Attachment 6

Kimley»Horn

MEMORANDUM

From: Elizabeth Chau, PE
Seitu Coleman, TE
Kimley-Horn and Associates, Inc.

To: Vaughan Clarke
Diamond Construction Inc.

Date: December 11, 2025

Re: ***Transportation Demand Management Plan for 490 E Middlefield in Mountain View, CA***

1. Introduction

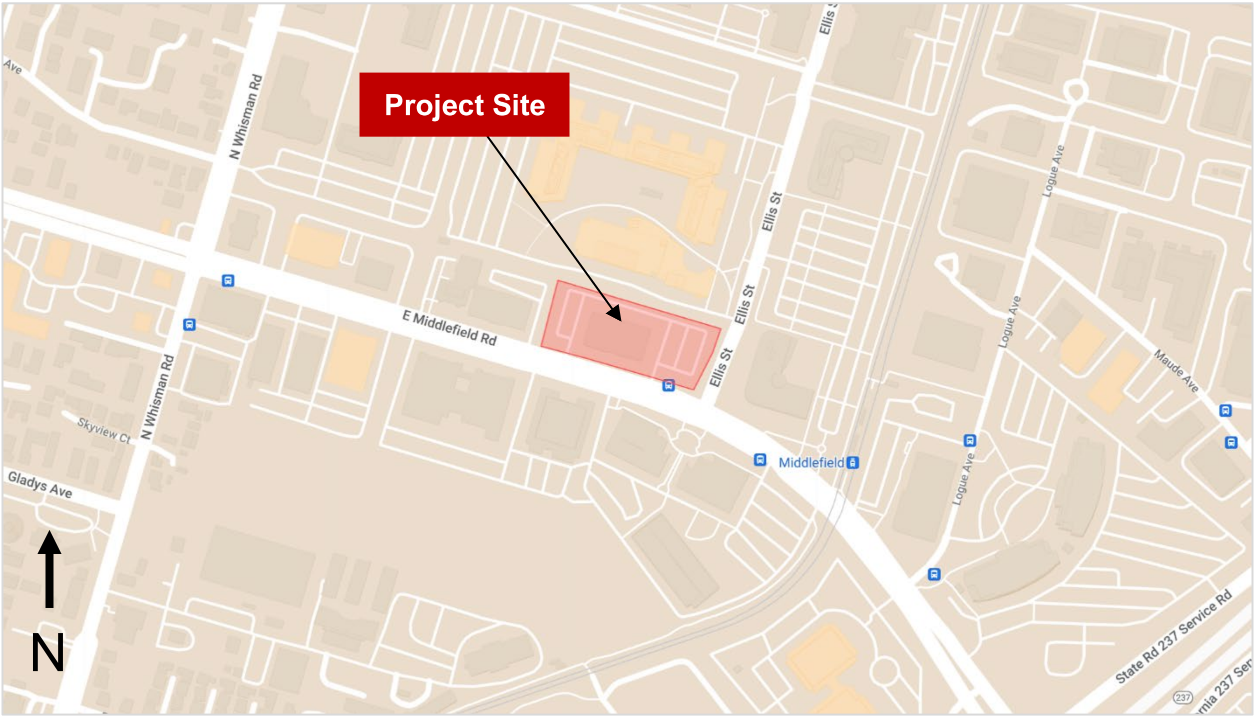
This memorandum summarizes a transportation analysis for a proposed redevelopment (the "Project") at 490 East Middlefield Road in Mountain View (the "City"), California. The Project would demolish an existing office building and construct a new mixed-use building with ground floor retail (9,371 square feet) and 460 units of apartment rentals on the upper floors. Of the 460 apartment units, 55 units would be below-market rate ("affordable housing"). A site plan is shown in **Appendix A**.

As part of the Project's entitlement process, the Project applicant (Diamond Construction, Inc.) submitted to the City of Mountain View a preliminary Senate Bill (SB) 330 application for the proposed redevelopment of the Project site. In response, the City of Mountain View requested a transportation demand management (TDM) plan and a completed Transportation Information Worksheet for the Project.

2. Project Location

The Project site is located at the southeast corner of the intersection of East Middlefield Road & Ellis Street, as shown in **Figure 1**.

Figure 1 – Project Location



Source: Google My Maps

3. Existing Conditions

The following sections describe the existing transportation network near the Project site, including bicycle and transit facilities.

3.1 Existing Bicycle Facilities

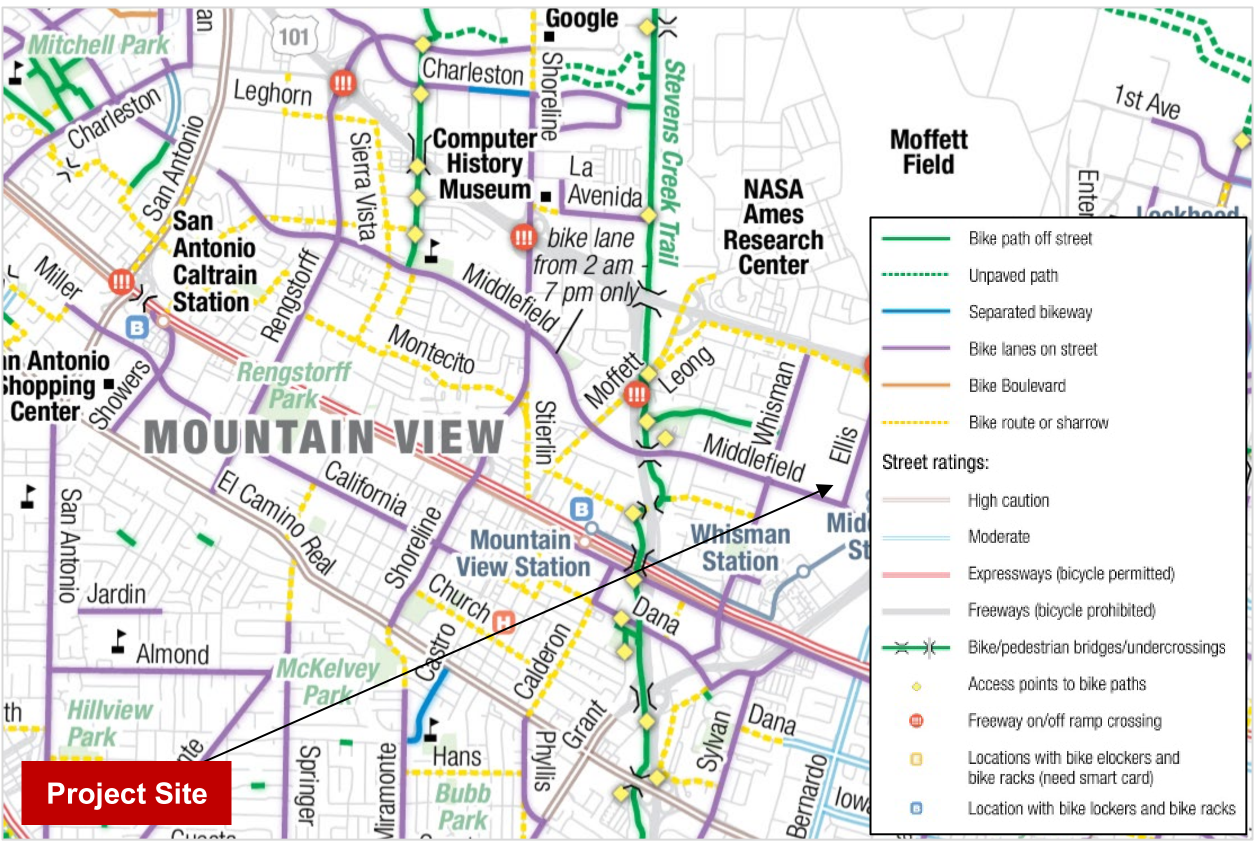
Bicycle facilities serve to improve the accessibility of a built environment to cyclists. A built environment with bicycle facilities (e.g., bike lanes and separated trails) and accommodative traffic control (e.g., bike phases at signalized intersections) results in a bike-friendly environment. The four main bikeway facilities include the following:

- Class I (Multi-use Separated Trail): A completely separated facility designed for the exclusive use of bicyclists and pedestrians with crossing points minimized.
- Class II (Bike Lane): A designated lane for the exclusive use or semi-exclusive use of bicycles with through travel by motor vehicles or pedestrians prohibited but with vehicle parking and cross-flows by pedestrians and motorists permitted.
- Class III (Bike Route): A route designated by signs or pavement markings and shared with pedestrians and motorists.
- Class IV (Separated Bikeway): An on-street facility reserved for use by bicyclists with physical separation between the bikeway and travel lanes. Physical separation exists which may consist of vertical elements such as curbs, landscaping, bollards, or parking lanes.

Figure 2 shows existing bicycle facilities within the study area as provided by the Santa Clara Valley Transportation Authority (VTA) Bikeways Map. Bicycle facilities are provided throughout the City of Mountain View. A list of bicycle facilities near the Project site is provided below:

- Class I
  - Along Athena Court and the Hetch Hetchy Trail between North Whisman Road and Easy Street
- Class II
  - Ellis Street between East Middlefield Road and Fairchild Drive
  - Middlefield Road between east and west of the study area
  - Whisman Road between Fairchild Drive and south of the study area
- Class III
  - Fairchild Drive between Ellis Street and west of the study area

Figure 2 – Existing Bicycle Facilities



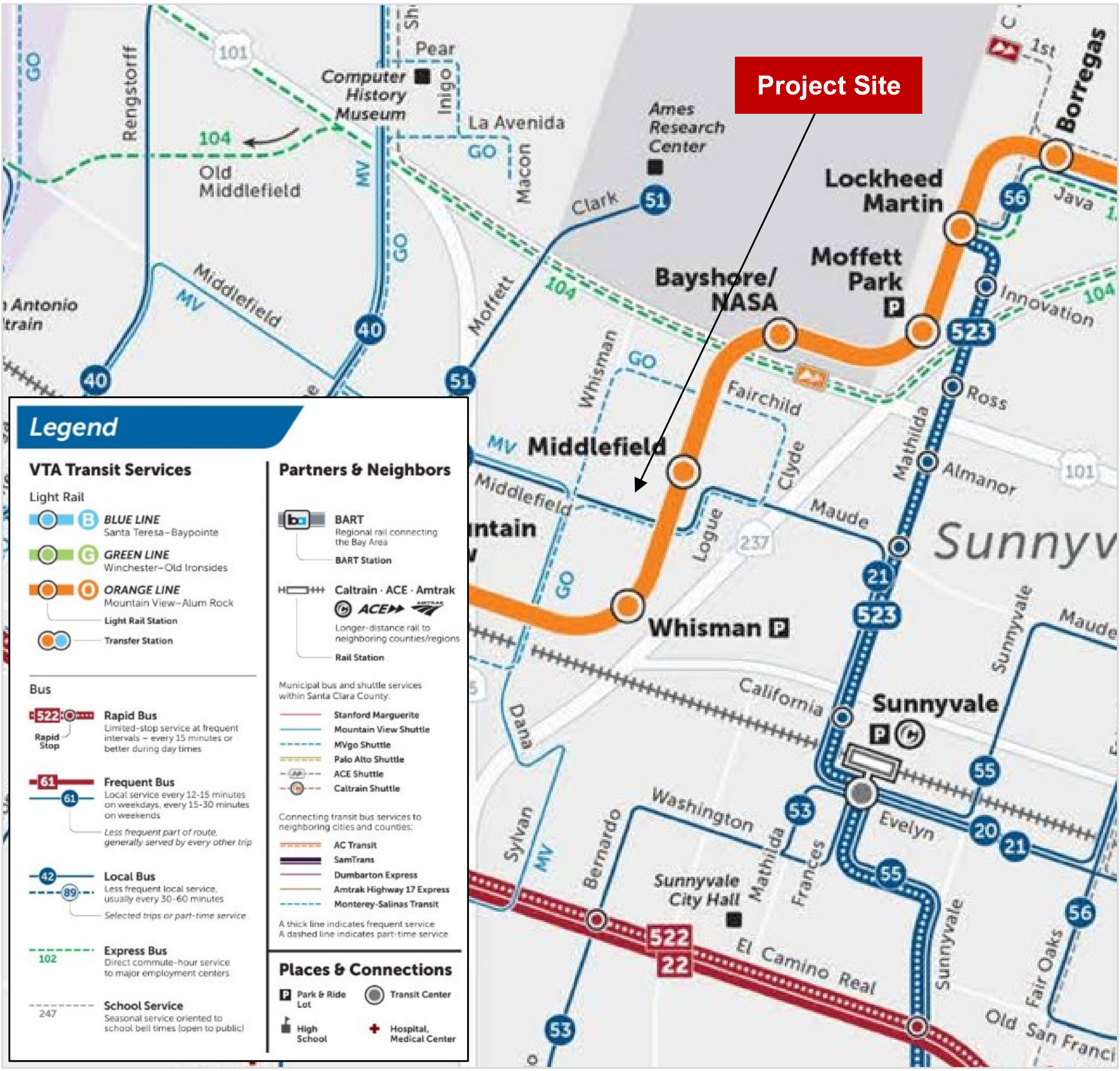
Source: Santa Clara Valley Transportation Authority Bikeways Map (https://www.vta.org/sites/default/files/2020-07/2020%20Bike%20Map_web_p2.pdf)

3.2 Existing Transit Facilities

Transit services constitute an important part of a transportation system as they provide roadway users with an alternative mode of transportation to the single-occupancy automobile. Transit services allow for a more efficient use of the local roadway network as they are typically higher capacity than automobiles, provide disadvantaged populations with an effective means of accessing services that are beyond practical walking or biking distances, and typically emit less greenhouse gas emissions per roadway user-mile than automobiles.

