey, census data, employment data and the Streetlight data, TRPA and WSP estimated that 13% of basin entry/exit trips were commuter trips (WSP 2020). This estimate includes the entire region and includes individuals residing in the Tahoe Region and commuting to a job outside of the region.

The number of commuters can also be estimated using Streetlight Data. Streetlight classifies trips in part based on the "home" location of the device that made the trip. One of the classes of trip types StreetLight identifies is "home-based work" trips, which are defined as trips that are taken on a semi-regular basis from the overnight location of the device (home) to daytime location of the device "work." Streetlight estimates that 20% of trips into or out of the Region are home based work trips. This works out to approximately 5,000 trips entry the region on an average day.

The 2019 South Shore Region Housing Needs and Opportunities assessment estimated that there between 4,480 - 5,555 people commuting to work in the South Tahoe region (Sullivan et al. 2019). The assessment found the average commuter to the region 4.4 times a week. Using the standard estimate of 252 work days a year, this would work out to 1.03 – 1.27 million entry trips into the south shore of the region alone, or 2,800- 3,500 daily. Using the 29,000 annual average daily entry trips CalTrans and NDOT

traffic counts, this estimate would be account for 9-12% of all daily basin entries, and 17-21% of stations commuters to the south share are likely to use.

Analyzing a region that included part of the north and west shore of Tahoe, and neighboring areas in Truckee, the Truckee North Tahoe Regional Workforce Housing Needs Assessment (TTCF) estimated that in 2013 that there were 9,271 people living outside the region that commuted into the area for work, and that 5,723 Residents of the region that were commuting out of the region for work (TTCF 2016). In aggregate this means 14,994 people commuting in or out for work. While the Truckee – North Tahoe study area extends outside the Tahoe region, the estimated percentage of the commuting population may provide insight. The study estimated that 46% of residents commuted outside the region for work, and that 58.6% of jobs within the region were filled by people commuting into the region. The study area included two entry exits points to the Tahoe Region, but could have also included individuals who commuted from another part of the Tahoe region, into the study area for work. The study likely excluded from its count individuals that live or work in Truckee, but commute into Tahoe for work. Assuming that study is fully representative of commute volumes into the north Tahoe region, and using a standard 252 work days a year to adjust for daily average volumes, would result in an estimate of over 10,000 daily commuter trips, or over half the daily average volumes on 267 and 89. Using a conservative approach and assuming that half of the commute trips identified reflect commuting into or out of the Tahoe region, would result in about 7,500 commuters on the north shore. This would result in 5,178 commuters on an average day, or nearly 25% of the average daily volume on 267 and 89 being attributed to commuters. Combing the more conservative approach to TTCF estimate above for the north shore (5,178) with the South Shore Region Housing Needs and Opportunities report assessment (3,500), results in an estimate of 8,678 commuters that could be used as a higher bound estimate.

Table 2: Estimates for the number of daily average commute trips into the Region

Total Trips	Commute Trips	% of Total	Source
29,049	1,743	6%	Stantec
29,049	3,567	12%	TRPA/WSP
29,049	4,357	15%	Sullivan
29,049	5,810	20%	StreetLight
29,049	8,678	30%	TTCF/Sullivan

3. Discretionary External Trips (Resident and Visitor)

Similar to the number of commuters, the number of discretionary external trips taken by residents or by overnight visitors to the Region is uncertain and could have a large impact on the estimated total effective population. Discretionary external trips are those trips taken by someone staying inside the region (either a resident or an overnight visitor), who travels outside the region for a non-work purpose (work trips are captured by the commute trips mentioned above). This includes residents traveling outside the region for recreation or shopping, as well as overnight visitors leaving the region for recreation (e.g., visitors skiing at Kirkwood or Alpine Meadows) and then returning to their overnight lodging in the Region.

