

SACOG Outside the Region VMT Estimation

Purpose

This VMT estimation methodology is provided to support SACOG and its member jurisdictions in implementing Senate Bill (SB) 743. The State Office of Research and Planning (OPR) advised that VMT estimation should not be truncated at model or jurisdiction boundaries. SACOG's SACSIM19 travel demand model allows for jurisdictions within the SACOG region to capture vehicle trips and VMT that occurs outside their jurisdiction boundaries, however, vehicle trips and VMT that extend outside the region boundaries are not accounted for. This document outlines a proposed methodology for estimating VMT using Sacramento Activity-Based Travel Simulation Model (SACSIM) and account for VMT outside the model's regional boundary extents.

Background

SACOG, as the Metropolitan Planning Organization (MPO) for the six counties and 22 cities in the Sacramento region, maintains and updates the regional travel demand model. This model (SACSIM) is updated every four years during the development of the Metropolitan Transportation Plan and Sustainable Communities Strategies (MTP/SCS). Regional land use updates, calibration, and validation of SACSIM are performed in part to comply with State air quality and environmental regulatory mandates. The SACSIM land use updates, validation efforts, and geographic boundaries spanning outside an individual city or county political boundary, make it a valuable technical resource for local project evaluation of transportation impacts under California Environmental Quality Act (CEQA). The implementation of SB 743 CEQA guidance came into effect July 1st, 2020 where lead agencies are now required to use VMT as a performance metric in project environmental impact analysis. Using a regional model could allow cities and counties to evaluate both project level VMT and GHG impacts. The OPR Technical Advisory states that the VMT impact should be measured with the full length of trips however, and not truncate trips and quantification of VMT at a jurisdictional boundary. The regional model has fixed boundaries at the edge of the MPO area, and quantification of VMT for trips extending past that boundary need to be addressed in order to respond to the OPR advisory. Modeling of vehicle trips previously stopped at the SACOG regional boundary at the adjacent county major roadways, known as gateways. This made it difficult to capture the full extent of VMT trips outside of the regional boundary. SACSIM VMT calculations did not account for the external portion of the trips outside the SACSIM gateways and to address this shortcoming, SACOG has developed a methodology to account for VMT trips outside of the SACOG region for a more comprehensive VMT count. The following sections provide steps and example process tables for using SACSIM for SB 743 analysis to account for external VMT that occurs outside the region using trip estimations from SACOG Region Replica trip information.

Outside the Region Trips Estimation Source

To estimate trips outside the SACOG region, an additional travel data is required outside of a typical stand-alone SACSIM scenario. Various data sources are currently available, but all come with their own benefits and constraints. Replica was chosen to estimate trips outside the region based on the following criteria:

- **Captures all movements** within the region by internal residents and external visitors. For better integration with SACSIM.
- **Big Data integration** using real time mobile location data and pairing with land use and Census demographic data.
- **Geographic Zone Compatibility:** Includes all SACOG internal planning zones and surrounding external zones by county (Amador, San Joaquin, Solano, Napa, Colusa, Butte, Nevada, Bay Area, Northern CA, Central and Southern CA). This can also be further disaggregated down if desired.
- **Origin/Destination Pairs:** Allows for Origin and Destination trip flows at the Block Group, Census Tract, SACOG TAZ, SACOG RAD, community type, county levels including external geographies described above.
- **Trip by Mode:** driving, walking, auto passenger, commercial vehicle, biking, public transit, taxi/TNC.
- **Trip by Purpose:** home, shop, work, errands, social, commercial, recreation.
- **Current Seasonal Data Availability:** Replica provides seasonal datasets up to 2019 with new seasonal releases expected sooner than other data sources available.

Table 1 Comparison of data sources considered

Source	Description	Pros	Cons	Proposed Use
Replica	Synthetic “snapshot” of all travelers to, from and within the SACOG region, derived for big data sources	Captures travel outside the region for trips to or from the region Includes all purposes of travel (work and non-work) Query-able data on travelers and geography	New source—has not been tested	Primary source of vehicle trip length estimates from SACSIM19 gateway locations to locations outside the region
American Community Survey Worker Flows	Rolling sample of approximately ~1% of population each year	Ongoing sample allows for updates Includes both residents of region and workers residing outside region Well known source	Only includes worker flows, no non-work travel included No information on frequency of flows. Geography of flows is coarse	Secondary source for validation of Replica data for worker travel
2018 SACOG Household Travel Survey	Detailed travel survey of nearly 4000 households in SACOG region	Includes travel outside the region Includes all purposes of travel	Excludes any residents outside the region, who travel to the region.	Secondary source for reasonableness checking of Replica data for SACOG residents

2012 Caltrans Statewide Household Travel Survey	Detailed travel survey of households across the state	Includes travel outside the SACOG region Includes all purposes of travel Includes residents from outside SACOG region	Very limited sample within the SACOG region (<1500 households) Currency of data	None
LEHD	Worker flows based on administrative records (i.e. not self-reported locations)	Query-able dataset of worker flows Includes both residents of region and workers residing outside region Flexibility in specifying geography of flows	Only includes worker flows, no non-work travel included Known problems with administrative addresses of workplace and actual work locations	None
Other Big Data (e.g. Streetlight Data)	Big data sources based on cellular, smartphone, or navigation device traces	Large sample Current Relatively fine spatial detail	Sample bias is not known Attribution of trip purpose is evolving	None—no access to these sources

Source: SACOG, July 2020.