Transit services near the Project site are provided by the Mountain View Transportation Management Association (MTMA), the Santa Clara Valley Transportation Authority (VTA) and the Peninsula Corridor Joint Powers Board (dba "Caltrain"). The transit routes and lines are shown in **Figure 3**, as provided by VTA.

Figure 3 – Existing Transit Services



Source: VTA Main Map (https://www.vta.org/sites/default/files/2024-10/VTA-System-Map_0.pdf)

3.2.1 MTMA

MTMA is a nonprofit membership organization that operates bus shuttle services under the brand name "MVgo" throughout the City of Mountain View. The organization is funded by businesses and property owners in the City and operates four bus routes, including Route A (the "blue" route), Route B (the "orange" route), Route C (the "teal" route), and Route D (the "yellow" route).

The alignment of Route A runs near the Project site along Middlefield Road. Route A forms a circuitous loop alignment starting from Mountain View Transit Center and provides coverage to the eastern portion of the City of Mountain View. Service spans from 7:08 a.m. to 10:08 a.m. in the morning and from 3:40 p.m. to 7:33 p.m. in the afternoon.

3.2.2 VTA

VTA is an independent special district that operates light rail, fixed-route scheduled bus services, and demand-response paratransit services throughout Santa Clara County. VTA additionally provides congestion management and countywide transportation planning services.

Route 21 is a local bus service that runs near the Project site and extends from the Santa Clara Transit Center to the Arboretum & Sand Hill bus stop in Palo Alto. Service is provided on weekdays, weekends (including Sundays), and holidays and spans from 5:30 a.m. to 9:55 p.m. on weekdays. The closest stop to the Project site is E Middlefield & Ellis.

The Orange Line is a light rail service that runs near the Project site and extends from the Mountain View Caltrain Station to the Alum Rock Station in San Jose. Service is provided on weekdays, weekends (including Sundays), and holidays and spans from 5:00 a.m. to 12:18 a.m. (next day) on weekdays. Middlefield Station is approximately 550 feet from the Project site.

3.2.3 Caltrain

Caltrain is a commuter rail service that operates a single line extending from the San Francisco 4th & King Street Station to the Gilroy Station. Caltrain stops at the Mountain View Station, which is approximately 1.2 miles from the Project site. Caltrain recently began electrified train service between the San Francisco 4th & King Street Station and the Tamien Station. Service spans from 4:37 a.m. to 1:28 a.m. (next day) on weekdays at relatively high frequencies and from 6:51 a.m. to 1:29 a.m. (next day) on weekends at relatively low frequencies.

4. Proposed Project

The following summarizes the trip generation for the proposed project.

4.1 Project Trip Generation

A trip generation evaluation typically refers to the Institute of Transportation Engineer's (ITE) *Trip Generation Manual, 11th Edition*, which is a standard reference used by jurisdictions throughout the country to estimate the trip generation potential of proposed developments.

A trip is defined in the *Trip Generation Manual* as a single or one-directional vehicle movement with either the origin or destination at a project site. In other words, a trip can be either "to" or "from" the site and therefore, a single visitor to a site is counted as two trips.

Trips are typically calculated from trip rates in the *Trip Generation Manual* for times of the day and week during which a proposed development's worst-case traffic impacts on the surrounding roadway network would be expected to occur. These time periods are typically the a.m. peak hour (generally between the hours of 7:00 a.m. to 9:00 a.m.) and the p.m. peak hour (generally between the hours of 4:00 p.m. to 6:00 p.m.) on a typical weekday.

For the purposes of this study, the following ITE land use codes (LUC) and their associated trip rates from the *Trip Generation Manual* were utilized:

- ITE LUC 822 Strip Retail Plaza (<40k) (Ground Floor Retail)
- ITE LUC 221 Multifamily Housing (Mid-rise) Close to Rail Transit (Market-rate Apartment Housing)
- ITE LUC 223 Affordable Housing (Below-market Rate Housing)

A summary of the trip generation evaluation is shown in **Table 1**. Internal captures and additional reductions by implementing TDM program were taken. Based on the CAPCOA methodology summarized in Table 2, the TDM program is expected to reduce project generated vehicle trips by approximately 14.1 percent in the daily period as well as in the AM and PM peak hours, reducing AM peak hour trips from 180 to 152 and PM peak hour trips from 204 to 170. The proposed Project would generate approximately 2,267 net new daily trips, 152 (57 in, 95 out) net new a.m. peak hour trips, and 170 (102 in, 68 out) net new p.m. peak hour trips.

Table 1 – Trip Generation Summary

Land Use	ITE Code	Size	Daily		AM Peak Hour					PM Peak Hour				
			Rate / Eqn	Total	Rate / Eqn	In:Out	In	Out	Total	Rate / Eqn	In:Out	In	Out	Total
490 E Middlefield Road Mixed-Use Development														
Ground Floor Retail														
Strip Retail Plaza (<40k)[3]	822	9.37 KSF	54.45	510	2.36	60:40	13	9	22	6.59	50:50	31	31	62
Internal Trip Capture - Retail to Market Rate Residential[1,2]				*-40*			*-1*	*-1*	*-2*			*-2*	*-2*	*-4*
Internal Trip Capture - Retail to Below-Market Rate Residential[1,2]				*0*			*0*	*0*	*0*			*0*	*0*	*0*
Net New Trips with Internal Capture Reductions				470			12	8	20			29	29	58
Market-Rate Apartment Housing														
Multifamily Housing (Mid-Rise) - Close to Rail Transit[4]	221	405 DU	4.75	1,924	0.32	36:64	47	83	130	0.29	65:35	76	41	117
Internal Trip Capture - Market Rate Residential to Retail[1,2]				*-20*			*-1*	*-1*	*-2*			*-1*	*-1*	*-2*
Net New Trips with Internal Capture Reductions				1,904			46	82	128			75	40	115
Below-Market Rate (Affordable) Housing														
Affordable Housing	223	55 DU	4.81	265	0.50	29:71	8	20	28	0.46	59:41	15	10	25
Internal Trip Capture - Below-Market Rate Residential to Retail[1,2]				*0*			*0*	*0*	*0*			*0*	*0*	*0*
Net New Trips with Internal Capture Reductions				265			8	20	28			15	10	25
Total Trips				**+2,699**			**+68**	**+112**	**+180**			**+122**	**+82**	**+204**
Total Internal Capture				**-60**			**-2**	**-2**	**-4**			**-3**	**-3**	**-6**
TDM Measures Reduction (14.08%)[5]				**-372**			**-9**	**-15**	**-24**			**-17**	**-11**	**-28**
Total Net New Trips				**+2,267**			**+57**	**+95**	**+152**			**+102**	**+68**	**+170**

Notes:

1. *Internal Trip Capture reductions were approximated using National Cooperative Highway Research Project Report 684 methodology and spreadsheet.*
2. *Daily internal trip capture reductions were approximated by assuming that daily internal trip capture reductions are 10x p.m. peak hour internal trip capture reductions.*
3. *ITE pass-by rates for LUC 822 are not available.*
4. *Middlefield Station with VTA light rail service is approximately 550 feet (i.e., within the one-quarter mile threshold) from the Project site.*
5. *See Table 2 for details.*

5. Required & Proposed TDM Program Elements

The proposed Project is within the boundaries of the City of Mountain View East Whisman Precise Plan. The East Whisman Precise Plan establishes TDM standards for research and development, office, and residential development projects that exceed thresholds of development intensity. The East Whisman Precise Plan requires all new residential developments to have a TDM plan with programs and measures to reduce trips in line with the City's Greenhouse Gas Reduction Program and other trip-reduction standards established by the City. The proposed Project falls within the category of residential developments and would be subject to the TDM standards established by the East Whisman Precise Plan, which includes the following:

5.1 TMA Membership

5.1.1 *New residential developments with at least 100 units shall become TMA members.*

The Project proposes 460 residential units and thus exceeds the threshold of 100 units. The Project would be required to become a member of the MTMA. The Project TDM plan would require the Project to be a member of the MTMA to be consistent with City of Mountain view standards and plans.

5.2 TDM Plan Site Requirements

5.2.1 *Maximum parking and carshare parking as defined by this chapter.*

According to the East Whisman Precise Plan vehicular off-street parking standards, the Project would be subject to maximums of 229, 202, 58, and 51 vehicular parking spaces for the proposed studio apartments, 1-bedroom apartments, 2-bedroom apartments, and retail space, respectively. This equates to a maximum allowed inventory of 526 vehicular parking spaces. The Project proposes an inventory of 499 (465 residential, 34 retail) vehicular parking spaces, which falls under the maximum allowed threshold. The Project would be consistent with City of Mountain View vehicular off-street parking standards.

The East Whisman Precise Plan includes minimum carshare parking standards. Based on the proposed land uses, the Project would be required to provide a minimum of five (5) carshare parking spaces. The Project would provide five (5) carshare parking spaces, which exceeds the minimum threshold. The Project would be consistent with City of Mountain View carshare parking standards.

5.2.2 *Bicycle parking as defined by this chapter.*

In terms of bicycle parking, the East Whisman Precise Plan includes minimum standards for short-term spaces and long-term spaces. Based on the proposed land uses, the Project would be required to provide a minimum of 54 short-term spaces and 462 long-term spaces, for a total of 516 spaces. The Project proposes 358 spaces (304 long-term, 54 short-term).

5.2.3 *Residential projects over 100 units shall provide a shared, common, collaborative workspace available to residents and their guests. This amenity can be offered in partnership with nearby residences or businesses.*

The Project is proposing shared common spaces in the form of 900 square-foot "Work From Home" rooms on the second and third floors in addition to lounges on all floors except the ground floor (see the site plans in **Appendix A**). These shared common spaces would allow residents to work from home and would result in a decrease in the number of trips generated by the development.

5.2.4 *Site design that supports alternative modes, such as orienting building entrances toward sidewalks, transit stop and bicycle routes.*

The Project is proposing a site design that promotes alternative modes in several ways. Firstly, the frontage of the Project is set back by five (5) feet more than the minimum requirement of eight (8) feet to provide a wide concrete sidewalk that is accommodative to pedestrian traffic. Additionally, the Project frontage abutting East Middlefield Road and Ellis Street would consist of retail space interspersed with covered mini courtyards to promote pedestrian presence and activities.

The Project site prioritizes the use of alternative modes by providing a bike room with an inventory of 304 spaces that is accessible from the lobby. Additionally, the Project site is located across the street from an existing bus stop and is approximately 550 feet from an existing light rail station. Furthermore, vehicular parking is either located away from the Project frontage with East Middlefield Road and Ellis Street or is placed behind the retail space and the bike room to deemphasize the use of automobiles. Whereas automobile use would be necessary for those with impaired mobility, accessible parking spaces are strategically located either near the Project frontage with East Middlefield Road and Ellist Street or near stairs and elevators within the development for shorter walking distances.

