TECHNICAL EVALUATION OF THE GREENHOUSE GAS EMISSIONS REDUCTION QUANTIFICATION FOR THE SHASTA REGIONAL TRANSPORTATION AGENCY'S SB 375 SUSTAINABLE COMMUNITIES STRATEGY

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California Environmental Protection Agency

Air Resources Board

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I. Executive Summary

The Sustainable Communities and Climate Protection Act of 2008 (SB 375) calls for the California Air Resources Board (ARB or Board) to accept or reject the determination of each metropolitan planning organization (MPO), that its Sustainable Communities Strategy (SCS) would, if implemented, achieve the passenger vehicle greenhouse gas (GHG) emissions reduction targets for 2020 and 2035, set by the Board in 2010.

For the Shasta Regional Transportation Agency's (SRTA) region, the Board set passenger vehicle GHG emissions reduction targets at zero (0) percent per capita decrease in 2020 and in 2035. On June 30, 2015, the SRTA Board of Directors approved the final *2015 Regional Transportation Plan for Shasta County* which includes the SCS (2015 RTP/SCS). SRTA's SCS projects that the region would reduce GHG emissions by 4.9 percent per capita in 2020 and 0.5 percent per capita in 2035, thereby achieving their targets. SRTA transmitted its adopted 2015 RTP/SCS and GHG quantification to ARB for review on September 16, 2015.

The SRTA region is located at the northern end of the Sacramento Valley with a population of approximately 180,000 people concentrated in the region's three incorporated cities, Redding, Shasta Lake, and Anderson. SRTA's RTP/SCS builds upon the region's blueprint, *ShastaFORWARD*, adopted in 2010, which focuses growth in seven newly-established Strategic Growth Areas (SGA). These SGAs, one located in each of the cities and in four of the unincorporated communities, are areas in which the region plans to increase employment and residential densities, and focus other strategies to reduce vehicle miles traveled. The RTP/SCS plans to increase average residential density by about 14 percent on a region-wide basis, and improve the existing transportation system by expanding service on existing bus routes, and providing more bicycle and pedestrian facilities. The RTP/SCS plans to invest almost $2.2 billion for the planning period of 2015-2035, allocated among transit, active transportation, roadway, and aviation improvements. With SCS implementation, SRTA projects a slight increase in the share of multi-family housing region-wide as well as preservation of resource areas and farmland. The combined effect of these land use and transportation strategies is to reduce per capita passenger vehicle GHG emissions in the region.

This report describes the method ARB staff used to review SRTA's GHG quantification and describes the results of the technical evaluation. ARB staff has concluded that the SCS, if implemented, would achieve the region's targets in 2020 and 2035. This conclusion is based on multiple factors, including the sensitivity of the MPO's travel model, the impact of assumptions used in the model, the types of projects and strategies in the SCS that support more sustainable development, and qualitative evidence from SCS performance indicators that indicate the region's ability to reduce per capita emissions.

II. Shasta Regional Transportation Agency

In California, each metropolitan planning organization (MPO) is responsible for preparing and updating a Regional Transportation Plan[1] (RTP) that includes a Sustainable Communities Strategy[2] (SCS), demonstrating a reduction in regional greenhouse gas (GHG) emissions from automobiles and light trucks to meet targets set by ARB. Shasta Regional Transportation Agency (SRTA) is the federally designated MPO and the State-designated regional transportation planning agency for Shasta County. SRTA is governed by a Board of Directors which includes seven members: three County Supervisors, one council member from each of the region's cities (Anderson, Redding, and Shasta Lake), and one member from the Redding Area Bus Authority (RABA).

A. Background

Shasta County is a largely rural county in the northern Sacramento Valley air basin, encompassing 3,847 square miles and having a population of approximately 180,000 residents. Much of Shasta County is mountainous, forested, and rural, with five federal forests and national park sites, four State parks, and many regional and community parks and open spaces. Shasta County has working mines, timberlands, and rangelands, and much of the region is prized for its outdoor recreational uses. Urban development in Shasta County is focused on the Sacramento valley floor in the Redding Urban Area, located in the south central portion of the county along the Interstate 5 (I-5) corridor, with most residential areas separated from most commercial, industrial, and retail areas. Figure 1 shows the region's population centers and major transportation facilities. The Redding Urban Area, which includes the region's three cities and unincorporated communities such as Cottonwood, comprises about 2 percent of the county's land area but over 66 percent of the county's population. The region's three cities account for about 62 percent of the region's population, with the remaining 38 percent residing in unincorporated communities. While only about 0.5 percent of Shasta County's acreage is farmland, more than half of the region's acreage is designated as a resource area, such as national, State, and other public parks and open space. There are several small Native American Rancherias in the region, located in rural areas.

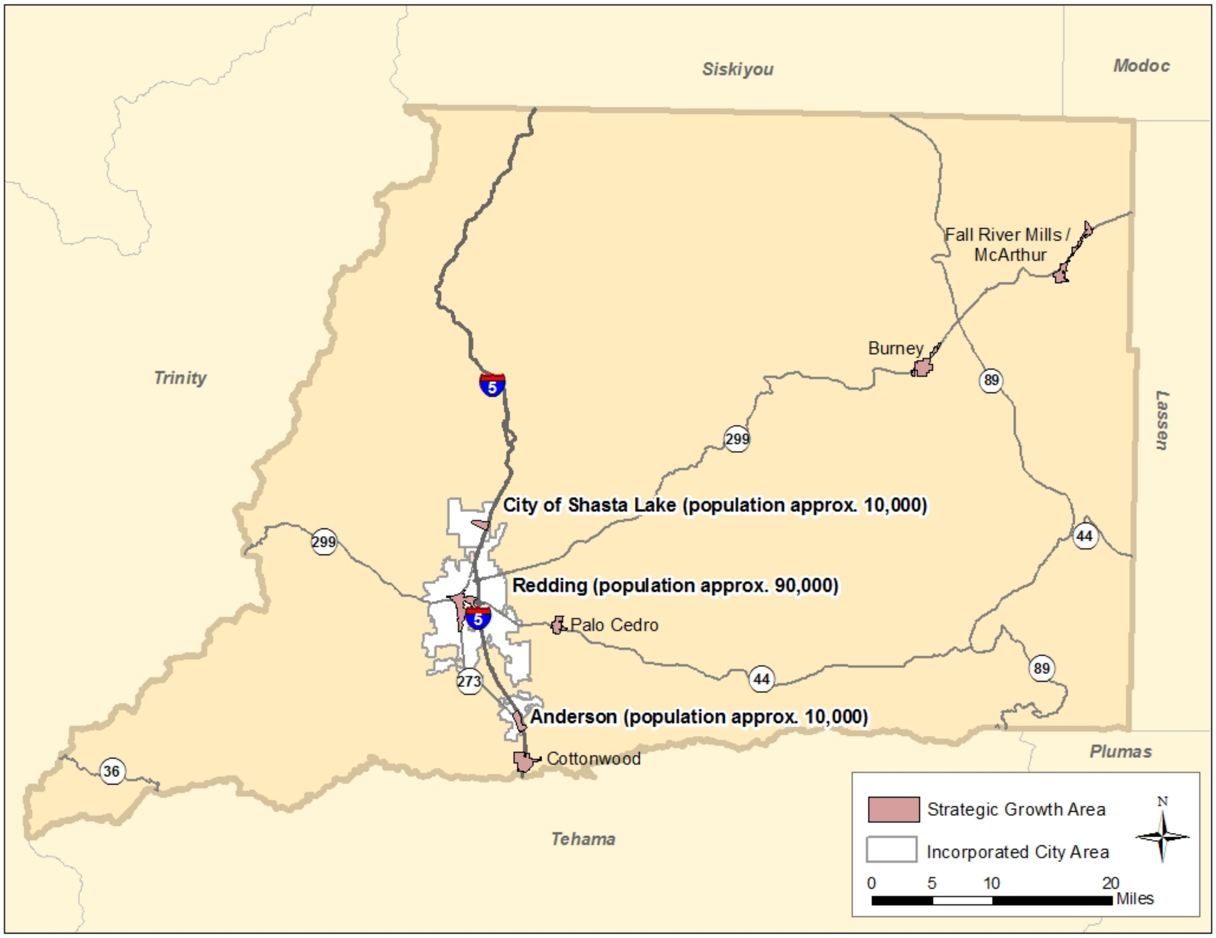
Though forestry and timber production industries were important employers in the past, the majority of employees in Shasta County currently work in the fields of education and health services, government services, retail trade, leisure and hospitality services, and professional and business services. The majority of Shasta County's employment

[1] An RTP is a federally required plan to finance and program regional transportation infrastructure projects, and associated operation and maintenance for the next 20 years.

[2] The SCS sets forth a forecasted development pattern for the region which, when integrated with the transportation network and other transportation measures and policies, will reduce the greenhouse gas emissions from automobiles and light trucks. It shall include identification of the location of uses, residential densities and building densities, information regarding resource areas and farmland.

centers are located along the I-5 corridor. Redding, the region's largest city, contains approximately two-thirds of the jobs in the region, while Anderson and Shasta Lake each have fewer than 5 percent of the region's jobs. Shasta County's 29 unincorporated towns and rural centers provide roughly a fourth of the region's employment.

Figure 1: SRTA Region



Several local and regional policies and programs are in place to encourage implementation of strategies that reduce the need to drive. The downtown core area of Redding has no limitations on residential or commercial densities, or on building height. In addition, Redding imposes lower transportation impact fees on developers in its downtown core, encouraging development to occur where densities are already greatest in the region, and where transit is already available. SRTA is currently providing incentives to encourage developers and local agencies to bring infill and redevelopment projects to Strategic Growth Areas (SGA), areas in which the region plans to increase employment and residential densities, and focus other strategies to reduce vehicle miles traveled (VMT). Reducing the number of lanes and re-striping of several downtown Redding streets to add new bicycle lanes has also recently been undertaken, as the region moves towards inclusion of more complete streets for multimodal transportation. The 2015 RTP/SCS aims to build upon these existing policies and practices in the region.

B. Transportation Planning in the Region

The 2015 RTP/SCS, which SRTA must update every five years,[3] provides a set of policies, strategies, and investments to maintain and improve the transportation system to meet the needs of the region for the 20 year planning period of 2015 - 2035. In developing its 2015 RTP/SCS, SRTA worked in coordination with staff from the cities of Anderson, Redding, and Shasta Lake, Shasta County, the Shasta County Air Quality Management District, the Shasta Local Area Formation Commission, RABA, Caltrans District 2, the Pit River Tribe, Redding Rancheria, and other community stakeholders. The following section describes the existing transportation network and factors considered in the planning of the SRTA region's transportation system.

Roadways

Many residents commute to work on the region's main transportation facilities (Figure 1), I-5, State Routes 36, 44, 89, 151, 273, and 299, or on the region's many county roads. The roadway network includes over 5,400 lane miles of freeway, highways, arterials, collectors, and local streets. Routine trips are usually reliant upon I-5 and regional highways, and, in the past, transportation funding has largely focused on maintaining these roadways.

Planning for a region's transportation system requires consideration of many factors, including where people live, work, shop, and recreate, along with expected changes in the region's population, demographics, housing needs, and economy. More trips are taken in the SRTA region to work than to any other types of destinations, so consideration of commute trips plays a large role in transportation planning. Approximately two-thirds of Shasta County's workers have an average one-way commute of 20 minutes or less. As would be expected due to the location of the majority of the jobs, shopping areas, and other destinations, residents of the unincorporated areas of Shasta County have the highest VMT per capita (25.4 miles per day) while residents of the region's cities have the lowest VMT per capita, with Redding residents having the lowest VMT per capita of all in the region (15.0 miles per day). Because Redding is California's largest urbanized area north of Sacramento, drivers from other counties in northern California make Shasta County a destination for retail and services not available in the surrounding rural counties. With attractions such as Lassen Volcanic National Park and Lake Shasta, the SRTA region also experiences tourist travel; in 2010, about 41 percent of the VMT from passenger vehicle travel began and/or ended outside of Shasta County, and this type of travel is expected to grow to about 50 percent of the SRTA region's VMT by 2035.

[3] Although SRTA is required to update its RTP every five years, they have chosen to do so every four years, beginning in 2018, to enable coordination of the RTP/SCS updates with local housing element updates.

Transit

RABA is the only fixed route bus transit operator, providing service to the cities of Redding, Anderson, Shasta Lake, the Redding Municipal Airport, and the community of Burney. RABA also provides demand-response and paratransit services. Additionally, three Native American tribes provide transportation services for tribal members. Interregional bus services provide connections to and from Redding including Greyhound Lines, Trinity Transit (Trinity County), and Sage Stage (Modoc County). Amtrak provides passenger rail service to and from Shasta County, though only two trains stop in Redding before heading north or south out of the region, in the very early morning hours.

Photo credit:
http://www.rabaride.com/about.html

More than 85 percent of transit riders in the SRTA region are transit-dependent, and transit ridership has increased by about 20 percent between the 2009-2010 fiscal year and the 2012-2013 fiscal year, when annual ridership on the region's fixed routes was nearly 808,000.

Active Transportation

Shasta County adopted its *2010 Bicycle Transportation Plan* (BTP) to help promote and encourage bicycle transportation opportunities and to help obtain funding to construct safe and effective bicycling infrastructure in the unincorporated regions of Shasta County, and to support the bicycle transportation goals of the three cities. Recognizing that increasing the region's mode share for bicycling can decrease dependency on automobile use, reduce traffic congestion, and reduce air pollution and GHG emissions, the BTP sets a goal of increasing the number of bicycle commuters in Shasta County by 5 percent by 2020. In 2010, the region had about 170 miles of bikeways and trails.

