City of Escondido VMT Exchange Program Documentation – Public Review Draft

Prepared for:
City of Escondido

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FEHR PEERS

Table of Contents

Appendices

List of Tables

Program Overview

Introduction

The following VMT Exchange Program Documentation provides the City of Escondido (City) with the technical basis for implementation of a VMT Exchange program to provide VMT mitigation options to projects with transportation VMT impacts. The VMT Exchange program provides a list of community-based transportation projects and programs that can be selected to be full or partial mitigation for a transportation VMT impact pursuant to the California Environmental Quality Act (CEQA). The program has co-benefits in that it supports the City's future transportation needs and assists the City in reaching its Climate Action Plan (CAP) goals.

The Program offers a variety of VMT reducing projects and programs, such as constructing bicycle and pedestrian facilities, improving transit stops, funding a City run circulator shuttle, and funding commute trip reducing programs for City staff and residents/employees within Escondido. The program will be implemented over time and the projects available for VMT mitigation will be expanded as city resources and/or new options become available. The initial program offers applicants the ability to construct City bicycle, pedestrian, and transit supportive infrastructure in exchange for VMT reduction that can be applied to their project. In the future, additional mitigation options such as a circulator shuttle and commute trip reduction programs may become available.

The VMT Exchange Program projects and programs are not already part of funded programs; therefore, meet the concept of additionality[1] – these projects/programs are in addition to what would have been implemented through other planning and capital improvement programs.

The VMT Exchange Program is a voluntary program that is designed to offer discretionary projects an option for reducing transportation VMT impacts either to less than significant or by providing mitigation to the extent feasible. A discretionary project with a significant transportation VMT impact may also choose to mitigate the impact using site specific mitigation measures outside of the VMT Exchange Program or a combination of site-specific measures plus use of the VMT Exchange Program.

The project/program list provided in the document is a live table that will be updated periodically to reflect the addition of VMT reducing projects and/or to reflect current research on the project/program's effectiveness at reducing VMT.

[1] Additionality is the requirement that the VMT reductions/exchange program projects would not have occurred absent inclusion in the exchange program. Additional information is provided in the UC Berkely publication, "Implementing SB 743, An Analysis of Vehicle Miles Traveled Banking and Exchange Frameworks," August 2018.

Background

SB 743 was made into law in 2013 fundamentally changing transportation impact analysis required for CEQA compliance. According to the new law, vehicle miles of travel (VMT) replaced auto level of service (LOS) and other similar measures of vehicular capacity or traffic congestion for determining significant impacts.

Transportation Demand Management (TDM) strategies have traditionally been utilized to change travel behavior as a way of reducing VMT. TDMs are generally most effective in urban areas where a project site is accessible through multiple travel modes (i.e., walking, bicycling, transit, and personal micro-mobility vehicles) offering similar travel times and convenience. On the other hand, TDM strategies are less effective in low-density suburban and rural areas where travel modes are more reliant upon personal automobiles. In these types of areas, a program-based approach to mitigation is typically more effective than applying strategies to a project site only. Following is a review of three common program-based approaches[2]:

- **Transportation Impact Fee Program** – is a traditional impact fee program in compliance with the Mitigation Fee Act[3]. The nexus for the fee program would be a VMT reduction goal consistent with the CEQA threshold established by a lead agency for SB 743 purposes. The City of Los Angeles is the first city in California to complete a nexus study for this type of program. The main difference from a fee program based on a metric such as vehicle level of service (LOS) is that the VMT reduction nexus results in a capital improvement program (CIP) consisting largely of transit, bicycle, and pedestrian projects. These types of fee programs are time-consuming to develop, monitor, and maintain but are recognized as an acceptable form of CEQA mitigation if they can demonstrate that the CIP projects will be fully funded and implemented.
- **VMT Mitigation Exchange** – relies on a developer agreeing to implement a predetermined VMT reducing project or proposing a new one. The project may be located in the vicinity of the project or elsewhere in the community, and possibly outside the community. The Exchange needs to have a facilitating entity that can match the VMT generator (the development project) with a VMT reducing project or action. The facilitating entity could be the lead agency or another entity that can provide the match and ensure through substantial evidence that the VMT reduction is valid. This option provides the most flexibility for mitigation project selection and is also the least complex to set up. Implementation is completed on a project-by-project basis, similar to typical mitigation measures.

  VMT Mitigation Bank – attempts to create a monetary value for VMT reduction such that a developer could purchase VMT reduction credits. The money exchanged for credits could be

[2] For more detail on each program, see VMT Mitigation Through Banks and Exchanges Understanding New Mitigation Approaches, Fehr & Peers, January 2020 (Draft)

[3] The Mitigation Fee Act: (Gov. Code, §66000) establishes requirements for local entities when imposing development fees.
https://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=GOV&division=1.&title=7.&part=&chapter=5.&article=

applied to local, regional, or state-level VMT reduction projects or actions. Like all VMT mitigation, substantial evidence would be necessary that the projects covered by the Bank would achieve expected VMT reductions and some form of monitoring may be required. This is more complicated than a simple exchange and requires more time and effort to set up and implement. The verification of how much VMT reduction is associated with each dollar or credit and tracking mitigation completion are more difficult parts of the program.

The option that best fits the needs of Escondido currently is an exchange program. The City will serve as the facilitating entity and will be responsible for administering the program and verifying that the agreed upon exchange projects are completed.

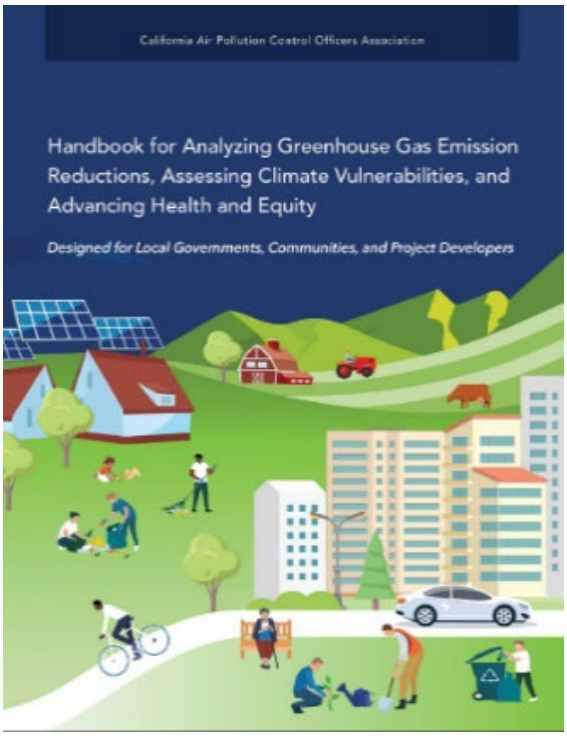
Project Identification

Selected projects in this program reflect the most recent development patterns in the area as well as the policy direction set in the City's General Plan and other planning documents. All selected projects are estimated to result in a reduction in the number of vehicle trips in their area of influence or target population.

Following is a list of planning documents reviewed that assisted in developing the initial VMT exchange program project/program list:

- General Plan (2012)
- Climate Action Plan (2021)
- Bicycle Master Plan (2012)
- Capital Improvement Program (2021-2022)
- Downtown Specific Plan (2013)
- Village Specific Plan (2017)
- East Valley Specific Plan – Draft (2021)
- Escondido Creek Trail Master Plan (2012)
- El Caballo Park Master Plan (2014)
- Grape Day Park Master Plan – Draft (2015)
- North County Transit District Project List (2021)
- Caltrans North County Project List (2021)

Nexus Methodology



The purpose of the nexus analysis is to:

- Provide justification for creating the VMT exchange program.
- Establish the relationship between the VMT exchange program individual projects/programs and the VMT reductions associated.

The VMT Exchange Program is a voluntary program that provides VMT mitigation options to discretionary development projects that have a significant transportation VMT impact. The individual exchange projects/programs listed in this VMT Exchange Program reduce existing citywide VMT, offsetting a significant environmental impact due to the increase in VMT caused by a particular development project. Therefore, there is a direct benefit to the development project applicant utilizing the program to reduce the development project's significant transportation VMT impact. In addition, the program offers opportunities to reduce VMT through

encouragement of active transportation, transit use and other VMT reducing strategies near population centers, where they can serve the largest community benefit. Encouraging active transportation is also one of the legislative intents of SB 743.