5.2.5 *Accessible, secure storage space for grocery and package delivery shall be provided in multifamily development.*

The Project is proposing a secure storage room on the ground floor by the entrance lobby. The storage room would provide groceries and packages from e-commerce deliveries to be stored securely.

5.3 TDM Plan Operational Requirements

5.3.1 *Property managers or homeowner associations (HOA) shall provide access to shared bicycles if a bikeshare service is not available nearby.*

The Project property manager would be responsible for providing residents with easy access to shared bicycles either by coordinating with a bikeshare service or by directly providing and maintaining a communal bike system. The property manager would demonstrate that shared bicycles are available to residents, that residents are regularly reminded and encouraged to use the shared bicycles, and that residents' suggestions to improve the program is taken into account (e.g., adding foldable baskets on bikes, using puncture-resistant tires) in the annual monitoring results to the City.

5.3.2 *Property managers or HOAs shall provide local transportation information to all residents through a website, leasing office, or initial leasing information.*

The Project property manager would be responsible for providing residents with local transportation information through maps, schedules, or discounted group pass programs that are available via a website, the proposed leasing office, or as part of the initial leasing information. The Project would demonstrate the provision of these services to residents in its annual monitoring results to the City.

5.3.3 *Property managers or HOAs shall support Safe Routes to Schools programs including facilitating parent gatherings and coordination of walking school buses and/or bike trains.*

The Project property manager would be responsible for coordinating with the City's Safe Routes to Schools program by facilitating parent gatherings and coordination of walking to school, to school buses, and/or bike trains. The Project would demonstrate the provision of these services to residents in its annual monitoring results to the City.

Table 2 summarizes the initial TDM measures proposed by the project and presents associated trip reduction percentages. Based on information from California Air Pollution Control Officers Association's (CAPCOA) *Handbook for Analyzing Greenhouse Gas Emission Reduction, Assessing Climate Vulnerability, and Advancing Health and Equity*. This reference was used due to the Santa Clara Countywide VMT Evaluation Tool having no residential VMT data for the Project site. The relevant transportation measures factsheets are included in **Appendix B**.

Table 2 – Proposed TDM Measure Summary

No.	TDM Measure	Description	CAPCOA Measures #	% Reduction
5.1.1	MTMA membership.	The Project owner or property manager would be required to be a member of the Mountain View Transportation Management Association.	T-7	4.00%[A]
5.2.1	Maximum vehicular parking requirements.	The Project as proposed would be subject to a maximum vehicular parking requirement of 526 spaces. The Project proposes an inventory of 499 spaces, satisfying the requirement.	T-15	0.61%
5.2.1	Minimum carshare parking requirements.	The Project as proposed would be subject to a minimum carshare parking requirement of five (5) carshare parking spaces. The Project proposes an inventory of five (5) carshare parking spaces, satisfying the requirement.	T-21A	0.15%
5.2.2	Minimum bicycle parking requirements.	The Project as proposed would be subject to minimum bicycle parking requirements of 54 short-term spaces and 462 long-term spaces, equating to a total of 516 spaces. The Project proposes an inventory of 304 spaces.	T-10	0.90%[B]
5.2.3	Shared workspace.	The Project as proposed would provide 900 square-foot shared "work-from-home" spaces on the second and third floors in addition to multiple lounge rooms on each of the residential floors. The shared work spaces would allow residents to work from home and would result in a decrease in the number of trips generated by the development.	T-7	4.00%[A]
5.2.4	Site design that supports alternative modes to the single-occupancy vehicle.	The Project provides wide sidewalks and retail spaces interspersed with mini-courtyards along its frontage with East Middlefield Road and Ellis Street to promote pedestrian traffic and activity. Additionally, the Project places vehicular parking towards the rear of the site while bicycle parking and ADA vehicular spaces are placed towards the front of the site for easy access for pedestrians, bicyclists, and those with impaired mobility. Furthermore, the Project site is across the street from the nearest bus stop and approximately 550 feet from the nearest light rail station.	T-7	4.00%[A]
5.2.5	Accessible and secure storage space for deliveries.	The Project provides storage room on ground floor by entrance lobby.	T-10	0.90%[B]
5.3.1	Bikeshare service.	The Project property manager would be responsible for providing residents easy access to shared bicycles either by coordinating with a bikeshare service or by direct providing and maintenance of bicycles to be shared by residents.	T-22A	0.02%
5.3.2	Local transportation information.	The Project property manager would be responsible for providing residents with local transportation information through maps, schedules, or discounted group pass programs that are available via a website, the proposed leasing office, or as part of the initial leasing information.	T-7	4.00%[A]
5.3.3	Safe Routes to Schools	The Project property manager would be responsible for coordinating with the City's Safe Routes to Schools program by facilitating parent gatherings and coordination of walking to school, to school buses, and/or bike trains.	T-56	8.40%
			Total Reduction	**14.08%**

Notes
[A] *Maximum reduction of 4% can be assumed for combination for marketing/educational-related elements.*
[B] *Reduction of 0.9% be achieved for all Project bicycle-facilities.*
[C] *Potential range included as not enough information at this time to determine reduction in trips.*

5.4 Parking Rationale

5.4.1 ***The TDM plan shall demonstrate that the parking provided is adequate to serve the needs of the development and shall consider the project's trip-reduction measures.***

Peak period vehicular parking demand of the Project was estimated using the ITE *Parking Generation Manual, 6th Edition*. Parking rates from the following ITE LUCs were selected to best represent the proposed land uses of the Project under the most conservative conditions:

- ITE LUC 822 Strip Retail Plaza (<40k) (Ground Floor Retail)
- ITE LUC 218 Multifamily Housing – 1 BR (Mid-rise) – Close to Rail Transit (Market-rate Apartment Housing (1 BR / Studio))
- ITE LUC 221 Multifamily Housing – 2 BR (Mid-rise) – Close to Rail Transit (Market-rate Apartment Housing (2 BR))
- ITE LUC 223 Affordable Housing – Income Limits (Below-market Rate (Affordable) Housing)

Table 3 below shows the estimated parking demand of the proposed Project. The Project would generate vehicular parking demands of approximately 374 spaces on a typical weekday (Monday-Thursday), 409 spaces on a typical Friday, and 394 spaces on a typical Saturday.

Table 3 – Estimated Parking Demand

Land Use	ITE LUC	Size	Weekday (Mon - Thurs)		Friday		Saturday	
			Rate / Eqn	Total	Rate / Eqn	Total	Rate / Eqn	Total
490 E Middlefield Road Mixed-Use Development								
Ground Floor Retail								
Strip Retail Plaza (<40k)	822	9.37 KSF	4.44 veh / KSF[1]	42	5.45 veh / KSF[1]	51	4.36 veh / KSF[1]	41
Parking Inefficiency Factor[5]			*15%*	*6*		*8*		*6*
Net New Parking Demand				48		59		47
Market-Rate Apartment Housing (1 BR / Studio)								
Multifamily Housing - 1 BR (Mid-Rise) - Close to Rail Transit[3,6]	218	379 DU	0.61 veh / DU[2]	231	0.61 veh / DU[2]	231	0.61 veh / DU[2]	231
Parking Inefficiency Factor[5]			*5%*	*12*		*12*		*12*
Net New Parking Demand				243		243		243
Market-Rate Apartment Housing (2 BR)								
Multifamily Housing - 2 BR (Mid-Rise) - Close to Rail Transit[3,7]	221	26 DU	1.42 veh / DU[1]	37	1.42 veh / DU[1]	37	1.34 veh / DU[2]	35
Parking Inefficiency Factor[5]			*5%*	*2*		*2*		*2*
Net New Parking Demand				39		39		37
Below-Market Rate (Affordable) Housing								
Affordable Housing - Income Limits	223	55 DU	P = 1.12(X) - 19.50 veh / DU[1]	42	1.19 veh / DU[1]	65	1.17 veh / DU[1]	64
Parking Inefficiency Factor[5]			*5%*	*2*		*3*		*3*
Net New Parking Demand				44		68		67
Total Parking Demand				**+352**		**+384**		**+371**
Additional Parking Demand from Inefficiencies				**+22**		**+25**		**+23**
Total Net New Parking Demand				**+374**		**+409**		**+394**

Source: ITE Parking Generation Manual, 6th Edition

Notes:

1. *85th percentile rate used to approximate parking demand.*
2. *Average rate used to approximate parking demand as 85th percentile rate was not available.*
3. *Middlefield Station with VTA light rail service is approximately 550 feet (i.e., within the one-quarter mile threshold) from the Project site.*
4. *The unit mix of 1 BR / Studio (94%) and 2 BR (6%) units was applied to the 55 units that are required to be below-market rate (BMR). The number of BMR units of each residential unit type was then subtracted from the total number of units of each residential unit type to determine the number of market-rate units by residential unit type.*
5. *The parking inefficiency factor adjusts the parking demand to account for inefficiencies in the use of parking spaces. Retail parking lots would be expected to have lower efficiencies than residential parking lots because parking demand is more variable, and drivers would spend more time searching for parking spaces as they would not be as familiar with the layout and locations of parking spaces.*
6. *Friday and Saturday parking rates for ITE LUC 218 are not available. Friday and Saturday parking rates were approximated by setting them equal to Monday-Thursday parking rates.*
7. *Friday parking rates for ITE LUC 221 are not available. Friday parking rates were approximated by setting them equal to Monday-Thursday parking rates.*

According to **Table 3**, the Project generates a peak vehicular parking demand of approximately 409 spaces on Fridays. This peak parking demand is lower than the proposed off-street inventory of 499 parking spaces. Note additionally that the peak parking demand is conservative as it includes parking inefficiency factors, uses the 85^{th} percentile parking rate instead of the average parking rate, and does not account for the TDM measures listed in **Table 2**. The estimated peak parking demand on Fridays represents a "worst-case scenario" and would likely not occur for most days of the year. Therefore, the parking provided by the Project is adequate to serve the needs of the development.

5.5 TDM Monitoring

5.5.1 *Annual TDM monitoring will be conducted by a third party and paid for by the property owner(s) or their representative. It will include parking counts to measure the peak parking demand and resulting parking rate.*

The Project TDM plan would provide annual updates to the City of Mountain View to demonstrate that the parking provided is adequate to serve the development's needs and would consider the development's trip-reduction measures by conducting parking surveys. Parking surveys would occur during a typical weekday not close to holidays or weekends (Tuesday, Wednesday, or Thursday) and not during inclement weather. Parking surveys would determine the occupancy rate of the Project's parking lots to monitor the adequacy of the inventory.

5.6 Monitoring Results

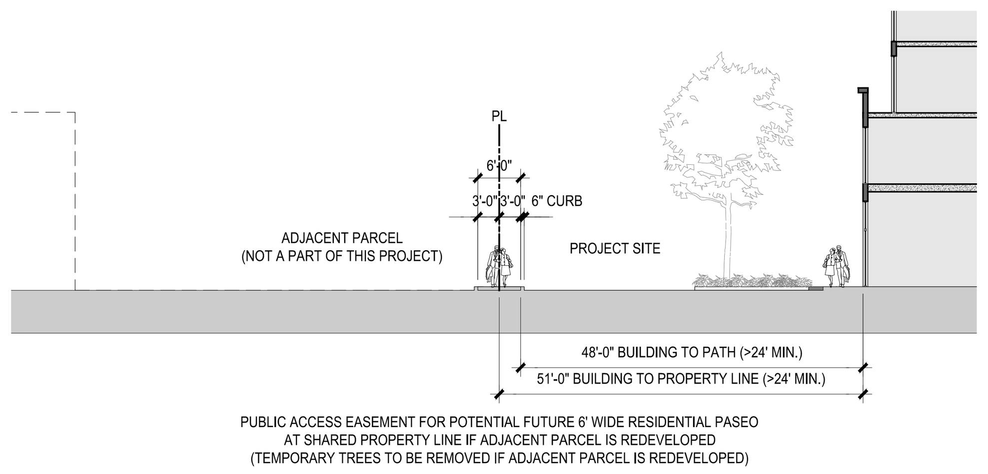
5.6.1 *Annual monitoring results shall be submitted to the City for review. The report will include a description of the measures in place and any new or modified measures since the last monitoring period. If the required trip-reduction standard is not met, the property manager or HOA shall submit a revised TDM plan to the City identifying new programs or policies to address the exceedance and reduce the number of vehicle trips.*

The Project TDM plan would provide annual monitoring results to demonstrate the Project's compliance with TDM measures. The Project property manager may decide to pursue additional TDM measures or discontinue TDM measures based on the observed effectiveness of the existing TDM measures. The changes in TDM measures and their effectiveness would be recorded in the annual monitoring results.