SACOG VMT Calculation Methodology

Internal-to-Internal VMT from SACSIM

SACSIM19 simulates several key types of travel by residents (non-commercial trips). Trips by SACOG residents to destinations within the SACOG region, are known as internal-internal (II) trips. These trips are modeled by DAYSIM, microsimulation discrete choice submodule and SACSIM's core module. A typical SACSIM model scenario run generates in a trip table for all trips within the region, II trips, prior to the final assignment loading the trips onto the roadway network links.. The residential VMT can be tallied to individual parcels for II residential travel and internal-external residential travel. II work related VMT can also be tallied based on the typical job location. Since the trip table (*trip.tsv*) is generated prior to the final assignment loading the trips onto the roadway network links, the trip distance is calculated based on the previous assignment's congested speeds. For this reason, a final step to attach the trip table to the final assignment skims to make sure the trip distances and travel time are accounted for from the final model iteration. This process and associated scripts are available at the SACOG website [model documentation](#) page [Appendix I SACSIM VMT Calculation Procedures](#). Cube Voyager scripts used are included in *Appendix I SACSIM VMT Calculation Procedures* attachment A and B or requested directly from SACOG modeling staff.

SACOG IXXI VMT Methodology

Trips by SACOG residents to destinations outside the SACOG region, known as internal-external, or IX trips. Trips by non-SACOG residents to destinations in the SACOG region, known as external-internal, or XI trips. SACOG utilized recommendations from the [“SB 743 Implementation Tools”](#) project for design of this methodology¹. The basic logic of the methodology is to: a) continue to rely on the SACSIM19 travel demand model for all distribution and routing of trips within the SACOG region, and from all points within the SACOG region to gateway locations; b) rely on available observed or current year data sources to estimate vehicle trip distributions and trip lengths from SACSIM19 gateway locations to all locations outside the SACOG region; c) use those distributions to calculate average trip lengths for all trips from gateway locations to locations outside the SACOG region; and d) estimate external VMT by multiplying the number of trips to/from the gateways by the average trip length associated with the external portion of trips for each internal TAZ and gateway.

The following section describes the five-step process to generate the external VMT by Gateway and by Internal TAZ distributions using SACSIM skims, internal-to-external and external-to-internal (IXXI) trip table, and Replica. Each step’s resulting tables by Gateway and TAZ are shown as an example of the process in *Outside SACOG VMT Estimation Steps* spreadsheet. The example uses data from the *2020 MTP/SCS 2016 base year* modeling files and *Replica Season: 2018 December to 2019 February*.

Step 1: Vehicle Trips at Gateways from SACSIM

After generating the new final iteration skims by attaching the trip table to the final trip distances and travel time described in the previous section and *SACSIM VMT Calculation Procedures*, the same skims are then attached to vehicle trips from the IXXI output trip matrix generated from the SACSIM IXXI submodule.

SACSIM primary simulation module (DAYSIM) simulates activities for households located within the Sacramento region. For this reason, an IXXI submodule is used to predict the trips entering and exiting the region. These trip flows are then fed back into the DAYSIM module to account and adjust for external travel by both SACOG residents existing for jobs, recreation, or shopping trips, and outside workers that have their primary employment locations inside the SACOG region. Trip generation of the gateway TAZs is an exogenous input consisting of person trips for gateway productions (i.e. trips produced outside the region, but traveling to attractions within the region) and for gateway attractions (i.e. trips produced within the region, but attracted to locations outside the region, as represented by the gateway zones). External trip purposes are: work, personal business, shopping, social-recreational, two axel commercial vehicle, three plus commercial vehicle, and airport passengers. Further information on SACSIM IXXI trip model can be found in the [SACSIM19 Model Documentation](#) Chapter 3 Section 3 External Travel.

The Cube Voyager script *sacsim19_ixxi_cveh_taz.s*, *attachment B of SACSIM VMT Calculation Procedures*, attaches the SACSIM IXXI submodule person trip output table, skims generated for the previous step I-I VMT, and household and employment totals by TAZ. Then uses these variables to calculate the number of IXXI passenger vehicle trip ends (VT) and IXXI passenger vehicle VMT originating and ending at each SACSIM internal TAZ.

¹ <https://www.sacog.org/sb-743-technical-assistance>

Table 2 shows the IXXI VMT by TAZ output results with variable and descriptions to calculate the IXXI VMT that will be used to calculate full IXXI VMT through the following steps. *Outside SACOG VMT Estimation Steps* spreadsheet shows Step 1 in an example of assembling the vehicle trips by gateway from SACSIM for the 2016 base year scenario.

Table 2 - IXXI VMT variables by TAZ

Variable	Description	Values
I	Traffic Analysis Zone (TAZ)	Gateway zones = 1-30, internal zones = 31-1533
IX_VT_I	Vehicle trips originating at zone I	
IX_VT_J	Vehicle trips ending at zone I	
IX_VHT_I	Vehicle Hours originating at zone I	
IX_VHT_J	Vehicle Hours ending at zone I	
IX_VMT_I	VMT originating at zone I	
IX_VMT_J	VMT ending at zone I	
IX_CVMT_I	Commercial VMT originating at zone I	
IX_CVMT_J	Commercial VMT ending at zone I	
SACOG 2020		

Step 2: Estimate Average Vehicle Trip Length for Travel outside-the-region by each using Replica

Using the Replica Dashboard Explorer interface, a trip table for all trips passing through an individual gateway must be generated. Often called a “Select Link” analysis where a trip shed is generated based on the distribution of trips only passing through designated link(s) to all the trips origins and destinations (O-D). This process was done for all SACSIM gateways by using the closet roadway link available in Replica. Figure 1 shows the process of identifying SACSIM gateway links, a point at the end of a stick-and-ball network, to the proper Replica roadway location. Figure 2 and 5 show a graphic representation of the SR-70 and I-80 gateway travel shed trip distribution by TAZ and roadway volume associated with trips both from internal and external travel. From the replica dashboard, only the aggregate total of internal trips by TAZ is shown graphically, however, when a report is generated, all internal and external trips, distance, and origin/destination are included in the trip tables used for estimating vehicle trip length. Figure 3 shows example of trip origins aggregated by county passing through the I-80 eastbound gateway.