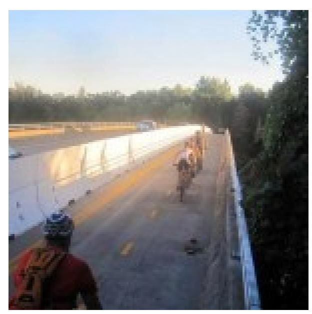


Photo credit:
http://shastalivingstreets.org/author/jeffersonius/page/5/

The City of Redding has adopted a formal complete streets policy, and SRTA has documented its sidewalks, trails, and bikeways in urban areas, enabling the non-motorized network to be integrated into its travel demand model. In 2014, the Shasta region was the recipient of two Caltrans Active Transportation Grant Program awards--$500,000 for a Safe Routes to Schools non-infrastructure award for projects in three school districts, and nearly $2.3 million for the City of Redding to improve its bicycle and pedestrian infrastructure on a major east-west downtown street.

III. SRTA 2015 RTP/SCS Development

A. SCS Foundational Policies

Several sustainable planning efforts preceded the development of SRTA's 2015 RTP/SCS. Foremost among these is the regional Blueprint, *ShastaFORWARD*. In March 2010, SRTA completed this long-range regional growth and development visioning process, with input from Shasta County residents. The Blueprint process included a comparison of three growth and development scenarios, leading to the selection of a preferred scenario that could guide the region's future growth. Having been already vetted with the public, these three scenarios and the preferred scenario were carried forward into the 2015 RTP/SCS planning process.

Additionally, the County has begun work on a regional climate action plan, with a draft released in November 2012. Its objectives are to contribute to the State's climate protection efforts, and provide California Environmental Quality Act streamlining benefits for development projects in the region.

The *Shasta County Parks, Trails and Open Space Plan* was adopted in 2009 to help identify the issues and opportunities for improving the parks, trails, and open space in Shasta County. It contains policies designed to enhance the region's economy, community health, and environmental sustainability through improvements to the region's parks, trails, and open spaces.

Each city and the county have general plans that help guide development within those local jurisdictions. The City of Shasta Lake is currently updating several elements of its 1999 general plan, and some elements of the County's 2004 general plan have been recently updated. Anderson's general plan was last updated in 2007, and Redding's was updated in 2000. The 2015 RTP/SCS relied upon land use assumptions consistent with the local agencies' general plans, as required by SB 375.

B. Development and Selection of the SCS Scenario

SRTA's 2015 RTP/SCS benefitted from the adoption of a new activity-based travel demand model, ShastaSIM, and also a study of transportation's effects on the economy in 16 northern California counties, and an evaluation of the region's transit needs. In addition, the region has worked on the coordination of transportation services between transit providers and has conducted an investigation of transit technologies. SRTA's 2015 RTP/SCS efforts were also informed by a plan for the integration of traffic data collection and management for the south central urban parts of the region.

SRTA began development of the SCS using the same three scenarios that had been studied for the 2010 regional Blueprint because these scenarios had been recently vetted through a public process. Each of the scenarios was tested with the urban growth model, UPlan, to provide information about how each one performed based on a variety of performance measures. Feedback from stakeholders and members of the public during the Blueprint process indicated the greatest interest in Scenarios B and C. In response, SRTA developed a preferred scenario for the Blueprint that blended those two scenarios. This same preferred scenario was also brought forth as the 2015 RTP/SCS scenario. The three Blueprint scenarios and the preferred scenario are described below.

Scenario A, Rural and Peripheral Growth, envisions growth and development to be distributed throughout the county, not only in the cities and towns. Average lot size would increase substantially, and residential and non-residential areas would be separate. Transportation investments would support more low-density residential development in rural areas, with some investment in public transit in existing urban areas. Scenario A would result in 96 percent large lot, 3 percent neighborhood,[4] and 1 percent urban development, and development of almost half of the region's prime agricultural lands. This scenario was the least desirable to the community, in part due to a stronger preference for preserving natural resources and open space.

Scenario B, Urban Core and Corridors, envisions a hub and spoke development pattern, with employment, commerce, and regional destinations focused within an urban hub and transportation corridors with a mix of multifamily housing, townhouses, neighborhood commercial, and traditional neighborhoods radiating out from the hub. Infill development would help maintain approximately the 2010 developed land footprint, and concentrating new development along select corridors would reduce the need for new roadways. Open space between urban corridors and a regional trails network provide the communities the connection with undeveloped land for which Shasta County is known. Transportation investments focus more on public transit and active transportation infrastructure along urban corridors. Scenario B would result in 75 percent large lot, 19 percent neighborhood, and 7 percent urban development, and preservation of nearly 2500 acres of prime agricultural land and over 21,000 acres of environmentally sensitive lands[5] compared to the current trend.[6]

Scenario C, Distinct Cities and Towns, would prevent cities and towns from growing together by maintaining open spaces between them and by including infill and redevelopment in the cities and towns, with rural development grouped on the fringes of the urban/suburban areas. Transportation investments would be used to connect communities and provide mobility choices within each community. As communities grow to their planned build-out size, new towns could be created. Scenario C would result in preservation of almost 4,000 acres of prime agricultural lands and 43,000 acres of environmentally sensitive lands, as compared with the current trend.

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[4] SRTA uses the term "neighborhoods" to mean suburban, single-family residential areas that are largely separated from non-residential land uses.

[5] Environmentally sensitive lands include those with endangered or threatened species, vernal pools, deer range, oak woodlands, wetlands, and riparian areas.

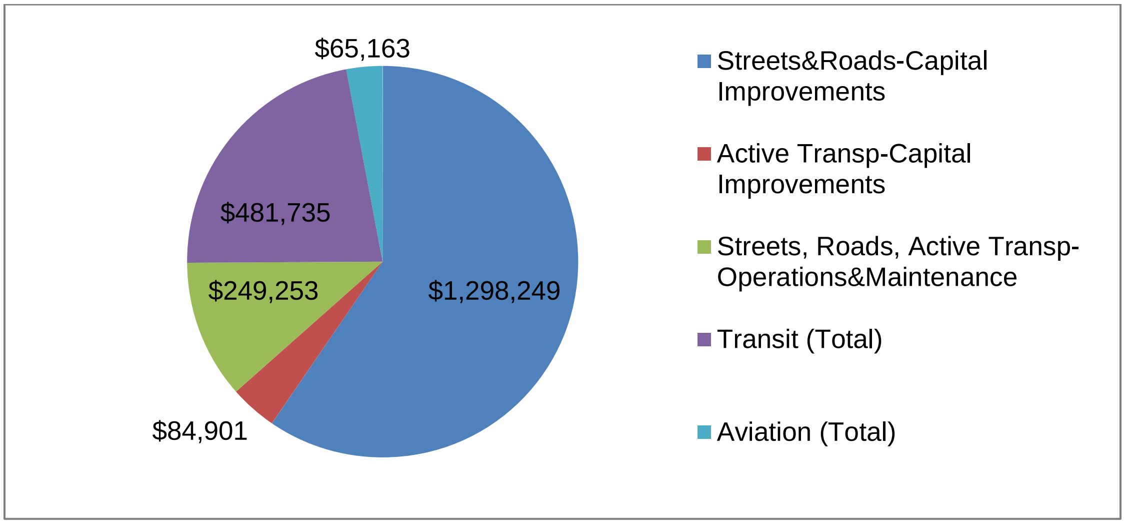
[6] SRTA's current trend scenario is a projection into the future that is based on plans, policies, and practices in existence at the time of the development of the 2010 ShastaFORWARD Blueprint document. SRTA used the current trend scenario as a point of reference against which to compare the SCS alternative scenarios.

The scenario that was selected as the basis of the final SCS was created by combining various aspects of Scenarios B and C. This scenario assumed growth and development would occur at a higher rate in Strategic Growth Areas (SGA) (Figure 1) than under the current trend. SRTA and local agencies worked together to choose seven locations for SGAs, one in each of the incorporated cities and in four of the unincorporated communities (Burney, Fall River Mills/MacArthur, Cottonwood, and Palo Cedro). SGAs are locations where SRTA envisions increasing population and employment density, diversifying land uses, encouraging more infill and redevelopment projects by providing incentives and other tools, and prioritizing public transportation, bicycle, and pedestrian infrastructure to build more multi-modal transportation options, all with the aim of reducing VMT. SRTA assumed that 6 to 10 percent of each jurisdiction's residential development would occur in SGAs, and SGAs would attract employment at a rate similar to that for residential development. Within these SGAs, SRTA assumed that a greater number of single family homes would be built and an even greater proportion of the housing units built would be multi-family housing, as compared to the current trend. Within the SGAs located in the region's three cities, 83 to 100 percent of the new households would be multi-family. SRTA also envisioned an increase in transit frequency throughout the region, with a doubling of the frequency on most existing routes region-wide, both within SGAs, and outside of SGAs.

C. Transportation Funding

The RTP must be financially constrained, meaning that proposed projects must be based on reasonably foreseeable revenues within the plan's timeframe. The SRTA 2015 RTP/SCS projects about $2 billion in total projected available funding from federal, State, and local sources, including federal transportation funding legislation, fuel taxes, license fees, developer-paid impact fees, and public transit fare revenue. The region has not implemented a self-help taxation measure, and therefore does not have this additional local source of revenue. SRTA's 2015 RTP/SCS invests approximately $482 million in transit (about 22 percent of total projected available funding); $85 million in active transportation infrastructure (about 4 percent); $249 million in operations and maintenance of streets and roads including active transportation facilities (about 11 percent); and $1.3 billion in capital improvements of streets and roads, including capacity expansion (almost 60 percent). Figure 2 summarizes the 2015 RTP/SCS expenditures by project type.

Figure 2: SRTA 2015 RTP/SCS Expenditures by Project Type
($ in thousands)



SRTA's planned transportation projects include constructing new bicycle and pedestrian facilities, replacing outdated buses and vans, improving roadway safety, adding intelligent transportation system (ITS) strategies such as signal synchronization and installation of changeable message signs, adding ramp meters to some highway on-ramps, repairing and replacing bridges, increasing roadway capacity, and improving and adding new interchanges.

IV. ARB STAFF TECHNICAL REVIEW

SRTA's quantification of GHG emissions reductions in the SCS is central to its determination that the SCS would meet the targets established by ARB. This section describes the method ARB staff used to review SRTA's determination that its SCS would meet its targets, and reports the results of staff's technical evaluation of SRTA's quantification of passenger vehicle GHG emissions reductions.

SRTA's analysis estimates that the SCS, if implemented, would achieve a 4.9 percent per capita reduction in GHG emissions from passenger vehicles by 2020, and a 0.5 percent per capita reduction by 2035. Based on ARB staff's evaluation of SRTA's SCS and technical documentation, the SCS, if implemented, would meet the targets set by the Board.

Methodology

Review of SRTA's quantification focused on the technical aspects of regional modeling that underlie the quantification of GHG emission reductions. To assess the technical soundness and general acceptability of the SRTA GHG quantification, four central components were evaluated: 1) data inputs and assumptions, 2) modeling tools, 3) model sensitivity, and 4) performance indicators. The general method of review is outlined in ARB's July 2011 document entitled *Description of Methodology for ARB Staff Review of Greenhouse Gas Reductions from Sustainable Communities Strategies Pursuant to SB 375*. To address the unique characteristics of each MPO region and modeling system, ARB's methodology is tailored to and expanded for the evaluation of each MPO. SRTA provided a copy of its travel model to ARB staff, which enabled a first-hand assessment of the model's structure and performance.

ARB staff evaluated how SRTA's models operate and perform when estimating travel demand, land use impacts, and future growth, and how well they provide for quantification of GHG emissions reductions associated with the SCS. ARB staff reviewed publicly available information in the 2015 RTP/SCS, accompanying documentation in the technical appendices, as well as the model documentation, user guide and validation report. In addition, SRTA provided clarifying information, sensitivity analyses, and a data table which can be found in Appendix A.

A. Data Inputs and Assumptions

The structure and operation of the regional travel demand model, its inputs and assumptions, and the model design process are discussed further in this section. ARB staff reviewed the inputs and assumptions used in ShastaSIM and compared them with modeling procedures described in the National Cooperative Highway Research Program's (NCHRP) *Report 716 Travel Demand Forecasting: Parameters and Techniques*, and other references. ARB staff found that the inputs and assumptions were reasonable and consistent with these references.

1. Regional Growth Forecast

MPOs such as SRTA use current and forecast demographic data to describe how the region's population will grow, and when used as an input to the travel demand model, where they will live, work, and travel. SRTA contracted with Dowling Associates in 2011 to update the regional growth forecast (RGF). Dowling Associates identified a set of economic forecasts produced for and published by Caltrans' Office of Transportation Economics in March of 2010. Dowling used the growth factors from this publication as described below to develop the 2011 RGF, shown in Table 1. Forecasts for future population, housing and employment growth show a consistent trend of less growth than previously anticipated.