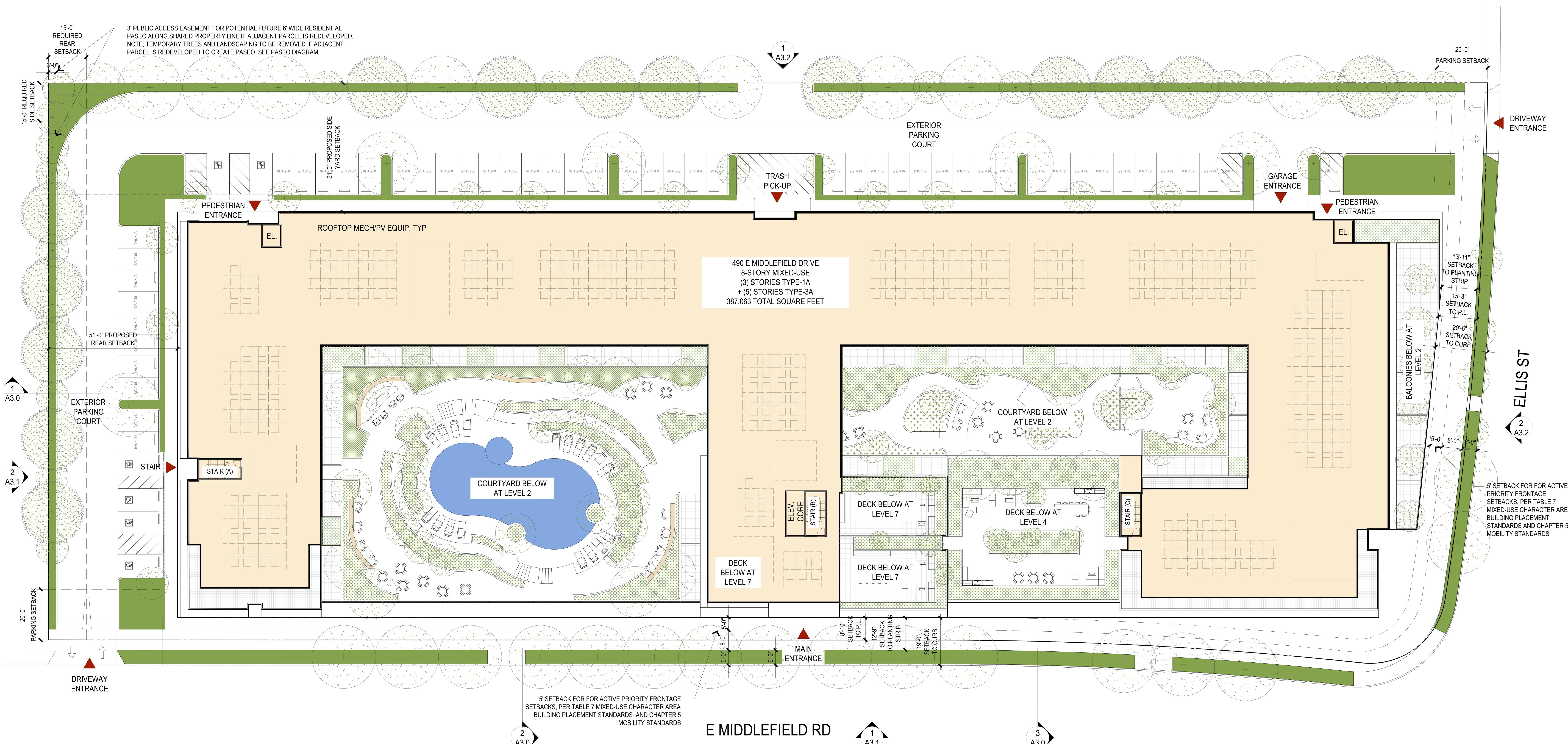
Appendix A – Site Plan

STACKHOUSE
DE LA PEÑA
TRACHTENBERG
ARCHITECTS

2421 Fourth Street
Berkeley, California 94710
510.649.1414
www.SDTArch.com



2 FUTURE PASEO DIAGRAM
3/64" = 1'-0" @ 36x24



NOTE: PHOTOVOLTAIC PANEL QUANTITIES, LOCATIONS, AND ELECTRICAL GENERATION TO BE DETERMINED IN COORDINATION WITH HVAC EQUIPMENT DESIGN.

SITE PLAN / ROOF PLAN
3/64" = 1'-0" @ 36x24

490 E MIDDLEFIELD ROAD

MOUNTAIN VIEW, CA

12.09.2024 SB-330 SUBMITTAL
01.31.2025 FORMAL PLANNING APPLICATION
04.14.2025 PLANNING RESUBMITTAL
06.20.2025 PLANNING RESUBMITTAL
08.26.2025 PLANNING RESUBMITTAL
10.20.2025 PLANNING RESUBMITTAL

JOB: 2425

SHEET:

SITE PLAN

A1.1

Appendix B – Relevant CAPCOA Transportation Measures

T-7. Implement Commute Trip Reduction Marketing

Photo Credit: Sacramento Area Council of Governments, 2012

GHG Mitigation Potential

4%

Up to 4.0% of GHG emissions from project/site employee commute VMT

Co-Benefits (icon key on pg. 34)

Climate Resilience

Commute trip reduction programs could result in less traffic, potentially reducing congestion or delays on major roads during peak AM and PM traffic periods. When this reduction occurs during extreme weather events, it better allows emergency responders to access a hazard site. Lower transportation costs would also increase community resilience by freeing up resources for other purposes.

Health and Equity Considerations

Design of CTR programs needs to consider existing mobility options in diverse communities and ensure equitable access and benefit to all employees. CTR programs may need to include multi-language materials.

Measure Description

This measure will implement a marketing strategy to promote the project site employer's CTR program. Information sharing and marketing promote and educate employees about their travel choices to the employment location beyond driving such as carpooling, taking transit, walking, and biking, thereby reducing VMT and GHG emissions.

Subsector

Trip Reduction Programs

Locational Context

Urban, suburban

Scale of Application

Project/Site

Implementation Requirements

The following features (or similar alternatives) of the marketing strategy are essential for effectiveness.

- Onsite or online commuter information services.
- Employee transportation coordinators.
- Onsite or online transit pass sales.
- Guaranteed ride home service.

Cost Considerations

Employer costs include labor and materials for development and distribution of survey and marketing materials to promote the program and educate potential participants.

Expanded Mitigation Options

This measure could be packaged with other commute trip reduction measures (Measures T-8 through T-13) as a comprehensive CTR program (Measure T-5 or T-6).

GHG Reduction Formula

$A = B \times C \times D$

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A	Percent reduction in GHG emissions from project/site employee commute VMT	0–4.0	%	calculated
User Inputs				
B	Percent of employees eligible for program	0–100	%	user input
Constants, Assumptions, and Available Defaults				
C	Percent reduction in employee commute vehicle trips	-4	%	TRB 2010
D	Adjustment from vehicle trips to VMT	1	unitless	assumed

Further explanation of key variables:

- (B) – This refers to the percent of employees that would be able to participate in the program. This will usually be 100 percent. Employees who might not be able to participate could include those who work nighttime hours when transit and rideshare services are not available or employees who are required to drive to work as part of their job duties. This input does not refer to the percent of employees who actually participate in the program.
- (C) – A review of studies measuring the effect of transportation demand management measures on traveler behavior notes that the average empirically-based estimate of reductions in vehicle trips for full-scale, site-specific employer support programs is 4 to 5 percent. To be conservative, the low end of the range is cited (TRB 2010).
- (D) – The adjustment factor from vehicle trips to VMT is 1. This assumes that all vehicle trips will average out to typical trip length ("assumes all trip lengths are equal"). Thus, it can be assumed that a percentage reduction in vehicle trips will equal the same percentage reduction in VMT.

GHG Calculation Caps or Maximums

Measure Maximum

(A_{max}) The maximum GHG reduction from this measure is 4 percent. This maximum scenario is presented in the below example quantification.

Subsector Maximum

($\sum A_{max_{T\text{-}5 \text{ through } T\text{-}13}} \leq 45\%$) This measure is in the Trip Reduction Programs subsector. This subcategory includes Measures T-5 through T-13. The employee commute VMT reduction from the combined implementation of all measures within this subsector is capped at 45 percent.

Mutually Exclusive Measures

If this measure is selected, the user may not also take credit for either Measure T-5 or T-6. However, this measure may be implemented alongside other individual CTR measures (Measures T-8 through T-13). The efficacy of individual programs may vary highly based on individual employers and local contexts.

Example GHG Reduction Quantification

The user reduces employee commute VMT by requiring that employers of a project market to employees travel options for modes alternative to single-occupied vehicles. In this example, the percent of employees eligible (B) is 100 percent, which would reduce GHG emissions from employee commute VMT by 4 percent.

$$A = \mathbf{100\%} \times -4\% \times 1 = -4\%$$

Quantified Co-Benefits

Improved Local Air Quality

The percent reduction in GHG emissions (A) would be the same as the percent reduction in NO_X, CO, NO_2, SO_2, and PM. Reductions in ROG emissions can be calculated by multiplying the percent reduction in GHG emissions (A) by an adjustment factor of 87 percent. See *Adjusting VMT Reductions to Emission Reductions* above for further discussion.

Energy and Fuel Savings

The percent reduction in vehicle fuel consumption would be the same as the percent reduction in GHG emissions (A).

VMT Reductions

The percent reduction in VMT would be the same as the percent reduction in GHG emissions (A).

Sources

- Transportation Research Board (TRB). 2010. *Traveler Response to Transportation System Changes Handbook, Third Edition: Chapter 19, Employer and Institutional TDM Strategies*. June. Available: http://www.trb.org/Publications/Blurbs/163781.aspx. Accessed: January 2021.

T-8. Provide Ridesharing Program

GHG Mitigation Potential

8%

Up to 8.0% of GHG emissions from project/site employee commute VMT

Co-Benefits (icon key on pg. 34)

Climate Resilience

Ridesharing programs could result in less traffic, potentially reducing congestion or delays on major roads during peak AM and PM traffic periods. When this reduction occurs during extreme weather events, it better allows emergency responders to access a hazard site. Lower transportation costs would also increase community resilience by freeing up resources for other purposes.

Health and Equity Considerations

Program should include all onsite workers, such as contractors, interns, and service workers. Because ridesharing is vehicle-based, and some employees may not be in areas with feasible rideshare networks, design of programs need to ensure equitable benefits to those with and without access to rideshare opportunities.

Measure Description

This measure will implement a ridesharing program and establish a permanent transportation management association with funding requirements for employers. Ridesharing encourages carpooled vehicle trips in place of single-occupied vehicle trips, thereby reducing the number of trips, VMT, and GHG emissions.

Subsector

Trip Reduction Programs

Locational Context

Urban, suburban

Scale of Application

Project/Site

Implementation Requirements

Ridesharing must be promoted through a multifaceted approach. Examples include the following.

- Designating a certain percentage of desirable parking spaces for ridesharing vehicles.
- Designating adequate passenger loading and unloading and waiting areas for ridesharing vehicles.
- Providing an app or website for coordinating rides.

Cost Considerations

Costs of developing, implementing, and maintaining a rideshare program in a way that encourages participation are generally borne by municipalities or employers. The beneficiaries include the program participants saving on commuting costs, the employer reducing onsite parking expenses, and the municipality reducing cars on the road, which leads to lower infrastructure and roadway maintenance costs.

Expanded Mitigation Options

When providing a ridesharing program, a best practice is to establish funding by a non-revocable funding mechanism for employer-provided subsidies. In addition, encourage use of low-emission ridesharing vehicles (e.g., shared Uber Green).

This measure could be paired with any combination of the other commute trip reduction strategies (Measures T-7 through T-13) for increased reductions.