Estimates of the number of external discretionary trips are highly variable. The 2005 resident and 2004 visitor travel surveys described above were used to calibrate the TRPA travel demand model estimate for the number of discretionary trips (NuStats 2004b, 2005; PB 2007). The resident survey estimated that 13% of trips taken by residents that had an external destination.

When balancing the total entry volume in the region using the TEPM, the volume of discretionary trips and resident commute trips have similar impacts on the overall population estimation. Increasing the number of discretionary trips or resident commute trips reduces the number of trips available for day visitors. Thus, reducing the number of discretionary trips by 2,000, creates 2,000 more trips that are then available and taken up by day visitors. An increase of a 2,000 day visitor trips, increases the overall population of the region on that day by 2,000 times the estimated occupancy of day visitor trips. If occupancy is estimated to be three individuals per vehicle, the results is an effective population increase of 6,000 (2,000 trips x 3 individuals per vehicle).

BACKGROUND / DATA SOURCES

The following sections provide summaries of available data sources to estimates the core parameters necessary to estimate the effective traveling population in the Tahoe Region. The individual estimates are utilized to both provide a range of possible values for use in estimating the effective population size.

ENTRY/EXIT TRAFFIC VOLUME

Entry/exit traffic volume is the number of cars entering or exiting the region through one of the seven roadways that provide access to the region.

CALTRANS / NDOT

The state departments of transportation routinely monitor and provide estimates of traffic volumes at numerous locations along the road segments they manage. It is important to note that CalTrans and NDOT traffic count stations where not placed with the specific intent on monitoring entry and exit traffic volume into Tahoe. Because the stations are not directly located at the basin entry or exit points, TRPA has selected the closest stations to the entry points, to best represent entry or exit volumes in the Tahoe Region.

Annual Average Daily Traffic (AADT) is the average of daily (24-hour total) traffic volumes for the year divided by 365 days for a particular location. Annual average daily traffic is calculated to compensate for seasonal influence, weekly variation, incomplete data, and other variables. Federal, State, Metropolitan Planning Organizations, cities, and local agencies rely on Annual Average Daily Traffic (AADT) values for planning, engineering, and analysis.

Table 3: CalTrans/NDOT Entry/Exit Traffic Volumes (2018)

Source	Route	Station	AADT	AADT - Entry
NDOT	SR431	0310369	5,050	2,525
NDOT	US50	0250280	15,700	7,850
NDOT	SR207	0050024	5,050	2,525
Caltrans	267	6.23 Martis Peak Road	10,600	5,300
Caltrans	89	13.058 Truckee River Bridge	10,600	5,300
Caltrans	Hwy 50	65.619 Echo Lake Rd	11,000	5,500
Caltrans	89	23.972 Luther Pass (ELEV. 7740)	3,200	1,600
	Total		61,200	30,600

STREETLIGHT

Streetlight allows users to place "gates" at any point along the roadway network and to assess the volume of cars passing through the identified point. Points were placed along regional boundary at all seven roadways leading into the region. Estimated AADT, for those points is included in the table below.

Table 4: Streetlight Entry/Exit AADT estimates (2018)

Source	Route	Location	AADT	AADT - Entry
Streetlight	SR431	Mt Rose	6,186	3,093
Streetlight	US50	Spooner	14,044	7,022
Streetlight	SR207	Kingsbury	6,860	3,430
Streetlight	267	Brockway	9,314	4,657
Streetlight	89	Truckee River	9,098	4,549
Streetlight	Hwy 50	Echo	7,632	3,816
Streetlight	89	Luther	1,860	930
	Total		54,994	27,497

CONSENSUS ENTRY TRAFFIC VOLUMES

Combining the Caltrans and NDOT traffic volumes with the StreetLight derived volumes allows for the calculation of a consensus-based estimate of traffic volumes entering and exiting the region. Using this consensus estimate for entry traffic volumes results in an average daily estimate of 29,049 trips into the region (Table 4).