Figure 1. SACSIM Gateway Zones Location Identification

May 2021

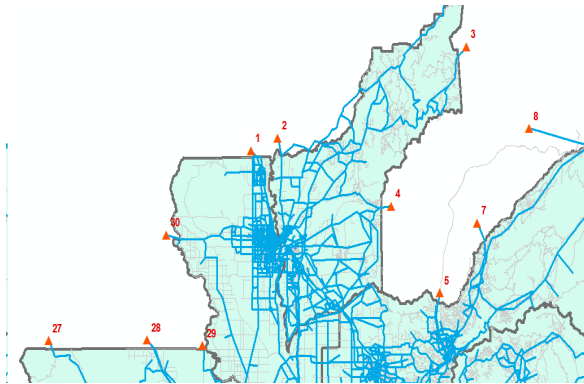


Figure 2. Replica Example Gateway Select Link Trip Distribution I-80 Westbound by Origin TAZs

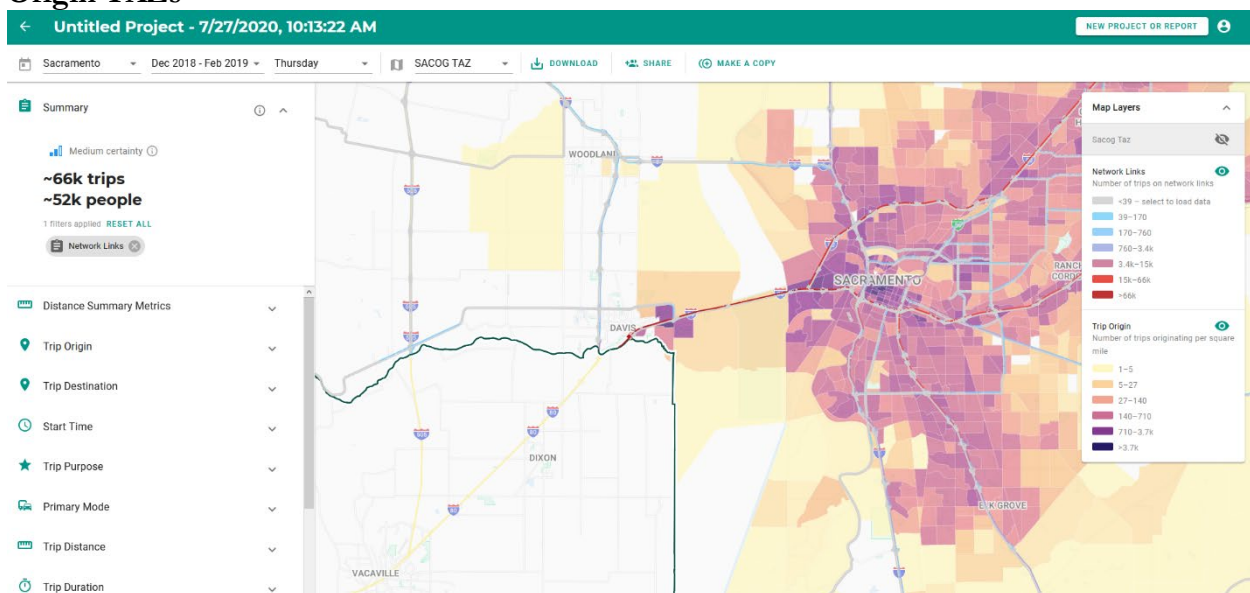


Figure 3. Replica Example Gateway Select Link Trip Distribution I-80 Eastbound by Origin Counties

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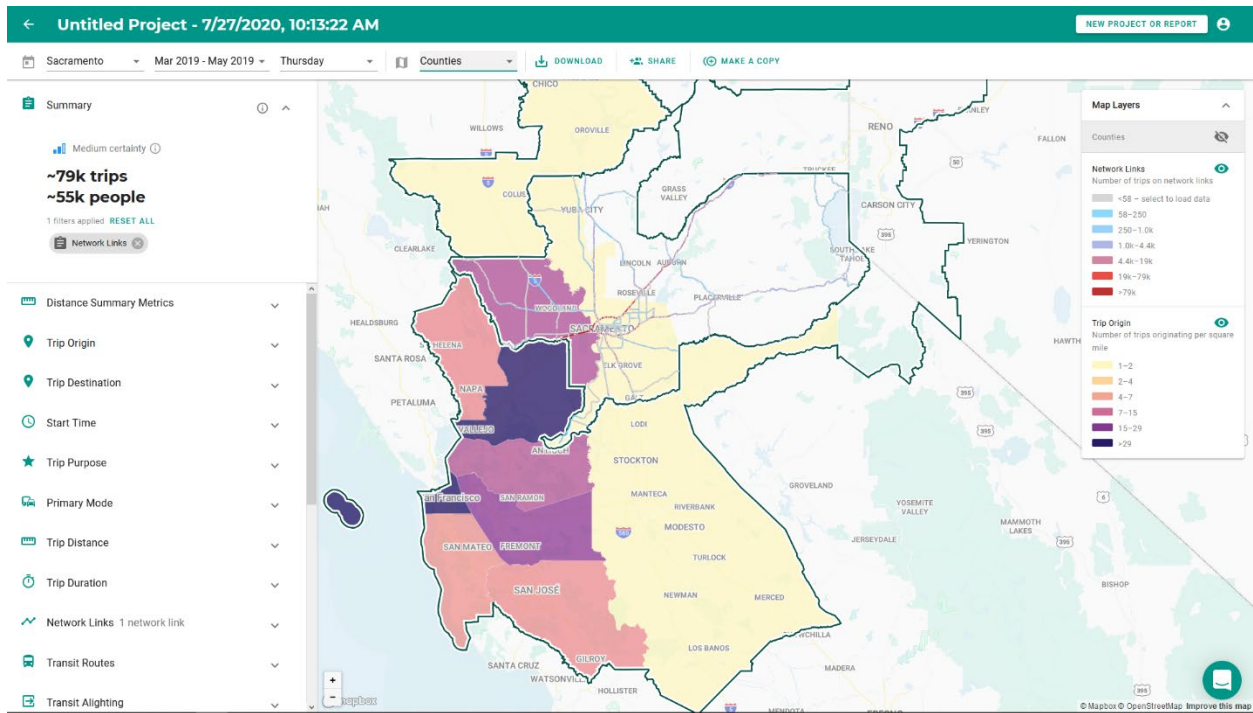