GHG Reduction Formula

$A = B \times C$

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A	Percent reduction in GHG emissions from project/site employee commute VMT	0–8.0	%	calculated
User Inputs				
B	Percent of employees eligible for program	0–100	%	user input
Constants, Assumptions, and Available Defaults				
C	Percent reduction in employee commute VMT	Table T-8.1	%	SANDAG 2019

Further explanation of key variables:

- (B) – This refers to the percent of employees that would be able to participate in the program. This will usually be 100 percent. Employees who might not be able to participate could include those who work nighttime hours when transit and rideshare services are not available or employees who are required to drive to work as part of their job duties. This input does not refer to the percent of employees who actually participate in the program.
- (C) – The percent reduction in employee commute VMT by place type is provided in Table T-8.1 in Appendix C. The reduction differs by place type because the willingness and ability to participate in carpooling is higher in urban areas than in suburban areas. Note that this measure is not applicable for implementation in rural areas (SANDAG 2019).

GHG Calculation Caps or Maximums

Measure Maximum

(A_{max}) The maximum GHG reduction from this measure is 8 percent.

Subsector Maximum

($\sum A_{max_{T\text{-}5\text{ through }T\text{-}13}} \leq 45\%$) This measure is in the Trip Reduction Programs subsector. This subcategory includes Measures T-5 through T-13. The employee commute VMT reduction from the combined implementation of all measures within this subsector is capped at 45 percent.

Mutually Exclusive Measures

If this measure is selected, the user may not also take credit for either Measure T-5 or T-6. However, this measure may be implemented alongside other individual CTR measures (Measures T-7 and T-9 through T-13). The efficacy of individual programs may vary highly based on individual employers and local contexts.

Example GHG Reduction Quantification

The user reduces employee commute VMT by requiring that employers of a project provide a ridesharing program to their employees. In this example, the percent of employees eligible (B) at a packaging and distribution center is 50 percent and the place type of the project is urban (C). GHG emissions from employee commute VMT would be reduced by 4 percent.

$A = \mathbf{50\%} \times -8\% = -4\%$

Quantified Co-Benefits

Improved Local Air Quality

The percent reduction in GHG emissions (A) would be the same as the percent reduction in NO_X, CO, NO_2, SO_2, and PM. Reductions in ROG emissions can be calculated by multiplying the percent reduction in GHG emissions (A) by an adjustment factor of 87 percent. See *Adjusting VMT Reductions to Emission Reductions* above for further discussion.

Energy and Fuel Savings

The percent reduction in vehicle fuel consumption would be the same as the percent reduction in GHG emissions (A).

VMT Reductions

The percent reduction in VMT would be the same as the percent reduction in GHG emissions (A).

Sources

- San Diego Association of Governments (SANDAG). 2019. *Mobility Management VMT Reduction Calculator Tool–Design Document.* June. Available: https://www.icommutesd.com/docs/default-source/planning/tool-design-document_final_7-17-19.pdf?sfvrsn=ec39eb3b_2. Accessed: January 2021.

T-9. Implement Subsidized or Discounted Transit Program

GHG Mitigation Potential

5.5 %

Up to 5.5% of emissions from employee/resident vehicles accessing the site

Co-Benefits (icon key on pg. 34)

Climate Resilience

Subsidized and discounted transit programs increase the capacity of low-income populations to use transit to evacuate or access resources during an extreme weather event. They could also incentivize more people to use transit, resulting in less traffic and better allowing emergency responders to access a hazard site during an extreme weather event. Lower overall out-of-pocket costs would also help increase community resilience by freeing up resources for other purposes.

Health and Equity Considerations

Program should include all onsite workers, such as contractors, interns, and service workers.

Measure Description

This measure will provide subsidized or discounted, or free transit passes for employees and/or residents. Reducing the out-of-pocket cost for choosing transit improves the competitiveness of transit against driving, increasing the total number of transit trips and decreasing vehicle trips. This decrease in vehicle trips results in reduced VMT and thus a reduction in GHG emissions.

Subsector

Trip Reduction Programs

Locational Context

Urban, suburban

Scale of Application

Project/Site

Implementation Requirements

The project should be accessible either within 1 mile of high-quality transit service (rail or bus with headways of less than 15 minutes), 0.5 mile of local or less frequent transit service, or along a designated shuttle route providing last-mile connections to rail service. If a well-established bikeshare service (Measure T-22-A) is available, the site may be located up to 2 miles from a high-quality transit service.

If more than one transit agency serves the site, subsidies should be provided that can be applied to each of the services available. If subsidies are applied for only one service, all variable inputs below should also pertain only to the service that is subsidized.

Cost Considerations

The employer cost is the recurring, direct cost for transit subsidies. The subsidies will lower the per capita income of the transit service, decreasing the revenue of the local transit agency. This cost may be offset by increased revenue from increased ridership. The beneficiaries include the program participants saving on commuting cost, the employer reducing onsite parking expenses, and the municipality reducing cars on the road, which leads to lower infrastructure and roadway maintenance costs.

Expanded Mitigation Options

This measure could be paired with any combination of the other commute trip reduction strategies (Measures T-7 through T-13) for increased reductions.

GHG Reduction Formula

$$A = \frac{C}{B} \times G \times D \times E \times F \times H \times I$$

GHG Calculation Variables

If subsidies or discounts target employees, the GHG reduction from this measure may be limited to work-related employee trips only (i.e., home-to- work) and work-to-other, where at least one trip end is work). If residents are targeted, the GHG reductions extend to all trips.

ID	Variable	Value	Unit	Source
Output				
A	Percent reduction in GHG emissions from employee/resident vehicles accessing the site	0–5.5	%	calculated
User Inputs				
B	Average transit fare without subsidy	[ ]	$	user input
C	Subsidy amount	[ ]	$	user input
D	Percent of employees/residents eligible for subsidy	0–100	%	user input
E	Percent of project-generated VMT from employees/residents	0–100	%	user input
Constants, Assumptions, and Available Defaults				
F	Transit mode share of all trips or work trips	Table T-3.1 or Table T-9.1	%	FHWA 2017
G	Elasticity of transit boardings with respect to transit fare price	-0.43	unitless	Taylor et al. 2008
H	Percent of transit trips that would otherwise be made in a vehicle	50	%	Handy & Boarnet 2013
I	Conversion factor of vehicle trips to VMT	1.0	unitless	assumption

Further explanation of key variables:

- (B and C) – The average transit fare and subsidy amount can be presented as either a fare per ride, or the cost of a monthly pass for typical transit service near the site. Pricing should be based on the expected means of subsidy implementation; for instance, if a monthly pass is provided to all residents, prices should be input on a monthly basis.
- (D) – The percentage of employees/residents associated with the site who have access to the subsidy. If subsidy is provided as an employee benefit, care should be taken to account for any contract or temporary workers who do not receive such benefits.
- (E) – The percentage of project-generated VMT from employees/residents is used to adjust the percent reduction in GHG emissions from the scale of employee and/or resident-generated VMT to project-generated VMT. If subsidies or discounts target employees at an office development, this value would simply be 100 percent. If the project site is a multifamily development with no onsite workers, this value would also be

100 percent. If the project site is a retail development, this value would be less than 100 percent, as it does not account for retail shopper trips to the site. The share of total VMT generated by employees for visitor-intensive uses, such as retail or medical offices, can be roughly estimated by multiplying the total number of employees by two (to account for both arrival and departure), divided by the total number of daily trips.

- (F) – Ideally, the user will calculate transit mode share for work trips or all trips of a Project/Site at a scale no larger than a census tract. Potential data sources include the U.S. Census, California Household Travel Survey (preferred), or local survey efforts. Care should be taken *not* to present the reported commute mode share as retrieved from the American Community Survey (ACS), unless the land use is office or employment based and the tables are based on work location (rather than home location). If the subsidies or discounts target employees and their commute trips, then the mode share should use the home-to-work trip purpose. If the user is not able to provide a project-specific value using one of the data sources described above, they have the option to input the transit mode share for one of the six most populated CBSAs in California. The transit mode share for work trips by CBSA is presented in Table T-9.1 in Appendix C (FHWA 2017). The transit mode share for all trips is provided in Table T-3.1 in Appendix C.
- (G) – A cross-sectional analysis of transit use in 265 urbanized areas in the U.S. found that a 0.43 percent decrease in transit boardings occurs for every 1 percent increase in transit fare price (Taylor et al. 2008). A policy brief summarizing the results of transit service strategies found this analysis to fall in the mid-point of observed, short-term values (Handy & Boarnet 2013). Price elasticities of transit demand vary based on both long-term and short-term demand, service type, and service location (Litman 2020 and Handy & Boarnet 2013).
- (H) – Not all new transit trips replace a vehicle trip. The share of transit trips that would otherwise be made by private vehicle ranges from less than 5 percent to 50 percent across studies. This assumption is based on observed values for high quality BRT service under the assumption that this measure is implemented alongside marketing measures and is targeted primarily at reducing vehicle commute trips. (Handy & Boarnet 2013). Note that this study looked at service improvements rather than fare changes and is used as a proxy variable. If project-specific or location-specific information is available, it should be substituted for this assumptive variable.
- (I) – The adjustment factor from vehicle trips to VMT is 1. This assumes that all vehicle trips will average out to typical trip length (“assumes all trip lengths are equal”). Thus, it can be assumed that a percentage reduction in vehicle trips will equal the same percentage reduction in VMT. Subsidies or discounts targeting commute trips may have a higher factor as they are generally longer than the trip lengths for other purposes.

GHG Calculation Caps or Maximums

Measure Maximum

(A_{max}) The GHG reduction is capped at 5.5 percent, which is based on the following assumptions:

- (C=B) – The subsidy coverage is capped at 100 percent of the typical transit fare.
- (D) – All employees are eligible for the subsidy.

- (E) – All project-generated VMT is from employee-generated VMT.
- (F) – Employees at an office development in the San Francisco-Oakland-Hayward CBSA have a default transit mode share for work trips of 25.60 percent.

Subsector Maximum

$(\sum A_{max_{T\text{-}5 \text{ through } T\text{-}13}} \leq 45\%)$ This measure is in the Trip Reduction Programs subsector. This subcategory includes Measures T-5 through T-13. The employee commute VMT reduction from the combined implementation of all measures within this subsector is capped at 45 percent.

Mutually Exclusive Measures

If this measure is selected, the user may not also take credit for either Measure T-5 or T-6. However, this measure may be implemented alongside other individual CTR measures (Measures T-7, T-8, T-10 through T-13). The efficacy of individual programs may vary highly based on individual employers and local contexts.

Example GHG Reduction Quantification

In this example, the user reduces VMT by providing all employees (D) of a proposed office development in the San Francisco-Oakland-Hayward CBSA a 100 percent transit subsidy in the form of a $100 monthly transit pass (C=B). The user would reduce GHG emissions from VMT by 5.5 percent.

$$A = \left(\frac{\$100}{\$100} \times -0.43\right) \times \mathbf{100\%} \times \mathbf{100\%} \times 25.60\% \times 50\% \times 1 = -5.5\%$$

Quantified Co-Benefits

Improved Local Air Quality

The percent reduction in GHG emissions (A) would be the same as the percent reduction in NO_X, CO, NO_2, SO_2, and PM. Reductions in ROG emissions can be calculated by multiplying the percent reduction in GHG emissions (A) by an adjustment factor of 87 percent. See *Adjusting VMT Reductions to Emission Reductions* above for further discussion.

Energy and Fuel Savings

The percent reduction in vehicle fuel consumption would be the same as the percent reduction in GHG emissions (A).

VMT Reductions

The percent reduction in VMT would be the same as the percent reduction in GHG emissions (A).

Sources

- Federal Highway Administration (FHWA). 2017. *National Household Travel Survey–2017 Table Designer.* Travel Day PMT by TRPTRANS by HH_CBSA, Workers by WRKTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021.
- Handy, L. and S. Boarnet. 2013. *Impacts of Transit Service Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions.* Available: http://www.arb.ca.gov/cc/sb375/policies/transitservice/transit_brief.pdf. Accessed: January 2021.
- Litman, T. 2020. *Transit Price Elasticities and Cross-elasticities.* Victoria Transport Policy Institute. April. Available: https://www.vtpi.org/tranelas.pdf. Accessed: January 2021.
- Taylor, B., D. Miller, H. Iseki, and C. Fink. 2008. *Nature and/or Nurture? Analyzing the Determinants of Transit Ridership Across US Urbanized Areas.* Transportation Research Part A: Policy and Practice, 43(1), 60-77. Available: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.367.5311&rep=rep1&type=pdf. Accessed: January 2021.

