Appendix B

GHG Emissions Inventory Methodology

Memo

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Date: November 21, 2025

To: Adam Gufarotti, Carlos Serna, Damaris Abraham, Bailey MacLean (City of Lake Elsinore)

From: Andrew Beecher, Natalie Kataoka, Poonam Boparai

Subject: Final Greenhouse Gas Emissions Inventory Memorandum for the City of Lake Elsinore Climate Action and Adaptation Plan

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INTRODUCTION

The City of Lake Elsinore (City) is currently in the process of developing its Climate Action and Adaptation Plan (CAAP) to provide a programmatic framework to reduce its greenhouse gas (GHG) emissions and adapt to the impacts of climate change. The first step in the City's climate action planning process is to develop a GHG emissions inventory, which is a snapshot of the GHG emissions associated with its jurisdiction in a given year. The purpose of an emissions inventory is to:

- establish a baseline against which future emissions levels and future reduction targets can be measured,
- understand the sources of GHG emissions, and
- monitor progress toward achievement of GHG reduction targets.

This memorandum (memo) summarizes the results of the City's GHG emissions inventory and includes a detailed description of the data and methods used to develop the inventory. It consists of two sections.

- **Section 1: Greenhouse Gas Emissions Inventory Summary** summarizes the analytical approach used to develop the City's 2022 community GHG emissions inventory and provides total emissions results by sector.
- **Section 2: Emissions Calculation by Sector** provides details on the calculation of each sector's emissions, including data on emissions-causing *activity* (i.e., the drivers of emissions, such as the quantity of therms of natural gas used in homes and businesses) and *emissions factors* (i.e., the amount of emissions per unit of activity, such as metric tons of carbon dioxide equivalent [$MTCO_2e$] per therm of natural gas used). Activity data and emissions factors are multiplied to calculate total emissions.

1 GREENHOUSE GAS EMISSIONS INVENTORY SUMMARY

Lake Elsinore's emissions inventory is a "production-based" inventory, which estimates GHG emissions caused by activities occurring within a defined boundary during a single year. This method accounts for emissions that are *caused* by activity within the boundary, even if the emissions themselves may physically occur outside the boundary. For example, if a natural gas–fired power plant generates a kilowatt-hour to serve electricity demand in the Lake Elsinore, the emissions associated with that kilowatt-hour would be attributed to the city, regardless of where the power plant is physically located.

The CAAP is being developed within the context of the City's General Plan Update (GPU) and its associated Draft Environmental Impact Report (DEIR), which considers the environmental effects of growth within the Lake Elsinore city limits and its Sphere of Influence (SOI). As such, the GHG emissions analysis for the CAAP, including the GHG emissions inventory, was prepared to maintain consistency with the boundary of the GPU and includes estimates of GHG emissions for both the city limits and SOI. The GHG emissions estimates for the city limits are based on available data on emissions generating activities within the City of Lake Elsinore boundary, including energy use, vehicle travel, off-road vehicle fuel use, water consumption, waste generation, and wastewater generation. Data on vehicle travel was available for the SOI, however since these areas are not within the city limits, other data on emissions generating activity were not available and were estimated based on the existing population and employment data. This memorandum presents the results of emissions for both the city limits and SOI, separately and combined, so that the City can effectively track GHG emissions over time as areas of the SOI may be annexed into the city limits.

The Lake Elsinore inventory includes six sectors of emissions:

- **Building energy** includes electricity and natural gas usage in residential and nonresidential buildings, as well as gasoline and diesel fuel usage in backup generators.
- **On-road transportation** includes emissions from vehicles that generally travel over roads, such as passenger cars, trucks, and buses. Activity for this sector is measured in terms of vehicle miles traveled (VMT).
- **Off-road equipment** includes emissions from equipment that generally does not travel on roads, such as construction equipment, waterborne vessels, and lawn and garden equipment.
- **Solid waste** includes methane emissions from landfilled solid waste.
- **Water** includes emissions from electricity used for pumping, conveying, treating, and distributing water in the city.
- **Wastewater** includes methane and nitrous oxide emissions from the treatment of wastewater generated in the city, as well as methane emissions from septic tanks.

This inventory does not include emissions from agriculture, though there has historically been a nominal amount of land designated for agricultural use in the city (less than 1 percent of total land use acreage in the city was considered agricultural in 2005 [City of Lake Elsinore 2011: 2]–more recent data is not available). The City does not currently have agricultural designated areas and does not plan to include any in the future General Plan Update or SOI (Serna, pers. comm., 2024). Therefore, it was assumed that there is not a significant amount of agriculture-driven emissions in the city limits or SOI.

Table 1 and Figure 1 below present emissions results by sector for calendar year 2022, for the Lake Elsinore city limits and SOI. The year 2022 was selected as the inventory year because it is the most recent year with complete data available. It also excludes data anomalies that arose due to the COVID-19 pandemic (such as reduced transportation emissions from increased telecommuting in 2020 and 2021). Results are presented in units of metric tons of carbon dioxide equivalent ($MTCO_2e$), which includes the global warming effects of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These gases are assumed to have 100-year global warming potentials (GWPs) of 1, 27, and 273, respectively, from the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment (Greenhouse Gas

Protocol 2024). GWP is a measure of "radiative forcing," or the amount of heat a GHG absorbs over a given timeframe relative to CO_2. For example, over a 100-year period, one molecule of CH_4 has 27 times the ability to absorb heat as a molecule of CO_2 and thus is counted as equivalent to the emission of 27 molecules of CO_2.