The program establishes quantifiable benefits associated with VMT reduction strategies. There are several resources for determining the reduction in VMT associated with the individual projects/programs in this VMT Exchange Program. For this VMT Exchange Program, the VMT reduction for each individual project/program is calculated based on the California Air Pollution Control Officers (*CAPCOA) 2021 Handbook for Analyzing Greenhouse Gas Emission Reduction, Assessing Climate Vulnerabilities, and Advancing Health and Equity (GHG Handbook)*. The GHG Handbook provides the most current collection of research and documentation on TDM effectiveness at reducing VMT. In addition, the program references research compiled for the first version of the CAPCOA GHG Handbook (*Quantifying Greenhouse Gas Mitigation Measures*, 2010).

This study is designed to provide the necessary technical analysis to support the estimated VMT reductions. Technical information provided should be maintained and reviewed periodically to ensure that it reflects current planning documents, new potential projects/programs, updated TDM research, and updates to the SANDAG Regional Travel Model. Selected output from the SANDAG Regional Travel Demand Model (Activity Based Model 2+, Base Year, Regional Plan Version) was used in the TDM effectiveness calculations.

During the periodic review process, City staff will administratively incorporate minor amendments to the exchange project list such as adding new bicycle, pedestrian, or transit exchange projects. Adding new programs (such as those described for future updates including a citywide commute trip reduction program or circulator shuttle service) are considered major amendments that would require City Council approval.

Funds collected for projects/programs identified in this VMT Exchange Program cannot be used for maintenance of existing facilities. All project/programs listed in this exchange program are additional to the roadway network; they do not exist today and are not contained in a funded improvement program. Note that upgrading an existing facility beyond standard requirements is an eligible project of this VMT Exchange Program.

VMT Exchange Program: Individual Projects/Programs

This section provides a description of the VMT reducing project and program types included in this VMT Exchange Program. The projects are separated into two categories: Early Action and Future. Initially, only bicycle, pedestrian, and transit supportive infrastructure/capital projects will be available as part of this exchange program. Once the program is established and additional City staff resources are available, other types of VMT reduction programs (circulator shuttle, commute trip reduction programs, etc.) may be offered. A sample of these future projects/programs are discussed in the "Future Exchange Program Options" section of this document.

Process for Selecting an Exchange Project

The process for a developer to choose a project or program from the list is as follows:

1. Communicate with Development Services Staff that the development project has a significant transportation VMT impact, as indicated in the completed Scoping Agreement, and that the applicant would like to utilize the Exchange Program for full or partial mitigation of the impact.
2. Development Services Staff will discuss options with the applicant. The available VMT reducing projects from the Exchange will be reviewed and identified based on feasibility and considering the following priorities:
    a. The exchange project is near the development project (within a ½ mile travel distance from the development project) and connects the project or existing community to an existing pedestrian, bicycle or transit corridor.
    b. If an exchange project that meets priority (a) cannot be identified, identify an exchange project that facilitates bicycle or pedestrian access to a key destination (park, school, community center, shopping) within ½ mile travel distance from the development project.
    c. If an exchange project that meets priorities (a) and (b) cannot be identified,, then expand the geography to citywide, first identifying an exchange project that connects existing communities to an existing pedestrian, bicycle or transit corridor and then expanding to an exchange project that facilitates bicycle or pedestrian access to a key destination (park, school, community center, shopping).

Implementation of an Exchange Project

VMT-reducing projects that an applicant voluntarily elects to implement would be adopted as mitigation measures in the CEQA environmental review document for the applicable project. The program would require that VMT-reducing projects be completed as a condition of project approval by the applicant before issuance of a building permit. Ongoing monitoring and tracking of the implementation of VMT-

reducing projects would be included in the City's annual climate action plan (CAP) implementation status report.

Early Action Exchange Program Projects

Table 1 provides the list of individual projects/programs, associated VMT reduction, and approximate construction costs for the early action exchange projects. **Appendix A** provides detailed calculation worksheets for each reduction strategy.

Pedestrian Network Projects

1. Increase Sidewalk Coverage

The objective of this measure is to increase access to surrounding land uses by providing new sidewalks, pedestrian bridges, and multi-use paths. A list of specific sidewalk project opportunities located near school areas and high activity pedestrian areas are identified and included in the Exchange Program.

Developers may select locations other than ones identified in this document; however, selected locations must be reviewed by the City Staff before applying VMT reductions to ensure that they are comparable to locations identified in this document and would result in increased pedestrian activity and meet the priority conditions stated above.

Note: While not a part of the VMT Exchange Program, development projects may take VMT reduction credit for construction of sidewalk along the project frontage (exterior edges of the project) if the new sidewalk fills a gap in the pedestrian network such that pedestrian connectivity is created. Sidewalks that are wholly contained within a development project (and therefore only serve the development project) are not eligible for VMT credit as part of the exchange program.

2. Improve Existing Pedestrian Infrastructure

The objective of this measure is to improve the existing pedestrian network through the implementation of measures that improve walking safety and quality that encourage people to walk instead of drive.

Such measures include installation of High-Visibility Crosswalks (HVC), pedestrian hybrid beacons, pedestrian signals, mid-block crosswalks, pedestrian refuge islands, speed tables, bulb-outs (curb extensions), curb ramps (at all corners of an intersection), roundabouts and mini-circles, pedestrian-only connections and districts, and planter strips with street trees (minimum 1 mile). Applicants must also demonstrate that the implementation of select measures will benefit a location that has existing pedestrian activity in consultation with City staff per the priority conditions stated above.

Applicants may propose pedestrian improvements other than the measures provided above, however, the applicant will need to demonstrate how the improvement encourages walking and may need to provide a VMT reduction study to justify the VMT reduction applied, if different from Table 1.

Bicycle Network Improvements

3. Increase Bike Facility Coverage

The objective of this measure is to increase access to surrounding land uses by increasing the number bicycle facilities or quality of existing bicycle facilities. Applicants may select a location from the bicycle network gaps/opportunities identified in the 2012 Bicycle Master Plan or any other planning document (General Plan, Specific Plan, …)if the selected location is not already funded by a different source. The City may require the applicant to provide evidence on how the construction of the proposed bicycle facility will connect existing bicycle facilities or land use origins/destinations per the priorities established above such that the project would be anticipated to increase bicycling and thereby resulting in reducing VMT.

Note: While not a part of the VMT Exchange Program, development projects may take VMT reduction credit for construction of bike lanes along the project frontage (exterior edges of the project) if the new bike lanes fill a gap in the bicycle network such that bicycle connectivity is created. Bicycle facilities that are wholly contained within a development project (and therefore only serve the development project) are not eligible for VMT credit as part of the exchange program.

Transit Supportive Improvements

4. Upgrade Bus Stops

The objective of this measure is to improve the quality of bus service by providing bus shelter improvements such as lighting, transit route information, bicycle racks/lockers, benches, shelters or other improvements that help enhance the bus service user's comfort and experience. VMT reduction for such improvements should meet North County Transit District's (NCTD's) standards for providing a bus shelter (NCTD Bus Stop Development Handbook, March 2018[4]) or receive approval from NCTD. The selected bus shelter locations shall be identified through consultation with City and NCTD Staff and/or selected from the locations included on NCTD's priority list (to the extent that the list is available).