T-10. Provide End-of-Trip Bicycle Facilities

GHG Mitigation Potential

4.4%

Up to 4.4% of GHG emissions from project/site employee commute VMT

Co-Benefits (icon key on pg. 34)

Climate Resilience

End-of-trip bicycle facilities could take more cars off the road, resulting in less traffic and better allowing emergency responders to access a hazard site during an extreme weather event. They could also make it easier for bicycle users to access resources in an extreme weather event.

Health and Equity Considerations

Facilities should be inclusive of all gender identities and expressions. Consider including gender-neutral, single-occupancy options to allow for additional privacy for those who want it.

Measure Description

This measure will install and maintain end-of-trip facilities for employee use. End-of-trip facilities include bike parking, bike lockers, showers, and personal lockers. The provision and maintenance of secure bike parking and related facilities encourages commuting by bicycle, thereby reducing VMT and GHG emissions.

Subsector

Trip Reduction Programs

Locational Context

Urban, suburban

Scale of Application

Project/Site

Implementation Requirements

End-of-trip facilities should be installed at a size proportional to the number of commuting bicyclists and regularly maintained.

Cost Considerations

Employer costs include capital and maintenance costs for construction and maintenance of facilities and potentially labor and materials costs for staff to monitor facilities and provide marketing to encourage use of new facilities. The beneficiaries include the program participants saving on commuting cost, the employer reducing onsite parking expenses, and the municipality reducing cars on the road, which leads to lower infrastructure and roadway maintenance costs.

Expanded Mitigation Options

Best practice is to include an onsite bicycle repair station and post signage on or near secure parking and personal lockers with information about how to reserve or obtain access to these amenities.

This measure could be paired with any combination of the other commute trip reduction strategies (Measures T-7 through T-13) for increased reductions.

GHG Reduction Formula

$$A = \frac{C \times (E - (B \times E))}{D \times F}$$

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A	Percent reduction in GHG emissions from employee project/site commute VMT	0.1–4.4	%	calculated
User Inputs				
	None			
Constants, Assumptions, and Available Defaults				
B	Bike mode adjustment factor	1.78 or 4.86	unitless	Buehler 2012
C	Existing bicycle trip length for all trips in region	Table T-10.1	miles	FHWA 2017a
D	Existing vehicle trip length for all trips in region	Table T-10.1	miles	FHWA 2017a
E	Existing bicycle mode share for work trips in region	Table T-10.2	%	FHWA 2017b
F	Existing vehicle mode share for work trips in region	Table T-10.2	%	FHWA 2017b

Further explanation of key variables:

- (B) – The bike mode adjustment factor should be provided by the user based on type of bike facility. A study found that commuters with showers, lockers, and bike parking at work are associated with 4.86 times greater likelihood to commute by bicycle when compared to individuals without any bicycle facilities at work. Individuals with bike parking, but no showers and lockers at the workplace, are associated with 1.78 times greater likelihood to cycle to work than those without trip-end facilities (Buehler 2012).
- (C and D) – Ideally, the user will calculate bicycle and auto trip length for a Project/Site at a scale no larger than a census tract. Potential data sources include the U.S. Census, California Household Travel Survey (preferred), or local survey efforts. If the user is not able to provide a project-specific value using one of these data sources, they have the option to input the trip lengths for bicycles and vehicles for one of the six most populated CBSAs in California, as presented in Table T-10.1 in Appendix C (FHWA 2017a). Trip lengths are likely to be longer for areas not covered by the listed CBSAs, which represent the denser areas of the state.
- (E and F) – Ideally, the user will calculate bicycle and auto mode share for work trips for a Project/Site at a scale no larger than a census tract. Potential data sources include the U.S. Census, California Household Travel Survey (preferred), or local survey efforts. If the user is not able to provide a project-specific value using one of these data sources, they have the option to input the regional average mode shares for bicycle and vehicle

work trips for one of the six most populated CBSAs in California, as presented in Table T-10.2 in Appendix C (FHWA 2017b). If the project study area is not within the listed CBSAs or the user is able to provide a project-specific value, the user should replace these regional defaults in the GHG reduction formula. For areas not covered by the listed CBSAs, which represent the denser areas of the state, bicycle mode share is likely to be lower and vehicle share higher than presented in Table T-10.2.

GHG Calculation Caps or Maximums

Measure Maximum

(A_{max}) The maximum GHG reduction from this measure is 4.4 percent. This maximum scenario is presented in the below example quantification.

Subsector Maximum

($\sum A_{max_{T\text{-}5 \text{ through } T\text{-}13}} \leq 45\%$) This measure is in the Trip Reduction Programs subsector. This subcategory includes Measures T-5 through T-13. The employee commute VMT reduction from the combined implementation of all measures within this subsector is capped at 45 percent.

Mutually Exclusive Measures

If this measure is selected, the user may not also take credit for either Measure T-5 or T-6. However, this measure may be implemented alongside other individual CTR measures (Measures T-7, T-8, T-9, and T-11 through T-13). The efficacy of individual programs may vary highly based on individual employers and local contexts.

Example GHG Reduction Quantification

The user reduces VMT by providing end-of-trip facilities for the project's employees, which encourages bicycle trips in place of vehicle trips. In this example, the type of bike facility provided by the project is parking with showers, bike lockers, and personal lockers (B). The project is within San Jose-Sunnyvale-Santa Clara CBSA, and the user does not have project-specific values for trip lengths and mode shares and for bicycles and vehicles. Per Tables T-10.1 and T-10.2 in Appendix C, inputs for these variables are 2.8 miles, 11.5 miles, 4.1 percent, and 86.6 percent, respectively (C, D, E, and F). GHG emissions from employee commute VMT would be reduced by 4.4 percent.

$$A = \frac{2.8 \text{ miles} \times \left(4.1\% - (4.86 \times 4.1\%)\right)}{11.5 \text{ miles} \times 86.6\%} = -4.4\%$$

Quantified Co-Benefits

Improved Local Air Quality

The percent reduction in GHG emissions (A) would be the same as the percent reduction in NO_X, CO, NO_2, SO_2, and PM. Reductions in ROG emissions can be calculated by multiplying the percent reduction in GHG emissions (A) by an adjustment factor of 87 percent. See *Adjusting VMT Reductions to Emission Reductions* above for further discussion.

Energy and Fuel Savings

The percent reduction in vehicle fuel consumption would be the same as the percent reduction in GHG emissions (A).

VMT Reductions

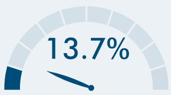
The percent reduction in VMT would be the same as the percent reduction in GHG emissions (A).

Sources

- Buehler, R. 2012. *Determinants of bicycle commuting in the Washington, DC region: The role bicycle parking, cyclist showers, and free car parking at work.* Transportation Research Part D, 17, 525–531. Available: http://www.pedbikeinfo.org/cms/downloads/DeterminantsofBicycleCommuting.pdf. Accessed: January 2021.
- Federal Highway Administration (FHWA). 2017a. *National Household Travel Survey–2017 Table Designer*. Travel Day PT by TRPTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021.
- Federal Highway Administration (FHWA). 2017b. *National Household Travel Survey–2017 Table Designer.* Workers by WRKTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021.

T-15. Limit Residential Parking Supply

GHG Mitigation Potential



Up to 13.7% of GHG emissions from resident vehicles accessing the site

Co-Benefits (icon key on pg. 34)

Climate Resilience

Limiting residential parking supply could incentivize increased use of public transit and thus result in less traffic, potentially reducing congestion or delays on major roads during peak AM and PM traffic periods. When this reduction occurs during extreme weather events, it better allows emergency responders to access a hazard site. Evacuation plans and plans for transport to cooling/heating/clean air centers during power outages or unhealthy air quality events, however, would need to consider needs of households without access to private vehicles.

Health and Equity Considerations

Limiting parking supply can reduce the cost of housing development and, potentially, increase housing supply and decrease housing expenses. However, this may negatively impact residents that do not have a viable alternative to personal vehicle travel.

Measure Description

This measure will reduce the total parking supply available at a residential project or site. Limiting the amount of parking available creates scarcity and adds additional time and inconvenience to trips made by private auto, thus disincentivizing driving as a mode of travel. Reducing the convenience of driving results in a shift to other modes and decreased VMT and thus a reduction in GHG emissions. Evidence of the effects of reduced parking supply is strongest for residential developments.

Subsector

Parking or Road Pricing/Management

Locational Context

Urban, suburban

Scale of Application

Project/Site

Implementation Requirements

This measure is ineffective in locations where unrestricted street parking or other offsite parking is available nearby and has adequate capacity to accommodate project-related vehicle parking demand.

Cost Considerations

Reducing residential parking supply, especially in high density residential areas, can have high-cost savings if it reduces the need for additional investment in parking infrastructure. Some of these savings may be offset by investments in alternative transport solutions, which will need to be robust to ensure that residents can effectively travel to work and all other destinations without a car.

Expanded Mitigation Options

When limiting parking supply, a best practice is to do so at sites that are located near high quality alternative modes of travel (such as a rail station, frequent bus line, or in a higher density area with multiple walkable locations nearby). Limiting parking supply may also allow for more active uses on any given lot, which may support Measures T-1 and T-2 by allowing for higher density construction.

GHG Reduction Formula

$$A = -\frac{B - C}{B} \times D \times E \times F$$

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A	Percent reduction in GHG emissions from resident vehicles accessing the site	0–13.7	%	calculated
User Inputs				
B	Residential parking demand	[ ]	parking spaces	user input
C	Project residential parking supply	[ ]	parking spaces	user input
D	Percentage of project VMT generated by residents	[ ]	%	user input
Constants, Assumptions, and Available Defaults				
E	Percent of household VMT that is commute based	37	%	Caltrans 2012
F	Percent reduction in commute mode share by driving among households in areas with scarce parking	37	%	Chatman 2013

Further explanation of key variables:

- (B) – The user can calculate the parking demand in the *ITE Parking Generation Manual* based on the project building square footage or number of du. For residential projects, this demand varies based on the size of each unit, and ranges from 1.0 spaces/unit for one-bedroom apartments to 2.6 spaces/unit for single-family homes with 3+ bedrooms.
- (D) – Available research on changes in parking supply focuses on residential land uses. Therefore, reductions are applied only to the share of VMT generated by residents of a project. For most residential projects, this will be 100 percent; however, for mixed-use projects, the user will need to provide project-specific data.
- (E) – The percent of household VMT that is commute-based varies from location to location; the statewide average is 37 percent (Caltrans 2012). If the user can provide a project-specific value based on their project type and area, they should replace the default in the GHG reduction formula.
- (F) – A study found that among households with limited off-street parking (<1 space per adult), there was a 37 percent decrease in auto mode share for commute trips. The method above pro-rates this reduction based on how much the project's parking supply is reduced from demand rates calculated in the *ITE Parking Generation Manual* (ITE 2019). In addition, this reduction is applied to commute trips only due to the limitations of the research.

GHG Calculation Caps or Maximums

Measure Maximum

(A_{max}) The percent reduction in GHG emissions is capped at 13.7 percent. This occurs for projects that have no onsite parking (C), 100 percent of VMT arising from residential land use (D), and 37 percent of all VMT arising from commute trips (E). This maximum scenario is presented in the below example quantification.

(C>B) Parking supply is considered to be limited when demand (C) exceeds supply (B). If demand is equal to or less than supply, then implementation of this measure would not result in a GHG reduction.

Subsector Maximum

($\sum A_{max_{T\text{-}14 \text{ through } T\text{-}16}} \leq 35\%$) This measure is in the Parking or Road Pricing/Management subsector. This subcategory includes Measures T-14 through T-16. The VMT reduction from the combined implementation of all measures within this subsector is capped at 35 percent.

Example GHG Reduction Quantification

The user reduces VMT by reducing a project's parking supply. In this example, the parking demand per ITE is 100 parking spaces (B) and the project would not supply any parking spaces (C). The user would reduce GHG emissions from VMT by 13.7 percent.

$$A = -\frac{100 \text{ spaces} - 0 \text{ spaces}}{100 \text{ spaces}} \times 100\% \times 37\% \times 37\% = \text{-}13.7\%$$

Quantified Co-Benefits

Improved Local Air Quality

The percent reduction in GHG emissions (A) would be the same as the percent reduction in NO_X, CO, NO_2, SO_2, and PM. Reductions in ROG emissions can be calculated by multiplying the percent reduction in GHG emissions (A) by an adjustment factor of 87 percent. See *Adjusting VMT Reductions to Emission Reductions* above for further discussion.