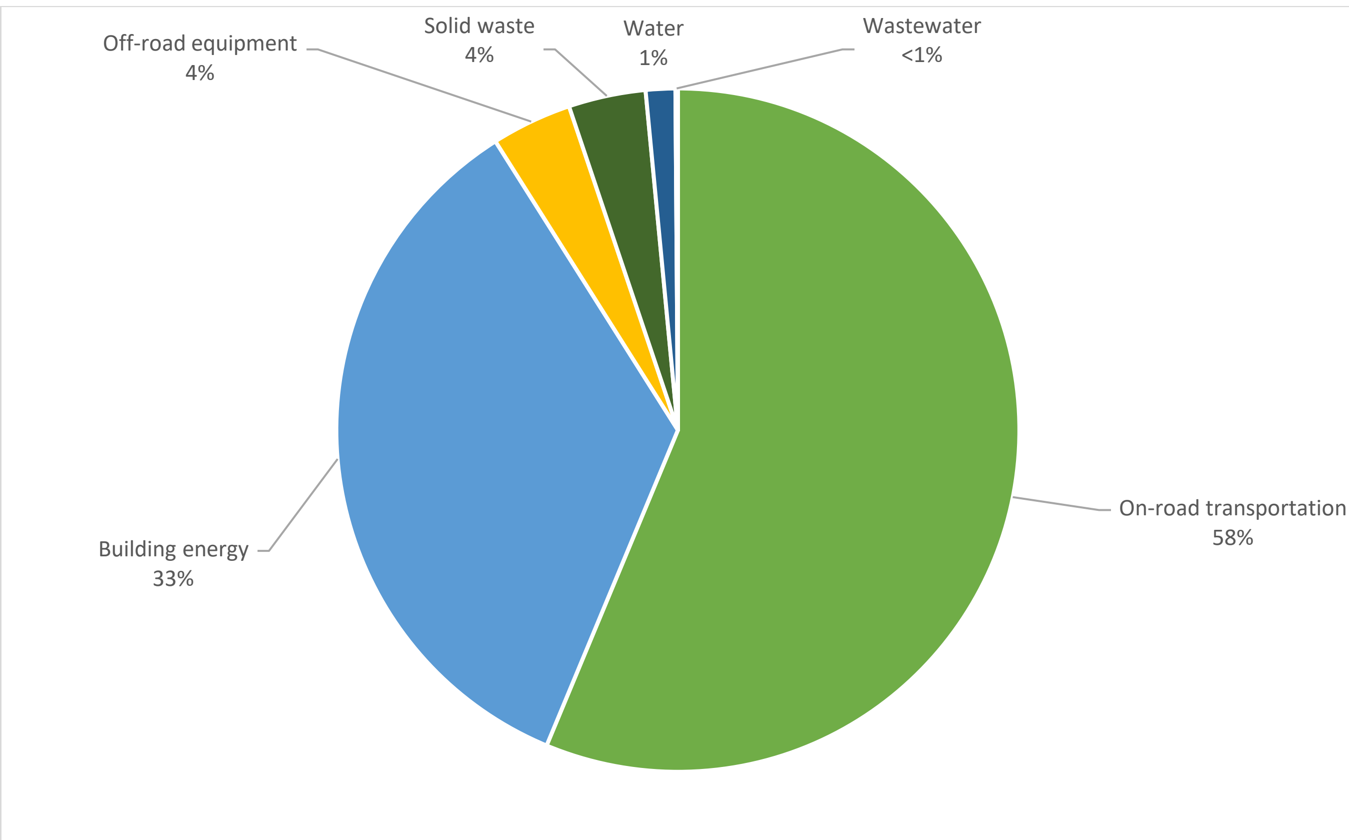
Table 1 2022 Community GHG Emissions Inventory Results ($MTCO_2e$)

Sector	City Limits	SOI	City Limits + SOI	Percent of Total
On-road transportation	218,322	62,463	280,784	58%
Building energy	126,475	36,051	162,526	33%
Off-road equipment	14,843	4,413	18,995	4%
Solid waste	13,810	4,152	18,224	4%
Water	5,291	1,691	6,982	1%
Wastewater	362	125	487	<1%
Total	**379,103**	**108,894**	**487,998**	**100%**

Notes: GHG = greenhouse gases; $MTCO_2e$ = metric tons of carbon dioxide equivalent; SOI = sphere of influence.

Totals may not sum exactly due to rounding.

Data Source: Modeled by Ascent in 2025.



Note: Totals are rounded to the nearest percent.

Data Source: Modeled by Ascent in 2025.

Figure 1 2022 Community GHG Emissions Inventory Results (City Limits + SOI)

2 EMISSIONS CALCULATION BY SECTOR

This section describes the details of each sector's emissions calculation, including the derivation of activity levels and emissions factors. Under each sector, the methods for estimating GHG emissions for both the city limits and SOI are provided separately. Generally, estimates of activity data and GHG emissions for the SOI are based on scaling of data applicable to the city limits based on demographic data including population, employment, or service population. The notable exception is the on-road transportation sector where modeled data was available for vehicle travel for both the city limits and SOI. The demographic data used for scaling are consistent with the expected growth in both the city limits and SOI between 2018 and 2045, as provided in Table 2, with values for 2022 interpolated between the years 2018 and 2025.

Table 2 Population, Employment, and Service Population for City Limits and Sphere of Influence

Demographic Factor	2018	2022	2025	2045
Lake Elsinore City Limits				
Population	58,684	64,915	69,588	113,240
Employment	14,067	15,863	17,210	30,617
Service Population	72,751	80,789	86,817	143,857
Lake Elsinore Sphere of Influence (SOI)				
Population	20,985	23,043	24,586	38,652
Employment	1,999	2,598	3,048	10,178
Service Population	22,984	25,818	27,943	48,830
Lake Elsinore City Limits + SOI				
Population	79,669	87,958	94,174	151,892
Employment	16,066	18,461	20,258	40,795
Service Population	95,735	106,607	114,760	192,687
Scaling Factor for Estimating SOI Activity from City Limits Activity[1]				
Population	0.3576	**0.3550**	0.3533	0.3413
Employment	0.1421	**0.1638**	0.1771	0.3324
Service Population	0.3159	**0.3196**	0.3219	0.3394

Notes: service population = population + employment. SOI = sphere of influence.

[1] Scaling factors for estimating SOI activity from city limits activity is the percentage of each demographic factor in the SOI as compared to the city limits. This factor is used in calculations where only city limits data are known, and SOI data is estimated based on population, employment, or service population. Only scaling factors for the year 2022 are used in calculations in the GHG inventory.

Data Source: Hermann, pers. comm., 2025a.

On-road transportation

City Limits and Sphere of Influence

Activity Data. Daily VMT output from the Riverside County Transportation Model (RIVCOM) was used to calculate emissions from on-road transportation. Daily VMT data was provided for four distinct trip types, listed below and converted to annual VMT assuming 353 travel days per year (Poss, pers. comm., 2024).

1) external-internal (the trip starts outside the boundaries of the city and ends inside the boundaries),
2) internal-external (the trip starts inside the boundaries of the city and ends outside the boundaries),
3) internal-internal (the trip both starts and ends inside the boundaries of the city), and

4) external-external (the trip both starts and ends outside the boundaries of the city).

To apportion VMT from the trips to Lake Elsinore, the VMT values for each of the trip types described above were assigned weights of 50, 50, 100, and 0 percent, respectively. This approach follows guidance from the Regional Targets Advisory Committee (RTAC). RTAC was formed by the California Air Resources Board (CARB) pursuant to SB 375 (Sustainable Communities and Climate Protection Act). SB 375 mandates that CARB work in consultation with the metropolitan planning organizations to set targets for vehicle emissions reductions, and that RTAC recommend methodologies for setting those targets. Details on the VMT estimates for the Lake Elsinore city limits are available in Attachment A, and VMT for the city limits and SOI combined are available in Attachment B.