The 2011 RGF used for this RTP/SCS shows a reduction in future population compared to previous forecasts, but it is still consistent with the latest California Department of Finance (DOF) projections for 2020 and 2035. The 2015 forecasted population was estimated by applying the growth rates obtained from the Caltrans forecast to the 2010 United States Census population estimate. The 2011 RGF population estimates are lower than the previous RGFs. For example, the 2011 RGF population estimate for 2030[7] is 16 percent lower than in the previous RGF. The 2011 RGF's population estimate is only 0.2 percent lower than DOF's estimate in the base year of 2010. In the forecast years of 2020 and 2035, the differences between estimates in the 2011 RGF and DOF are 1 percent and 3 percent, respectively, with the 2011 RGF predicting a higher population than DOF.

The 2011 RGF estimates for households were developed using growth rates for households from the Caltrans publication applied to 2010 United States Census data. The 2011 RGF household estimates follow a similar pattern to population, with the 2030 estimate of households being 15 percent lower than in the previous RGF.

The California Department of Housing and Community Development (HCD), in accordance with state housing law, produces a Regional Housing Needs Assessment (RHNA) that is intended to ensure that there is sufficient housing capacity in the region to house the population across all income categories. SRTA's most recent RHNA allocation from HCD is 2,200 housing units by 2020. SRTA staff estimates that over 4,000 households are expected to be added to the region by 2020, therefore the SCS is consistent with the most recent RHNA allocation.

For employment, the 2011 RGF starts with the employment estimate from the California Employment Development Department (EDD) for Shasta County in 2010. The EDD estimate is intended to represent full-time equivalent employment, while the SRTA model intends to capture the travel by all types of employment including part-time, seasonal, work-at-home, etc. In consultation with SRTA, Dowling Associates adjusted the 2010 EDD base number upwards by eight percent to account for this under-reporting. Using this adjusted base data, the future employment forecast was developed by applying the growth rates from the Caltrans publication to the 2010 EDD

[7] 2030 is used for comparison because the previous growth forecast did not include 2035.

estimate. The 2011 RGF employment forecast is 23 percent lower than the previous RGFs.

Table 1: SRTA 2011 Regional Growth Forecast Demographic Assumptions (Population, Employment, Households)

	2005	2010	2020	2035	Percent Change (2005-2035)
Population	173,029	177,223	190,192	214,364	24%
Employment	69,629	63,054	72,361	83,968	21%
Households	67,392	70,346	78,054	89,274	32%

Source: SRTA 2011

2. Current and Future Land Use

Most models that are used to simulate the demand for travel, such as ShastaSIM, depend on input data that represent both existing, or current, land uses in the region as well as the resulting land uses anticipated from implementation of the preferred scenario. The level of detail that a model requires can vary depending on the modeling software in use. The activity-based model used by SRTA, ShastaSIM is capable of using data with an extensive amount of detail including land use, as well as population, households, employment, and other characteristics associated with the land use.

ShastaSIM is designed to use the Shasta County Geographic Information System (GIS) parcel database as the foundation for land use inputs. Parcels are used by ShastaSIM as the basic unit for referencing the location of land use, associated socioeconomic data such as population, households, and employment, and transportation data associated with the parcel, such as distance to transit stops, parking supply, and roadways.

The Shasta County GIS database consists of approximately 95,000 parcels representing the best available and detailed information about what is actually “on the ground” in Shasta County.

There are four jurisdictions in the SRTA region (the cities of Redding, Shasta Lake, and Anderson, and unincorporated Shasta County) that adopt unique comprehensive land use plans commonly known as general plans. SRTA staff created a land use input file using the assessor’s parcel database for the base year of 2010 that represents land use in the region in 2010.

SRTA staff, in consultation with its member agencies, assigned the forecasted growth from the 2011 RGF to various locations within the jurisdictions, including urban core and town centers within the SGAs (see Figure 1). SRTA and its member agencies assume that six to 10 percent of the anticipated future growth in population would occur in the SGAs with a corresponding share of employment growth also occurring in the SGAs. In developing the SCS and assigning future forecasted growth, SRTA staff assumes increased transit service frequency in SGAs and accelerated delivery of active transportation investments, as well as a population and employment shift to SGAs and increased residential densities in SGAs. .

SRTA staff created a new parcel land use input file for each of the future years modeled, consistent with the preferred growth scenario. This new land use input file is created by starting with the base year input file created from the parcel database, and modifying it to reflect the impact of approved and expected projects and project scheduling, according to the assumptions in the preferred scenario.

All the land use information in ShastaSIM is consistent with all agency general plans, and incorporates the SGAs discussed previously in this report.

3. Transportation Network

The modeled transportation network is an abstract of the real world transportation infrastructure. ShastaSIM uses coded representations of the county's existing and future roadway and transit networks with edits to reflect incorporated comprehensive projects provided by local jurisdictions.

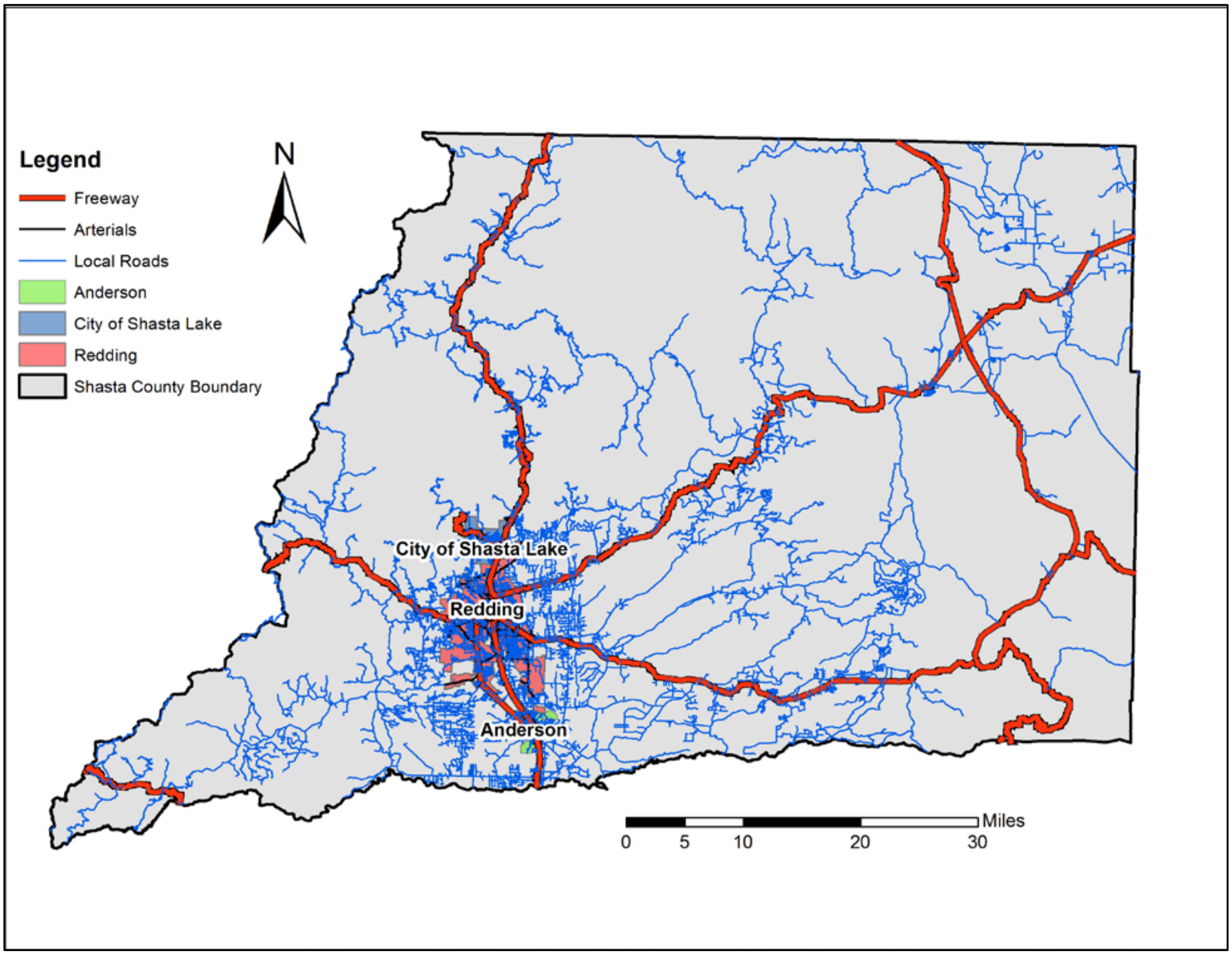
a) Roadway Network

The road network only includes important streets (generally freeways, highways, expressways, arterials, and collectors). The model does not include some collector streets or most local streets. Most local streets and driveways are instead represented by simplified network links called "zone centroid connectors" that represent local connections to the coded road network. ShastaSIM uses facility type classifications consistent with the Federal Functional Highway Classification system. The ShastaSIM roadway network has a 2010 base year network and all proposed improvements are added on top of the base year network. Table 2 summarizes the reported lane miles by facility type, and Figure 3 shows the roadway network for Shasta County.

Table 2: Base Year Roadway Lane Miles by Facility Type

Facility Type	Freeway	Highway	Expressway	Arterial	Collector	Local	Ramp
Lane Miles (2010)	307.8	512.1	52.0	601.1	939.0	370.9	36.2

Figure 3: SRTA Roadway Network

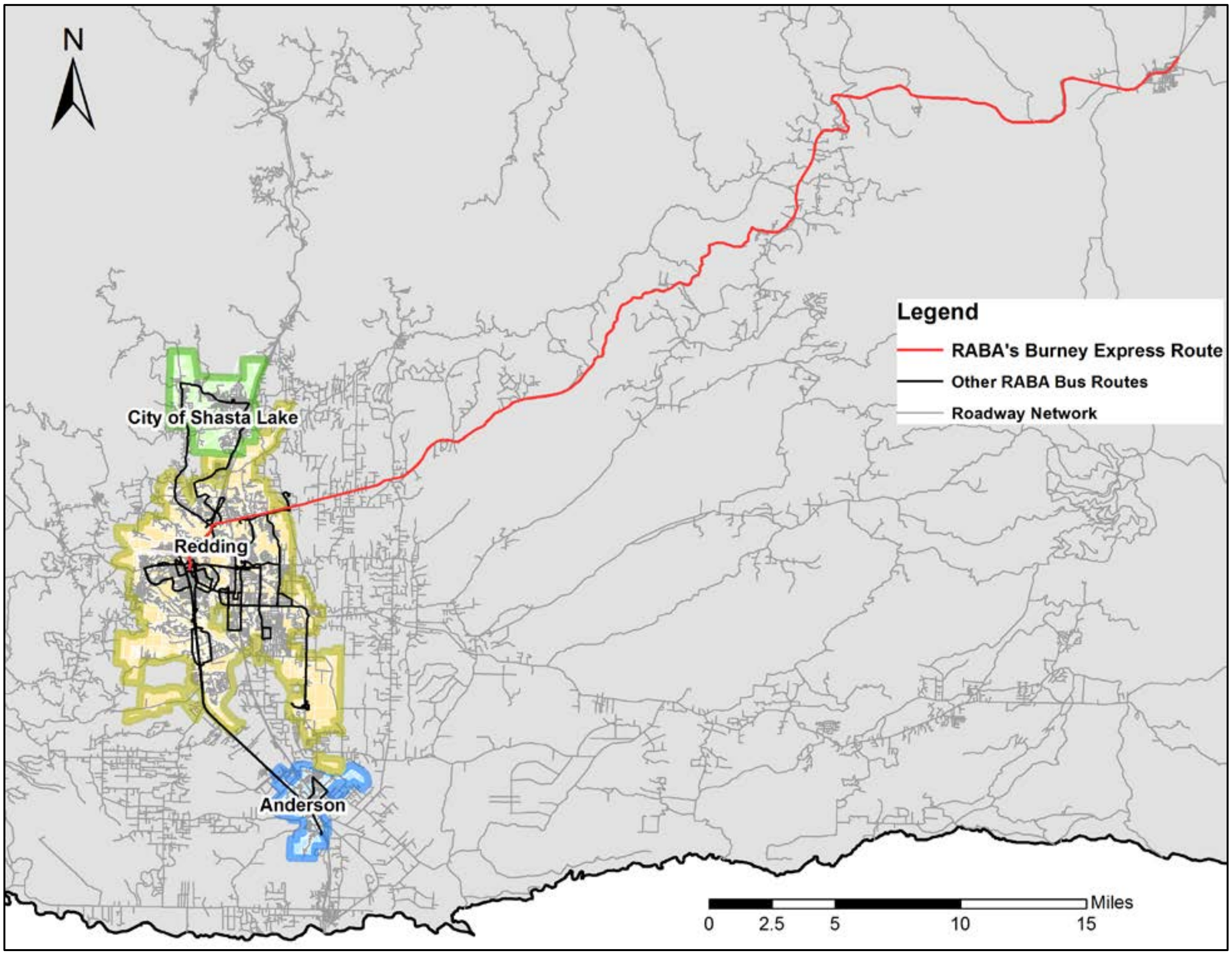


Link capacity is defined as the number of vehicles that can pass a point on a roadway at free-flow speed in an hour. One important reason for using link capacity as an input to the travel model is for congestion impact, which can be estimated as the additional vehicle-hours of delay traveling below free-flow speed. Shasta SIM assumes the link capacities based on the Transportation Research Board's 2000 *Highway Capacity Manual*. The characteristics of each link are determined by terrain, facility type, and area type using Bureau of Public Roads formulas.

b) Transit Network

The 2010 base year transit network consists of the lines operated by the Redding Area Bus Authority (RABA). Bus routes are coded directly on the road network. The routes are specified as a series of nodes on the road network. The transit network includes attributes such as transit route name, frequency (peak and off-peak periods), distance and direction. The average wait time for a bus is assumed to be one-half the headway. Access to and from each bus stop is based on the road network distances and an assumed walk speed of three miles per hour. The transit network is shown in Figure 4.