NORTH COUNTY TRANSIT DISTRICT — Section 3: Bus Stop Guidelines

	Required Amenities	Recommended Amenities	Optional Amenities
Shelter Stops	• Bus stop sign • ADA accessible pad • Bench • Shelter • Connection to adjacent sidewalks/pathways • Trash receptacle	• Lighting • Bicycle racks/lockers • Transit route information • Screening from sun / elements (landscaping) • Transit system information	• Digital messaging signs

[4] https://lfportal.nctd.org/weblink/0/edoc/118390/2018%20Bus%20Stop%20Development%20Handbook.pdf

Table 1: VMT Exchange Program Early Action Project List

#	Project	Unit	Daily VMT Reduction	Cost [a] (Actual costs will vary based on site conditions)
Pedestrian Network Improvements				
1. Increase Sidewalk Coverage				
1.1	Rose Elementary: E. Lincoln Avenue between N. Rose Street and Thomas Way (North side)	850 feet	49 VMT	$170,000
1.2	Rose Elementary: N. Rose Street between E. Lincoln Avenue and E. El Norte Parkway (East side)	1750 feet	101 VMT	$349,000
1.3	Rincon Middle School: Conway Drive between Rincon Avenue and Lehner Avenue (Both side)	3800 feet	219 VMT	$756,000
1.4	Rincon Middle School: N. Ash Street between Spur Court to the City Limits (Both sides)	2250 feet	130 VMT	$448,000
1.5	Felicita Elementary: S. Redwood Street between 13th Avenue and 15th Avenue (West side)	700 feet	41 VMT	$140,000
1.6	Felicita Elementary: S. Redwood Street between 15th and W. Felicita Avenue (Both sides)	1150 feet	66 VMT	$229,000
1.7	Felicita Elementary: 15th Avenue between Tulip Street and Centre City Parkway (Both sides)	2250 feet	130 VMT	$448,000
1.8	Felicita Elementary: 13th Avenue between S. Redwood Street and South Quince Street (South sides)	400 feet	23 VMT	$80,000
1.9	Hidden Valley Middle School: S. Citrus Avenue between La Ramada Lane and Patterson Road (East side)	950 feet	55 VMT	$189,000
1.10	Farr Elementary: Farr Avenue between North Ash St and North Fig Str (North side)	1100 feet	64 VMT	$219,000
1.11	Conway Elementary School: Sheridan Avenue between N. Ash Street and Fallsview Place (North sides)	950 feet	55 VMT	$189,000
1.12	Escondido High School: Sheridan Avenue between Taft Street and N. Elm Street (Both sides)	2100 feet	121 VMT	$418,000
1.13	Calvin Christian School: Vista Avenue between N. Ash Street and Bello Hills Lane (South side)	920 feet	53 VMT	$183,000
1.14	N. Ash Street between Rincon Avenue and Madison Avenue	Various	303 VMT per 1 mile of new sidewalk	$1,050,000 per 1 mile
1.15	Stanley Avenue between N. Broadway Street and Conway Street	Various	303 VMT per 1 mile of new sidewalk	$1,050,000 per 1 mile

Table 1: VMT Exchange Program Early Action Project List

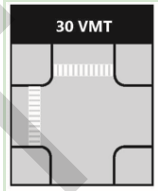
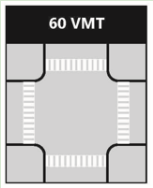
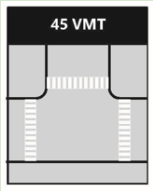
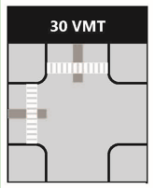
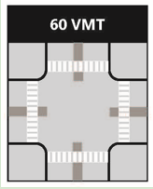
#	Project	Unit	Daily VMT Reduction	Cost [a] (Actual costs will vary based on site conditions)
1.16	Other locations [b]	Various	303 VMT per 1 mile of new sidewalk	$1,050,000 per 1 mile
2. Improve Existing Pedestrian Infrastructure				
2.1	Intersection High-Visibility Crosswalks (HVC)	2 legs striped as HVC	30 VMT 	$5,000-$10,000
		4 legs striped as HVC	60 VMT 	
		3 legs striped as HVC for T-intersection	45 VMT 	
2.2	Intersection Pedestrian Refuge Islands	2 Islands	30 VMT 	$20,000-$60,000
		4 islands	60 VMT 	

Table 1: VMT Exchange Program Early Action Project List

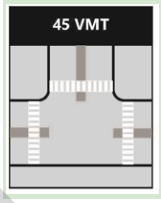
#	Project	Unit	Daily VMT Reduction	Cost [a] (Actual costs will vary based on site conditions)
		3 islands for T-Intersection	45 VMT 	
2.3	Intersection Raised Crosswalk (If HVC are also installed, VMT reduction is NOT doubled)*	2 raised crosswalks	30 VMT (See 2.1 for image)	$20,000-$60,000
		4 raised crosswalks	60 VMT (See 2.1 for image)	
		3 raised crosswalks for T-Intersection	45 VMT (See 2.1 for image)	
2.4	Intersection Pedestrian Signal Upgrades (countdown pedestrian heads plus accessible pedestrian signals (APS))	1 Intersection Upgrade (whole intersection)	60 VMT per intersection	Varies
2.5	Install Intersection Curb Ramps (Directional Ramps Preferred).	1 Corner	8 VMT per corner improved	$10,000

Table 1: VMT Exchange Program Early Action Project List

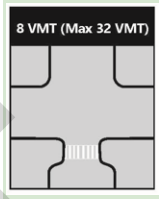
#	Project	Unit	Daily VMT Reduction	Cost [a] (Actual costs will vary based on site conditions)
2.6	Install Curb-Extensions (bulb-outs).	1 Intersection Approach	8 VMT per intersection approach. 32 VMT Max. 	Varies based on location and drainage considerations
2.7	Upgrade Existing or Install New Mid-Block Crossing with HVC and Rapid Rectangular Flashing Beacons (RRFBs)/Pedestrian Hybrid Beacon (PHB) (or other pedestrian activated crossing signals) as determined appropriate by the City's Crosswalk Policy	1 HVC Mid-Block Crossing with RRFB or PHB	30 VMT per mid-block crossing with RRFB or PHB	$30,000-$50,000
2.8	Mid-Block Crossing Pedestrian Refuge Island and other improvements as determined appropriate by the City's Crosswalk Policy.	1 Island	30 VMT per unit	$10,000-20,000
2.9	Mid-Block Crossing Raised Crosswalk and other improvements as determined appropriate by the City's Crosswalk Policy	1 Raised Crosswalk	30 VMT per unit	$10,000-20,000

Table 1: VMT Exchange Program Early Action Project List

#	Project	Unit	Daily VMT Reduction	Cost [a] (Actual costs will vary based on site conditions)
2.10	Traffic calming (traffic circles, speed tables, other speed reduction features) as identified in the City's Traffic Management Toolbox[5]	Each device	30 VMT per each device (max 60 VMT per block)	Varies
2.11	Other pedestrian improvements may be identified through consultation with City staff.	1 measure	30 VMT per measure as reviewed/ approved by City Staff	Varies by measure
Bicycle Network Improvements				
3. Increase Bike Facility Coverage				
3.1	New Class I or Class IV Bikeway	1 mile (bi-directional)	107 VMT	Varies
3.2	New Class II Bike Lane	1 mile (bi-directional)	71 VMT	Varies
3.3	Upgrade Bicycle facility from (Class II to Class I or IV; Class III to Class I, II, or IV)	1 mile (bi-directional)	36 VMT	Varies
Transit Supportive Improvements				
4. Upgrade Bus Stops				
4.1	Upgrade an Existing Bench Stop to Shelter Stop if all NCTD criteria are met). Upgrade must include all required amenities for shelter stops per the NCTD Bus Stop Development Book.	1 upgrade	50 VMT	$10,000-25,000 per shelter

[5] https://www.escondido.org/Data/Sites/1/media/Engineering/TrafficManagementToolbox.pdf

Table 1: VMT Exchange Program Early Action Project List

#	Project	Unit	Daily VMT Reduction	Cost [a] (Actual costs will vary based on site conditions)

a. Cost associated to each improvement is estimated based on historical data and previous projects that Fehr and Peers has conducted around the San Diego Region. Actual costs will vary based on site specific conditions.
b. Selected location must be reviewed by City staff to ensure that VMT benefits are comparable to similar locations identified by the City.

Future Exchange Program Options

The following provides a summary of additional TDM-type programs/projects that the City could consider integrating into the exchange program based on demand for exchange projects and as time/resources are available. Including these items into the exchange program will require additional evaluation to determine the implementation logistics and to develop the mechanism for the City to collect and ensure long-term funding for these purposes.

Table 2 summarizes possible programs/projects to include in the exchange program with initial estimates of VMT reduction and cost of these options.

Trip Reduction Marketing

1. Implement Trip Reduction Marketing (Future)

The objective of this measure is to fund programs that aim to reduce VMT and GHG emissions through education and marketing of trip reduction strategies. Following is a selection of example programs that could apply to the City of Escondido:

- Marketing programs (e.g. Escondido Transport Options campaign) focusing on educating and informing commuters on the benefits of alternative travel options (carpooling, transit, walking, biking, …).
- Programs that provide information on commuting resources through digital/online platforms (e.g. Install strategically located kiosks with information on commute alternatives or/and use wayfinding applications or newsletters to share commute information).
- Periodic regional events that promote and encourage commute alternatives to driving alone, such as Bike to Work Month, Dump the Pump, Rideshare Week, Walk and Bike to School Day, and other similar events.