Emissions Factors. Emissions factors (in grams of CO_2e per vehicle mile traveled, or gCO_2e per VMT) were calculated using VMT and fuel consumption data from CARB's EMissions FACtor 2025 (EMFAC2025) model (CARB 2025). EMFAC provides VMT and fuel consumption data for 54 different vehicle types, ranging from passenger cars to heavy trucks. These data were aggregated to the four vehicle categories in the RIVCOM model (Autos, Light Trucks, Medium Trucks, and Heavy Trucks) in order to calculate an emissions factor for each vehicle category. Table 3 below shows the results of this analysis.

Table 3 Calculation of 2022 On-Road Vehicle Emissions

RIVCOM Vehicle Category	RTAC VMT per Year	Vehicle Category Emissions Factor (gCO_2e/VMT)	Emissions ($MTCO_2e$)
City Limits			
Autos	502,686,120	377	189,699
Light Trucks	3,898,330	445	1,735
Medium Trucks	4,878,258	1,361	6,639
Heavy Trucks	11,292,773	1,793	20,249
City Limits Total	*522,755,481*	*NA*	*218,322*
Sphere of Influence (SOI)			
Autos	160,852,771	377	60,701
Light Trucks	1,106,705	445	302
Medium Trucks	1,230,558	1,361	548
Heavy Trucks	2,743,869	1,793	912
SOI Total	*165,933,903*	*NA*	*62,463*
City Limits + SOI			
Autos	663,538,891	377	250,400
Light Trucks	5,005,035	445	2,037
Medium Trucks	6,108,816	1,361	7,187
Heavy Trucks	14,036,642	1,793	21,161
City Limits + SOI Total	*688,689,384*	*NA*	*280,785*

Notes: g = grams; $MTCO_2e$ = metric tons of carbon dioxide equivalent; NA = not applicable; RIVCOM = Riverside County Transportation Model; RTAC = Regional Targets Advisory Committee; SOI = Sphere of Influence; VMT = vehicle miles traveled.

Totals may not sum exactly due to rounding.

Data Source: VMT analysis by Fehr and Peers in 2025 (see Attachment A and Attachment B). GHG emissions modeled by Ascent in 2025.

Building energy

City Limits

Activity Data. Electricity usage data for 2022 was provided by Southern California Edison (SCE) (Brenner, pers. comm., 2024); natural gas usage data by Southern California Gas Company (SoCalGas) (Mejia, pers. comm., 2024); and backup generator data by the South Coast Air Quality Management District (SCAQMD) (Trapp, pers. comm., 2024).

Emissions Factors. Emissions factors for electricity were sourced from SCE's 2022 Power Content Label (SCE 2022). Emissions factors for natural gas, diesel, and gasoline were sourced from the U.S. Environmental Protection Agency (EPA) (2024a). These emissions factors were applied to their respective fuels to calculate emissions, as shown in Table 4 below.

Table 4 Calculation of 2022 Building Energy Emissions — City Limits

Fuel Type	Sector	Sub-Sector	Total Activity	Activity Units	Pounds CO_2e Per Unit of Activity	Emissions ($MTCO_2e$)
Electricity	Nonresidential	NA	151,104	MWh	552.0	37,834
Electricity	Residential	NA	176,681	MWh	552.0	44,238
Natural gas	Nonresidential	Commercial	1,532,304	therms	11.7	8,139
Natural gas	Nonresidential	Industrial	8,447	therms	11.7	45
Natural gas	Residential	Single-family residential	5,904,990	therms	11.7	31,364
Natural gas	Residential	Multi-family residential	875,316	therms	11.7	4,649
Diesel	Nonresidential	Backup generation	23,123	gallons	22.6	237
Gasoline	Nonresidential	Backup generation	1,786	gallons	19.4	16
Subtotal: Residential Building Energy Emissions ($MTCO_2e$)						*80,251*
Subtotal: Nonresidential Building Energy Emissions ($MTCO_2e$)						*46,270*
Total Building Energy Emissions — City Limits ($MTCO_2e$)						**126,521**

Notes: g = grams; $MTCO_2e$ = metric tons of carbon dioxide equivalent; MWh = megawatt-hours; NA = not applicable.

Totals may not sum exactly due to rounding.

Data Source: Modeled by Ascent in 2025.

Table 4 does not include emissions from natural gas burning at Pacific Clay Products, even though this facility is located within the boundaries of the city. Pacific Clay Products is a brick manufacturer that uses natural gas to heat brickmaking kilns (Trapp, pers. comm., 2024). In 2022, natural gas consumption at Pacific Clay Products produced approximately 13,000 $MTCO_2e$ (emissions data for this facility is publicly available from CARB's Mandatory Reporting of Greenhouse Gas Emissions database [see CARB 2024a]).

Pacific Clay Products is excluded from this emissions inventory because it is regulated under the California Greenhouse Gas Cap-and-Trade Program (Cap-and-Trade). Cap-and-Trade establishes an aggregate GHG allowance budget for covered entities (generally facilities with high levels of GHG emissions, including Pacific Clay Products) and provides a trading mechanism for compliance instruments (allowance or offset credit). Facilities regulated under Cap-and-Trade may purchase allowances to emit GHG emissions from facilities that reduce GHG emissions (e.g., solar farms) or sell emission-offset credits to other facilities that need to reduce their emissions to meet CARB's industry-wide emissions cap. As a facility that is covered under the Cap-and-Trade program, the City does not have the regulatory authority to implement policies or programs that would affect the GHG emissions of Pacific Clay Products. Therefore, emissions associated with Pacific Clay Products are excluded from this inventory.

Sphere of Influence

Activity Data. Activity data for the SOI was estimated based on electricity, natural gas, and diesel fuel consumption activity estimates for the city limits, which was scaled to cover the SOI based on population and employment. Energy consumption for residential buildings was scaled based on population, and energy consumption from nonresidential buildings was scaled based on employment.

Emissions Factors. Emissions factors used for city limits GHG emissions calculations were also used for the SOI.

Tabe 5 provides an overview of the scaling factors used to estimate activity data for the SOI, resulting activity data for the SOI, and resulting emissions estimates for building energy in the SOI.