Table 5: Consensus Entry/Exit Traffic Volumes (2018)

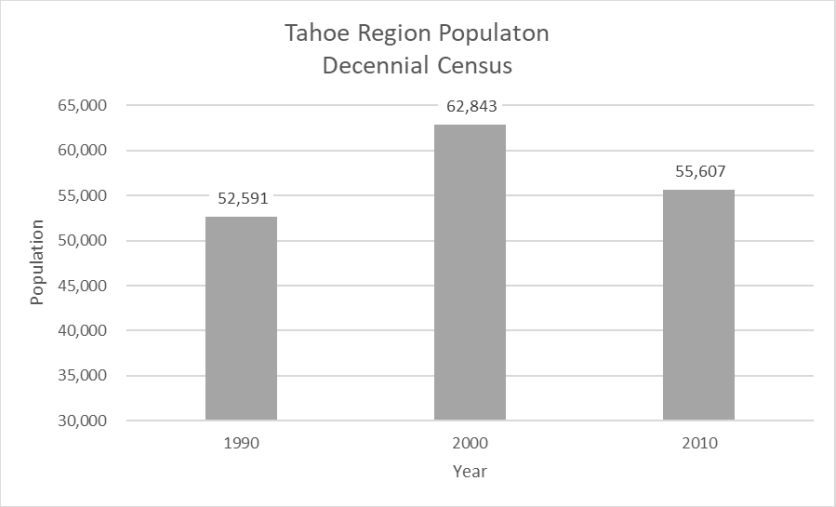
Route	Streetlight	Caltrans/NDOT	Average	Entry Average
SR431	6,186	5,050	5,618	2,809
US50	14,044	15,700	14,872	7,436
SR207	6,860	5,050	5,955	2,978
267	9,314	10,600	9,957	4,979
89	9,098	10,600	9,849	4,925
Hwy 50	7,632	11,000	9,316	4,658
89	1,860	3,200	2,530	1,265

Total	54,994	61,200	58,097	29,049

RESIDENT POPULATION

DECENNIAL CENSUS

The 2010 decennial census reported 55,607 total residents in the Lake Tahoe Region, an 11.5% decline from the 62,843 total residents in region in the 2000 decennial census. Both California and Nevada have experienced significant population growth within the last 30 years, while the population in the Tahoe region has not grown at nearly the same rate. The last three decennial censuses revelated a divergence between population trends in the Tahoe Region and the two states as a whole. Between 1990 and 2010, Nevada's population more than doubled (1.2 to 2.7 million) and California's population increased by



25% (29.7 to 37.3 million). While the two states added nearly 9 million people, the population of the Tahoe region grew by just 3,016 persons or 6% during this period.

The slight increase between the 1990 and 2010 decennial census population masks divergent trends in the last decade of the 20th century and first decade of the 21st; the region's population grew by almost 20% between 1990 and 2000, before declining by 11.5% between 2000 and 2010.

AMERICAN COMMUNITY SURVEY

The US Census Bureau's American Community Survey (ACS) continuously gathers economic and demographic data to compliment the decennial census. The most recent population data reported in the 2018 ACS estimated a total population of 51,577 in the Lake Tahoe Region.

While the ACS is not a complete count, like the decennial census it addresses some of the shortcomings of the decennial census data. The decennial census uses a date of April 1st to establish residency for the purpose of the count. For regions with seasonal fluxes in population this represents a potentially biased estimate of population, and the continuous ACS sampling may provide a more accurate estimate of the population of the region (Van Auken et al. 2006). ACS population estimates for areas with populations under 65,000 use between 3-5 years of monthly sample data (Van Auken et al. 2006). Differences