Energy and Fuel Savings

The percent reduction in vehicle fuel consumption would be the same as the percent reduction in GHG emissions (A).

VMT Reductions

The percent reduction in VMT would be the same as the percent reduction in GHG emissions (A).

Sources

- California Department of Transportation (Caltrans). 2012. *California Household Travel Survey (CHTS)*. Available: https://www.nrel.gov/transportation/secure-transportation-data/tsdc-california-travel-survey.html. Accessed: January 2021.
- Chatman, D. 2013. Does TOD need the T? On the importance of factors other than rail access. *Journal of the American Planning Association* 79(1). Available: https://trid.trb.org/view/1243004. Accessed: January 2021.
- Institute of Transportation Engineers (ITE). 2019. Parking Generation Manual. 5th Edition. February. Available: https://ecommerce.ite.org/IMIS/ItemDetail?iProductCode=PG5-ALL. Accessed: May 2021.

T-21-A. Implement Conventional Carshare Program

GHG Mitigation Potential

0.15%

Up to 0.15% of GHG emissions from vehicle travel in the plan/community

Co-Benefits (icon key on pg. 34)

Climate Resilience

Carshare programs can increase accessibility and provide redundancy to vehicles that can be used to evacuate or obtain resources during an extreme weather event. Carshare programs can allow residents to give up or avoid car ownership, leading to cost savings that can help build economic resilience.

Health and Equity Considerations

Provide inclusive mechanisms so people without bank accounts, credit cards, or smart phones can access the system.

Measure Description

This measure will increase carshare access in the user's community by deploying conventional carshare vehicles. Carsharing offers people convenient access to a vehicle for personal or commuting purposes. This helps encourage transportation alternatives and reduces vehicle ownership, thereby avoiding VMT and associated GHG emissions. A variation of this measure, electric carsharing, is described in Measure T-21-B, *Implement Electric Carshare Program*.

Subsector

Neighborhood Design

Locational Context

Urban, suburban

Scale of Application

Plan/Community

Implementation Requirements

The GHG mitigation potential is based, in part, on literature analyzing one-way carsharing service with a free-floating operational model. This measure should be applied with caution if using a different form of carsharing (e.g., roundtrip, peer-to-peer, fractional).

Cost Considerations

The costs incurred by the carshare program service manager (typically a municipality or carshare company) may include the capital costs of purchasing vehicles; costs of storing, maintaining, and replacing the fleet; and costs for marketing and administration. Some of these costs may be offset by income generated through program use.

Expanded Mitigation Options

When implementing a carshare program, best practice is to discount carshare membership and provide priority parking for carshare vehicles to encourage use of the service.

GHG Reduction Formula

$$A = \frac{B \times (E - D)}{C}$$

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A	Percent reduction in GHG emissions from vehicle travel in plan/community	0–0.15	%	calculated
User Inputs				
B	Number of vehicles deployed in plan/community	[ ]	integer	user input
C	VMT in plan/community without measure	[ ]	VMT per day	user input
Constants, Assumptions, and Available Defaults				
D	Conventional VMT avoided with measure	68.2	VMT per day per vehicle	Martin and Shaheen 2016
E	Conventional VMT added with measure	24.4	VMT per day per vehicle	Martin and Shaheen 2016

Further explanation of key variables:

- (B) – The number of cars in the carshare program is selected by the carshare provider, but its magnitude is relative to the size of the service area. A study of several carsharing programs (Martin and Shaheen 2016) documented a range of carshare fleet sizes for different North American cities: Calgary (590), San Diego (406), Seattle (640), Vancouver (920), Washington, D.C. (626).
- (C) – The total plan/community VMT should represent the expected total VMT generated by all land use in that area. The most appropriate source for this data is from a local travel demand model.
- (D) – Conventional VMT avoided per deployed carshare vehicle was derived based on a study of conventional-engine based car share programs in Calgary, Seattle, Vancouver, and Washington, D.C. It accounts for VMT avoided from carshare users who sold their personal vehicles and carshare users who decided not to purchase a personal vehicle, both directly because of the availability of carshare (Martin and Shaheen 2016).
- (E) – Conventional VMT added per deployed carshare vehicle was derived based on a study of conventional-engine based car share programs in Calgary, Seattle, Vancouver, and Washington, D.C. It accounts for the VMT of the carshare vehicles (Martin and Shaheen 2016).

GHG Calculation Caps or Maximums

Measure Maximum

(A_{max}) The maximum GHG reduction from this measure is 0.15 percent. This maximum scenario is presented in the below example quantification.

Subsector Maximum

($\sum A_{max_{T\text{-}18 \text{ through } T\text{-}22\text{-}D}} \leq 10\%$) This measure is in the Neighborhood Design subsector. This subcategory includes Measures T-18 through T-22-D. The VMT reduction from the combined implementation of all measures within this subsector is capped at 10 percent.

Example GHG Reduction Quantification

The user reduces plan/community VMT by deploying carshare vehicles. In this example, the project would be in the city of San Diego, which in 2017 had a VMT per day of 24,101,089 miles (C) (SANDAG 2019). Assuming twice the number of vehicles used in the Car2go San Diego program (B), the GHG emissions from plan/community VMT would be reduced by 0.15 percent.

$$A = \frac{\textbf{812 vehicles} \times (24.4 \frac{\text{VMT}}{\text{day}\cdot\text{vehicle}} - 68.2 \frac{\text{VMT}}{\text{day}\cdot\text{vehicle}})}{\textbf{24,101,089} \frac{\textbf{VMT}}{\textbf{day}}} = -0.15\%$$

Quantified Co-Benefits

Improved Local Air Quality

The percent reduction in GHG emissions (A) would be the same as the percent reduction in NO_X, CO, NO_2, SO_2, and PM. Reductions in ROG emissions can be calculated by multiplying the percent reduction in GHG emissions (A) by an adjustment factor of 87 percent. See *Adjusting VMT Reductions to Emission Reductions* above for further discussion.

Energy and Fuel Savings

The percent reduction in vehicle fuel consumption would be the same as the percent reduction in GHG emissions (A).

VMT Reductions

The percent reduction in VMT would be the same as the percent reduction in GHG emissions (A).

Sources

- Martin, E. and S. Shaheen. 2016. *The Impacts of Car2go on Vehicle Ownership, Modal Shift, Vehicle Miles Traveled, and Greenhouse Gas Emissions: An Analysis of Five North American Cities.* July. Available: https://tsrc.berkeley.edu/publications/impacts-car2go-vehicle-ownership-modal-shift-vehicle-miles-traveled-and-greenhouse-gas. Accessed: March 2021.
- San Diego Association of Governments (SANDAG). 2019. *Mobility Management VMT Reduction Calculator Tool – Design Document.* June. Available: https://www.icommutesd.com/docs/default-source/planning/tool-design-document_final_7-17-19.pdf?sfvrsn=ec39eb3b_2. Accessed: January 2021.

T-22-A. Implement Pedal (Non-Electric) Bikeshare Program

GHG Mitigation Potential

0.02%

Up to 0.02% of GHG emissions from vehicle travel in the plan/community

Co-Benefits (icon key on pg. 34)

Climate Resilience

Bikeshare programs can incentivize more bicycle use and decrease vehicle use, which have health benefits and can thus improve community resilience. This can also improve connectivity between residents and resources that may be needed in an extreme weather event.

Health and Equity Considerations

Provide inclusive mechanisms so people without bank accounts, credit cards, or smart phones can access the system.

Measure Description

This measure will establish a bikeshare program. Bikeshare programs provide users with on-demand access to bikes for short-term rentals. This encourages a mode shift from vehicles to bicycles, displacing VMT and thus reducing GHG emissions. Variations of this measure are described in Measure T-22-B, *Implement Electric Bikeshare Program*, Measure T-22-C, *Implement Scootershare Program,* and Measure T-22-D, *Transition Conventional to Electric Bikeshare*.

Subsector

Neighborhood Design

Locational Context

Urban, suburban

Scale of Application

Plan/Community

Implementation Requirements

The GHG mitigation potential is based, in part, on literature analyzing docked (i.e., station-based) bikeshare programs. This measure should be applied with caution if using dockless (free-floating) bikeshare.

Cost Considerations

The costs incurred by the service manager (e.g., municipality or bikeshare company) may include the capital costs for purchasing a bicycle fleet; installing accessible and secure docking stations; storing, maintaining, and replacing the fleet; and marketing and administration. Some of these costs may be offset by income generated through program use. Program participants will benefit from the cost savings from access to cheaper transportation alternatives (compared to private vehicles, private bicycles, or use of ride-hailing services). The local municipality may achieve cost savings through a reduction of cars on the road leading to lower infrastructure and roadway maintenance costs.

Expanded Mitigation Options

Best practice is to discount bikeshare membership and dedicate bikeshare parking to encourage use of the service. Also consider including space on the vehicle to store personal items while traveling, such as a basket.

GHG Reduction Formula

This measure methodology does not account for the direct GHG emissions from vehicle travel of program employees picking up and dropping off bikes.

$$A = -1 \times \frac{(C - B) \times D \times E \times F}{G \times H}$$

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A	Percent reduction in GHG emissions from vehicle travel in plan/community	0–0.02	%	calculated
User Inputs				
B	Percent of residences in plan/community with access to bikeshare system without measure	0–100	%	user input
C	Percent of residences in plan/community with access to bikeshare system with measure	0–100	%	user input
Constants, Assumptions, and Available Defaults				
D	Daily bikeshare trips per person	0.021	trips per day per person	MTC 2017
E	Vehicle to bikeshare substitution rate	19.6	%	McQueen et al. 2020
F	Bikeshare average one-way trip length	1.4	miles per trip	Lazarus et al. 2019
G	Daily vehicle trips per person	2.7	trips per day per person	FHWA 2018
H	Regional average one-way vehicle trip length	Table T-10.1	miles per trip	FHWA 2017

Further explanation of key variables:

- (B and C) – Access to bikesharing is measured as the percent of residences in the plan/community within 0.25 mile of a bikeshare station. For dockless bikes, assume that all residences within 0.25 mile of the designated dockless service area would have access.
- (D) – An analysis of bike share service areas in the San Francisco Bay Area estimated that in locations with access to bikesharing, there were between 21 and 25 bikeshare trips per day per 1,000 residents (MTC 2017). To be conservative, the low end of this range is cited.
- (E) – A literature review of several academic and government reports found that the average car trip substitution rate by bikeshare trips was 19.6 percent. This included bikeshare programs in Washington D.C., Minneapolis, and Montreal (McQueen et al. 2020).

- (F) – A case study on average trip lengths for pedal and electric bikeshare programs in San Francisco reported a one-way pedal bikeshare trip of 1.4 miles (Lazarus et al. 2019).
- (G) – A summary report of the 2017 National Household Travel Survey data found that the average person in the U.S. takes 2.7 vehicle trips per day (FHWA 2018).
- (H) – Ideally, the user will calculate auto trip length for a plan/community at a scale no larger than a census tract. Potential data sources include the U.S. Census, California Household Travel Survey (preferred), or local survey efforts. If the user is not able to provide a plan-specific value using one of these data sources, they have the option to input the existing regional average one-way auto trip length for one of the six most populated CBSAs in California, as presented in Table T-10.1 in Appendix C (FHWA 2017). Trip lengths are likely to be longer for areas not covered by the listed CBSAs, which represent the denser areas of the state.

GHG Calculation Caps or Maximums

Measure Maximum

(A_{max}) For projects that use default CBSA data from Table T-10.1, the maximum percent reduction in GHG emissions (A) is 0.02 percent. This maximum scenario is presented in the below example quantification.

Subsector Maximum

($\sum A_{max_{T\text{-}18 \text{ through } T\text{-}22\text{-}D}} \leq 10\%$) This measure is in the Neighborhood Design subsector. This subcategory includes Measures T-18 through T-22-D. The VMT reduction from the combined implementation of all measures within this subsector is capped at 10 percent.