Figure 4. Replica Example Gateway Select Link Trip Distribution SR 70 Northbound near Yuba City

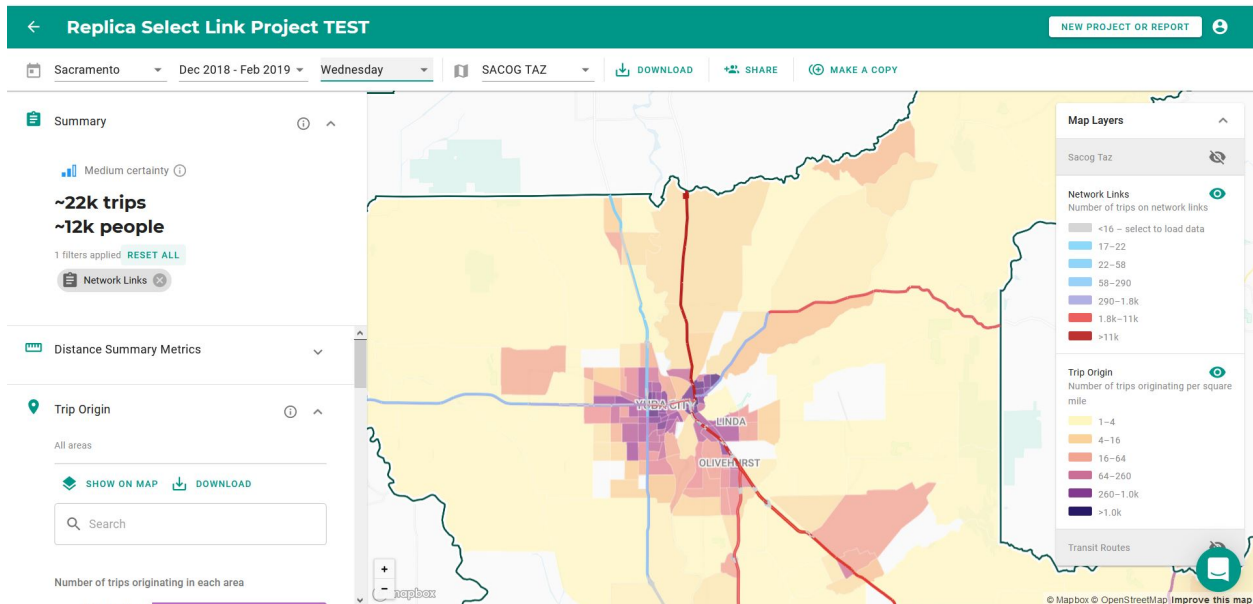
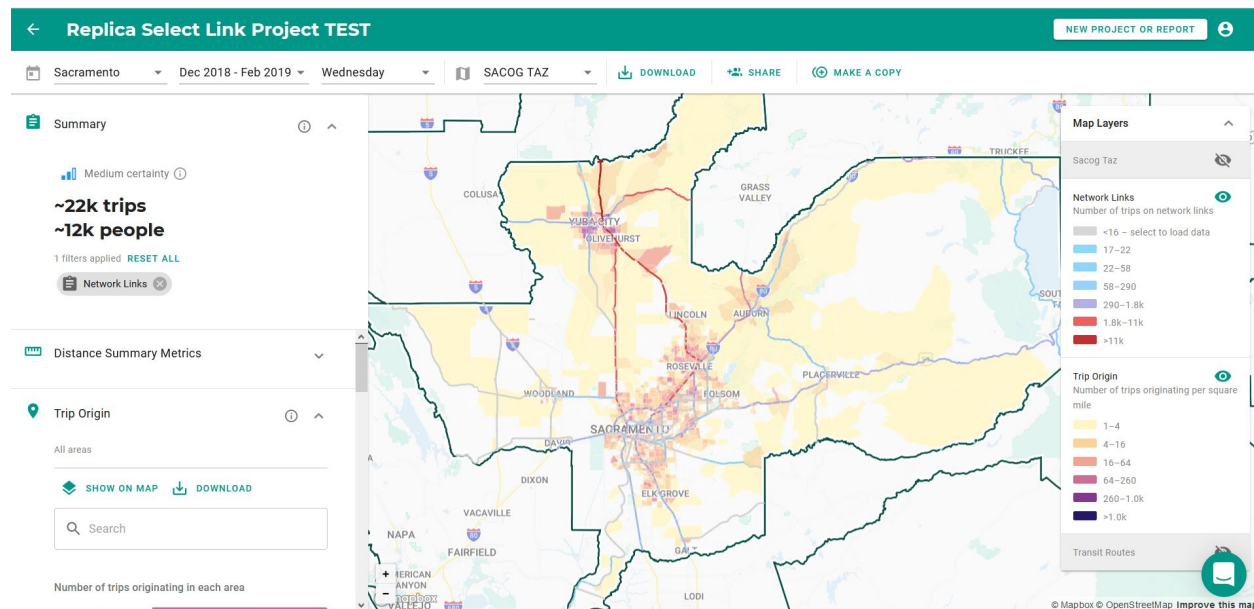