Figure 4: SRTA Transit Network



4. Auto Operating Cost

SRTA's travel model assumes that out-of-pocket auto operating costs have the greatest influence in determining automobile usage. These costs include fuel, maintenance, and tire wear averaged per mile for a typical driver. The auto operating cost excludes fixed cost factors such as purchase price of the automobile, financing costs, insurance, and depreciation. The assumed 2005 and 2010 auto operating cost expressed in year 2009 dollars is 15 cents per mile, and is 27 cents and 29 cents per mile for 2020 and 2035, respectively.

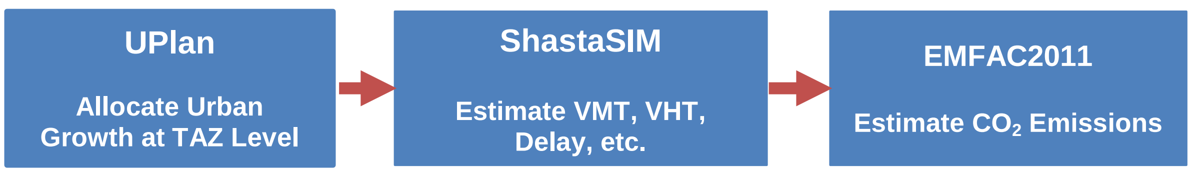
B. Modeling Tools

ARB staff assessed how well the travel model replicates observed results based on both the latest inputs (socioeconomic, land use, and travel data) and assumptions used to model the SCS. Similar to the Sacramento Area Council of Governments (SACOG), SRTA used a land use scenario planning tool (UPlan), a trip-based travel demand model (ShastaSIM), and the ARB vehicle emission model (EMFAC2011) to quantify the

GHG emissions for its 2015 RTP/SCS. The analysis years for the GHG emissions were 2005, 2020, and 2035. ARB staff reviewed the documentation of ShastaSIM's location choice model and the DaySim personal activity simulation tool to assess whether an appropriate methodology was used to quantify the expected reduction in GHG emissions from SRTA's SCS. ARB staff also compared SRTA's modeling practices against the California Transportation Commission's (CTC) *2010 California Regional Transportation Plan Guidelines*, the Federal Highway Administration's (FHWA) *Model Validation and Reasonableness Checking Manual*, and other key modeling guidance and documents.

Figure 5 illustrates the modeling process, and the following sections provide a detailed description of each component. SRTA made no off-model adjustments in its GHG quantification.

Figure 5: SRTA'S Modeling Tools[8]



1. Land Use Allocation Tool

SRTA used UPlan to allocate the region's land use growth. UPlan is a GIS-based, scenario-testing land use planning tool which allocates urban growth in several land use types for small (parcel-sized) grid cells. UPlan relies on fine-grained grid data that represent existing urban land uses, local general land use plans, and all other relevant natural and built features to calculate the suitability of a growth choice and to allocate growth accordingly.

2. Travel Demand Model

In order to improve travel demand modeling abilities, SRTA developed an activity-based model for the region, using Proposition 84 Modeling Incentive grant funds from the Strategic Growth Council. SRTA uses the new activity-based model for the modeling of strategies aimed at reducing regional VMT and associated GHG emissions.

An activity-based model (ABM) simulates travel behavior at the parcel level instead of at the TAZ level, as in traditional four-step travel models. ABMs allocate households and jobs to the parcel level, allowing the capture of smaller-scale land use changes. ShastaSIM is an advanced forecasting tool that simulates individuals' travel patterns as a series of "trip-legs" connecting activities during the course of a 24-hour day. The parcel-level land use data, combined with a person-day activity and travel simulator,

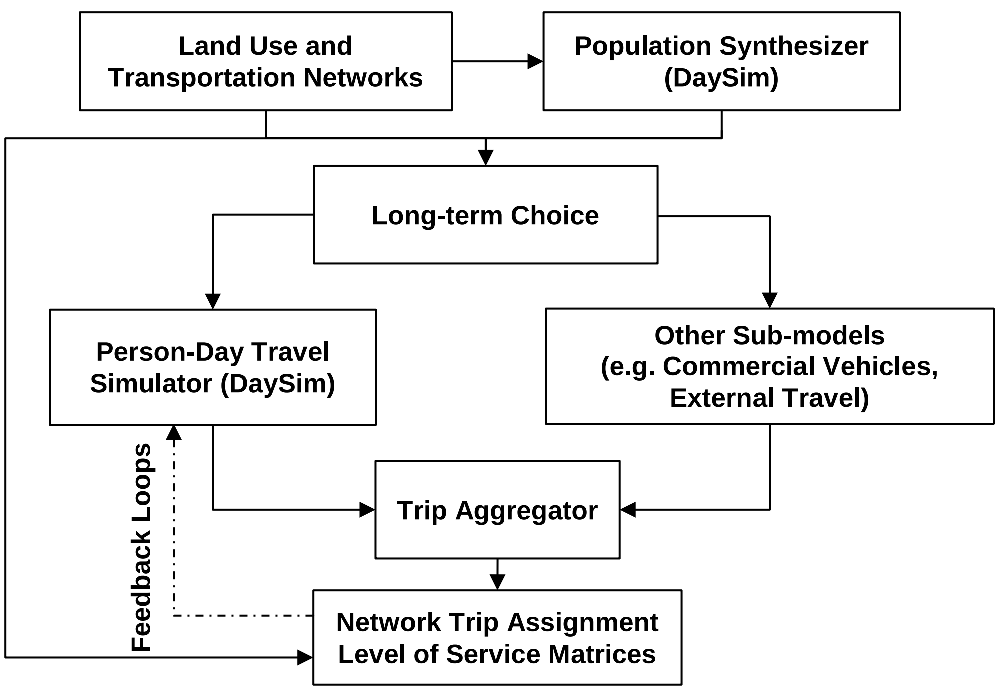
[8] TAZ = Traffic Analysis Zone, VMT = Vehicle Mile Traveled, VHT = Vehicle Hour Traveled.

provides a level of model sensitivity and detail regarding representation of land use and its effects on travel behavior that was not available with SRTA's previous travel model.

SRTA's travel model is the Shasta Activity-Based Travel Simulation Model (ShastaSIM). As part of its plan development process, SRTA used ShastaSIM to assess the long-term needs of the region's transportation system such as roadways, transit planning, and goods movement. SRTA also used ShastaSIM to perform federally required air quality conformity analyses and the technical analysis for determining if GHG emissions reduction targets will be achieved through implementation of the 2015 RTP/SCS.

This section reviews some key components of ShastaSIM: population synthesizer, day-pattern activity simulator (DaySim), and trip assignment; and discusses the model validation process SRTA performed to establish the credibility of the model's outputs. Similar to other types of travel demand models, ShastaSIM is an aggregation of a number of different sub-models as shown in Figure 6. ShastaSIM starts with a land use and transportation network and population generator that feeds into a location choice model. Then, the locations of resident, employment, and schools were fed into DaySim and other sub-models. The trip aggregator is a sub-model that summarizes all trips and uses them as inputs to trip assignment. The trip assignment procedure provides feedback to DaySim, and DaySim adjusts the person's activity based on the feedback.

Figure 6: SRTA's Activity-based Travel Demand Model



a) Population Synthesizer

ShastaSIM utilizes Shasta County's GIS parcel database as the basic spatial unit for referencing socioeconomic data such as households, population, employment, school enrollment, and parking attributes that are used in the model. The model uses DaySim's built-in synthesizer to create a synthesized population. DaySim simulates a day of activity and travel for each person in each household of a synthetic population distributed throughout a given geographical area. The population synthesizer was then compared to the 2010 population data included in Shasta County's updated Regional Housing Need Allocation (RHNA) numbers.

b) Long-Term Choice Model

Long-term choice models include choices for workers, students, and automobile ownership. For people who are both students and workers, the model estimates the usual work location and school location.

DaySim treats work/school location and auto ownership as long-term decisions since they do not change for months or sometimes for years. It uses a probability-based model with the constraints of travel distance, mode choice, and destination choices to identify work and school location choices. The number of jobs available and school enrollment were used as constraints.

Structurally, the usual school location sub-model is similar to the work location model, but with person types focused on students (K-12 and college/university). Because of the strong relationship between usual school location and enrollment at the school site, and the generally shorter trip length associated with school trips, the array of land use variables is simpler compared to the work location sub-model. Like work locations, alternative sampling is used in the model application. For purposes of this model, college/university students are students enrolled at one of the region's public community colleges, private colleges, or graduate schools.

The automobile ownership sub-model includes outright ownership, leasing, or availability of an automobile to a household for general use by other means. The sub-model includes constants for ownership "choices" of no cars, one car, two cars, three cars, or four-or-more cars. Separate constants are included for households with one through four or more driving-aged people. Other demographic variables relate to life cycle stage (e.g. presence of retired persons, school age children, or college/university students) or to household income level.

c) Day-Pattern Activity Simulator (DaySim)

The DaySim sub-model simulates the full day's activity and travel schedule of each person per household in the Shasta region. DaySim captures the complex aspects of travel decisions such as mode, location, and time, and represents the individual decision-making process of people's travel choices. This simulation provides more accurate travel demand forecasts compared to four-step travel models. DaySim is implemented by replacing and extending a certain portion of a typical four-step model (trip generation, trip distribution, and mode choice) into several distinct routines or sub-models: location choice, auto ownership, day pattern, tour, and trip level models. DaySim accounts for all travel by residents of Shasta County where their travel remains within the region. The simulation is at the person level, so the major outputs of DaySim relate to personal travel for work, school, social/recreational, and other non-work purposes. Hence, prior to applying the DaySim model, it is necessary to first develop a "synthetic population" of regional residents. The synthetic population represents individual actors of the model in the form of households and household members. Each household has certain characteristics like household size, income, number of cars, and address. Household locations determine some of the travel origins and destinations.

d) Tour-Level Model

A tour[9]-level model predicts the primary destination, mode, and time-of-day for all tours determined in the activity generator step. Therefore, once the day pattern has been estimated for each person, the model schedules the tours that he or she would take. If work or school is involved in a tour, then it becomes the primary destination. A work tour is developed as a nested logit model with alternate locations of work. Places of travel for non-work/non-school tours are determined at the tour-level destinations. A multinomial logit model uses purpose of tours, mode choices, distances, parking at destinations, street patterns, density, and commercial employment.

e) Trip-Level Model

In trip-level models, the number of estimated tours is converted into the number of trips. For each trip, the trip-level models are applied with the constraints of tour-level predictions. For example, a person bikes to work and he/she cannot drive a car back home from work. Intermediate stop locations are predicted based on the constraints of tour origin and primary destination, using a multinomial logit model with trip characteristics such as tour purpose, tour mode, stop purpose, stop placement in tour, person type, as well as household characteristics. The model was calibrated from top to bottom since the higher level model adjustments tend to affect the lower level models.

3. Trip Assignment

Similar to the four-step model, the assignment step of ShastaSIM is performed by converting person tours to vehicle trips, aggregating those trips into trip tables, and assigning them to the highway and transit networks. ShastaSIM runs over three time periods (AM peak, PM peak, and off-peak) using multi-class user equilibrium assignments to assign vehicle trips on the transportation network for single-occupancy vehicles (SOV), high-occupancy vehicles (HOV), and transit. Transit trips are assigned to the best path based on the shortest in-vehicle time plus the weighted out-of-vehicle times.

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[9] A tour is a unit of analysis that measures the sequence of trips, originating from a single location, such as home or work. This unit of analysis helps to better account for the influence connections between trips have on travel behavior.

To estimate the congested travel time and delay, ShastaSIM uses a volume delay function from the 2000 *Highway Capacity Manual*. In ShastaSIM, the different assignment functions are used for different facility types such as freeways, expressways/highways, major arterials, and minor arterials.

Traffic data for validation were obtained from a variety of sources, including the Caltrans traffic count databases, local traffic counts provided by Shasta County and the cities of Redding, Anderson, and Shasta Lake, and counts derived from recent traffic impact studies.

ShastaSIM uses a capacity constrained assignment function to estimate link volumes and speeds. Its validation meets the standard criteria for model validation as indicated in Table 3.

Table 3: Static Validation According to CTC's 2010 RTP Guidelines*

Validation Item	Criteria for Acceptance	ShastaSIM
Correlation Coefficient	at least 0.88	0.95
Percent RMSE[10]	below 40%	38%
Percent of links with volume-to-count ratios within Caltrans deviation allowance	at least 75%	80%

*California Transportation Commission, *2010 Regional Transportation Plan Guidelines* (*CTC Guidelines*).

ShastaSIM validation meets the FHWA targets for total volume by road type (Table 4) for all road types. The Shasta ABM validation results show the smallest percent errors of 0.4 and 1.1 for arterial and highway/expressway, respectively, which are well within the FHWA standards. Collector/local shows 22.7 percent error and falls under the 25 percent target range. Freeway traffic volume shows a 7 percent error but still meets both FHWA and Shasta standards. Overall, modeled traffic volume is 2.7 percent higher than traffic counts, which falls within the FHWA standard. The percentage errors by functional class all met with FHWA standards.