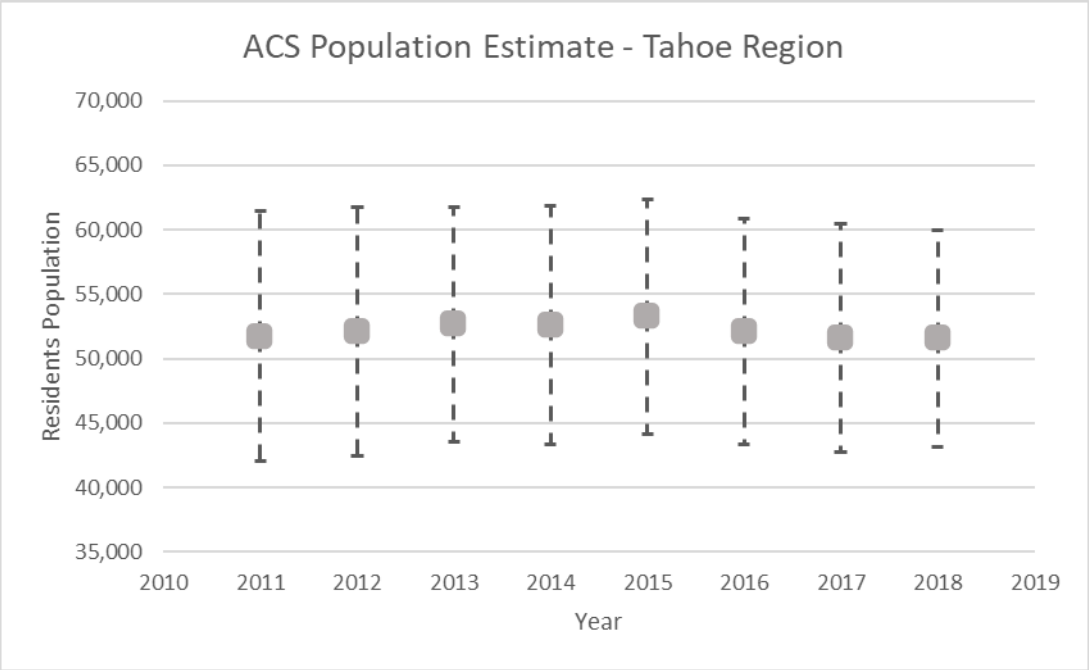


Figure 2: Resident Population of Lake Tahoe Region (American Community Survey 2010-2018)

between ACS and Decennial census estimates have been shown to be larger in communities where larger fractions of the housing stock is seasonal (Van Auken et al. 2006).

The 2018 American Community Survey (ACS) 5-year U.S. census estimates suggest that the population for the Region has been relatively stable recently, having declined only slightly between 2010 and 2018. We rely on these statistics cautiously because the margin of error is larger than the estimated change. The decline in resident population in the Tahoe Region between 2010 and 2018 was in stark contrast to the growth in the states of California and Nevada (US Census Bureau 2019).

OVERNIGHT OCCUPANCY DATA

The TEPM approach to estimate the effective population relies on information about the total number of non-residents traveling into or staying the region overnight. Non-residents of the region stay in a variety of accommodation types with the region including private homes, campgrounds, hotels/motels, resorts and casinos.

HOTELS/MOTELS/CASINOS/VHRS

Visitors to the region that stay in a casino, hotel, motel, or vacation home rental pay transient occupancy tax to the jurisdiction in which they stay. Aggregating jurisdiction's reports for TOT collected, the total annual rooms rented in the region for the last four years where complete data is summarized below.

Table 6: Annual Hotel/Motel/Casino/VHR Rooms Rented (Jurisdiction TOT Reports 2015-2019)

Year	Occupied Unit Nights	Daily Average
2015	1,776,566	3,821
2016	1,903,151	4,093
2017	2,123,166	4,566
2018	2,180,587	4,689

CAMPGROUNDS

Campsites in the Region are managed by numerous public and private entities including the USFS, California State Parks, the City of South Lake Tahoe, and Tahoe City Public Utilities District. Reporting by campground operator varies, as does the reliability of the estimates for the average number of individuals at each site. Campgrounds in the region generally operate from late May through September. The last year for which complete data is available from all operators is 2018, when 99,284 campsite nights were booked within the region.