Figure 5. Replica Example SR 70 Gateway Select Link Trip Distribution SR 70 Northbound Regionally



After all gateway trips tables are identified, the individual trip tables are processed to include the Replica generated trip table including trip SACOG TAZ Origin, Destination, mode of travel, purpose of travel, and total trip Distance (internal and external distance) in miles for each individual trip record. These tables are then combined into a master table for processing simplicity and prepared to attach the SACSIM distance skims by associating the SACOG TAZ O-D pairs. Once the skims are attached, the SACSIM gateway-internal passenger vehicle trip distance is calculated from SACSIM vehicle trip distance for each trip O-D pair. Finally, the external distance outside the region is calculated by:

$$\text{External Distance Estimation} = \text{Replica Trip Distance} - \text{SACSIM Internal Trip Distance}$$

The trip table is then aggregated up by each gateway and each internal SACOG TAZ Origin for External-to-Internal (XI) and internal SACOG TAZ to gateway for Internal-External (IX) to calculate the average passenger vehicle trip distance outside SACOG by zone. *Outside SACOG VMT Estimation Steps* spreadsheet shows Step 2 Tables shows the SACOG Gateways XI and IX average vehicle trips distances by Gateway and by each internal SACOG TAZ.

Step 3 Estimate VMT for Travel Outside SACOG Region by Internal TAZ

To calculate the total VMT outside the region and distribution associated with each internal SACOG TAZ, the total outside the region to internal TAZ IX and XI vehicle trips from SACSIM (Step 1) are multiplied by the estimate average vehicle trip distance outside the region (Step 2). In a few locations, the outside the region trip distance was unknown because Replica did not have any trip going outside the region. For these locations, if SACSIM passenger vehicles trips to or from the gateways exist, the opposite trip direction (internal to external versus external to internal trip) average passenger vehicle trip distance was used. If there was no distance estimation for either direction for the zone, the regional average IX or XI trip distance is used for to estimate the VMT calculation. Alternatively, an adjacent known gateway average distance outside the region could be used for the VMT

estimation. *Outside SACOG VMT Estimation Steps* spreadsheet Step 3 Table shows the VMT outside of SACOG region by internal TAZ.

Step 4 Distribution of Outside VMT by Gateway

The total outside the region VMT can be calculated by adding up the results of Step 3 VMT by internal zone. The gateway outside VMT can then be calculated by using the existing SACSIM gateway VMT distribution and proportionally applying the outside the region total VMT per gateway. *Outside-SACOG VMT Estimation* spreadsheet Step 1 shows SACSIM truncated gateway VMT and Step 4 Table shows the VMT outside of the SACOG region by gateway.

Step 5 Calculate Total IXXI VMT by TAZ

To recalculate the full adjusted IXXI VMT by TAZ, the initial SACSIM internal portion of the IX and XI VMT need to be combined with the external portion calculated in Steps 3 and 4 by zone. In other words, the full VMT for external to internal travel is the sum of the IX_VMT_I from (Step 1) and the external to internal outside the region VMT calculated in step 4, and the full VMT for internal to external travel is the sum of the IX_VMT_J and the internal-to-external outside the region VMT calculated in step 4. *Outside SACOG VMT Estimation Steps* spreadsheet shows Step 5 Tables shows the total IXXI VMT estimation by Gateway and internal SACOG TAZ.

Residential VMT

After the revised IXXI total VMT has been recalculated to include external portion of trips (Step 5), residential IXXI VMT by TAZ can be recalculated using the following equation:

$$IX_VMT_RES = (IX_VMT_I + IX_VMT_J) * (HHS / (1 + HHS + 1.1 * (EMPTOT - FOOD - RET - 0.25 * SVC)))$$

Table 3 shows the descriptions and variables used in the equation. This is also in the outputs of the script *saccsim19_ixxi_cveh_taz.s* used previously to generate the IX vehicle trips and VMT.

Table 3 - IXXI VMT and other variables by TAZ

Variable	Description	Values
I	Traffic Analysis Zone (TAZ)	Gateway zones = 1-30, internal zones = 31-1533
IX_VT_I	Vehicle trips originating at zone I	
IX_VT_J	Vehicle trips ending at zone I	
IX_VHT_I	Vehicle Hours originating at zone I	
IX_VHT_J	Vehicle Hours ending at zone I	
IX_VMT_I	VMT originating at zone I	
IX_VMT_J	VMT ending at zone I	
IX_CVMT_I	Commercial VMT originating at zone I	
IX_CVMT_J	Commercial VMT ending at zone I	

HHS	Households in zone I	
EMPTOT	Jobs in zone I	
FOOD	Jobs in Food sector in zone I	
RET	Retail jobs in zone I	
SVC	Service Jobs in zone I	
IX_VMT_RES (internal-external VMT made by SACOG residents)	$= (IX_VMT_I + IX_VMT_J) * (HHS / (1 + HHS + 1.1 * (EMPTOT - FOOD - RET - 0.25 * SVC)))$	
SACOG 2020		

Full residential VMT including internal-internal (II) travel can be calculated by adding the IX_VMT_RES by TAZ to the residential II VMT. See SACSIM [VMT Computation Procedures](#) to calculate II VMT.