Table 4: Validation Results by Roadway Functional Class

Functional Class	Count	Model	Percent Error	FHWA Standard
Freeway	1,274,370	1,363,163	7.0%	+/- 7%
Highway/Expwy	531,931	537,910	1.1%	+/- 10%
Arterial	715,053	717,964	0.4%	+/- 15%
Collector/Local	111,274	85,977	-22.7%	+/- 25%

[10] RMSE (root-mean squared error) measures average error between observed and modeled traffic volumes on links.

4. Model Validation

Model validation is a critical step in the development of any regional travel demand model. It establishes the credibility of the model to predict future travel behavior. The *CTC Guidelines* provide both requirements and recommendations for MPOs to enhance the modeling capabilities and validation procedures.

In validating its model, SRTA conducted both base year validation of ShastaSIM as well as future year validation, as recommended by the *CTC Guidelines*. Base year validation is also called static validation and is performed by comparing the model results to observed data. Future year (or dynamic) validation tests the predictive capabilities of the model by changing the input data for future year forecasts. For both static and dynamic validation, SRTA compared model outputs to observed data as a check on the reasonableness of its modeling results.

The Shasta County travel model transit validation is based on a comparison of the model's estimated daily transit ridership against observed daily transit ridership. RABA's average daily ridership counts between April 2011 and April 2012 shows 2,617 daily riders on all routes combined, while ShastaSIM yields 2,789 modeled boardings. The model is within 6.6 percent of overall daily ridership, which is within an acceptable range, with respect to FHWA's *The Travel Model Improvement Program: Travel Model Validation and Reasonableness Checking Manual*, on fixed-route transit services in Shasta County.

5. EMFAC Model

ARB's Emission Factor model (EMFAC2011) is a California-specific model which calculates weekday emissions of air pollutants from all on-road motor vehicles including passenger cars, trucks, and buses for calendar years 1990 to 2035. SRTA used EMFAC 2011, which was the latest approved version of the model at the time the 2015 RTP/SCS was being developed, to quantify GHG emissions, following instructions provided by ARB staff.

6. Planned Model Improvements

SRTA adopted the same auto operating costs used by SACOG. However, recent data from the American Automobile Association's Fuel Gauge Report indicates that fuel prices in Shasta County may be higher than those in Sacramento. SRTA will consider adjusting its auto operating cost assumptions in future model updates.

Although SRTA has developed an ABM, SRTA staff is continuing to work on long-range model improvements, such as updating the value-of-time coefficients in the road pricing model; changing specifications of the destination choice model to reflect mode choice and other mode level service measures; and adding pedestrian and bicycle related variables into the model.

ARB staff offers recommendations and suggestions for SRTA to improve the model's forecasting ability (Table 5). These recommendations should be incorporated into the model improvement program that SRTA is currently developing.

Table 5: Suggestions and Recommendations for Model Improvement

ARB Staff Suggestions for SRTA Model Improvements
• Use the latest available independent data sources such as the National Household Travel Survey (NHTS), Census Transportation Planning Package (CTPP), and the American Community Survey (ACS) to validate the travel model.
• Update the auto operating cost, including fuel price, cost of vehicle maintenance and tire replacement cost based on the localized estimations.
• Validate the vehicle ownership model results against the Department of Motor Vehicles' (DMV) data.
• Calibrate the various sub-models based on the latest California Household Travel Survey (CHTS) and other recent observed data.
• Continue to gather the most recent traffic count data at different facility types to ensure there are sufficient sample sizes.

C. Model Sensitivity

Sensitivity analysis tests the responsiveness of the travel demand model to changes in selected input variables. The responsiveness, or sensitivity, of the model to changes in key inputs indicates whether the model can reasonably estimate the anticipated change in VMT and associated GHG emissions resulting from the policies in the SCS. This analysis usually assumes one input variable change at a time and examines the range of output change. Sensitivity analyses are not intended to quantify model inputs or outputs or provide analyses of actual modeled data.

Model sensitivity test results were compared to elasticities[11] in the empirical literature in order to evaluate the model's ability, given the data inputs and assumptions, to produce reasonable forecasts. In those instances where the findings were corroborated by the empirical literature, the findings were referred to as either sensitive directionally or sensitive in magnitude. If the modeled direction of change was consistent with findings in the empirical literature, the model was considered directionally sensitive. If the amount of change predicted by the model was consistent with the literature, the model was considered sensitive in magnitude. In those cases where sensitivity test results could not be specifically corroborated by the empirical literature, ARB staff has indicated

[11] An elasticity is defined as the percent change in one variable divided by the percent change in another variable.

whether the model was at least sensitive directionally, meaning that changes in model inputs resulted in expected changes to model outputs.

SRTA performed tests for residential density and transit frequency. The “base” condition used for comparison in each of these tests is the 2035 RTP Project scenario. The test scenarios assume various roadway network and transit improvements proposed in the 2015 RTP/SCS, along with shifts of growth from jurisdictions as a whole to specific targeted SGAs. In addition, ARB staff assisted SRTA in conducting the auto operating cost sensitivity test for calendar year 2010.

1. Residential Density

Residential density is typically measured either as a ratio of population divided by land area (e.g., people per square mile) or housing units divided by land area (e.g., dwelling units per acre). Increasing residential density has been considered an effective land use strategy to reduce VMT in a region because empirical studies have shown that denser residential developments tend to be associated with fewer trips and lower VMT.

The 2035 RTP Project scenario assumes that 6 percent of citywide growth is redirected from the City of Redding as a whole to the Downtown Redding SGA. The 2035 RTP Project scenario was modified to represent two new land use scenarios. The shift of growth to the Downtown Redding SGA was increased from 6 percent to 25 percent for one scenario, and to 50 percent for the other test scenario.

Table 6 shows the results of the land use tests. The average trip distance decreases under each scenario. Daily transit boardings and transit mode share increase for both test scenarios, which suggests better utilization of transit with increased residential density.

Table 6: Residential Density Sensitivity Test Results

Measure Of Effectiveness	2035 RTP Project	Land Use Test Shift to Redding SGA		% Change Compared to 2035 RTP Project	
		25% Shift	50% Shift	25% Shift	50% Shift
Average Trip Distance (mi)	5.40	5.37	5.29	-0.6%	-2.0%
Drive Alone Mode Share	46.09%	45.87%	45.53%	-0.5%	-1.2%
Transit Mode Share	0.63%	0.65%	0.73%	3.6%	17.3%
Daily Transit Boardings	6,452	6,836	7,739	6.0%	19.9%
Daily Vehicle Trips	553,847	552,105	549,270	-0.3%	-0.8%

Total daily vehicle trips and passenger vehicle VMT show decreases under both scenarios, providing evidence that the model is sensitive directionally to residential density changes. Table 7 shows the model responsiveness to residential density changes and the magnitude of change is very close to that reported in empirical studies.

Table 7: Impact of Residential Density on VMT

Test Case	2035 RTP Project	Expected VMT Low*	Expected VMT High*
2035 Base	6,101,158	-	-
25 % Shift	6,080,992	5,824,830	6,004,980
50% Shift	6,032,111	5,644,681	5,928,967

* Calculated based on elasticities of -0.05 to -0.12 (Boarnet and Handy, 2014).

2. Transit Frequency Tests

Transit frequency is known to influence transit ridership. To determine the responsiveness of ShastaSIM to transit frequency, two alternative frequencies were tested: a 50 percent decrease, and a 100 percent increase from the base case. For these scenarios, the peak and off-peak frequency of all bus routes was halved and doubled. As transit service becomes more frequent, transit ridership is expected to increase, and conversely, transit ridership is expected to decline with decreasing frequency.

The model test results are shown in Table 8. The ridership response to transit frequency changes were compared to the expected ridership based on an elasticity of 0.5. The directionality of these changes and the magnitude of impact from transit frequency changes are reasonable and within the range reported in the empirical literature.

Table 8: Transit Frequency Sensitivity Test Results

Test Case	Modeled Ridership	Expected Ridership*
50% Decrease	3,143	4839
2035 Base	6,452	-
100% Increase	11,459	9678

* Calculated based on elasticities of 0.5 (Boarnet and Handy, 2014).

3. Auto Operating Cost

Auto operating cost is an important factor influencing travelers' auto use. The components of SRTA's auto operating cost include fuel price, vehicle maintenance cost, and tire replacement cost. When auto operating cost increases, travelers are expected to drive less. Conversely, when auto operating cost decreases, travelers are expected to drive more.

Three testing scenarios were designed to examine the responsiveness of the model to changes in auto operating cost. Table 9 summarizes the shift in VMT with a 33 percent decrease, 25 percent decrease, and 33 percent increase in auto operating cost. The modeled VMT for each of the test cases changed in the expected directions: as the auto operating cost increases, VMT decreases, and as auto operating cost decreases, VMT increases. ARB staff compared these modeled VMTs to what would be expected based on the elasticity of VMT with respect to the change in auto operating cost from the empirical literature. The modeled VMT from each of SRTA's sensitivity tests changed in the expected direction and fell within the expected range of short-run VMT. The change in modeled VMT is outside the expected range of long-run VMT. This change is probably due to the limited options of alternative mode of transportation in the SRTA region. Therefore, residents and commuters have to rely on auto modes for transportation activities.

Table 9: Impact of Auto Operating Cost on VMT

Test Case	Shasta Modeled VMT (thousands)	Short-run Expected Range		Long-run Expected Range	
		Minimum	Maximum	Minimum	Maximum
33% decrease	3,448,054	3,377,499	3,610,025	3,477,153	3,731,825
25% decrease	3,413,636	3,372,131	3,548,287	3,447,626	3,640,559
Base case	3,355,354	-	-	-	-
33% increase	3,258,216	3,100,683	3,333,209	2,978,883	3,233,555
Source: -0.026 (Small and Van Dender, 2010), -0.195 (Burt and Hoover, 2006), and -0.091 to -0.093 (Boilard, 2010) for short-run; -0.131 (Small and Van Dender, 2010), and -0.29 to -0.31 (Goodwin et al., 2004) for long-run.					

D. SCS Performance Indicators

ARB staff evaluated changes in non-GHG emissions indicators that describe SCS performance for qualitative evidence that the SCS, if implemented, could meet the region's targets. ARB staff evaluated the indicators' directional consistency with SRTA's modeled GHG emissions reductions, and the general relationships between those indicators and GHG emissions reductions based on the empirical literature, as discussed in the ARB-funded policy briefs and corresponding technical background documents.[12] The SCS performance indicators evaluated include residential density, the mix of single family and multi-family housing, per capita passenger VMT, trip distance for single occupancy vehicles, and transit boardings.

1. Land Use Indicators

To determine the benefits of the development pattern in the SCS on GHG emissions from passenger vehicles, the evaluation focused on two performance indicators related to land use: changes in residential density, and the mix of housing types.

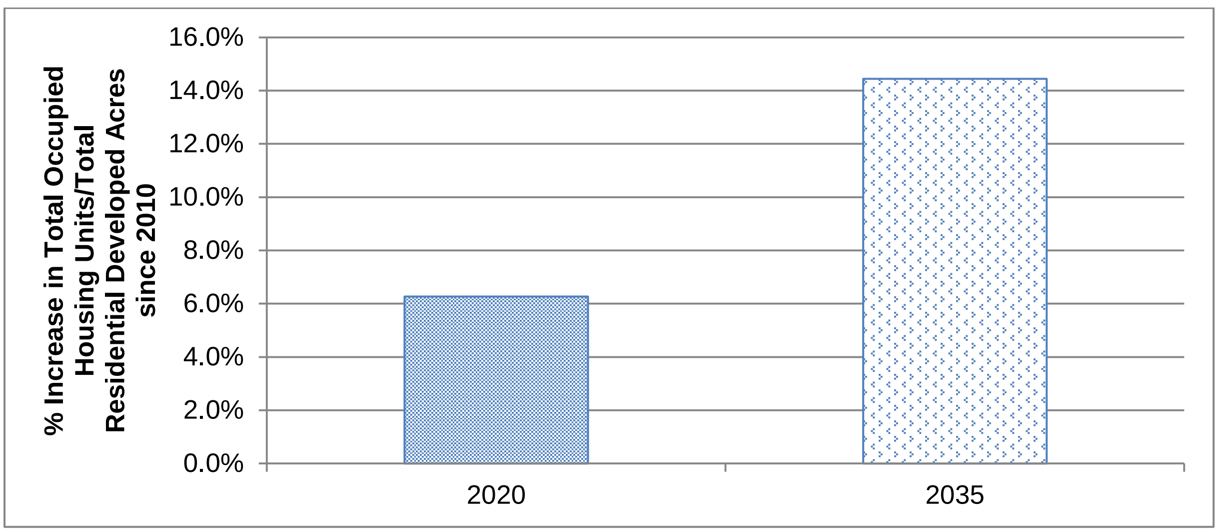
[12] These policy briefs and technical background documents, which seek to identify the impacts of key transportation and land use policies on vehicle use and GHG emissions, and which are based on the scientific literature, can be found at http://arb.ca.gov/cc/sb375/policies/policies.htm

a) *Residential Density*

Residential density is a measure of the average number of dwelling units per acre of developed land. When residential density increases, it is expected to change travel behavior including reductions in average trip length, and eventually a decrease in regional VMT; this is supported by relevant empirical literature. Brownstone and Golob (cited in Boarnet and Handy 2014) analyzed National Household Travel Survey (NHTS) data and observed that denser housing development significantly reduces annual VMT and fuel consumption, which directly results in the reduction in GHG emissions. They reported that households in areas with 1,000 or more units per square mile drive 1,171 fewer miles and consume 64.7 fewer gallons of fuel than households in less dense areas. Boarnet and Handy (2014) reported that doubling residential density reduces VMT on an average of 5 to 12 percent.