Applicants would provide general funding to the City for the administration and management of trip reduction marketing to City residents and employees.

2. Fund City Employee Trip Reduction Program (Future)

The City could administer and manage a trip reduction program specifically designed to reduce driving by city staff. Applicants would provide general funding to the City for the program. The program could include ride-share matching, free-ride-home programs, commute trip planning services, commute "gamification[6]"/incentives for not driving, etc. Public Transit/Shuttle Improvement

[6] Gamification is the application of typical elements of game playing (e.g. point scoring, competition with others, rules of play) to other areas of activity, typically as a technique to encourage participation.

3. Downtown Escondido On-Demand Shuttle (Future)

The objective of this measure is to provide funding for the upfront capital investment and continued operation of a Downtown Escondido on-demand shuttle. The service could provide zero-emission electric vehicles for on-demand free rides around the downtown area. Beyond an initial capital investment, the program requires continuous funding per month to stay operational.

Table 2: VMT Exchange Program Future Programs

#	Project	Unit	Daily VMT Reduction	Estimated Cost
Trip Reduction Marketing				
1. Implement Trip Reduction Marketing				
1.1	Fund marketing programs (e.g. Escondido Transport Options campaign) that focuses on educating and informing commuters on alternative travel options (carpooling, transit, walking, biking, …).	Employee (1-year program – funding for 30 years[7])	Varies	$3,450 per VMT [a] $115 per VMT per year
1.2	Fund programs that provide information on commuting resources though digital/online platforms (e.g. Install strategically located kiosks with information on commute alternatives or/and use way finding applications or newsletters to share commute information).	Employee (1-year program – funding for 30 years)	Varies	$3,450 per VMT [a] $115 per VMT per year
1.3	Fund annual regional events that promote and encourage commute alternatives to driving alone such as Bike to Work Month, Dump the Pump, Rideshare Week, Walk and Bike to School Day, and other similar events.	Employee (1-year program – funding for 30 years)	Varies	$3,450 per VMT [a] $115 per VMT per year
2. Fund City Employee Trip Reduction Program				
2.1	Fund programs that incentivize City employees to commute using alternative modes of transportation.	Employee (1-year program – funding for 30 years)	Varies	$3,450 per VMT [a] $115 per VMT per year
Shuttle Improvement				
3. Downtown Escondido On-Demand Shuttle				
3.1	Fund a program that increase access within downtown are during peak commute hours through implementation of intra-city shuttles that run within the downtown area [c]	minimum 2 shuttles for 1 month – funding for 1 year	Varies (Each shuttle reduces 26 daily VMT)	$4,900 per shuttle per month [b] ($4,524 per VMT)

[7] 30 years was used as a timeframe because it is a common planning horizon and commonly used in CEQA mitigation and monitoring programs for monitoring mitigation measures.

Table 2: VMT Exchange Program Future Programs

#	Project	Unit	Daily VMT Reduction	Estimated Cost

a. City of Escondido has approximately 700 staff and employees. Assuming one support staff to run the program ($75,000 salary + benefits) and average of $50 per employee marketing material, the city would require funding of approximately $110,000 to operate the program each year, which results in (700 x 1.37 VMT reduction per employee) 959 daily VMT reduction. Average cost to reduce 1 daily VMT is calculated at $115 for 1 year. For a 30-year program, the cost is $3,450 ($115*30 years).

b. According to a 2019 article on the San Diego Union-Tribune ([update]), City of San Diego operates a 22 all-electric vehicle service (FRED) that moves people around the San Diego downtown area for free, the service was reported to move an average of 17,500 passengers per month (27 passengers served per day per shuttle). The average cost of operation is also reported at $6 per passenger or $4,900 per month per shuttle (27 passengers*$6/day*30days). According to SANDAG Regional Model, trips that occur within Escondido downtown area have an average length of approximately 0.5 mile per trip. Assuming that trips occur by single-occupant vehicles, 26 VMT translates to 52 individual passengers that could be served by minimum 2 shuttles. This results in a cost of $4,900 per month reducing 13 daily VMT per shuttle = $377/month to reduce 1 daily VMT. If the program requires funding the shuttle for 1 year, the cost is $4,524 per VMT ($377*12 months per year).

Using the Exchange Program

This section provides instructions to applicants on utilizing the VMT Exchange program, defined variables necessary to perform the calculations, and provides a sample calculation.

Process for Using the Exchange Program

1. Perform Transportation VMT Analysis

- Determine VMT/capita, VMT/Employee, or Total VMT (depending on project type).
- Perform impact analsyis to determine if there is a significant VMT impact. If there is an impact, move to Step 2.

2. Apply On-Site Mitigation Measures

- Identify any on-site mitigation measures through consultation with City staff.
- Calculate their effectiveness at reducing the project's VMT.
- If after applying on-site measures there is still a significant impact, move to Step 3.

3. Calculate amount of VMT needed to reduce the impact.

- For residential and employment projects that use an efficiency metric (i.e. VMT/capita or VMT/employee), a calculation must be performed to determine how much total VMT reduction would be needed to meet the VMT threshold.
- To calculate the amount of VMT reduction needed, use standard persons per household and standard number of employees as defined in the section below. Multiply the project VMT/capita or VMT/employee by the standard to get a total VMT value. Multipy the threshold by the same standard to get the total VMT needed to meet the threshold. The difference in these two values is the amount of VMT reduction needed to elminate the VMT impact.
- For a project that uses "total VMT" as the threshold, any amount of total VMT above existing VMT needs to be reduced.
- Move to Step 4.

4. Choose VMT Exchange Projects/Programs

- Select projects or programs from the VMT Exchange, Table 1 that total the amount of VMT needed to reduce the project impact (or that reduce the impact to the extent feasible).

Standard Household Size and Number of Employees

The following standard values will be applicable to all projects utilizing the VMT Exchange Program. The values will be reviewed and updated periodically.

Standard Household Size

The average household size in Escondido as reported in the City's 2021-2029 Housing Element (March 2021) is 3.21 persons per household (US Census Bureau American Community Survey 2014-2018). For purposes of the VMT Exchange Program, the average number of bedrooms per household is two (2). Therefore, the average number of people per bedroom is 1.6. The following persons per household should be applied to perform the VMT reduction needed calculation in Step 3:

- Studio: 1.0 persons per unit
- Single/Multi-Family Residences: 1.6 persons per bedroom or 3.2 persons per unit – whichever results in a lower population.

Standard Number of Employees by Employment Use

SANDAG uses a standard number of employees per square foot of employment use, provided by use. For purposes of calculating expected number of employees for purposes of applying the VMT Exchange Program, the SANDAG data will be used. A sample of commonly used employment types is provided below (see Attachment B for a comprehensive list of employment uses):

- Hotel (Low-Rise): 1,600 square feet per employee
- Light Industrial: 600 square feet per employee
- Low Rise Office (less than or equal to 100,000SF): 450 square feet per employee

Sample Calculation

The following provides a sample calculation for using the VMT Exchange Program

1. Perfrom Transportation VMT Analysis

- Sample Project: 80 residential units, VMT/capita is 19.5 and the VMT threshold is 16.2 VMT/capita.
- The project VMT>threshold; therefore, the project has a significant impact.

2. Apply On-Site Mitigation Measures

- Project identified on-site mitigation measures that reduces the VMT by 7.2%.
- Applying the 7.2% reduction results in a mitigated VMT/capita of 18.1.
- The mitigated VMT/Capita>threshold; therefore, the project still has a significant impact.