Work Tour VMT

In OPR guidelines, worker travel is often associated with office projects VMT, where the employment-generating projects inside the region generate VMT outside the region by workers residing outside the region. SACSIM can identify and capture VMT from external workers who work within the SACOG region that occurs within the SACOG region, but cannot predict their initial origins outside the region or full length of these trips. SACSIM does estimate the number of jobs taken by external workers within each TAZ. For this reason, in past iterations of Work VMT, external worker VMT has been removed completely to create SACOG Work VMT and VMT per Job by TAZ by removing the portion of jobs taken by outside workers.

To estimate external workers total VMT, methodology can build off the IXXI VMT steps above and are outlined in steps 6 through 11 in the *Outside SACOG VMT Estimation Steps* spreadsheet.

Step 6. Using SACSIM IXXI trip table, determine the number of jobs taken by external workers per TAZ by the xi-external worker rate multiplied by the number of jobs. Calculate number of vehicle trips taken by external works by the following equation:

$$VT_ExWkr = ExWkr * 1.7 * (0.89 + 0.11 / 2.34)$$

Where:

VT_ExWkr - number of vehicle trips by external workers

ExWkr = number of external workers

Constants:

1.7 – Person to Vehicle Trip Factor

0.89 – drive alone trip mode share

0.11 – shared ride trip mode share

2.34- shared ride vehicle occupancy factor

Step 7. Split external vehicle trips by XI and IX.

Step 8. Calculate internal worker VMT by TAZ. Replica gateway trip tables, which account for all trips made by persons both inside and outside SACOG region by purpose and mode, can be used to estimate trip length outside the region by TAZ and at gateways as described in Step 2 above. From this vehicle trip proportion, internal (travel inside the SACOG region) portion of external worker's VMT can be calculated by multiplying this portion of vehicle trips by the total proportion of the total VMT (by I and J respectively) by TAZ.

Step 9. Calculate external VMT taken by external workers. By the external workers portion of IXXI vehicle trips by zone, calculated in Step 1, multiplied by the external trip length outside the region calculated from the Replica trip tables.

Step 10. Add external workers' external and internal VMT together for total external worker travel

Step 11. Calculate total Worker VMT per Job. Add IXXI worker VMT to SACOG Work VMT (II) for total worker VMT. Use total employment by TAZ from SACSIM as the numerator, including jobs take by external workers, calculate total Worker VMT per Job by total worker VMT divided by the total SACSIM employment by TAZ.

Results and Checking for Reasonableness

Table 4 and 5 show the residential VMT per capita percent change by county once the IXXI VMT adjustment process has been applied and residential VMT recomputed with external travel. Table 4 shows VMT outside the region using Replica Spring seasonal trips and Table 5 shows Winter seasonal trips. The Seasonal change shows overall increasing trip lengths outside the region during the spring season. An average of these two seasons could be used to estimate average annual outside the region trip lengths.

Counties with population and job centers near the edge of the SACOG region such as Yolo County show the most increase in VMT as there was likely more trip truncation from the SACSIM gateways than areas more central to the SACSIM model.

Table 4. Spring Season Outside the Region Residential VMT per Capita Change by County

	Residential VMT per Capita		
County	Cut at Gateway	Including outside	% Change
El Dorado	29.24	30.83	5%
Placer	21.29	23.64	11%

Sacramento	15.91	18.53	16%
Sutter	14.58	17.14	18%
Yolo	17.79	25.12	41%
Yuba	23.04	24.92	8%
Region	17.91	20.82	16%

*Replica trip distances based on SACOG Replica model season: 2019 March through 2019 May.
SACOG 2020

Table 5. Winter Season Outside the Region Residential VMT per Capita Change by County

	Residential VMT per Capita		
County	Cut at Gateway	Including outside	% Change
El Dorado	29.24	30.42	4%
Placer	21.29	22.96	8%
Sacramento	15.91	17.97	13%
Sutter	14.58	16.60	14%
Yolo	17.79	22.59	27%
Yuba	23.04	24.49	6%
Region	17.91	20.08	12%

*Replica trip distances based on SACOG Replica model season: 2018 December through 2019 February.
SACOG 2020

Table 6 shows Worker VMT per Capita by County. The table shows a comparison of SACOG resident workers average trip length compared to non SACOG resident workers whom work in the region. As expected, non SACOG resident workers have a significantly longer average trip length. The average VMT per SACOG job when including external workers to just SACOG residents also increase by five percent region wide.

Table 6. Spring Season Worker VMT per Capita by County

	Worker VMT per Capita by County			
County	SACOG Resident Workers	Average External VMT by Non SACOG Resident Workers	Average VMT Per Job (Including External Workers)	% Change
El Dorado	26.05	93.93	26.78	3%

Placer	19.81	98.12	21.65	9%
Sacramento	17.26	120.45	19.62	14%
Sutter	15.45	65.13	16.95	10%
Yolo	18.63	108.54	30.56	64%
Yuba	21.55	78.81	23.40	9%
Region	18.19	110.70	21.30	17%

*Replica trip distances based on SACOG Replica model season: 2019 March through 2019 May.
SACOG 2021

Table 7 and 8 show the example SACSIM 2016 base year passenger vehicle trips, Replica Spring or seasonal estimated vehicle trip distance outside the region, and estimated scenario VMT outside the region at each gateway. The longest outside region vehicle trip distances estimation occurs outside the Yuba and Nevada county line along SR 49 west of Marysville Road. However, the largest VMT increase outside the region occurs along I-80 west of SR 505 West of the SACOG region towards the bay area due to the large number of total trips passing through this gateway. This corroborates with the land use surrounding these areas and traffic volumes observed at these gateways. Figure 6 shows the example VMT change by county before and after by percentage above or below the regional average for comparison.

