5.2 TRAFFIC AND MULTIMODAL CIRCULATION

MULTIMODAL NETWORK

ANALYSIS METHODOLOGY

To provide a comparative analysis of three circulation and three land use alternatives, the multimodal analysis used multiple evaluation metrics for each mode and summed up the scores to identify performance across alternatives. Access to the bicycle and transit network, defined as people living or working in locations with access to each modal network, was used to compare circulation alternatives with land use alternatives (LUA). Access to the pedestrian network cannot be analyzed directly since there is no "walkshed" for the pedestrian network that can be linked to land use in the same way that exists for transit. Therefore, the evaluation of the pedestrian network for each Circulation Alternative does not measure a significant distinction between LUAs. The pedestrian analysis focuses on evaluating network coverage as well as changes to Study Area 4, San Mateo's Downtown, where the Circulation Alternative includes various projects intended to benefit the Downtown as a local and regional destination regardless of changes to land use.

In addition, please refer to the discussion of pedestrian and bicycle safety as an aspect of equity and public health in Section 5.6.

1. PEDESTRIAN NETWORK METHODOLOGY

The Pedestrian Master Plan (2012), specifically its pedestrian greenway network, are included in all three alternatives, limiting the amount of variation for citywide pedestrian projects in the General Plan Update Circulation Alternatives. The future pedestrian network analysis depends on the calculation of several metrics to estimate both network coverage and quality, using through proxies such as public realm, safety, and tree coverage. The following metrics were developed to evaluate the pedestrian network:

- Increase in Sidewalk Coverage: Calculated a 'maximum' possible from existing street lengths and compared to existing sidewalks plus alternatives for both study areas and the entire city.
- Increase in Public Realm: Measured percent of street length within SA 4 (Downtown) receiving traffic calming, place making, pedestrianization, and other public realm improvements.
- Safety Improvements: Identified areas with historic pedestrian-involved injury collisions that have occurred from 2015-2017 and overlayed with circulation alternatives.

- Increase in Tree Coverage: Estimate of area covered by tree shading (10-foot radius of each point in GIS) was combined with the greenway corridor network from the Pedestrian Master Plan. The output was the same citywide for all alternatives since they all include the greenway corridors. Calculated changes in SA 4 (Downtown) are a result of individual projects in Alternatives A and C.

2. Bicycle Network Methodology

The recently adopted Bicycle Master Plan (2020) provides a comprehensive network for San Mateo, limiting the amount of variation for bicycle projects in the General Plan Update Circulation Alternatives. The future bicycle network evaluation looked at both coverage as well as access to bicycle facilities between the different land use changes. The following metrics were developed for evaluating the bicycle network:

- Increased Bike Facility Coverage: Calculated a 'maximum' possible bike facility mileage from existing street lengths and compared to existing bike facilities of all facility classes plus alternatives for the entire city.

- Increased Protected Bike Facility Coverage: Calculated the percent of the total bike network that is protected by comparing existing total bike network plus future bike network with existing protected bike facilities of all classes plus alternatives for the entire city.

- Increased Bike Facility Access for Residents: Calculated a bike access area by buffering all existing and future bike facilities by an 1/8 of a mile. An eighth of a mile was chosen because it represents approximately half a block. This was overlayed with existing and future population for all land use alternatives to estimate the number of residents served by the network.

- Increased Bike Facility Access to jobs: Calculated a bike access area by buffering all existing and future bike facilities by an 1/8 of a mile. This was overlayed with existing and future employment for all land use alternatives to estimate the number of jobs served by the network.

- Increased Protected Bike Facility Access for Residents: Calculated a protected bike access area by buffering all existing and future protected bike facilities by an 1/8 of a mile. This was overlayed with existing and future population for all land use alternatives to estimate the number of residents served by the network.

- Increased Protected Bike Facility Access for Employees: Calculated a protected bike access area by buffering all existing and future protected bike facilities by an 1/8 of a mile. This was overlayed with existing and future employment for all land use alternatives to estimate the number of jobs served by the network.

3. Transit Network Methodology

Transit service was evaluated based on coverage of the entire network as well as the frequent network. The frequent transit network is made up of bus lines with 15-minute frequencies or less as well as Caltrain. The following metrics were developed for evaluating the transit network:

- Transit Coverage for Residents: Buffered stops in the transit network with pre-COVID service and with each circulation alternative by ¼ mile to identify existing and future transit service coverage. This was overlayed with existing and future population for all land use alternatives to estimate the number of residents served by the network.

- Transit Coverage to Jobs: Buffered stops in the transit network with pre-COVID service and with each circulation alternative by ¼ mile to identify existing and future transit service coverage. This was overlayed with existing and future employment for all

land use alternatives to estimate the number of jobs served by the network.

- Frequent Transit Access for Residents: Buffered frequent stops (15 minutes or better + Caltrain) in the transit network with pre-COVID service and with each circulation alternative by 1/4 mile to identify existing and future transit service coverage. This was overlayed with existing and future population for all land use alternatives to estimate the number of residents served by the network.