3. Calculate amount of VMT needed to reduce the impact.

- The expected project population is: 80 units*3.2 people per unit = 256
- 256 people * 18.1 VMT/capita = 4,634 VMT
- 256 people * 16.2 VMT/capita threshold = 4,147 VMT to meet threshold
- Difference: 4,634-4,147 = 487 VMT needed to achive full mitigation

4. Choose VMT Exchange Projects/Programs

- Select items from the VMT exchange that total 487 VMT
  - 1 mile of sidewalk: 303 VMT
  - 2 bus stop upgrades: 100 VMT
  - 1 mid-block crosswalk: 30 VMT
  - Install curb ramps on 4 corners of an intersection: 60 VMT
  - TOTAL: 493 VMT > 487 VMT - full mitigation achieved

Appendix A
VMT Reduction Calculations

Early Action Exchange Program Projects

Pedestrian Network Improvements

1. Increase sidewalk coverage

Source:

- *Handbook for Analyzing Greenhouse Gas Emission Reduction, Assessing Climate Vulnerabilities, and Advancing Health and Equity (GHG Handbook), 2021, Measure T-18*

$$A = \left(\frac{C}{B} - 1\right) \times D = \left(\frac{15.5 \text{ mile}}{14.5 \text{ mile}} - 1\right) \times -0.05 \approx -0.34\%$$

Parameter		Quantity
A	Percent reduction of VMT (Max allowed = 6.4%)	
B	Average sidewalk length in 0.6-mile radius in the City of Escondido[1]	14.5 mile
C	Average sidewalk length in 0.6-mile radius in the City of Escondido + 1-mile new sidewalk	15.5 mile
D	The elasticity of VMT with respect to the ratio of sidewalks-to-streets	-0.05

1. The City of Escondido maintains approximately 300 miles of streets. Assuming roughly 80% of the streets have sidewalks on both sides, total sidewalks are estimated at 300 X 2-side X 80% = 480 miles of sidewalks. The City of Escondido has a land area of 37.34 square miles of land. It is estimated that Escondido has an approximate density of (480 miles of sidewalk / 37.34 square miles of land =) 12.85 miles of sidewalk per square mile of land. The GHG handbook recommends a study area of a 0.6-mile radius (1.13 square miles) to calculate VMT reduction achieved from increasing sidewalk coverage. A study area is estimated to have an average of (1.13 square miles x 12.85 miles of sidewalks / square mile of land =) 14.5 miles of sidewalk.

Walking is typically an alternative for short trips and may not replace trips that are longer than 1 mile. The reduction is applied only on the VMT generated from all trips that start and end in the City of Escondido and the trip length is shorter than 1 mile. The average VMT reduction per mile of new sidewalks is calculated as below:

Total VMT in Escondido from Trips that are < 1 mile (per SANDAG ABM2+ Model 2016 Base Year) = 89,090

$$\text{Average VMT reduction} = A \times \text{Total VMT} = 0.34\% \times 89{,}090 \text{ VMT} = \frac{303 \text{ VMT reduced}}{1 \textit{ mile of new sidewalk}}$$

The purpose of this calculation is to create the average amount of VMT reduced by adding one mile of sidewalk within Escondido. This calculation uses Escondido specific assumptions about sidewalk density, sidewalk coverage, and VMT within Escondido (for only trips that are less than 1 mile long). The total VMT from trips that start and end in Escondido that are less than 1 mile long is sourced from the SANDAG AMB 2+ Regional Travel Demand Model for the 2016 base year. In addition, only VMT associated with trips that are shorter than 1 mile are included because adding sidewalks will primarily affect shorter trips. In other words, converting a car trip to a walking trip will only be possible for short car trips.

The GHG Handbook, Measure T-18 information is provided on the following pages for reference.

T-18. Provide Pedestrian Network Improvement

GHG Mitigation Potential

Up to 6.4% of GHG emissions from vehicle travel in the plan/community

Co-Benefits (icon key on pg. 34)

Climate Resilience

Improving pedestrian networks increases accessibility of outdoor spaces, which can provide health benefits and 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

Ensure that the improvements also include accessibility features to allow for people of all abilities to use the network safely and conveniently. Ensure that sidewalks connect to nearby community assets, such as schools, retail, and healthcare.

Measure Description

This measure will increase the sidewalk coverage to improve pedestrian access. Providing sidewalks and an enhanced pedestrian network encourages people to walk instead of drive. This mode shift results in a reduction in VMT and GHG emissions.

Subsector

Neighborhood Design

Locational Context

Urban, suburban, rural

Scale of Application

Plan/Community

Implementation Requirements

The GHG reduction of this measure is based on the VMT reduction associated with expansion of sidewalk coverage expansion, which includes not only building of new sidewalks but also improving degraded or substandard sidewalk (e.g., damaged from street tree roots). However, pedestrian network enhancements with non-quantifiable GHG reductions are encouraged to be implemented, as discussed under *Expanded Mitigation Options*.

Cost Considerations

Depending on the improvement, capital and infrastructure costs may be high. However, improvements to the pedestrian network will increase pedestrian activity, which can increase businesses patronage and provide a local economic benefit. 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 improving sidewalks, a best practice is to ensure they are contiguous and link externally with existing and planned pedestrian facilities. Barriers to pedestrian access and interconnectivity, such as walls, landscaping buffers, slopes, and unprotected crossings should be minimized. Other best practice features could include high-visibility crosswalks, pedestrian hybrid beacons, and other pedestrian signals, mid-block crossing walks, pedestrian refuge islands, speed tables, bulb-outs (curb extensions), curb ramps, signage, pavement markings, pedestrian-only connections and districts, landscaping, and other improvements to pedestrian safety (see Measure T-35, *Provide Traffic Calming Measures*).

GHG Reduction Formula

$$A = \left(\frac{C}{B} - 1\right) \times D$$

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A	Percent reduction in GHG emissions from household vehicle travel in plan/community	0–6.4	%	calculated
User Inputs				
B	Existing sidewalk length in study area	[ ]	miles	user input
C	Sidewalk length in study area with measure	[ ]	miles	user input
Constants, Assumptions, and Available Defaults				
D	Elasticity of household VMT with respect to the ratio of sidewalks-to-streets	-0.05	unitless	Frank et al. 2011

Further explanation of key variables:

- (B and C) – Sidewalk length should be measured on both sides of the street. For example, if one 0.5-mile-long street has full sidewalk coverage, the sidewalk length would be 1.0 mile. If there is only sidewalk on one side of the street, the sidewalk length would be 0.5 mile. The recommended study area is 0.6 mile around the pedestrian network improvement. This represents a 6- to 10-minute walking time.
- (D) – A study found that a 0.05 percent decrease in household vehicle travel occurs for every 1 percent increase in the sidewalk-to-street ratio (Frank et al. 2011; Handy et al. 2014).

GHG Calculation Caps or Maximums

Measure Maximum

(A_{max}) The percent reduction in GHG emissions (A) is capped at 3.4 percent, which is based on the following assumptions:

- 35.2 percent of vehicle trips are short trips (2 mile or less, average of 1.29 miles) and thus could easily shift to walking (FHWA 2019).
- 64.8 percent of vehicle trips are longer trips that are unlikely to shift to walking (2 miles or more, average of 10.93 miles) (FHWA 2019).
- So $A_{max} = \frac{35.2\% \times 1.29 \text{ miles}}{64.8\% \times 10.93 \text{ miles}} = 6.4\%$

Subsector Maximum

($\sum A_{max_{T\text{-}18 \text{ through } T\text{-}22\text{-}C}} \leq 10\%$) This measure is in the Neighborhood Design subsector. This subcategory includes Measures T-18 through T-22-C. 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 household VMT by improving the pedestrian network in the study area. In this example, the existing sidewalk length (B) is 9 miles, and the sidewalk length with the measure (C) would be 10 miles. With these conditions, the user would reduce GHG emissions from household VMT within the study area by 0.6 percent.

$$A = \left(\frac{10 \text{ miles}}{9 \text{ miles}} - 1\right) \times -0.05 = -0.6\%$$

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

Improved Public Health

Users are directed to the Integrated Transport and Health Impact Model (ITHIM) (CARB et al. 2020). The ITHIM can quantify the annual change in health outcomes associated with active transportation, including deaths, years of life lost, years of living with disability, and incidence of community and individual disease.

Sources

- California Air Resources Board (CARB), California Department of Public Health (CDPH), and Nicholas Linesch Legacy Fund. 2020. Integrated Transport and Health Impact Model. Available: https://skylab.cdph.ca.gov/HealthyMobilityOptionTool-ITHIM/#Home. Accessed: September 17, 2021.
- Federal Highway Administration (FHWA). 2019. *2017 National Household Travel Survey Popular Vehicle Trip Statistics*. Available: https://nhts.ornl.gov/vehicle-trips. Accessed: January 2021.