Based on SRTA's reported 2015 RTP/SCS land use data, residential density of all development from 2010 to 2035 in Shasta County would increase by more than 14 percent with implementation of the 2015 RTP/SCS (Figure 7). This increase in residential density supports SRTA's GHG emissions reduction estimates, as the empirical literature indicates an increase in residential density is likely to result in reductions in household VMT and auto trip length, shifts in travel mode away from single occupancy vehicles, and resulting reductions in GHG emissions.

Figure 7: Increase in Region Average Residential Density from Base Year 2010

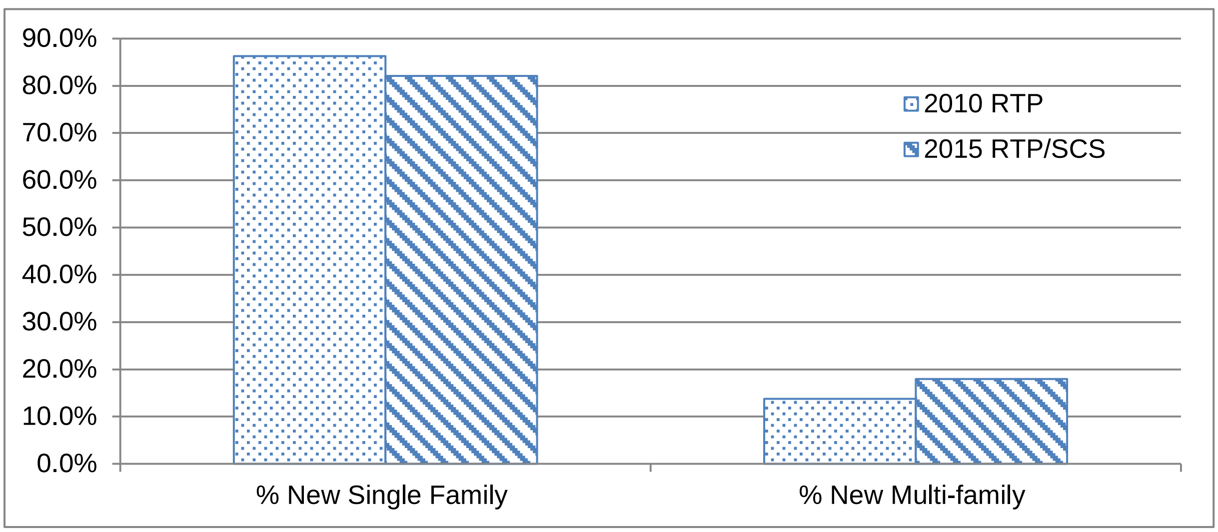


b) *Mix of Housing Types*

The mix of single-family and multi-family housing influences the land use patterns in a region. The greater the proportion of housing growth that is small-lot and multi-family housing types, the more opportunity a region has to accommodate future growth through a more compact land use pattern. As the region shifts its policy emphasis from construction of single unit homes on large lots to development of a greater proportion of single unit homes on smaller lots and multi-family housing, the travel characteristics in the SRTA region are expected to change.

SRTA's 2015 RTP/SCS indicates a slight shift towards a greater percentage of new multi-family housing units relative to the total number of new housing units. Figure 8 shows the percentage of new housing, by type, anticipated by the 2015 RTP/SCS as compared to the prior plan. By 2035, the share of new multi-family housing units is forecasted to increase from about 14 percent of the total new housing units under the 2010 RTP, to about 18 percent under the 2015 RTP/SCS. The share of single-family units decreases, by 2035, from about 86 percent of new units under the 2010 RTP, to about 82 percent of new units under the 2015 RTP/SCS. These trends in increased multi-family housing and corresponding decrease in single family housing units further support the forecasted GHG emissions reductions for the SRTA region.

Figure 8: Shift Towards Multi-Family Housing (2010 – 2035)



2. Transportation-related Indicators

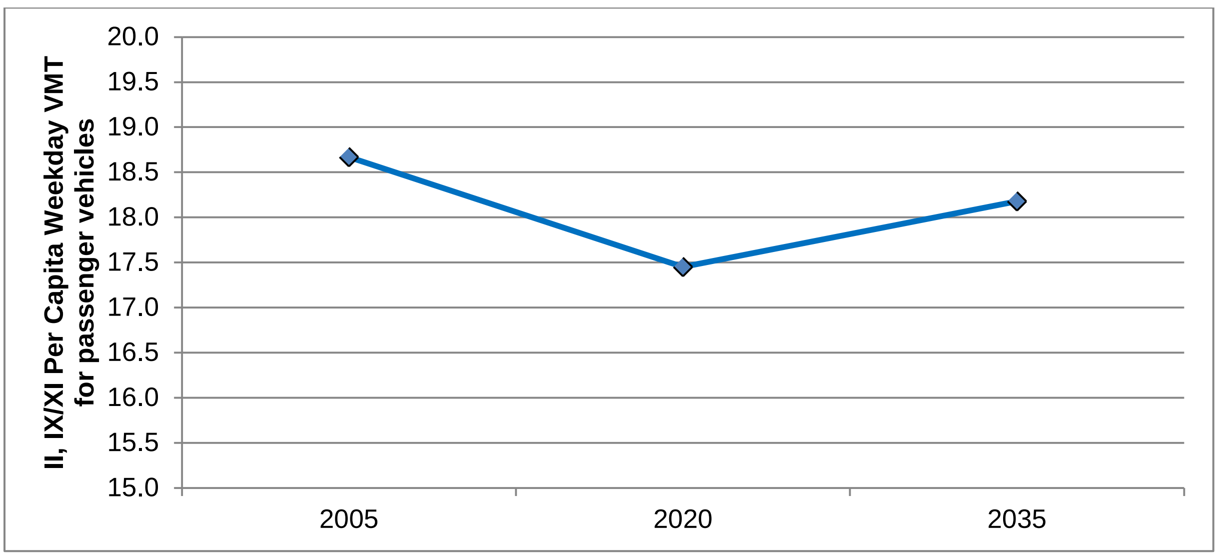
ARB staff evaluated three transportation-related performance indicators: passenger vehicle VMT, average single occupancy vehicle trip length, and transit boardings.

a) Passenger Vehicle Miles Traveled

SRTA's 2015 RTP/SCS shows a net decline in per capita passenger VMT from all modes of travel between 2005 and 2035, as shown in Figure 9. Per capita VMT decreases by 6.5 percent between 2005 and 2020, and by 2.6 percent between 2005 and 2035. The rise in per capita VMT between 2020 and 2035 is attributed to an anticipated rebound in the region's economy, causing an increase in the amount of travel, while regional housing growth remains fairly low, providing minimal opportunities for the types of development projects that typically help reduce regional VMT.

The quantification of GHG emissions from passenger vehicles is a function of VMT and vehicle speeds, in addition to other factors. Supporting these VMT reductions, data SRTA reported show that the average weekday trip length for single occupancy vehicles, which make about 50 percent of the trips in the SRTA region, declines over time. These results are directionally consistent with, and supportive of, SRTA's reported per capita GHG emissions reduction trend over time.

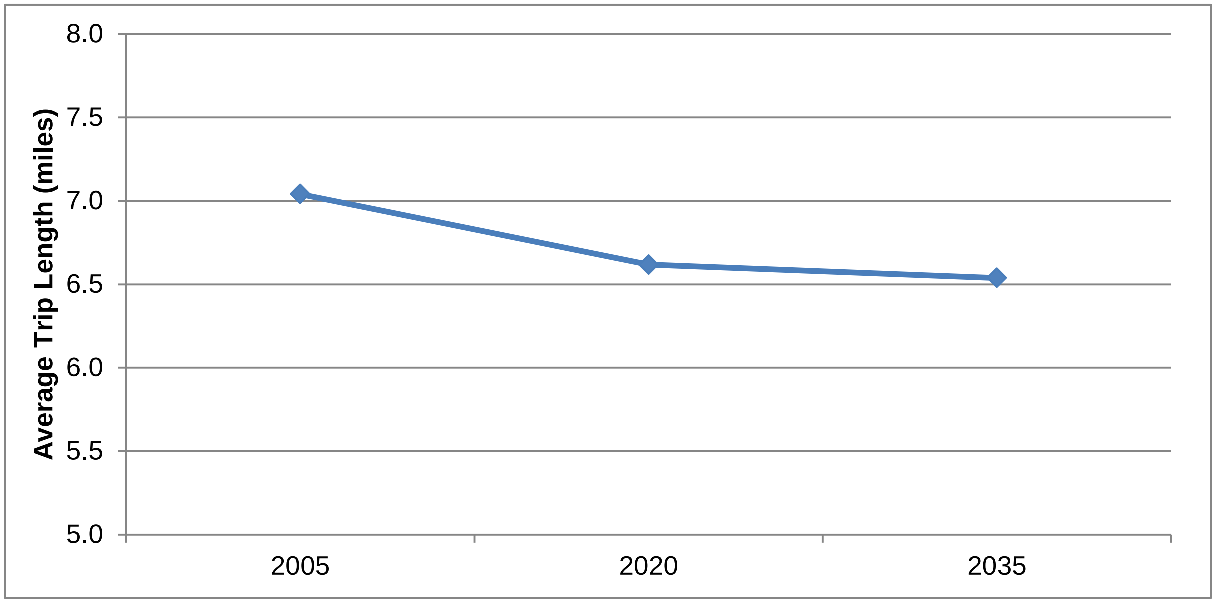
Figure 9: SB 375 Per Capita Passenger VMT (2005 – 2035)



b) Average Trip Length of Single Occupancy Vehicles

Changes in the average trip length of single occupant passenger vehicles can contribute to an overall reduction of GHG emissions in a region by decreasing overall miles traveled in a vehicle. By increasing the number of housing and employment opportunities within the region's SGAs, SRTA expects the region's population to experience a decrease in the distance needed to drive to work, shopping areas, and other amenities. Figure 10 shows the change in average trip length for single occupancy vehicles in the SRTA region. The data shows that the average solo driver will drive about 7 percent fewer miles between 2005 and 2035. This trend supports the GHG emissions reductions estimated for the SRTA region.

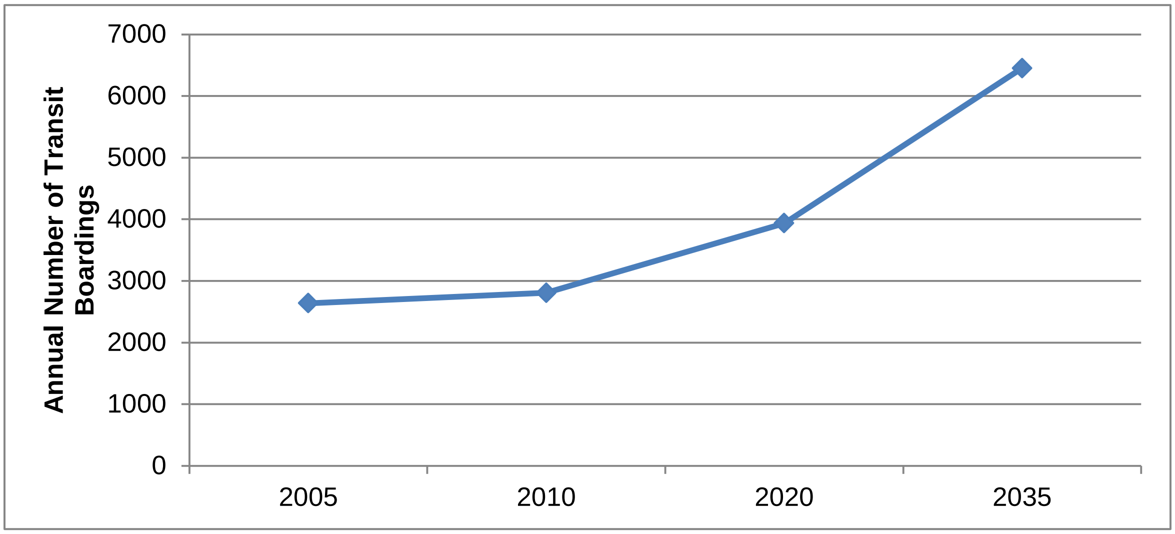
Figure 10: Average Single Occupancy Vehicle Trip Length (2005 – 2035)



c) Transit Boardings

An increase in transit ridership can indicate that people are decreasing the amount of miles traveled in automobiles by shifting their travel mode to transit. Increase in transit frequency can result in increased transit ridership, as discussed in Handy et al. (2013). SRTA's 2015 RTP/SCS includes assumptions to nearly double transit frequency by 2035, with a reduction in headways from 60 to 30 minutes on most routes, and, during peak travel times, to 15 minute headways on some routes. Figure 11 shows the increase in transit boardings between 2005 and 2035 in the SRTA region. The modeling shows that daily transit boardings are expected to rise steadily from just over 2,800 in 2010 to nearly 6,500 in 2035. To the extent that this increase in transit ridership supplants automobile use, regional per capita VMT is expected to decrease. SRTA's modeled increase in transit ridership provides additional evidence for SRTA's GHG emissions estimates.