Table 5 Calculation of 2022 Building Energy Emissions — Sphere of Influence

Fuel Type	Sector	Sub-Sector	Scaling Factor	SOI Activity Estimate	Activity Units	Emissions ($MTCO_2e$)
Electricity	Nonresidential	NA	Employment	24,751	MWh	6,197
Electricity	Residential	NA	Population	62,716	MWh	15,703
Natural gas	Nonresidential	Commercial	Employment	250,998	therms	1,332
Natural gas	Nonresidential	Industrial	Employment	1,384	therms	7
Natural gas	Residential	Single-family residential	Population	2,096,084	therms	11,122
Natural gas	Residential	Multi-family residential	Population	310,709	therms	1,649
Diesel	Nonresidential	Backup generation	Employment	3,788	gallons	39
Gasoline	Nonresidential	Backup generation	Employment	293	gallons	3
Subtotal: Residential Building Energy Emissions ($MTCO_2e$)						*28,473*
Subtotal: Nonresidential Building Energy Emissions ($MTCO_2e$)						*7,578*
Total Building Energy Emissions — SOI ($MTCO_2e$)						**36,051**

Notes: g = grams; $MTCO_2e$ = metric tons of carbon dioxide equivalent; MWh = megawatt-hours; NA = not applicable; SOI = Sphere of Influence.

Totals may not sum exactly due to rounding.

Data Source: Modeled by Ascent in 2025.

Off-road Equipment

City Limits and Sphere of Influence

Activity Data. The CARB OFFROAD2021 model was used to obtain data on the quantity of fuel used by off-road equipment for the entire Riverside County (including all cities and unincorporated areas) for the relevant off-road equipment categories (CARB 2024b). These fuel quantities were then downscaled to the city limits and SOI only based on each equipment category's relevant scaling factor (employment, population, or service population [the sum of employment and population] expressed as a percentage of Riverside County). Employment data was sourced from the California Employment Development Department (2024) and population data from the California Department of Finance (2024).

Emissions Factors. Emissions factors for gasoline, diesel, and natural gas from The Climate Registry (2022) were applied to each equipment category's fuel usage, as appropriate. Table 6 below shows the results of this calculation.

Table 6 Calculation of 2022 Off-Road Equipment Emissions

			Gallons of Off-Road Fuel Used in Lake Elsinore			$kgCO_2e$/Gallon			
Off-Road Sector	County-to-city Scaler	Scaler Amount	Diesel	Gasoline	Natural Gas	Diesel	Gasoline	Natural Gas	Total Emissions ($MTCO_2e$)
City Limits									
Industrial	Employment	1.45%	8,409	21,467	48,875	10.38	9.274	6.819	620
Light commercial equipment	Employment	1.45%	8,051	92,516	6,671	10.38	9.274	6.819	987
Portable equipment	Employment	1.45%	265,913	0	0	10.24	NA	NA	2,724
Lawn and garden equipment	Population	2.67%	2,852	149,135	0	10.36	9.391	NA	1,430
Recreational equipment	Population	2.67%	0	36,608	0	NA	9.267	NA	339
Pleasure craft	Population	2.67%	0	63,895	0	NA	8.860	NA	566
Construction and mining	Service population	2.29%	632,860	10,169	0	10.39	9.261	NA	6,668
Transport refrigeration units	Service population	2.29%	147,321	0	0	10.24	NA	NA	1,509
City Limits Total	*NA*	*NA*	*1,065,406*	*373,791*	*55,546*	*NA*	*NA*	*NA*	*14,843*
SOI									
Industrial	Employment	0.24%	1,377	3,516	8,006	10.38	9.274	6.819	102
Light commercial equipment	Employment	0.24%	1,319	15,155	1,093	10.38	9.274	6.819	162
Portable equipment	Employment	0.24%	43,558	0	0	10.24	NA	NA	446
Lawn and garden equipment	Population	0.95%	1,013	52,938	0	10.36	9.391	NA	508
Recreational equipment	Population	0.95%	0	12,995	0	NA	9.267	NA	120
Pleasure craft	Population	0.95%	0	22,681	0	NA	8.860	NA	201
Construction and mining	Service population	0.73%	202,243	3,250	0	10.39	9.261	NA	2,131
Transport refrigeration units	Service population	0.73%	47,079	0	0	10.24	NA	NA	482
SOI Total	*NA*	*NA*	*296,589*	*110,534*	*9,099*	*NA*	*NA*	*NA*	*4,152*
City Limits + SOI Total	*NA*	*NA*	*1,361,995*	*484,325*	*64,644*	*NA*	*NA*	*NA*	*18,995*

Notes: CO_2e = kilograms of carbon dioxide equivalent; kg = kilograms; MT = metric tons; NA = not applicable; SOI = Sphere of Influence.

Totals may not sum exactly due to rounding.

Data Source: Modeled by Ascent in 2025.

Solid waste

City Limits

Activity Data. Disposal tonnage data for the city was obtained from CalRecycle (2024). These data contain total short tons of solid waste sent to landfills, by destination landfill. These data were then matched with the EPA's Landfill Methane Outreach Program (LMOP) database (EPA 2024b) to determine, for each landfill, whether the methane gas emitted by decomposing solid waste was captured (capturing and flaring landfill gas reduces emissions by preventing the release of fugitive methane). According to LMOP, all of the city's destination landfills use methane flaring.

Emissions Factors. These data were then input into International Council for Local Environmental Initiatives (ICLEI) Equation SW.4.1., which estimates methane emissions based on tonnage of landfilled waste (ICLEI 2019). Table 7 below shows the results of this analysis.

Table 7 Calculation of 2022 Solid Waste Emissions — City Limits

Landfill	Short Tons of Waste Sent to Landfill	Emission Factor ($MTCH_4$ per Short Ton)	Emissions ($MTCH_4$)	Emissions ($MTCO_2e$)
El Sobrante Landfill	54,464	0.0081	439.8	11,874
Badlands Landfill	6,104	0.0081	49.3	1,331
Prima Deshecha Sanitary Landfill	1,994	0.0081	16.1	435
Frank R. Bowerman Sanitary LF	508	0.0081	4.1	111
Olinda Alpha Sanitary Landfill	100	0.0081	0.8	22
Lamb Canyon Landfill	69	0.0081	0.6	15
County of San Bernardino Solid Waste Management Division	50	0.0081	0.4	11
Chiquita Canyon, Inc.	47	0.0081	0.4	10
Azusa Land Reclamation, Inc.	11	0.0081	0.1	2
City Limits Total	**63,347**	**NA**	**511.5**	**13,810**

Notes: $MTCH_4$ = metric tons of methane; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Totals may not sum exactly due to rounding.

Data Source: Modeled by Ascent in 2024.

Sphere of Influence

Activity Data. Activity data for the SOI was estimated based on the tonnage of landfilled waste for the city limits, which was scaled to cover the SOI based on service population.