- Frank, L., M. Greenwald, S. Kavage, and A. Devlin. 2011. *An Assessment of Urban Form and Pedestrian and Transit Improvements as an Integrated GHG Reduction Strategy*. WSDOT Research Report WA-RD 765.1, Washington State Department of Transportation. April. Available: www.wsdot.wa.gov/research/reports/fullreports/765.1.pdf. Accessed: January 2021.
- Handy, S., S. Glan-Claudia, and M. Boarnet. 2014. *Impacts of Pedestrian Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions: Policy Brief*. September. Available: https://ww2.arb.ca.gov/sites/default/files/2020-06/Impacts_of_Pedestrian_Strategies_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf. Accessed: January 2021.

Pedestrian Network Improvements

2. Improve existing pedestrian infrastructure

The GHG Handbook does not provide a quantitative approach for determining the VMT reduction associated with pedestrian improvements or traffic calming. However, the GHG Handbook does document that (GHG Handbook, page 133):

> **Expanded Mitigation Options**
>
> When improving sidewalks, a best practice is to ensure they are contiguous and link externally with existing and planned pedestrian facilities. Barriers to pedestrian access and interconnectivity, such as walls, landscaping buffers, slopes, and unprotected crossings should be minimized. Other best practice features could include high-visibility crosswalks, pedestrian hybrid beacons, and other pedestrian signals, mid-block crossing walks, pedestrian refuge islands, speed tables, bulb-outs (curb extensions), curb ramps, signage, pavement markings, pedestrian-only connections and districts, landscaping, and other improvements to pedestrian safety (see Measure T-35, *Provide Traffic Calming Measures*).

Additionally, GHG Handbook Measure T-35 Provide Traffic Calming also describes improving the bicycle and pedestrian experience by reducing travel speeds, encouraging walking and biking. The measure is described as follows (GHG Handbook, page 53):

> **T-35. Provide Traffic Calming Measures**
>
> This measure requires projects to include pedestrian/bicycle safety and traffic calming measures above jurisdictional requirements. Roadways should also be designed to reduce motor vehicle speeds and encourage pedestrian and bicycle trips with traffic calming features. Traffic calming features may include marked crosswalks, count-down signal timers, curb extensions, speed tables, raised crosswalks, raised intersections, median islands, tight corner radii, roundabouts or mini-circles, on-street parking, planter strips with street trees, chicanes/chokers, and others. Providing traffic calming measures encourages people to walk or bike instead of using a vehicle. This mode shift will result in a decrease in vehicle miles traveled. In 2017, 3,904 people were killed and 277,160 injured by vehicle collisions in California; traffic calming can reduce injuries and death, which improves health (State of California et al., 2018). Traffic calming also promotes active transportation, which improves physical health.

As noted in the GHG Handbook, the improvements are intended to improve pedestrian experience and safety to encourage more people to choose walking instead of driving for nearby destinations. The previous version of the CAPCOA GHG Handbook did provide some limited research about the amount of VMT reduction associated with pedestrian improvements and traffic calming features. However, since the research was limited and not geographically diverse, the update GHG Handbook does not offer specific VMT quantification of these measures.

An engineering/planning judgement estimate was made assuming the number of new walking trips that would result daily from these types of improvements. The improvements are estimated to convert up to

25 short vehicle trips to walking trips per day. The average walking trip length is 0.6 miles one-way (based on the GHG Handbook) or 1.2 miles round-trip. Therefore, 25 additional walking trips reduces VMT by 1.2 miles *25 walking trips = 30 VMT per one pedestrian improvement.

In addition, planning/engineering judgement was used to establish what constitutes "one pedestrian improvement." For improvements at intersections, (such as enhancing the crosswalks, adding raised crosswalks, or installing median refuse islands) features that improve access for a walking desire line across two intersection legs is considered an improvement. This is logical because if you are walking and need to access the opposite corner of the intersection you would need to cross two legs of the intersection to continue to your desired destination. Therefore, to be inclusive of all walking desire lines the improvements should upgrade the pedestrian conditions on least two intersection legs to be considered one pedestrian improvement.

For mid-block locations, a single crossing provides access to all pedestrian desire lines; therefore, upgrading the mid-block location results in the same VMT reduction benefit as upgrading two legs of an intersection.

Curb ramp installation also encourages pedestrian activity for people who use mobility devices, have limited mobility, and for people who are pushing strollers, wagons, etc. Most intersections in Escondido have curb ramps; however, some intersections have incomplete (not all corners have them) or completely missing ramps. To offer flexibility and achieve the benefit of having curb ramps installed, the 30 VMT reduction per improvement was divided by four (4) to reflect a typical four-corner intersection (30/4=7.5, rounded to the nearest whole number = 8). Also note that directional curb ramps are preferred in Escondido, which results in two curb ramps per intersection corner. The 8 VMT reduced is "per corner" not "per ramp."

Bicycle Network Improvements

3. Increase bike facility coverage

Source:

- *Handbook for Analyzing Greenhouse Gas Emission Reduction, Assessing Climate Vulnerabilities, and Advancing Health and Equity, 2021, Measure T-19-A*

$$A = -B \times \left(\frac{\frac{F}{I} \times (C + D) \times E_i \times G}{H} \right)$$

Parameter		Quantity
A	Percent reduction of VMT (Max allowed = 0.8%)	
B	Percent of plan/community VMT on parallel roadway	100%
C	Active transportation adjustment factor	0.0014
	(Assumptions: average ADT = 12k-24k, facility length = 1 mile)	
D	Credit for key destinations near project	0.0005
	(Assumptions: number of key destinations within 0.5 mile = 3	
E_1	Growth factor adjustment for facility type (New Class I or Class IV bikeway)	1.54
E_2	Growth factor adjustment for facility type (New Class II bike lane)	1.00
E_3	Growth factor adjustment for facility type (Convert Class II to IV)	0.54
F	Annual days of use of new facility (San Diego)	323
G	Existing regional average one-way bicycle trip length (mile – San Diego)	2.0
H	Existing regional average one-way vehicle trip length (mile – San Diego)	19.1
I	Days per year	365

VMT reduction per mile of bike facility is estimated in the following table per facility type. The reduction is applied only on the VMT generated from all trips that start and end in the City of Escondido and the trip length is shorter than 3 miles.

	Facility Type		
	E_1	E_2	E_3
Percent reduction of VMT (A)	0.03%	0.02%	0.01%
VMT reduction per mile of bike facility (A X Total VMT)	107 VMT	71 VMT	36 VMT

Bicycling is typically an alternative for short trips and may not replace trips that are longer than 3 miles. The reduction is applied only on the VMT generated from all trips that start and end in the City of Escondido and the trip length is shorter than 3 miles. The average VMT reduction per mile of bicycle facility is calculated as below:

Total VMT in Escondido from Trips that are < 3 mile (per SANDAG ABM2+ Model 2016 Base Year) = 355,000 VMT

$$\text{Average VMT reduction } = \text{A } \times \text{Total VMT} = .03\% \times 355{,}000 \text{ VMT} = \frac{107 \text{ VMT reduced}}{1 \textit{ mile of new class I or IV bikeway}}$$

$$\text{Average VMT reduction } = \text{ A } \times \text{Total VMT} = .02\% \times 355{,}000 \text{ VMT} = \frac{71 \text{ VMT reduced}}{1 \textit{ mile of new class II bikeway}}$$

$$\text{Average VMT reduction } = \text{A } \times \text{Total VMT} = .01\% \times 355{,}000 \text{ VMT} = \frac{36 \text{ VMT}}{1 \textit{ mile of converted class II to class I or IV bikeway}}$$

The purpose of this calculation is to create the average amount of VMT reduced by adding one mile of bikeway (or converting 1 mile of bike lanes to bike path or cycle track) within Escondido. This calculation uses Escondido specific assumptions about VMT within Escondido (for only trips that are less than 3 miles long). The total VMT from trips that start and end in Escondido that are less than 3 miles long is sourced from the SANDAG AMB 2+ Regional Travel Demand Model for the 2016 base year. Only VMT associated with trips that are shorter than 3 miles are included because adding bikeways will primarily affect shorter trips. In other words, converting a car trip to a bicycling trip will only be possible for short car trips.

The GHG Handbook, Measure T-19A information is provided on the following pages for reference.