The average number of visitors per campsite is not always captured in reporting. California State Parks currently estimates total visitation based on 4.5 persons per campsite, but suggests it likely represents

an underestimate of the total number of visitors served. USFS records indicate that there are between 2.6-3.7 persons per occupied site depending on the year. And, at CSLT campground, persons per site over the last three years has averaged 3.4-3.5 people. Using operator-based occupancy rates, there were 385,736 person nights at campgrounds in the Tahoe Region in 2018.

VISITOR LENGTH OF STAY

The 2004 TRPA summer visitor travel survey found the average overnight visitor spent 6.0 days in Tahoe, with longer stays on the north shore (6.6 days) than on the south shore (5.5 days) (NuStats 2004b). Winter survey results revealed similar north-south patterns, with shorter overall lengths of stay (NuStats 2004a). The winter survey found the average overnight visitor spent 4.9 days in Tahoe, 5.3 days for north shore visitors and 4.7 days for visitors to the south shore.

In 2017, Dean Runyon and Associates (DRA) completed a comprehensive review of the economic impacts of visitation on the California side of North Lake Tahoe region for the North Lake Tahoe Resort Association (NLTRA) (DRA 2017). The study area included Tahoe region from Tahoma north and east within the Tahoe region to the Nevada state line. In 2017, NLTRA estimated there were 1,275,000 visitors to the region (NLTRA 2018). The report estimated that there were 3,233,000 visitor days at overnight accommodations in the region (NLTRA 2018). The visitation estimates of the report utilized estimates of both the number of persons per accommodation type (Table 6) and the average length of stay by accommodation type (Table 7). The average length of stay of all overnight visitors to the Region was estimated by the study to be 4.3 nights (DRA 2017).

Table 7: Person per unit by Accommodation Type (DRA 2017)

	Hotel/Motel/B&B	Rented Condo/Home	Private/Vacation Home	Campground
Persons per Unit	2	3	2.5	3

Table 8: Average length of stay by Accommodation type (DRA 2017

	Hotel/Motel/B&B	Rented Condo/Home	Private/Vacation Home	Campground
Length of Stay	3.4	3.5	10.4	3.5

DAY VISITATION

The 2017 Corridor Connection Plan estimated day visitation through the use of anonymous cell phone data from AirSage (Albright 2016; TTD 2017). The plan estimated that in 2014, 9.4 million vehicles carrying 24.4 million visitors entered the Tahoe Basin. The corridor connection plan estimated that 87% of trips entering the region were visitor trips (TTD 2017), and that 7% of trips entering the Region were resident trips. The plan estimated that 19% of vehicle entry trips into the region were for day visitation and that just over 40% of visitors to the region spent less than a day in Tahoe (TTD 2017). Using the 19% estimate for the fraction of entry trips taken by day visitors and 29,049 entry trips from the consensus estimate, would yield a daily average of 5,519 day visitor entry trips. The AirSage reports that the overall estimate were derived from, suggest that visitor arrival in summer (July) is nearly twice that of winter (February) (Albright 2016). AirSage summer volumes are more consistent with the estimated day visitation volumes of the TRPA travel demand model, which models an average summer day.

Consistent with the AirSage analysis, the findings of the North Lake Tahoe Resort Association (NLTRA) visitation study estimated that 42% of visitors to the region were day visitors (NLTRA 2018). Importantly, this does not mean that on an individual day that 42% of visitors in the region are day trippers (DRA 2017). The report also calculated the total number of visitor days, defined as, “The total number of days of all adult visitors who stayed in the North Lake Tahoe Area during the calendar year.” When looking at total visitor days, the report found only 14% of visitors days were day visitors (DRA 2017). The 14% of all visitor days is also consistent with the AirSage data presented in Corridor Connection Plan, which suggested that day visitors were responsible for about 15% of all visitor days in the Region.

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