Emissions Factors. Emissions factors used for city limits GHG emissions calculations were also used for the SOI.

Tabe 8 provides an overview of the scaling factors used to estimate activity data for the SOI, resulting activity data for the SOI, and resulting emissions estimates for solid waste disposal in the SOI.

Table 8 Calculation of 2022 Solid Waste Emissions — Sphere of Influence

Landfill	Scaling Factor	SOI Short Tons of Waste Sent to Landfill Estimate	Emissions ($MTCH_4$)	Emissions ($MTCO_2e$)
El Sobrante Landfill	Service Population	17,405	141	3,795
Badlands Landfill	Service Population	1,951	16	425
Prima Deshecha Sanitary Landfill	Service Population	637	5.1	139
Frank R. Bowerman Sanitary LF	Service Population	162	1.3	35
Olinda Alpha Sanitary Landfill	Service Population	32	0.3	7
Lamb Canyon Landfill	Service Population	22	0.2	5
County of San Bernardino Solid Waste Management Division	Service Population	16	0.1	3
Chiquita Canyon, Inc.	Service Population	15	0.1	3
Azusa Land Reclamation, Inc.	Service Population	3	0.03	1
SOI Total	**NA**	**20,244**	**163**	**4,413**

Notes: $MTCH_4$ = metric tons of methane; $MTCO_2e$ = metric tons of carbon dioxide equivalent; SOI = Sphere of Influence.

Totals may not sum exactly due to rounding.

Data Source: Modeled by Ascent in 2025.

Water

City Limits

Activity Data. Emissions from water usage in the city limits are a result of the electricity used to pump, treat, and deliver water to end users. Data on total water usage within the city limits for the year 2022 was obtained from Elsinore Valley Municipal Water District (EVMWD) (Zaleski, pers. comm, 2024a). For the purposes of calculating emissions, this water usage was divided into four categories:

1) groundwater,
2) surface water from Canyon Lake,
3) imported water from the State Water Project (SWP), and
4) imported water from the Colorado River Aqueduct (CRA).

The proportion of the city's water supply from each of the four categories was estimated based on information from EVMWD (2024a) and Western Municipal Water District (2023: 6), which is the supplemental water supplier for EVMWD. Once the quantity of water usage was calculated, the energy required to deliver this water to the city limits was calculated (in terms of kilowatt-hours (kWh) per acre-foot of water). There are four distinct components of energy usage:

1) extraction (pumping groundwater to the surface using wells);
2) conveyance (transport of untreated water from source to treatment facility, via aqueducts, pipelines, or canals over long distances);
3) treatment (making the water potable), assumed to occur at the Canyon Lake Water Treatment Plant (located outside the boundaries of the city [EVMWD 2016: 13]); and
4) distribution (transporting the treated water from the Canyon Lake Water Treatment Plant to the end user).

Data on the energy intensity of these four categories (in kWh per acre-foot of water) was derived from the Next10 report *The Future of California's Water-Energy-Climate Nexus* (Next10 2021: 12 and 18).

Emissions Factors. SCE electricity emissions factors were applied to electricity associated with groundwater and local deliveries, as pumps used to deliver groundwater and Canyon Lake surface water were assumed to be powered by electricity from SCE. It is not known which utilities provided power to deliver imported water (both SWP and CRA), so an aggregated emissions factor for the entirety of California was used for these sources (eGRID 2024).

Table 9 shows the results of this calculation.

Table 9 Calculation of 2022 Water Emissions — City Limits

Water Source	Acre-Feet per Year	Electric Utility	Electric Emissions Factor ($MTCO_2e/MWh$)	Extraction Energy Intensity (kWh/AF)	Conveyance Energy Intensity (kWh/AF)	Treatment Energy Intensity (kWh/AF)	Distribution Energy Intensity (kWh/AF)	Total Electricity Usage (MWh)	Total Emissions ($MTCO_2e$)
Groundwater	2,089	SCE	0.2512	146[1]	NA[2]	227	501	1,827	457
Local deliveries (Canyon Lake Surface Water)	836	SCE	0.2512	NA[2]	128	227	501	715	179
Imported (SWP)	4,346	CAMX	0.2269	NA[2]	3,280	227	501	17,419	3,952
Imported (CRA)	1,087	CAMX	0.2269	NA[2]	2,115	227	501	3,089	701
City Limits Total	**8,358**	**NA**	**NA**	NA	**NA**	**NA**	**NA**	**23,050**	**5,281**

Notes: AF = Acre-feet; CRA = Colorado River Aqueduct; CAMX = Western Electric Coordination Council's California subregion; kWh = kilowatt-hour; MWh = megawatt-hour; $MTCO_2e$ = metric tons of carbon dioxide equivalent; NA = not applicable; SWP = State Water Project.

1 Extraction energy intensity for groundwater was prorated to 23 percent of its initial value—this represents energy usage from wells that are located in the city of Wildomar, outside the boundaries of the city of Lake Elsinore (based on well location data from Zaleski, pers. comm, 2024b). The other 77 percent of energy usage is due to pumping from wells located in the boundaries of the city of Lake Elsinore—these are already included in the building energy sector and are thus not included in the water sector to prevent double counting.

2 A value of "NA" here indicates that this stage in the water delivery process does not occur in significant quantities for that water source. Groundwater is generally extracted close to where it is used and does not require transport over long distances. Canyon Lake water and imported water do not require extraction from the ground using wells.

Totals may not sum exactly due to rounding.

Data Source: Modeled by Ascent in 2025.

Sphere of Influence

Activity Data. Activity data for the SOI was estimated based on the water usage for the city limits, which was scaled to cover the SOI based on service population. Electricity consumption from the various water supply categories and components were calculated for the SOI using the same factors as used for the city limits calculations.

Emissions Factors. Emissions factors used for city limits GHG emissions calculations were also used for the SOI.

Tabe 10 provides an overview of the scaling factors used to estimate activity data for the SOI, resulting activity data for the SOI, and resulting emissions estimates for water usage in the SOI.

Table 10 Calculation of 2022 Water Emissions — Sphere of Influence

Water Source	Electric Utility	Scaling Factor	SOI Acre-Feet per Year Estimate	SOI Total Electricity Usage (MWh)	Total Emissions ($MTCO_2e$)
Groundwater	SCE	Service population	668	584	147
Local deliveries (Canyon Lake Surface Water)	SCE	Service population	267	229	57
Imported (SWP)	CAMX	Service population	1,389	5,567	1,263
Imported (CRA)	CAMX	Service population	347	987	224
SOI Total	**NA**	**NA**	**2,671**	**7,366**	**1,691**

Notes: AF = Acre-feet; CRA = Colorado River Aqueduct; CAMX = Western Electric Coordination Council's California subregion; MWh = megawatt-hour; $MTCO_2e$ = metric tons of carbon dioxide equivalent; NA = not applicable; SOI = Sphere of Influence; SWP = State Water Project.