T-19-A. Construct or Improve Bike Facility

GHG Mitigation Potential

Up to 0.8% of GHG emissions from vehicles parallel roadways

Co-Benefits (icon key on pg. 34)

Climate Resilience

Constructing and improving bike facilities 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

Prioritize low-income and underserved areas and communities with lower rates of vehicle ownership or fewer transit options. Make sure that the bicycle facility connects to a larger existing bikeway network that accesses destinations visited by low-income or underserved communities.

Measure Description

This measure will construct or improve a single bicycle lane facility (only Class I, II, or IV) that connects to a larger existing bikeway network. Providing bicycle infrastructure helps to improve biking conditions within an area. This encourages a mode shift on the roadway parallel to the bicycle facility from vehicles to bicycles, displacing VMT and thus reducing GHG emissions. When constructing or improving a bicycle facility, a best practice is to consider local or state bike lane width standards. A variation of this measure is provided as T-19-B, *Construct or Improve Bike Boulevard*.

Subsector

Neighborhood Design

Locational Context

Urban, suburban

Scale of Application

Plan/Community. This measure reduces VMT on the roadway segment parallel to the bicycle facility (i.e., the corridor). An adjustment factor is included in the formula to scale the VMT reduction from the corridor level to the plan/community level.

Implementation Requirements

The bicycle lane facility must be either Class I, II, or IV. Class I bike paths are physically separated from motor vehicle traffic. Class IV bikeways are protected on-street bikeways, also called cycle tracks. Class II bike lanes are striped bicycle lanes that provide exclusive use to bicycles on a roadway.

Cost Considerations

Capital and infrastructure costs for new bike facilities may be high. 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

Implement alongside Measures T-22-A, T-22-B, and/or T-22-C to ensure that micromobility users can ride safely along bicycle lane facilities and not have to ride along pedestrian infrastructure, which is a risk to pedestrian safety.

GHG Reduction Formula

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

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A	Percent reduction in GHG emissions from displaced vehicles on roadway parallel to bicycle facility	0–0.8	%	calculated
User Inputs				
B	Percent of plan/community VMT on parallel roadway	0–100	%	user input
C	Active transportation adjustment factor	Table T-19.1	unitless	CARB 2020
D	Credits for key destinations near project	Table T-19.2	unitless	CARB 2020
E	Growth factor adjustment for facility type	Table T-19.3	unitless	CARB 2020
Constants, Assumptions, and Available Defaults				
F	Annual days of use of new facility	Table T-19.4	days per year	NOAA 2017
G	Existing regional average one-way bicycle trip length	Table T-10.1	miles per trip	FHWA 2017
H	Existing regional average one-way vehicle trip length	Table T-10.1	miles per trip	FHWA 2017
I	Days per year	365	days per year	standard

Further explanation of key variables:

- (B) – The percent of total plan/community VMT within the roadway parallel to the bike facility should represent the expected total VMT generated by all land use in that area, including office, residences, retail, schools, and other uses. The most appropriate source for this data is from a local travel demand forecasting model. An alternate method uses VMT per worker or VMT per resident as calculated for SB 743 compliance and screening purposes multiplied by the population in the area.
- (C, D, and E) – The active transportation adjustment factor, key destination credit, and growth factor adjustment should be looked up by the user in Tables T-19.1 through T-19.3 in Appendix C. The active transport adjustment factor is based on the existing annual average daily traffic (AADT) of the facility, length of the proposed bike facility, and the city population. The key destination credit is based on the number of key destinations within 0.5-mile of the facility. The growth factor is based on the type of proposed bicycle facility.
- (F) – The annual days of use for the new facility should be looked up by users in Table T-19.4 based on the county in which the project is located. The days of use is based on the number of days per year where there is no rainfall (i.e., <=0.1 inches) (NOAA 2017).

- (G and H) – Ideally, the user will calculate bicycle and vehicle trip lengths for the corridor at a scale no larger than the surrounding 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 regional average one-way bicycle and vehicle trip lengths for one of the six most populated CBSAs in California provided in Table T-10.1 in Appendix C (FHWA 2017).

GHG Calculation Caps or Maximums

Measure Maximum

(A_{max}) For projects that use CBSA data from Table T-10.1 in Appendix C, the maximum percent reduction in GHG emissions (A) is 0.8 percent. This is based on a neighborhood project the size of a large corridor (B = 100%) within the CBSA of Sacramento-Roseville-Arden-Arcade that uses the highest values for (C, D, and E) in Tables T-19.1 through T-19.3 and annual use days for Sacramento County (F) in Table T-19.4. This maximum scenario is presented in the below example quantification.

(C_{max}) The active transportation adjustment factor (C) was determined for roadways with AADT ranging from 1 to 30,000 (CARB 2020). Roadways with AADT greater than 30,000 are generally not appropriate for bicycle facilities. Care should be taken by the user in interpreting the results from this equation for a project roadway with AADT greater than 30,000.

Subsector Maximum

($\sum A_{max_{T\text{-}18 \text{ through } T\text{-}22\text{-}C}} \leq 10\%$) This measure is in the Neighborhood Design subsector. This subcategory includes Measures T-18 through T-22-C. 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 VMT by constructing a bicycle facility that displaces vehicle trips with bicycle trips. In this example, the following assumptions are made to obtain inputs from Tables T-19.1 through T-19.3 in Appendix C:

- Percent of plan/community VMT on parallel roadway (B) = 100%. The project would establish a bike corridor the whole length of a central commercial thoroughfare. It is assumed this main street makes up the entire neighborhood.
- Active transportation adjustment factor (C) = 0.0207. Existing AADT on the roadway parallel to the proposed bicycle facility is 10,000, the facility length is 2.5 miles, and the project site is in a university town with a population of 200,000.
- Key destination credit (D) = 0.003. There are 10 key destinations within 0.25 mile of the project site.
- Growth factor adjustment (E) = 1.54. The bike facility would be a new Class IV bikeway.

The project is within the Sacramento-Roseville-Arden-Arcade CBSA and the user does not have project-specific values for average bicycle and vehicle trip lengths. Accordingly, the inputs of 2.9 miles and 10.9 miles, respectively (G and H), from Table T-10.1 in Appendix C are assumed. The user would displace GHG emissions from project study area VMT by 0.8 percent.

$$A = -100\% \times \left(\frac{\frac{307 \text{ days}}{365 \text{ days}} \times (0.0207 + 0.003) \times 1.54 \times 2.9 \text{ miles}}{10.9 \text{ miles}} \right) = -0.8\%$$

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).

Improved Public Health

Users are directed to the ITHIM (CARB et al. 2020). The ITHIM can quantify the annual change in health outcomes associated with active transportation, including deaths, years of life lost, years of living with disability, and incidence of community and individual disease.

Sources

- California Air Resources Board (CARB). 2020. *Quantification Methodology for the Strategic Growth Council's Affordable Housing and Sustainable Communities Program*. September. Available: https://ww2.arb.ca.gov/sites/default/files/classic/cc/capandtrade/auctionproceeds/draft_sgc_ahsc_qm_091620.pdf. Accessed: January 2021.
- California Air Resources Board (CARB), California Department of Public Health (CDPH), and Nicholas Linesch Legacy Fund. 2020. Integrated Transport and Health Impact Model. Available: https://skylab.cdph.ca.gov/HealthyMobilityOptionTool-ITHIM/#Home. Accessed: September 17, 2021.
- 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.

- National Oceanic and Atmospheric Administration (NOAA). 2021. *Global Historical Climatology Network–Daily (GHCN-Daily), Version 3*. 2015-2019 Average of Days Per Year with Precipitation >0.1 Inches. Available: https://www.ncei.noaa.gov/access/search/data-search/daily-summaries?bbox=38.922,-120.071,38.338,-119.547&place=County:1276&dataTypes=PRCP&startDate=2015-01-01T00:00:00&endDate=2019-01-01T23:59:59. Accessed: May 2021.

Transit Supportive Improvements

4. Upgrade Bus Stops

The GHG Handbook does not provide a quantitative approach for determining the VMT reduction associated with bus stop improvements. However, the GHG Handbook does include an qualitative measure documenting that improving bus stop locations enhances users' experience and can lead to increased ridership (GHG Handbook, page 55):

> **T-46. Improve Transit Access, Safety, and Comfort**
>
> This measure requires projects improve transit access and safety through sidewalk/crosswalk safety enhancements, bus shelter improvements, improved lighting, and other features. Work with the community to determine barriers to use, most desired improvements, and other access challenges.