Figure 11: Transit Ridership (2005 – 2035)



V. Conclusion

This report documents ARB staff's technical evaluation of SRTA's adopted 2015 RTP/SCS. This evaluation affirms that the SCS would, if implemented, meet the Board adopted per capita GHG emissions reduction targets of zero (0) percent reduction in 2020 and in 2035.

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APPENDIX A. Shasta Regional Transportation Agency's 2015 RTP/SCS DATA TABLE

Modeling Parameters	2005 (if available)	2010 (base year)	2020 (With Project)	2020 (Without Project)	2035 (With Project)	2035 (Without Project)	Data Source(s)
DEMOGRAPHICS							
Total population - forecasted	173,029	177,223	190,192	190,192	214,364	214,364	**Shasta County Forecast Assumptions Memorandum, Dowling Associates, November 8, 2011**
Percent Increase in Pop		*2.42%*	*7.32%*		*12.71%*		
Group quarters population - – excludes institutionalized group quarters population	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total employment	69,629	63,054	72,361	72,361	83,968	83,968	**Shasta County Forecast Assumptions Memorandum, Dowling Associates, November 8, 2011**
Employment Growth		*-6,575*	*9,307*		*11,607*		
Average unemployment rate (%)	N/A	N/A	N/A	N/A	N/A	N/A	
Growth in Employment since 2005		*-6,575*	*2,732*		*14,339*		
Total number of households	67,392	70,346	78,054	78,054	89,274	89,274	Shasta County Forecast Assumptions Memorandum, Dowling Associates, November 8, 2011
Persons per household - Forecast	2.57	2.52	2.44	2.44	2.40	2.40	2010: 2010 Census Summary File 1; 2005, 2020, & 2035: ShastaSIM and Land use and employment forecast memo
Auto ownership per household	1.91	1.91	1.91	1.92	1.92	1.92	ShastaSIM Travel Model - File: [year]_population.dbf
Weighted Median household income (Year XXXX $)	$42,227	$41,023	N/A	N/A	N/A	N/A	**2005** - 2005 American Community Survey, Table S1903, Median Income in the Past 12 Months (in 2005 Inflation-adjusted Dollars). **2010** - 2010 American Community Survey 1-year Estimates, Table S1903, Median Income in the Past 12 Months (in 2010 Inflation-adjusted Dollars).
LAND USE							
Total acres	2,465,948						

Modeling Parameters	2005 (if available)	2010 (base year)	2020 (With Project)	2020 (Without Project)	2035 (With Project)	2035 (Without Project)	Data Source(s)
Prime agricultural lands affected by development (acres)	N/A	10,804	10,588	10,804	10,588	10,804	ShastaSIM Travel Model; GIS data from sources as defined by CA GC Section 65080.01: Shasta County General Plan, California Department of Conservation Farmland Mapping and Monitoring Program website, USFWS, FEMA Maps, CA Conservation Easement Database, Geologic Hazards database (ENPLAN).
Environmentally sensitive lands affected by development (acres)	N/A	1,218,506	1,218,488	1,219,730	1,218,592	1,219,798	
Less farmland affected due to project			216		216		
Less resource land affected due to project			1,242		1,206		
Total resource area acres (CA GC Section 65080.01)	1,309,997						
Total farmland acres (CA GC Section 65080.01)	12,666						
Total developed acres							
Total commercial developed acres		14,617	17,981	17,829	18,571	18,371	ShastaSIM Travel Model and GIS files
Total residential developed acres		198,106	202,482	202,227	210,530	208,549	
Total housing units (Occupied) - Modeled	70,343	71,151	77,283	77,277	86,534	86,546	ShastaSIM Travel Model - MOE_2015_RTP.xlsx
Total housing units within SGAs*	10,731	10,824	11,847	11,684	13,487	12,423	ShastaSIM Travel Model - VMT_Summaries_Comparison.xlsx
New housing units within SGAs*	0	0	1,023	0	1,640	0	ShastaSIM Travel Model - VMT_Summaries_Comparison.xlsx
Housing vacancy rate (%)	8.93%	8.91%	8.71%	8.69%	8.53%	8.52%	ShastaSIM Travel Model - File - parcel_update_allocHH.csv
Total single-family housing units	48,962	49,629	54,870	55,011	62,257	62,905	ShastaSIM Travel Model - File - parcel_update_allocHH.csv (columns L-P)
Total multi-family housing units	13,123	13,264	14,155	14,008	16,019	15,383	
Total mobile home units & other	8,258	8,258	8,258	8,258	8,258	8,258	
Total mixed use (housing / retail) buildings	N/A	N/A	N/A	N/A	N/A	N/A	
Regional average residential density		0.36	0.38	0.38	0.41	0.41	Calculated from ShastaSIM Model outputs and GIS data
By Jurisdiction							
Anderson		3.54	3.64	3.76	4.01	3.96	

Modeling Parameters	2005 (if available)	2010 (base year)	2020 (With Project)	2020 (Without Project)	2035 (With Project)	2035 (Without Project)	Data Source(s)
Redding		3.58	3.31	3.33	3.39	3.41	
Shasta Lake		2.58	2.54	2.54	2.33	2.31	
Urbanized area average residential density		0.88	0.91	0.91	0.98	0.98	
Strategic Growth Areas							
Shasta Lake		8.15	7.74	8.15	9.69	8.22	
Anderson		8.34	5.79	8.38	11.28	8.61	
Downtown Redding		9.89	9.72	10.73	12.79	10.87	
Cottonwood		2.50	2.46	2.45	2.55	2.52	
Palo Cedro		0.85	1.52	1.44	2.59	1.39	
Burney		3.00	2.37	2.36	2.95	2.6	
Fall River		1.81	1.91	1.92	2.13	2.08	
Total housing units within 1/4 mile of transit stations and stops	29,370	29,848	31,613	31,479	32,977	32,571	ShastaSIM Travel Model - MOE_2015_RTP.xlsx (Transit Summary Tab); Table 14 of 2015 RTP
New housing units within 1/4 mile of transit stations and stops	0	0	1,765	0	1,364	0	
Total housing units within 1/2 mile of transit stations and stops	40,254	41,147	44,644	44,564	48,340	47,833	
New housing units within 1/2 mile of transit stations and stops	0	0	3,497	0	3,696	0	
Total employment within 1/4 mile of transit stations and stops	44,847	47,023	53,605	53,538	58,169	57,160	ShastaSIM Travel Model - MOE_2015_RTP.xlsx (Transit Summary Tab); Table 14 of 2015 RTP
New employment within 1/4 mile of transit stations and stops	0	0	6,582	0	4,564	0	
Total employment within 1/2 mile of transit stations and stops	49,097	53,187	61,780	61,711	68,753	68,072	
New employment within 1/2 mile of transit stations and stops	0	0	8,593	0	6,973	0	
Total employment within SGAs*	19,145	19,783	22,578	22,288	25,903	24,839	ShastaSIM Travel Model - VMT_Summaries_Comparison.xlsx
TRANSPORTATION SYSTEM							

Modeling Parameters	2005 (if available)	2010 (base year)	2020 (With Project)	2020 (Without Project)	2035 (With Project)	2035 (Without Project)	Data Source(s)
Total lane miles	3,826.7	3,839.6	3,883.4	3,900.1	3,929.8	3,965.1	ShastaSIM Travel Model - Road System Measures of Effectiveness Tables
Freeway (lane miles)	306.8	307.8	329.2	337.2	341.1	342.4	
Highway / Expressway (lane miles)	510.6	512.1	513.7	513.7	513.7	513.7	
HOV (lane miles)	N/A	N/A	N/A	N/A	N/A	N/A	
Arterial (lane miles)	601.8	601.1	609.3	616.3	631.6	653.6	
Collector (lane miles)	933.1	939.0	953.3	954.3	966.5	976.1	
Local (lane miles)	369.9	370.9	370.5	370.5	369.1	370.3	
Freeway-Freeway Interchange (lane miles)	N/A	N/A	N/A	N/A	N/A	N/A	
Regular transit bus operation miles (modeled)	1,944	1,967	2,269	1,967	3,757	2,161	ShastaSIM Travel Model
Bus rapid transit bus operation miles	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Commuter / Light Rail operation miles	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Transit total daily vehicle service hours	117.3	128.1	152.3	132.2	235.6	132.7	ShastaSIM MOE Table - Transit Summary
Bicycle and pedestrian trail/lane miles (Class I & II totals) (Modeled)	n/a	143.99	159.13	143.99	273.33	143.99	ShastaSIM Travel Model and GIS files; 2015 RTP pages 57-61; Table 14
Class I (modeled)	60.5	60.5	62.3	60.5	64.1	60.5	
Class II (modeled)	83.5	83.5	96.8	83.5	209.3	83.5	
Miles of sidewalk	N/A	N/A	N/A	N/A	N/A	N/A	
Vanpool (total riders per weekday)	N/A	N/A	N/A	N/A	N/A	N/A	
TOUR & TRIP DATA							
Number of Tours (by primary tour purpose)							
Work	55,952	56,755	60,726	60,488	67,601	67,542	ShastaSIM Travel Model - RTP2015\MOE\POUT\Compare_Tours.xlsx
School	33,432	33,921	36,277	35,988	40,453	40,317	
Escort	35,249	35,097	38,906	39,141	43,494	43,812	
Personal Business	42,143	42,219	46,222	46,093	52,206	51,939	

Modeling Parameters	2005 (if available)	2010 (base year)	2020 (With Project)	2020 (Without Project)	2035 (With Project)	2035 (Without Project)	Data Source(s)
Shopping	39,877	40,225	42,906	43,362	48,079	47,972	
Meal	11,799	11,572	12,952	12,832	14,555	14,595	
Social/Recreation	36,391	36,694	40,286	40,237	44,900	44,722	
Home							
Number of trips (by trip destination) per day	655,704	661,715	717,363	718,160	803,686	802,577	
Work (all)	88,648	89,795	95,668	95,995	107,362	106,827	ShastaSIM Travel Model - Compare Mode Share Table
Work (from home)	53,086	53,743	57,411	57,227	63,886	63,868	
School	34,335	34,852	37,305	37,002	41,535	41,461	
Escort	63,794	63,939	70,847	71,103	79,417	79,932	
Personal Business	70,352	70,751	77,716	77,727	87,447	87,243	
Shopping	68,044	68,814	73,869	74,446	82,653	82,901	
Meal	25,988	26,099	28,797	28,648	32,277	32,060	
Social/Recreation	49,700	50,706	54,886	55,098	61,707	61,254	
Home	254,843	256,759	278,275	278,141	311,288	310,899	
Average trip distance (miles) by mode							
Drive alone	7.0	7.1	6.6	6.6	6.5	6.6	ShastaSIM Travel Model - Compare Mode Share Table
Shared ride (2 persons)	4.9	5.0	4.8	4.9	4.9	4.8	
Shared ride (3+ persons)	4.9	4.9	5.0	5.1	5.0	5.1	
School bus	5.9	6.1	7.0	7.2	6.9	6.8	
Transit	0.3	0.3	0.4	0.4	0.4	0.4	
Bicycle	2.0	2.0	2.1	2.1	2.1	2.1	
Walk	0.7	0.7	0.7	0.7	0.7	0.7	
All modes	**5.6**	**5.7**	**5.4**	**5.4**	**5.4**	**5.4**	
Average trip distance (miles) by trip destination							
Average work trip length (all work trips)	8.9	8.9	8.5	8.4	8.4	8.5	ShastaSIM Travel Model - Compare Mode Share Table
Average work trip length (home-to-work trips)	12.8	12.8	12.1	12.0	11.9	12.0	

Modeling Parameters	2005 (if available)	2010 (base year)	2020 (With Project)	2020 (Without Project)	2035 (With Project)	2035 (Without Project)	Data Source(s)
Average school trip length	4.2	4.3	4.6	4.7	4.6	4.5	
Average escort trip length	3.7	3.8	3.6	3.6	3.6	3.6	
Average personal business trip length	4.5	4.5	4.3	4.3	4.3	4.3	
Average shopping trip length	3.8	3.8	3.7	3.7	3.7	3.7	
Average meal trip length	4.1	4.0	4.0	4.0	4.0	4.0	
Average social/recreation trip length	4.6	4.6	4.4	4.4	4.4	4.5	
Average home trip length	6.3	6.4	6.1	6.1	6.0	6.1	
Average trip duration (minutes) by mode							
Drive alone	10.5	10.5	9.9	9.8	9.8	9.9	ShastaSIM Travel Model - Compare Mode Share Table
Shared ride (2 persons)	7.9	8.0	7.8	7.8	7.8	7.8	
Shared ride (3+ persons)	7.9	7.9	8.1	8.2	8.1	8.1	
School bus	35.2	36.5	41.9	43.4	41.2	40.7	
Transit	41.9	40.8	40.2	42.6	35.5	44.7	
Bicycle	12.0	12.1	12.5	12.5	12.5	12.8	
Walk	13.5	13.6	13.7	13.6	14.6	14.3	
All modes	**10.1**	**10.1**	**10.0**	**10.0**	**10.0**	**10.0**	
Average trip duration (minutes) by trip destination							
work trip duration (all work trips)	13.5	13.5	13.1	12.9	13.1	13.1	ShastaSIM Travel Model - Compare Mode Share Table
work trip duration (home-to-work trips)	18.3	18.2	17.5	17.3	17.6	17.4	
school trip duration	13.3	13.4	15.0	15.5	14.9	14.6	
escort trip duration	6.8	6.9	6.7	6.7	6.8	6.7	
personal business trip duration	8.1	8.1	8.0	8.0	8.1	8.0	
shopping trip duration	7.0	7.0	6.9	6.9	6.9	6.9	
meal trip duration	7.5	7.5	7.5	7.5	7.6	7.5	
Social/Recreation trip duration	8.6	8.5	8.4	8.4	8.5	8.5	
home trip duration	11.2	11.2	11.0	11.0	11.1	11.0	