Table 9 shows the average vehicle trip distance and VMT by Outside the region by Non SACOG resident external workers by gateway. Forty percent of external worker VMT uses the gateway between Yolo and Solano county along Interstate 80. This corridor serves as major commuter corridor for workers between SACOG region and the Bay Area. SR-99 between Sacramento County and San Joaquin county shares the second largest portion of external worker VMT at twelve percent external worker VMT.

Table 7. Spring Season Average Vehicle Trip Distance and VMT Outside SACOG Region by Gateway

ID	Gateway Description	Passenger Vehicle Trips from SACSIM Base Year (2016)	Average Vehicle Trip Distance Outside SACOG Region from Replica	Outside SACOG Region VMT
1	SR99N--Sutter/Butte CL	10,845	23.48	340,740
2	SR70N--Yuba/Butte CL	8,828	30.72	365,522
3	Marysville Rd--W.of SR49 Yuba/Nev CL	471	54.19	34,202
4	SR20NE--Yuba/Nevada CL	2,996	39.97	150,615
5	SR49NE--Placer/Nevada CL	20,807	13.63	668,919

6	I-80NE--E.of Yuba Gap	12,033	65.15	968,812
7	SR174NE--Placer/Nevada CL	3,327	9.57	160,008
8	SR20NE--Placer/Nevada CL	1,751	61.49	167,304
9	Omo Ranch Rd E--N. of SR88	961	23.63	67,411
10	US50E--E. of Ice House Rd	6,020	35.40	518,735
13	SR16+SR49E--Sacramento/Amador CL	7,289	42.34	309,542
15	SR99S--Sacramento/SJ CL	40,265	49.85	1,255,561
16	Lincoln Rd S--Sacramento/SJ CL	3,804	23.94	116,656
17	Franklin Rd S--Sacramento/SJ CL	629	22.58	26,075
18	I-5 S--Sacramento/SJ CL	28,394	61.36	1,104,944
19	SR160S--S of SR12 Contra Costa	6,214	51.90	327,472
20	CR95A--Yolo/Solano CL	314	5.20	10,823
21	CR104/Mace Blvd. SW--S.of CR32D/Mont	928	11.73	24,432
22	I-80 W--W. of I-505	114,446	45.04	4,874,359
23	SR128W--Yolo/Solano CL	1,384	27.67	81,613
24	Putah Creek Rd W--W. of Winters Rd	120	15.14	4,686
25	SR12SE--E. of SR160 SJ	1,852	39.72	111,844
26	SR12SW--E. of SR160 Solano	6,149	36.16	348,309
27	SR16N--Yolo/Colusa CL	312	39.78	22,654
28	I-5N--Yolo/Colusa CL	10,065	49.45	562,259
29	SR45--Sutter/Colusa CL	429	16.83	24,783
30	SR20NW--Sutter/Colusa CL	3,568	25.47	154,342
	Total	294,202	44.01	12,802,623

*Replica trip distances based on SACOG Replica model season: 2019 March through 2019 May.

May 2021

SACOG 2020

Table 8. Winter Season Average Vehicle Trip Distance and VMT Outside SACOG Region by Gateway

ID	Gateway Description	Passenger Vehicle Trips from SACSIM Base Year (2016)	Average Vehicle Trip Distance Outside SACOG Region from Replica*	Outside SACOG Region VMT
1	SR99N--Sutter/Butte CL	10,845	20.94	251,326
2	SR70N--Yuba/Butte CL	8,828	28.35	269,603
3	Marysville Rd--W.of SR49 Yuba/Nev CL	471	64.40	25,227
4	SR20NE--Yuba/Nevada CL	2,996	33.16	111,091
5	SR49NE--Placer/Nevada CL	20,807	14.38	493,381
6	I-80NE--E.of Yuba Gap	12,033	55.41	714,585
7	SR174NE--Placer/Nevada CL	3,327	6.46	118,019
8	SR20NE--Placer/Nevada CL	1,751	51.50	123,401
9	Omo Ranch Rd E--N. of SR88	961	21.07	49,722
10	US50E--E. of Ice House Rd	6,020	35.90	382,610
13	SR16+SR49E--Sacramento/Amador CL	7,289	24.38	228,314
15	SR99S--Sacramento/SJ CL	40,265	40.17	926,081
16	Lincoln Rd S--Sacramento/SJ CL	3,804	23.35	86,039
17	Franklin Rd S--Sacramento/SJ CL	629	7.32	19,233
18	I-5 S--Sacramento/SJ CL	28,394	45.67	814,989
19	SR160S--S of SR12 Contra Costa	6,214	46.72	241,541
20	CR95A--Yolo/Solano CL	314	4.84	7,983
21	CR104/Mace Blvd. SW--S.of CR32D/Mont	928	26.19	18,021

22	I-80 W--W. of I-505	114,446	28.39	3,595,248
23	SR128W--Yolo/Solano CL	1,384	26.98	60,197
24	Putah Creek Rd W--W. of Winters Rd	120	11.09	3,457
25	SR12SE--E. of SR160 SJ	1,852	35.07	82,494
26	SR12SW--E. of SR160 Solano	6,149	24.01	256,907
27	SR16N--Yolo/Colusa CL	312	34.86	16,709
28	I-5N--Yolo/Colusa CL	10,065	25.68	414,714
29	SR45--Sutter/Colusa CL	429	13.64	18,280
30	SR20NW--Sutter/Colusa CL	3,568	13.14	113,840
	Total	294,202	33.24	9,443,010

*Replica trip distances based on SACOG Replica model season: 2018 December through 2019 February.
SACOG 2020