Example GHG Reduction Quantification

The user reduces plan/community VMT by deploying bikesharing throughout the area. In this example, the project is in the Los Angeles-Long Beach-Anaheim CBSA, and the one-way vehicle trip length would be 9.72 miles (H). Assuming 100 percent of residents in the plan/community would have bikeshare access (C) where there was no existing access (B), the user would reduce GHG emissions from plan/community VMT by 0.02 percent.

$$A = -1 \times \frac{(\mathbf{100\% - 0\%}) \times 0.021 \, \frac{\text{trips}}{\text{day}\cdot\text{person}} \times 19.6\% \times 1.4 \, \frac{\text{miles}}{\text{trip}}}{2.7 \, \frac{\text{trips}}{\text{day}\cdot\text{person}} \times 9.72 \, \frac{\text{miles}}{\text{trip}}} = -0.02\%$$

Quantified Co-Benefits

Improved Local Air Quality

The percent reduction in GHG emissions (A) would be the same as the percent reduction in NO_X, CO, NO_2, SO_2, and PM. Reductions in ROG emissions can be calculated by multiplying the percent reduction in GHG emissions (A) by an adjustment factor of 87 percent. See *Adjusting VMT Reductions to Emission Reductions* above for further discussion.

Energy and Fuel Savings

The percent reduction in vehicle fuel consumption would be the same as the percent reduction in GHG emissions (A).

VMT Reductions

The percent reduction in VMT would be the same as the percent reduction in GHG emissions (A).

Sources

- Federal Highway Administration (FHWA). 2017. *National Household Travel Survey–2017 Table Designer*. Travel Day PT by TRPTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021.
- Federal Highway Administration (FHWA). 2018. *Summary of Travel Trends 2017–National Household Travel Survey*. July. Available: https://www.fhwa.dot.gov/policyinformation/documents/2017_nhts_summary_travel_trends.pdf. Accessed: January 2021.
- Lazarus, J., J. Pourquier, F. Feng, H. Hammel, and S. Shaheen. 2019. *Bikesharing Evolution and Expansion: Understanding How Docked and Dockless Models Complement and Compete – A Case Study of San Francisco*. Paper No. 19-02761. Annual Meeting of the Transportation Research Board: Washington, D.C. Available: https://trid.trb.org/view/1572878. Accessed: January 2021.
- McQueen, M., G. Abou-Zeid, J. MacArthur, and K. Clifton. 2020. Transportation Transformation: Is Micromobility Making a Macro Impact on Sustainability? *Journal of Planning Literature*. November. Available: https://doi.org/10.1177/0885412220972696. Accessed: March 2021.
- Metropolitan Transportation Commission (MTC). 2017. *Plan Bay Area 2040 Final Supplemental Report–Travel Modeling Report*. July. Available: http://2040.planbayarea.org/files/2020-02/Travel_Modeling_PBA2040_Supplemental%20Report_7-2017.pdf. Accessed: January 2021.

T-56. Active Modes of Transportation for Youth

GHG Mitigation Potential

22.2%

Up to 22.2% of GHG emissions from school commute vehicle travel

Co-Benefits (icon key on pg. 34)

Climate Resilience

Planning that promotes more active modes of transportation for youth allows children to travel to a safe place more easily during emergencies. This measure could also take more cars off the road, resulting in less traffic and better allowing emergency responders to access a hazardous site during an extreme weather event. Furthermore, increasing youth active transportation modes can have health benefits, improving community resilience.

Health and Equity Considerations

Shifting children's trips to school from private car trips to bus, bicycling, or walking trips promotes consistent physical activity in children. Prioritize underserved areas with lower rates of vehicle ownership or fewer transit options.

Measure Description

This measure accounts for reductions in VMT achieved by projects that provide infrastructure to support any form of active transport among youth. Trips to school and extracurricular activities represent most of the everyday travel taken by youth. Thus, ensuring that children can use active transportation whenever possible can serve to reduce VMT and allow them to get the necessary exercise to live healthy lives.

Safe Routes to Schools (SR2S) provides federal funding for new sidewalks, bike lanes, off-street pathways, and street crossings to help children use active modes of transportation to get to school, bringing health benefits to children, in addition to reductions in VMT from mode-shifts away from private vehicle trips. This is a blanket measure that can cover projects related to all forms of active transport among youth. Methods for this measure were influenced by methodology from CARB (CARB 2023).

Subsector

School Programs

Locational Context

Urban, suburban

Scale of Application

Project/Site

Implementation Requirements

Specific projects that are implemented need not be funded by SR2S or be located at a school; however, one advantage of the program is the requirement for student travel surveys, which provide critical before and after project data, to quantify the effects of the program.

Cost Considerations

Depending on the improvement, capital and infrastructure costs may be high. Eligible projects may be able to utilize federal funding through California's SR2S program. In addition, the local municipality may achieve cost savings through a reduction of cars on the road leading to lower infrastructure and roadway maintenance costs.

Expanded Mitigation Options

When paired with Measure T-40, *Establish a School Bus Program*, students who live beyond walking or biking distance from their school will have an option for lower-emissions transportation to get to school.

GHG Reduction Formula

$$A = C \times F \times \frac{B - D}{G \times E \times (1 - C) + C \times D \times F}$$

GHG Calculation Variables

ID	Parameter	Value	Unit	Source
Output				
A	Percent reduction in GHG emissions from vehicle travel among students within walking/biking distance	0–22.2	%	calculated
User Inputs				
B	Known or estimated percent of students within 2 miles who are driven to school after project implementation	0–100	%	Use survey data – see tools from SR2S
Constants, Assumptions, and Available Defaults				
C	Percent of students living within 2 miles of the school	62	%	SR2S Partnership 2013
D	Percent of students within 2 miles who are driven to school before measure implementation	51	%	SR2S Partnership 2013
E	Percent of students more than 2 miles who are driven to school	66	%	FHWA 2023
F	Average driving distance for students who could walk or bike to school	2	miles	Assumption
G	Average driving distance for students who cannot walk or bike to school (> 2 miles)	8.66	miles	FHWA 2023

Further explanation of key variables:

- (B) – This is the percentage of students who could walk or bike to school who are driven to school after the project implementation. An informed estimate could be used if calculating reductions for a future project; however, survey data after the fact will provide the most accurate result.
- (C) – It is estimated in SR2S Partnership's 2013 report that 62 percent of students live within 2 miles of their school. The assumption that students are not willing to bike or walk longer than 2 miles is a simplification that makes it easier to exclude students who could not have benefited from infrastructure or programming that encourages walking and biking to school. If survey data are available, users should select a value that is representative of the school, school district, or youth center where the project is being implemented.
- (D) – This represents the percentage of students who live within 2 miles from school but are driven to school nonetheless. This value is from the statewide average, but a local-specific value should be used if that is available for the school or school district.

- (E) – This represents the percentage of students outside of the 2-mile radius who are driven to school. This value is derived from 2022 NHTS data, but a local value should be used instead if it is available.
- (F) – This value represents the average driving distance for students who could walk or bike to school. This is based on the earlier assertion that students would not be willing to travel more than 2 miles by bike or on foot to school. If survey data are available, users should select a value that is representative of the school, school district, or youth center where the project is being implemented.
- (G) – Using 2022 NHTS data, it is estimated that the average driving distance for students who cannot walk or bike to school is 8.66 miles. If more local data is available for the school area, use that value instead.

GHG Calculation Caps or Maximums

Measure Maximum

(A_{max}) The percent reduction in GHG emissions (A) is capped at 22.2 percent. The benefits are unlikely to be this high because this level assumes that all students who could walk or bike to school start doing so.

Subsector Maximum

($\sum A_{max_{T\text{-}40 \,\&\, T\text{-}56}} \leq 57\%$) This measure is in the School Programs subsector. This subcategory includes Measures T-40 and T-56 at the Project/Site scale of application. The school trip VMT reduction from the combined implementation of all measures within this subsector is capped at 57 percent. The reduction percentage for this measure is applicable to the School Programs subsector, which includes school commute trips. If users would like to apply the reduction percentage to community-wide emissions, the reductions can be converted to community-scale reductions by multiplying the reduction percentage by 1.64 percent (FHWA 2023).

Example GHG Reduction Quantification

A school installs a new raised pedestrian crossing in combination with an outreach program that brings children to school as part of a walking school bus. After this program is implemented, the percentage of students within 2 miles of school who are driven to school drops to 20 percent (B). This would lead to a reduction in GHG emissions from school trips of 13.5 percent.

$$A = 62\% \times 2\text{ mi} \times \frac{\mathbf{20\%} - 51\%}{8.66\text{ mi} \times 66\%\ (1 - 62\%) + 62\% \times 51\% \times 2\text{ mi}} = -13.5\%$$

Quantified Co-Benefits

Improved Air Quality

The percent reduction in GHG emissions (A) would be the same as the percent reduction in NOx, CO, NO_2, SO_2, and PM. Reductions in ROG emissions can be calculated by multiplying the percent reduction in GHG emissions (A) by an adjustment factor of 87 percent. See *Adjusting VMT Reductions to Emission Reductions* for further discussion.

Energy and Fuel Savings

The percent reduction in vehicle fuel consumption achieved by the measure would be the same as the percent reduction in GHG emissions (A).

VMT Reductions

The percent reduction in VMT achieved by the measure would be the same as the percent reduction in GHG emissions (A).

Sources

- California Air Resources Board (CARB). 2023. Clean Mobility Benefits Quantification Methodology. Available: https://ww2.arb.ca.gov/sites/default/files/auction-proceeds/carb_clean-mobility-qm_draft_july2023.pdf. Accessed: August 2023.
- Federal Highway Administration (FWHA). 2023. 2022 National Household Travel Survey. Available: https://nhts.ornl.gov/.Accessed: December 2023.
- Safe Routes to School National Partnership (SR2S Partnership). 2013. Travel to School in California: Key Findings from the National Household Travel Survey. Available: https://saferoutespartnership.org/sites/default/files/pdf/Travel%20to%20School%20in%20California%20Policy%20Brief%20PAGES.pdf. Accessed: December 2023.

Table T-10.1. Average One-Way Bicycle and Vehicle Trip Length of All Trips by California Core-Based Statistical Area

Core-Based Statistical Area	Trip Length (miles)	
	Bicycle	Vehicle
Los Angeles-Long Beach-Anaheim	1.7	9.7
Riverside-San Bernardino-Ontario	2.2	11.7
Sacramento-Roseville-Arden-Arcade	2.9	10.9
San Diego-Carlsbad	2.0	19.1
San Francisco-Oakland-Hayward	2.1	12.4
San Jose-Sunnyvale-Santa Clara	2.8	11.5

Source: Federal Highway Administration. 2017. National Household Travel Survey – 2017 Table Designer. Travel Day PT by TRPTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021.

Table T-10.2. Average Bicycle and Vehicle Mode Share of Work Trips by California Core-Based Statistical Area

Core-Based Statistical Area	Mode Share	
	Bicycle	Vehicle
Los Angeles-Long Beach-Anaheim	1.0%	90.7%
Riverside-San Bernardino-Ontario	0.4%	95.3%
Sacramento-Roseville-Arden-Arcade	2.2%	89.5%
San Diego-Carlsbad	1.3%	91.8%
San Francisco-Oakland-Hayward	2.8%	67.1%
San Jose-Sunnyvale-Santa Clara	4.1%	86.6%

Source: Federal Highway Administration. 2017. National Household Travel Survey – 2017 Table Designer. Workers by WRKTRANS by HH_CBSA. Available: https://nhts.ornl.gov/. Accessed: January 2021.

Table T-11.1. Average One-Way Vehicle Commute Trip[1] Length by California Core-Based Statistical Area

Core-Based Statistical Area	Vehicle Trip Length (miles)
Los Angeles-Long Beach-Anaheim	14.07
Riverside-San Bernardino-Ontario	18.62
Sacramento-Roseville-Arden-Arcade	14.23
San Diego-Carlsbad	14.52
San Francisco-Oakland-Hayward	15.63
San Jose-Sunnyvale-Santa Clara	12.44

Source: Federal Highway Administration. 2017. National Household Travel Survey – 2017 Table Designer. Travel Day VT by HH_CBSA by TRPTRANS by TRIPPURP. Available: https://nhts.ornl.gov/. Accessed: January 2021.

[1]Trips included in this dataset were for work-related trips (HBW).