A nominal reduction of 50 VMT per bus shelter upgrade is assumed to be achieved from this improvement. The average vehicle trip length in Escondido is 6.1 miles one-way (or 12.2 miles round trip), based on the base year (2016) ABM2+ SANDAG Model. A planning/engineering judgement assumption is applied assuming that upgrading a bus stop to provide a bus shelter (and required amenities) would encourage approximately 4-5 additional bus riders per day, it would result in a reduction of 49-61 VMT (12.2*4=49 and 12.2*5=61). 50 VMT was selected as a conservative assumption.

FUTURE PROGRAMS

The following summarizes the estimated effectiveness of several programs that may be considered in the future for inclusion into the VMT Exchange program.

Trip Reduction Marketing

1. Implement trip reduction marketing

Source:

- *Handbook for Analyzing Greenhouse Gas Emission Reduction, Assessing Climate Vulnerabilities, and Advancing Health and Equity, 2021, Measure T-7*

$$A = B \times C \times D = 1 \times 0.04 \times 1 = -4\%$$

Parameter		Quantity
A	Percent reduction in GHG emissions from project/site employee commute VMT (Max allowed = 4%)	-4%
B	Percent of employees eligible for program[1]	100%
C	Percent reduction in employee commute vehicle trips	-4%
D	The adjustment from vehicle trips to VMT	1.0

1. Eligible employees are usually 100 percent. Employees who might not be able to participate include night-time employees or jobs that require employees to drive to work.

VMT reduction achieved from implementation of trip reduction marketing is calculated as below. The estimated reduction applies to all work-related trips that occur within the City of Escondido.

$$\text{VMT reduction} = \frac{4\% \times \text{City of Escondido Total Work Related VMT}}{\text{Total number of employees in the City of Escondido}} = \frac{4\% \times 1{,}824{,}574 \text{ VMT}}{53{,}288}$$
$$= 1.37 \text{ VMT/Employee}$$

The City of Escondido Total Work Related VMT and number of employees is sourced from the SANDAG ABM 2+ Regional Travel Demand Model for the 2016 base year.

2. Fund City employees trip reduction program

VMT reduction calculated for this strategy is similar to measure 4 on a per-employee basis. The average fund associated with such a program is approximately $5,000. The effectiveness is only applicable if a program is fully funded. Partially funded programs would require the City of Escondido to complete the funding for the program to become effective.

Public Transit/Shuttle Improvement

3. Downtown Escondido on-demand Shuttle

Source:

- *Handbook for Analyzing Greenhouse Gas Emission Reduction, Assessing Climate Vulnerabilities, and Advancing Health and Equity, 2021, Measure T-25*

$$\mathrm{A} = -1 \times \frac{C - B}{B} \times \mathrm{D} \times \mathrm{E} \times \mathrm{F} \times \mathrm{G} = -1 \times 1 \times 2.4\% \times 0.7 \times 57.8\% \times 1 = 0.97\%$$

Parameter		Quantity
A	Percent reduction in GHG emissions from plan/community VMT (Max allowed = 4.6%)	
B	Total transit service miles or service hours in plan/community before expansion[1]	
C	Total transit service miles or service hours in plan/community after expansion[1]	
D	Transit mode share in plan/community (San Diego)	2.4%
E	The elasticity of transit demand with respect to service miles or service hours	0.7
F	Statewide mode shift factor	57.8%
G	The adjustment from vehicle trips to VMT	1.0

1. Considering that no shuttle service is running to/from the downtown area, the expansion in shuttle service miles is assumed to be 100%.

VMT reduction achieved from implementation of providing funding for intra-city shuttle program is calculated as below. The estimated reduction applies to all trips that occur between all TAZs that fall inside Escondido downtown area.

$$\text{VMT reduction} = 0.97\% \times \text{VMT from trips start and end in downtown} = 0.97\% \times 2{,}696 = 26 \text{ VMT}$$

Appendix B

Standard Number of Square Feet Per Employee by Land Use (SANDAG)

SANDAG Land Use Codes, Definitions, and Square Feet Per Employee Conversions

Land Use Codes and Definitions

lu_code	land use	description	source
1501	Hotel (Low-Rise)	Hotels, motels, and other transient accommodations with three or less floors. Commonly found along freeways and prime commercial areas.	SANDAG ABM2+
1502	Hotel (High-Rise)	Hotels and motels that have four or more floors. Primarily found in downtown areas and near tourist attractions.	SANDAG ABM2+
1503	Resort	Resorts with hotel accommodations that usually contain recreation areas. Examples of resorts would be La Costa Health Spa, Lawrence Welk, and the Olympic Resort in Carlsbad near the airport.	SANDAG ABM2+
2001	Heavy Industry	Shipbuilding, airframe, and aircraft manufacturing. Usually located close to transportation facilities and commercial areas. Parcels are typically large, 20-50 acres.	SANDAG ABM2+
2101	Industrial Park	Office/industrial uses clustered into a center. The primary uses are industrial but may include high percentages of other uses in service or retail activities.	SANDAG ABM2+
2103	Light Industry - General	All other industrial uses and manufacturing not included in the categories above. These are not located inside of parks but are usually along major streets or clustered in certain areas. Includes manufacturing uses such as lumber, furniture, paper, rubber, stone, clay, and glass; as well as light industrial uses as auto repair services and recycling centers. Mixed commercial and office uses (if not large enough to be identified separately) are also included. General industrial areas are comprised of 75 percent or more of industrial uses (manufacturing, warehousing, and wholesale trade).	SANDAG ABM2+
2104	Warehousing	Usually large buildings located near freeways, industrial, or strip commercial areas.	SANDAG ABM2+
2105	Public Storage	Public self-storage buildings are typically long, rectangular and closely spaced. Also includes RV and boat storage areas.	SANDAG ABM2+
2201	Extractive Industry	Mining, sand and gravel extraction, salt evaporation.	SANDAG ABM2+
2301	Scrap Yards/Auto Dismantling/Landfill	The landscape should show visible signs of the activity. Also include auto wrecking/dismantling and recycling centers.	SANDAG ABM2+
6001	Office (High-Rise)	High rise buildings with more than four stories containing banking, offices for business and professional services (finance, insurance, real estate), some retail activities and restaurants.	SANDAG ABM2+
6002	Office (Low-Rise)	Low rise buildings with less than five stories containing banking, offices for business and professional services (finance, insurance, real estate), some retail activities and restaurants.	SANDAG ABM2+
6003	Government Office/Civic Center	Large government office buildings or centers (outside of military reservations) and civic centers, or city halls of local governments. Also includes the Chamber of Commerce buildings and DMV Offices.	SANDAG ABM2+
6502	Hospital - General		SANDAG ABM2+

6509	Other Health Care	Medical centers and buildings or offices, health care services, and other health care facilities. Smaller medical offices and facilities may be included within office, strip commercial, or other surrounding uses.	SANDAG ABM2+
6802	Other University or College		SANDAG ABM2+
6803	Junior College	Includes trade or vocational schools.	SANDAG ABM2+
6804	Senior High School	9 - 12	SANDAG ABM2+
6805	Junior High School or Middle School	6 - 8	SANDAG ABM2+
6806	Elementary School	K - 7	SANDAG ABM2+

Employment Density by Land Use Code (square feet per employee unless otherwise noted)

lu_code	description	Value_per_unit
1501	Hotel (Low-Rise)	1600
1502	Hotel (High-Rise)	1550
1503	Resort	700
2001	Heavy Industry	200
2101	Industrial Park	600
2103	Light Industry - General	700
2104	Warehousing	1250
2105	Public Storage	22900
2201	Extractive Industry	150
2301	Scrap Yards/Auto Dismantling/Landfill	1200
6001	Office (High-Rise - greater than 100000 SF)	400
6002	Office (Low-Rise - less or equal to 100000 SF)	450
6003	Government Office/Civic Center	650
6502	Hospital - General	300
6509	Other Health Care	450

6802	Other University or College	1 employee per 47 students
6803	Junior College	1 employee per 14 students
6804	Senior High School	1 employee per 12 students
6805	Junior High School or Middle School	1 employee per 17 students
6806	Elementary School	1 employee per 9 students