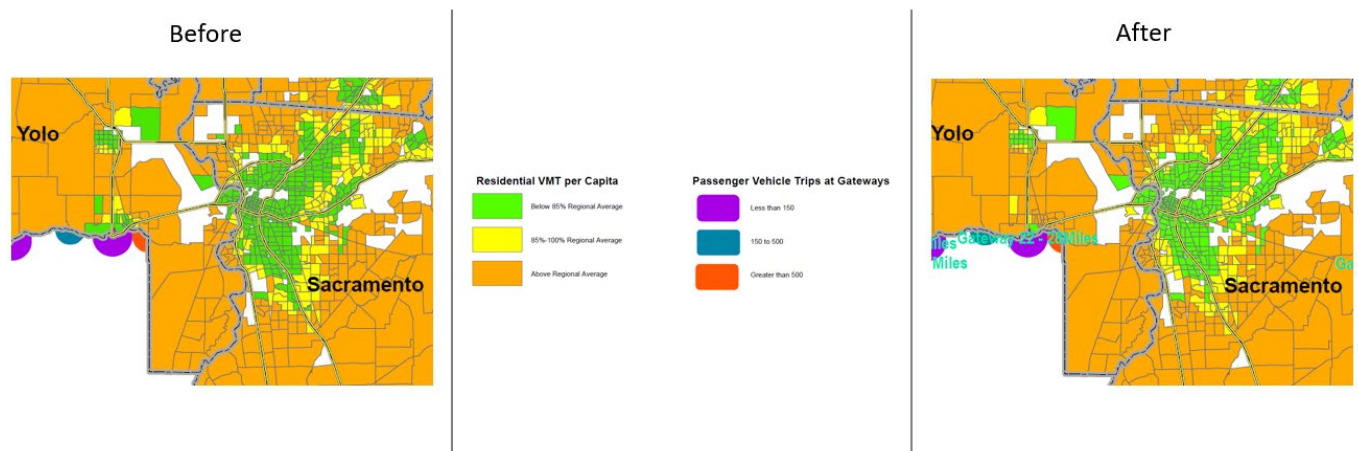
Table 9. Non SACOG Resident Worker VMT Outside SACOG Region by Gateway

ID	Gateway Description	Average External VMT by Non SACOG Resident Workers
1	SR99N--Sutter/Butte CL	33,188
2	SR70N--Yuba/Butte CL	35,443
3	Marysville Rd--W.of SR49 Yuba/Nev CL	3,327
4	SR20NE--Yuba/Nevada CL	15,245
5	SR49NE--Placer/Nevada CL	47,822
6	I-80NE--E.of Yuba Gap	99,157
7	SR174NE--Placer/Nevada CL	8,552
8	SR20NE--Placer/Nevada CL	14,903
9	Omo Ranch Rd E--N. of SR88	4,349
10	US50E--E. of Ice House Rd	36,533
13	SR16+SR49E--Sacramento/Amador CL	36,340
15	SR99S--Sacramento/SJ CL	207,949
16	Lincoln Rd S--Sacramento/SJ CL	11,675
17	Franklin Rd S--Sacramento/SJ CL	2,117
18	I-5 S--Sacramento/SJ CL	181,074
19	SR160S--S of SR12 Contra Costa	38,128

20	CR95A--Yolo/Solano CL	537
21	CR104/Mace Blvd. SW--S.of CR32D/Mont	1,788
22	I-80 W--W. of I-505	595,916
23	SR128W--Yolo/Solano CL	6,130
24	Putah Creek Rd W--W. of Winters Rd	321
25	SR12SE--E. of SR160 SJ	10,091
26	SR12SW--E. of SR160 Solano	30,883
27	SR16N--Yolo/Colusa CL	1,844
28	I-5N--Yolo/Colusa CL	60,976
29	SR45--Sutter/Colusa CL	1,508
30	SR20NW--Sutter/Colusa CL	13,071
	Total	1,498,867

*Replica trip distances based on SACOG Replica model season: 2019 March through 2019 May.
SACOG 2020

Figure 6. Example of Outside SACOG Region VMT Adjustment Comparison by TAZ and Gateway



Next Steps

Further Validation and Reasonable Checking

As mentioned above, other data sources are currently available to estimate different forms of travel outside of SACSIM boundaries, but all come with their own benefits and challenges. The California Statewide Travel Demand Model (CSTDm) maintained by Caltrans provides travel by purpose and mode. Origin Destination flows can be used to compare with Replica out of region residential trip flows. Gateway total vehicle volumes by mode can also be used to compare overall network volumes and gateway distributions. Further adjustments may be needed to compare CSTDm geography TAZs to SACOG and Replica TAZs as well as comparing difference in base scenario years.

Comparisons with the 2018 SACOG Household Travel Survey can also be used for reasonableness checking. The travel survey includes travel outside the region but only includes travel by SACOG residents.

American Community Survey (ACS) provides person commuter flow data by tract and county. This can also be used for reasonableness checking for the work VMT between counties. This data does not include other purposes or the same SACSIM TAZ geographies and will need to be further analyzed.

Project Screening Maps

To support local jurisdictions' SB 743 implementation efforts, SACOG has developed additional thresholds and screening maps for projects within the region. The additional maps will include residential VMT per Capita include IXXI estimated trip lengths outside the region, and Workers per Job include external workers. The maps will be revised based on the IXXI VMT adjustments described in this document.

Trip Length by purpose, mode, county distributions

Future analysis is needed to determine external county flows to each SACOG Gateway. Similar, OD County to internal TAZ OD flows will also be helpful to further disaggregated estimated trip distances outside the region. In future versions of Replica trips tables, we hope to be able to attach the SACOG population to the trip tables to further determine trip lengths and parse out external worker trips to estimate external workers external trip lengths separately by mode and trip purpose.