Totals may not sum exactly due to rounding.

Data Source: Modeled by Ascent in 2025.

Wastewater

City Limits

Activity Data. EVMWD operates three wastewater reclamation facilities (WRFs): Regional WRF, Railroad Canyon WRF, and Horsethief Canyon WRF. These facilities serve the city of Lake Elsinore, as well as several other cities (including Wildomar, Murrieta, and Canyon Lake, as well as portions of unincorporated Riverside County). EVMWD provided data for these WRFs, including total population served, effluent nitrogen, and electricity usage (Zaleski, pers. comm, 2024c). It was assumed that 42 percent of the wastewater emissions from these WRFs would be apportioned to the Lake Elsinore city limits (Lake Elsinore contained approximately this amount of EVMWD population served in 2022 in the city limits, based on population data for the city of Lake Elsinore from the California Department of Finance [2024]), and that wastewater treatment utilized organisms that aerobically digest waste (EVMWD 2024b). In addition, residents' septic systems were counted as a driver of methane emissions, assuming 136 septic systems serving a population of 464 residents (based on septic system counts from the County of Riverside Department of Environmental Health [pers. comm., 2024] and persons per household data from the Environmental Systems Research Institute [2024]).

Emissions Factors. The wastewater activity data described above was used to calculate emissions, using methods from ICLEI (2019). ICLEI publishes a guidance document with equations for calculating emissions from wastewater treatment plants and septic tanks. Table 11 below shows how these equations were used to calculate wastewater emissions.

Table 11 Calculation of Wastewater Emissions — City Limits

Emissions Source	ICLEI Equation Used	Emissions Driver	Quantity of Emissions Driver in City of Lake Elsinore	Emissions ($MTCO_2e$)
Nitrous oxide emissions from WWTP with nitrification/denitrification	WW.7	Population served	64,915 people	155
Electricity usage at WWTP[1]	WW.15	kWh used at WWTP	482,235 kWh/year	109
Fugitive nitrous oxide emissions from effluent discharge	WW.12	Nitrogen load	63 kg N/day	44
Fugitive methane emissions from septic systems	WW.11 (Alt)[2]	Number of septic systems	136 septic systems	54
City Limits Total	**NA**	**NA**	**NA**	**362**

Notes: Alt = alternative method; ICLEI = International Council For Local Environmental Initiatives; kg = kilogram; kWh = kilowatt-hour; $MTCO_2e$ = metric tons of carbon dioxide equivalent; N = nitrogen; WW= wastewater; WWTP = wastewater treatment plant. Totals may not sum exactly due to rounding.

[1] Electricity consumed by the Regional Wastewater Reclamation Facility (Regional WRF) is already counted in the building energy sector because the Regional WRF is physically located in Lake Elsinore. Thus, it is not included in the wastewater sector to avoid double counting. However, Railroad Canyon WRF and Horsethief Canyon WRF are located outside the boundaries of the city of Lake Elsinore (in the cities of Lake City and Corona, respectively). The kWh/year value presented in this table includes only the electricity from these facilities that was used to serve customers in the city of Lake Elsinore.

[2] "Alt," or alternative method, refers to an ICLEI equation that is used to estimate emissions when certain data is not available. In this case, WW.11 (alt) is used because biological oxygen demand by the microorganisms in the septic tank is not available. Only the population served by septic systems is available.

Data Source: Modeled by Ascent in 2025.

Sphere of Influence

GHG emissions for wastewater treatment in the SOI are estimated by scaling the GHG emissions from each wastewater emissions source by population. Since wastewater calculations are primarily population based, and the sewer service providers and wastewater treatment facilities are the same in the SOI as the city limits, activity data and emissions factors for wastewater are not necessary to differentiate for the SOI.

Tabe 12 provides an overview of the scaling factors used to estimate GHG emissions for wastewater treatment, and resulting GHG emissions for the SOI.

Table 12 Calculation of Wastewater Emissions — Sphere of Influence

Emissions Source	Scaling Factor	Emissions ($MTCO_2e$)
Nitrous oxide emissions from WWTP with nitrification/denitrification	Population	55
Electricity usage at WWTP	Population	35
Fugitive nitrous oxide emissions from effluent discharge	Population	16
Fugitive methane emissions from septic systems	Population	19
SOI Total	**NA**	**125**

Notes: $MTCO_2e$ = metric tons of carbon dioxide equivalent; SOI = sphere of influence; WWTP = wastewater treatment plant.

Totals may not sum exactly due to rounding.

Data Source: Modeled by Ascent in 2025.

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Attachment A

VMT Analysis for Lake Elsinore City Limits

Fehr & Peers

Memo

Date: October 17, 2025

To: Poonam Boparai, Ascent

From: Paul Herrmann, TE
Trevor Lien
Lorraine Liao

Subject: **Lake Elsinore Climate Action & Adaptation Plan (CAAP) Vehicle Miles Traveled (VMT) Methodology and Inventory Summary**

Fehr & Peers prepared an inventory of the Vehicle Miles Traveled (VMT) data for the City of Lake Elsinore in support of the Climate Action & Adaptation Plan (CAAP). The inventory utilizes VMT data from the travel demand forecasting model adopted by the County of Riverside, the Riverside County Model (RIVCOM). This memorandum presents a summary of the data sources used to develop the inventory and details related to the modeling methods.

Background

VMT estimates for large urban areas and associated sub-areas are commonly developed using regional travel demand models. These models are developed and periodically updated, calibrated, and validated for use in long range infrastructure planning, environmental impact assessments, and air quality conformity analyses by local and regional agencies. Regional travel demand models output daily vehicle trips for each Traffic Analysis Zone (TAZ) across various trip purposes based on inputs such as the transportation network and socioeconomic data such as population, households, and employment.

The latest version of the RIVCOM model was used to estimate VMT for the City. This updated RIVCOM model is the most appropriate travel demand model for forecasting traffic volumes and VMT in the City as it reflects updated land use assumptions and is consistent with the latest City of Lake Elsinore 2045 general plan update and the 2020 Southern California Association of Governments Regional Transportation Plan and Sustainable Communities Strategy (SCAG RTP/SCS). **Table 1** shows the socioeconomic data assumptions for model base year 2018, existing year 2025, interim year 2030, and model horizon year 2045.