Modeling Parameters	2005 (if available)	2010 (base year)	2020 (With Project)	2020 (Without Project)	2035 (With Project)	2035 (Without Project)	Data Source(s)
MODE SHARE							
Vehicle Mode Share (AM Peak Period)							
Drive alone (% of trips)	50.8%	50.9%	49.5%	49.8%	49.4%	49.6%	ShastaSIM Travel Model - Compare Mode Share Table
Shared ride (2 persons) (% of trips)	20.9%	20.9%	21.0%	21.0%	21.0%	21.1%	
Shared ride (3+ persons) (% trips)	16.4%	16.5%	17.3%	17.2%	17.6%	17.6%	
School Bus (% trips)	3.5%	3.4%	3.8%	3.8%	3.8%	3.8%	
Transit (% of trips)	0.3%	0.4%	0.5%	0.4%	0.7%	0.4%	
Bike (% of trips)	1.9%	1.9%	1.9%	1.8%	1.8%	1.8%	
Walk (% of trips)	6.1%	6.0%	6.0%	5.9%	5.7%	5.7%	
Vehicle Mode Share (PM Peak Period)							
Drive alone (% of trips)	49.2%	49.3%	47.7%	47.9%	47.7%	47.6%	ShastaSIM Travel Model - Compare Mode Share Table
Shared ride (2 persons) (% of trips)	27.2%	27.1%	27.5%	27.4%	27.3%	27.8%	
Shared ride (3+ persons) (% trips)	16.5%	16.5%	17.4%	17.6%	17.7%	17.6%	
School Bus (% trips)	0.8%	0.8%	0.9%	0.9%	0.9%	0.9%	
Transit (% of trips)	0.3%	0.3%	0.5%	0.3%	0.6%	0.3%	
Bike (% of trips)	0.9%	1.0%	1.0%	1.0%	1.0%	1.0%	
Walk (% of trips)	5.0%	5.0%	5.0%	4.9%	4.7%	4.8%	
Vehicle Mode Share (Whole Day)							
Drive alone (% of trips)	47.8%	47.8%	46.1%	46.4%	46.1%	46.1%	ShastaSIM Travel Model - Compare Mode Share Table
Shared ride (2 persons) (% of trips)	26.1%	26.1%	26.6%	26.4%	26.4%	26.7%	
Shared ride (3+ persons) (% trips)	17.0%	17.0%	17.8%	17.9%	18.2%	18.2%	
School Bus (% trips)	1.7%	1.7%	1.8%	1.9%	1.8%	1.8%	
Transit (% of trips)	0.3%	0.3%	**0.4%**	0.3%	**0.6%**	0.3%	
Bike (% of trips)	1.3%	1.3%	1.3%	1.3%	1.2%	1.3%	
Walk (% of trips)	5.8%	5.9%	5.9%	5.8%	5.6%	5.6%	

Modeling Parameters	2005 (if available)	2010 (base year)	2020 (With Project)	2020 (Without Project)	2035 (With Project)	2035 (Without Project)	Data Source(s)
Transit Boardings (modeled)	2,638	2,808	3,936	3,069	6,452	3,354	ShastaSIM Travel Model - MOE_2015_RTP.xlsx - Transit Summary Tab; 2015 RTP - Table 14 (page 76)
TRAVEL MEASURES							
Vehicle Miles Traveled (typical weekday, all vehicles, all miles)	5,606,121	5,701,977	6,166,473	6,171,441	7,374,997	7,390,629	EMFAC2011
Total SB-375 VMT per weekday for passenger vehicles (ARB vehicle classes of LDA, LDT1, LDT2 and MDV) (miles)	3,896,516	3,767,199	4,003,507	4,033,985	4,711,914	4,724,007	EMFAC2011
Total II (Internal) VMT per weekday for ARB vehicle classes (miles)	2,236,600	2,215,113	2,157,890	2,174,318	2,365,381	2,376,176	EMFAC2011 and ShastaSIM Travel Model file (VMT_Summaries_Comparison)
Total IX/XI VMT per weekday for ARB vehicle classes (miles)	993,611	934,265	1,161,017	1,169,856	1,531,372	1,530,578	EMFAC2011 and ShastaSIM Travel Model file (VMT_Summaries_Comparison)
Total XX VMT per weekday for ARB vehicle classes (miles)	666,304	617,821	684,600	689,811	815,161	817,253	EMFAC2011 and ShastaSIM Travel Model file (VMT_Summaries_Comparison)
Congested Peak Hour VMT on freeways (Lane Miles, V/C ratios >0.75)	AM Peak: 6,466 PM Peak: 0	AM Peak: 12,789 PM Peak: 6,154	AM Peak: 9,817 PM Peak: 1,412	AM Peak: 1,334 PM Peak: 0	AM Peak: 13,211 PM Peak: 2,552	AM Peak: 10,884 PM Peak: 2,855	ShastaSIM Travel Model - MOE_2015_RTP.xlsx
Congested Peak VMT on all other roadways (Lane Miles, V/C ratios >0.75)	AM Peak: 9,279 PM Peak: 13,378	AM Peak: 8,432 PM Peak: 8,115	AM Peak: 6,370 PM Peak: 11,026	AM Peak: 7,266 PM Peak: 9,856	AM Peak: 10,975 PM Peak: 16,311	AM Peak: 11,089 PM Peak: 16,903	ShastaSIM Travel Model - MOE_2015_RTP.xlsx
CO2 EMISSIONS							
Total CO2 emissions per weekday for all vehicle classes all miles (tons)	1,249,816	1,257,796	1,411,550	1,413,356	1,739,455	1,742,415	EMFAC2011 outputs
Total CO2 emissions per weekday for passenger vehicles (SB 375 VMT) (ARB vehicle classes LDA, LDT1, LDT2, and MDV) (tons)	639,660	627,977	668,760	669,829	789,002	790,843	EMFAC2011 outputs
Total II (Internal) CO2 emissions per weekday for ARB vehicle classes (tons)	367,165	369,250	360,462	361,038	396,079	397,794	EMFAC2011 and ShastaSIM Travel Model file (VMT_Summaries_Comparison)

Modeling Parameters	2005 (if available)	2010 (base year)	2020 (With Project)	2020 (Without Project)	2035 (With Project)	2035 (Without Project)	Data Source(s)
Total IX / XI trip CO2 emissions per weekday for ARB vehicle classes (tons)	163,113	155,738	193,940	194,250	256,426	256,233	EMFAC2011 and ShastaSIM Travel Model file (VMT_Summaries_Comparison)
Total XX trip CO2 emissions per weekday for ARB vehicle classes (tons)	109,382	102,988	114,358	114,541	136,497	136,816	EMFAC2011 and ShastaSIM Travel Model file (VMT_Summaries_Comparison)
INVESTMENT (Thousands)							
Total RTP Expenditure (Year XXXX $)	N/A	N/A	N/A	N/A	$ 2,179,301	N/A	2015 RTP - Financial Section; Tables 20-22 Short term (2015-2025) is based on year 2015 $; Long term (2026-2035) is based on year 2025 $.
Streets and Roads - Capital Improvements ($)	N/A	N/A	N/A	N/A	$1,298,249	N/A	
Active Transportation - Capital Improvements ($)	N/A	N/A	N/A	N/A	$84,901	N/A	
Streets, Roads and Active Transportation - Operations and Maintenance ($)	N/A	N/A	N/A	N/A	$249,253	N/A	
Transit - Capital Improvements ($)	N/A	N/A	N/A	N/A	$ 100,667	N/A	
Transit - Operations and Maintenance ($)	N/A	N/A	N/A	N/A	$ 381,068	N/A	
Aviation - Capital Improvements ($)	N/A	N/A	N/A	N/A	$22,161	N/A	
Aviation - Operations and Maintenance ($)	N/A	N/A	N/A	N/A	$43,002	N/A	
Other (Complete Streets – maintain and sustain existing infrastructure) (YOE$, millions)	N/A	N/A	N/A	N/A	$ -	N/A	
TRANSPORTATION USER COSTS							
Vehicle operating costs (Year 2009 $ per mile)	$ 0.15	$ 0.15	$ 0.27	$ 0.27	$ 0.29	$ 0.29	ShastaSIM Travel Model
Gasoline price (Year XXXX $ per gallon)	N/A	N/A	N/A	N/A	N/A	N/A	

Modeling Parameters	2005 (if available)	2010 (base year)	2020 (With Project)	2020 (Without Project)	2035 (With Project)	2035 (Without Project)	Data Source(s)
Average transit fare (Year XXXX $)							ShastaSIM Travel Model
Fixed-route	$ 0.75	$ 0.75	$ 0.75	$ 0.75	$ 0.75	$ 0.75	
Express route	$ 2.00	$ 2.00	$ 2.00	$ 2.00	$ 2.00	$ 2.00	
Parking cost (Year XXXX $)	N/A	N/A	N/A	N/A	N/A	N/A	

APPENDIX B: 2010 CTC RTP Guidelines Addressed in SRTA's 2015 RTP/SCS

This appendix lists the requirements in the California Transportation Commission's (CTC) Regional Transportation Planning (RTP) Guidelines that are applicable to the SLOCOG regional travel demand model, and which SLOCOG followed. In addition, listed below are the recommended practices from the CTC RTP Guidelines that SLOCOG incorporated into its modeling system.

Requirements

- Each MPO shall model a range of alternative scenarios in the RTP Environmental Impact Report based on the policy goals of the MPO and input from the public.
- MPO models shall be capable of estimating future transportation demand at least 20 years into the future. (Title 23 CFR Part 450.322(a))
- For federal conformity purposes, each MPO shall model criteria pollutants from on-road vehicles as applicable. Emission projections shall be performed using modeling software approved by the EPA. (Title 40 CFR Part 93.111(a))
- Each MPO shall quantify the reduction in greenhouse gas emissions projected to be achieved by the SCS. (California Government Code Section 65080(b)(2)(G))
- The MPO, the state(s), and the public transportation operator(s) shall validate data utilized in preparing other existing modal plans for providing input to the regional transportation plan. In updating the RTP, the MPO shall base the update on the latest available estimates and assumptions for population, land use, travel, employment, congestion, and economic activity. The MPO shall approve RTP contents and supporting analyses produced by a transportation plan update. (Title 23 CFR Part 450.322(e))
- The metropolitan transportation plan shall include the projected transportation demand of persons and goods in the metropolitan planning area over the period of the transportation plan. (Title 23 CFR Part 450.322(f)(1))

Recommendations

- The use of three-step models can continue for the next few years. The models should be run to a reasonable convergence towards equilibrium.
- The models should account for the effects of land use characteristics on travel, either by incorporating effects into the model process or by post-processing.
- During the development period of more sophisticated/detailed models, there may be a need to augment current models with other methods to achieve reasonable levels of sensitivity. Post-processing should be applied to adjust model outputs where the models lack capability, or are insensitive to a particular policy or factor. The most commonly referred to post-processor is a "D's" post-processor, but

postprocessors could be developed for other non-D factors and policies, too. (See Section 3.6, Reference 3, for additional guidance)

- The models should address changes in regional demographic patterns.
- Geographic Information Systems (GIS) capabilities should be developed in these counties, leading to simple land use models in a few years.
- All natural resources data should be entered into the GIS.
- Parcel data should be developed within a few years and an existing land use data layer created.
- For the current RTP cycle (post last adoption), MPOs should use their current travel demand model for federal conformity purposes, and a suite of analytical tools, including but not limited to, travel demand models (as described in Categories B through E), small area modeling tools, and other generally accepted analytical methods for determining the emissions, VMT, and other performance factor impacts of sustainable communities strategies being considered pursuant to SB 375.
- Measures of means of travel should include percentage share of all trips (work and non-work) made by all single occupant vehicle, multiple occupant vehicle, or carpool, transit, walking, and bicycling.
- To the extent practical, travel demand models should be calibrated using the most recent observed data including household travel diaries, traffic counts, gas receipts, Highway Performance Monitoring System (HPMS), transit surveys, and passenger counts.
- It is recommended that transportation agencies have an on-going model improvement program to focus on increasing model accuracy and policy sensitivity. This includes on-going data development and acquisition programs to support model calibration and validation activities.
- For models with a mode choice step, if the travel demand model is unable to forecast bicycle and pedestrian trips, another means should be used to estimate those trips.
- When the transit mode is modeled, speed and frequency, days, and hours of operation of service should be included as model inputs.
- When the transit mode is modeled, the entire transit network within the region should be represented.
- Agencies are encouraged to participate in the California Inter-Agency Modeling Forum. This venue provides an excellent opportunity to share ideas and help to ensure agencies are informed of current modeling trends and requirements.
- MPOs should work closely with state and federal agencies to secure additional funds to research and implement the new land use and activity-based modeling methodologies. Additional research and development is required to bring these new modeling approaches into mainstream modeling practice.