Table 1: Lake Elsinore RIVCOM Socioeconomic Data Summary

Category	2018 (Base Year)	2025	2030	2045
Population	58,684	69,588	78,596	113,240
Households	16,857	20,335	23,251	34,755
Total Employment	14,069	17,211	19,877	30,617
Service Population	72,753	86,819	98,501	253,187

Note: Data for years 2025 and 2030 are interpolated between base year and horizon year model data.
Source: RIVCOM Travel Demand Model; Fehr & Peers, 2025.

Methodology

There are a variety of methods that can be used to model data that capture different relationships between the length of the trip, where the trip starts and ends, and how that mileage is captured and assigned to Lake Elsinore for the purpose of analyzing VMT. For both methods described below, VMT was calculated at the local level by TAZ or roadway link and aggregated to the city level. Land use and transportation system inputs were found to be consistent between the City's General Plan update and the 2020 SCAG RTP/SCS. These findings were confirmed by the City prior to analysis.

Fehr & Peers utilized the Regional Transportation Advisory Committee (RTAC) VMT calculation methodology, also referred to as the half-accounting method, to prepare VMT forecasts. Using this methodology, 100% of the VMT with two trip ends within the City of Lake Elsinore is attributed to the City (**ii**), 50% of the VMT with only one trip end located in Lake Elsinore is attributed to the City (**ixxi**) – the other 50% is allocated to the jurisdiction where the other trip end is located, and 0% of the VMT for trips that pass-through the City (**xx**) is included in the half-accounting methodology. This method is considered state-of-the-practice for use in CAAPs as it allocates the VMT that specific agencies can influence as part of the inventory.

The Boundary Method is another way to measure VMT that estimates all the travel that takes place within Lake Elsinore and truncates the mileage of each trip to only the distance traveled within the border of Lake Elsinore. Under this method, the VMT is estimated for Lake Elsinore and captures all VMT occurring on city roadways, including all through trips that neither start nor end in the city. This is done by selecting the roadway links within the RIVCOM model by City. VMT is then calculated based on the link volumes and link lengths within Lake Elsinore.

The Boundary Method was utilized to provide an estimate of all VMT occurring within Lake Elsinore, including cut-through traffic. Since emissions vary by type of vehicle and by speed of travel, VMT was calculated separately for vehicle classification and then categorized by speed bins (in 5 MPH increments). Typically, if there is an increase in land use, then trips would increase and subsequently boundary VMT would also increase.

For both sets of data, VMT estimates were provided for the years 2018, 2025, 2030, and 2045. The RIVCOM model reflecting the base year of 2018 and horizon year of 2045 were used to develop a straight-line interpolation to provide VMT forecasts for the years 2025 and 2030.

VMT Results

Daily average citywide origin-destination VMT, VMT for different vehicle classification, and VMT per service population are summarized in **Table 2** for years 2018, 2025, 2030, and 2045. The daily VMT by speed bin and mode classification is provided in **Table 3** for years 2018, 2025, 2030, and 2045.

Table 2: Daily Average Origin-Destination (OD) VMT Estimates

		Total (Full-Accounting) VMT		RTAC VMT						Service Population	RTAC VMT/SP					
Year		i	x	Total	Auto	Light Trucks	Medium Trucks	Heavy Trucks	Truck		Total	Auto	Light Trucks	Medium Trucks	Heavy Trucks	Truck
2018	i	133,412	1,190,651	1,302,672	1,251,652	9,912	12,364	28,744	51,020	72,753	17.91	17.20	0.14	0.17	0.40	0.70
	x	1,147,868	-													
2025	i	183,831	1,451,927	1,614,560	1,553,331	11,892	14,911	34,426	61,229	91,187	17.71	17.03	0.13	0.16	0.38	0.67
	x	1,409,532	-													
2030	i	219,844	1,638,552	1,837,337	1,768,815	13,307	16,731	38,485	68,522	104,355	17.61	16.95	0.13	0.16	0.37	0.66
	x	1,596,434	-													
2045	i	327,884	2,198,428	2,505,668	2,415,268	17,550	22,189	50,660	90,400	143,857	17.42	16.79	0.12	0.15	0.35	0.63
	x	2,157,141	-													

Source: RIVCOM Model; Fehr & Peers, 2025.
1. RTAC VMT = 100% internal-internal + 50% internal-external + 50% external-internal
2. Service Population = Population + Total Employment

Table 3: Lake Elsinore Daily Average VMT (Boundary) by Speed

Speed Bin	2018 (Base)	2025 (Interpolation)	2030 (Interpolation)	2045 (Horizon)
0 MPH to 5 MPH	-	-	-	-
5 MPH to 10 MPH	743	551	413	-
10 MPH to 15 MPH	59,132	71,746	80,756	107,787
15 MPH to 20 MPH	14,840	16,221	17,207	20,166
20 MPH to 25 MPH	39,320	46,684	51,944	67,725
25 MPH to 30 MPH	103,457	110,007	114,685	128,719
30 MPH to 35 MPH	90,268	119,581	140,519	203,333
35 MPH to 40 MPH	148,188	227,486	284,127	454,051
40 MPH to 45 MPH	174,305	192,718	205,871	245,328
45 MPH to 50 MPH	92,280	104,959	114,015	141,185
50 MPH to 55 MPH	32,391	49,536	61,783	98,522
55 MPH to 60 MPH	93,523	85,665	80,052	63,212
60 MPH to 65 MPH	28,122	54,082	72,625	128,253
65 MPH +	831,246	907,828	962,529	1,126,633
TOTAL	1,707,816	1,987,064	2,186,527	2,784,915

Source: RIVCOM Model; Fehr & Peers, 2025

Attachment B

VMT Analysis for Lake Elsinore City Limits and Sphere of Influence

Fehr & Peers

Memo

Date: October 31, 2025

To: Poonam Boparai – Ascent

From: Paul Herrmann, T.E., Trevor Lien, and Lorraine Liao – Fehr & Peers

Subject: Lake Elsinore Climate Action & Adaptation Plan (CAAP) Vehicle Miles Traveled (VMT) Methodology and Inventory Summary

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Fehr & Peers prepared an inventory of the Vehicle Miles Traveled (VMT) data for the City of Lake Elsinore, including the SOI, (City) in support of the Climate Action & Adaptation Plan (CAAP). The inventory utilizes VMT data from the travel demand forecasting model adopted by the County of Riverside, the Riverside County Model (RIVCOM). This memorandum presents a summary of the data sources used to develop the inventory and details related to the modeling methods.

Background

VMT estimates for large urban areas and associated sub-areas are commonly developed using regional travel demand models. These models are developed and periodically updated, calibrated, and validated for use in long range infrastructure planning, environmental impact assessments, and air quality conformity analyses by local and regional agencies. Regional travel demand models output daily vehicle trips for each Traffic Analysis Zone (TAZ) across various trip purposes based on inputs such as the transportation network and socioeconomic data such as population, households, and employment.

The latest version of the RIVCOM model was used to estimate VMT for the City. This updated RIVCOM model is the most appropriate travel demand model for forecasting traffic volumes and VMT in the City as it reflects updated land use assumptions and is consistent with the latest City of Lake Elsinore 2045 general plan update and the 2020 Southern California Association of Governments Regional Transportation Plan and Sustainable Communities Strategy (SCAG RTP/SCS). **Table 1** shows the socioeconomic data assumptions for model base year 2018, existing year 2025, interim year 2030, and model horizon year 2045.

Table 1: Lake Elsinore and SOI RIVCOM Socioeconomic Data Summary

Category	2018 (Base Year)	2025	2030	2045
Population	79,669	94,177	106,131	151,892
Households	23,377	27,957	31,768	46,610
Total Employment	16,066	20,456	24,309	40,795
Service Population	95,735	114,770	130,643	192,687

Note: Data for years 2025 and 2030 are interpolated between base year and horizon year model data.
Source: RIVCOM Travel Demand Model; Fehr & Peers, 2025.

Methodology

There are a variety of methods that can be used to model data that capture different relationships between the length of the trip, where the trip starts and ends, and how that mileage is captured and assigned to Lake Elsinore for the purpose of analyzing VMT. For both methods described below, VMT was calculated at the local level by TAZ or roadway link and aggregated to the city level. Land use and transportation system inputs were found to be consistent between the City's General Plan update and the 2020 SCAG RTP/SCS. These findings were confirmed by the City prior to analysis.

Fehr & Peers utilized the Regional Transportation Advisory Committee (RTAC) VMT calculation methodology, also referred to as the half-accounting method, to prepare VMT forecasts. Using this methodology, 100% of the VMT with two trip ends within the City of Lake Elsinore is attributed to the City (**ii**), 50% of the VMT with only one trip end located in Lake Elsinore is attributed to the City (**ixxi**) – the other 50% is allocated to the jurisdiction where the other trip end is located, and 0% of the VMT for trips that pass-through the City (**xx**) is included in the half-accounting methodology. This method is considered state-of-the-practice for use in CAAPs as it allocates the VMT that specific agencies can influence as part of the inventory.

The Boundary Method is another way to measure VMT that estimates all the travel that takes place within Lake Elsinore and truncates the mileage of each trip to only the distance traveled within the border of Lake Elsinore. Under this method, the VMT is estimated for Lake Elsinore and captures all VMT occurring on city roadways, including all through trips that neither start nor end in the city. This is done by selecting the roadway links within the RIVCOM model by City. VMT is then calculated based on the link volumes and link lengths within Lake Elsinore.

The Boundary Method was utilized to provide an estimate of all VMT occurring within Lake Elsinore, including cut-through traffic. Since emissions vary by type of vehicle and by speed of travel, VMT was calculated separately for vehicle classification and then categorized by speed bins (in 5 MPH increments). Typically, if there is an increase in land use, then trips would increase and subsequently boundary VMT would also increase.

For both sets of data, VMT estimates were provided for the years 2018, 2025, 2030, and 2045. The RIVCOM model reflecting the base year of 2018 and horizon year of 2045 were used to develop a straight-line interpolation to provide VMT forecasts for the years 2025 and 2030.

VMT Results

Daily average citywide origin-destination VMT, VMT for different vehicle classification, and VMT per service population are summarized in **Table 2** for years 2018, 2025, 2030, and 2045. The daily VMT by speed bin and mode classification is provided in **Table 3** for years 2018, 2025, 2030, and 2045.

Table 2: Lake Elsinore and SOI Daily Average Origin-Destination (OD) VMT Estimates

	Total (Full-Accounting) VMT			RTAC VMT						Service Population	RTAC VMT/SP					
Year		i	x	Total	Auto	Light Trucks	Medium Trucks	Heavy Trucks	Truck		Total	Auto	Light Trucks	Medium Trucks	Heavy Trucks	Truck
2018	i	215,033	1,566,607	1,736,082	1,673,969	12,510	15,054	34,549	62,113	95,735	18.13	17.49	0.13	0.16	0.36	0.65
	x	1,475,491	-													
2025	i	287,755	1,866,012	2,112,121	2,034,022	15,430	18,994	43,675	78,099	120,871	17.47	16.83	0.13	0.16	0.36	0.65
	x	1,782,721	-													
2030	i	339,699	2,079,872	2,380,720	2,291,203	17,516	21,807	50,193	89,517	138,825	17.15	16.50	0.13	0.16	0.36	0.64
	x	2,002,170	-													
2045	i	495,532	2,721,453	3,186,518	3,062,746	23,774	30,249	69,748	123,771	192,687	16.54	15.89	0.12	0.16	0.36	0.64
	x	2,660,519	-													

Source: RIVCOM Model; Fehr & Peers, 2025.
1. RTAC VMT = 100% internal-internal + 50% internal-external + 50% external-internal
2. Service Population = Population + Total Employment

Table 3: Lake Elsinore and SOI Daily Average VMT (Boundary) by Speed

Speed Bin	2018 (Base)	2025 (Interpolation)	2030 (Interpolation)	2045 (Horizon)
0 MPH to 5 MPH	-	-	-	-
5 MPH to 10 MPH	743	551	413	-
10 MPH to 15 MPH	65,336	81,433	92,931	127,424
15 MPH to 20 MPH	15,573	16,764	17,615	20,166
20 MPH to 25 MPH	43,633	50,713	55,771	70,943
25 MPH to 30 MPH	123,956	126,952	129,092	135,513
30 MPH to 35 MPH	94,592	126,878	149,940	219,124
35 MPH to 40 MPH	184,638	261,085	315,690	479,505
40 MPH to 45 MPH	267,341	289,844	305,918	354,138
45 MPH to 50 MPH	75,691	96,562	111,470	156,192
50 MPH to 55 MPH	38,106	59,339	74,506	120,006
55 MPH to 60 MPH	156,408	132,246	114,988	63,212
60 MPH to 65 MPH	28,122	53,649	71,883	126,584
65 MPH +	957,897	1,032,203	1,085,280	1,244,508
TOTAL	2,052,037	2,328,220	2,525,494	3,117,316

Source: RIVCOM Model; Fehr & Peers, 2025