- Frequent Transit Access to Jobs: Buffered frequent stops (15 minutes or better + Caltrain) in the transit network with pre-COVID service and with each circulation alternative by 1/4 mile to identify existing and future transit service coverage. This was overlayed with existing and future employment for all land use alternatives to estimate the number of jobs served by the network.

4. Pedestrian Network Evaluation

Table 8 presents the comparative analysis of the circulation alternatives for the pedestrian network. Each row has a possible high score of three (+++) and low score of one (+). Each analysis shows the relative difference between each alternative. Where the score is the same, there is no significant difference between the alternatives. Alternative C scored the highest because the downtown traffic calming, and public realm improvement included in the superblock approach would provide the most pedestrian benefits. Alternative B scored the lowest since there are the fewest pedestrian improvements in that alternative.

Table 8 Pedestrian Network Evaluation

Pedestrian Improvements	Circulation Alternative A	Circulation Alternative B	Circulation Alternative C
Increase in Sidewalk Coverage - Study Areas	+++	+	+++
Increase in Sidewalk Coverage - Citywide	++	+	++
Safety Improvements	++	+	+++
Public Realm Improvements - Downtown (SA 4)	++	+	+++
Tree Coverage Increase - Citywide	++	++	++
Tree Coverage Increase - Downtown (SA 4)	+++	+	+++
Pedestrian Score Total	14/18	7/18	16/18

5. Bicycle Evaluation

Table 9 presents the comparative analysis of the circulation alternatives for the bicycle network. Each row has a possible high score of three (+++) and low score of one (+). Each analysis shows the relative difference between each alternative. Where the score is the same, there is no significant difference between the alternatives. Alternatives A and C scored the highest because they include bicycle and public realm improvements on El Camino Real that are not included in Alternative B. Given the high level of bicycle coverage, particularly in the study areas where most growth is planned, there were no significant distinctions between the land use alternatives.

6. Transit Evaluation

Table 10 presents the comparative analysis of the circulation alternatives for the transit network. Each row has a possible high score of three (+++) and low score of one (+). Each analysis shows the relative difference between each alternative. Where the score is the same, there is no significant difference between the alternatives. Alternatives B and C scored the highest because they include increased transit coverage from a new east-west transit connect or microtransit/on-demand shuttle as well as improved transit service on El Camino Real. Land Use Alternative C, which places the highest numbers of new residents near frequent transit, had a higher percent or residents with access to frequent transit than the other land use alternatives.

Table 9 Bicycle Network Evaluation

Bicycle Improvements	Circulation Alternative A			Circulation Alternative B			Circulation Alternative C		
	LU A	LU B	LU C	LU A	LU B	LU C	LU A	LU B	LU C
Bike Facility Coverage	+++			+++			+++		
Protected Bike Facility Coverage	+++			++			+++		
Bike Facility Access for Residents	+++	+++	+++	+++	+++	+++	+++	+++	+++
Bike Facility Access to Jobs	++	++	++	++	++	++	++	++	++
Protected Bike Facility Access for Residents	++	++	++	++	++	++	++	++	++
Protected Bike Facility Access to Jobs	++	++	++	++	++	++	++	++	++
Biking Score Total	15/18			14/18			15/18		

Table 10 Transit Network Evaluation

Transit Improvement	Circulation Alternative A			Circulation Alternative B			Circulation Alternative C		
	LU A	LU B	LU C	LU A	LU B	LU C	LU A	LU B	LU C
Transit Access for Residents	++	++	++	++	++	+++	++	++	+++
Transit Access to Jobs	++	++	++	++	++	++	++	++	++
Frequent Transit Access for Residents	++	++	++	++	++	++	++	++	++
Frequent Transit Access to Jobs	+	+	+	+	+	+	+	+	+
Transit Score Total	7/12	7/12	7/12	7/12	7/12	8/12	7/12	7/12	8/12

TRAFFIC ANALYSIS

METHODOLOGY

This section describes the analysis of the circulation system in context of the proposed land use and circulation alternatives. The General Plan team used the countywide traffic model to project how the land use alternatives would affect Vehicle Miles Traveled (VMT), mode shift, Vehicle-Hours Traveled (VHT), average speed, and Vehicle-Hours of Delay (VHD). A model allows planners to simulate potential future conditions. The traffic modeling is based off the existing road network and proposed and existing bike facilities in the City Bicycle Master Plan as well as other proposed transit improvements and pedestrian facilities.

The analysis of these delay based and mode shift metrics pairs each land use alternative with Circulation Alternative C. The performance of each land use alternative in context of these metrics is then compared to each land use alternative and to existing conditions (2019). Therefore, all tables in this section identify the Land Use Alternatives A, B or C matched with Circulation Alternative C. The General Plan team chose to model the land use alternatives against Circulation Alternative C because it represents an amalgamation of the proposed circulation improvements in all the circulation alternatives.

VEHICLE MILES TRAVELED (VMT)

A common indicator used to quantify the amount of motor vehicle use is Vehicle Miles Traveled (VMT). VMT represents the total number of miles driven per day by persons traveling to and from a defined area. VMT can include the total VMT for all San Mateo travel, which is a useful comparative evaluation metric for the general plan, or it can include VMT per person (capita) and VMT per employee that is required for CEQA environmental analysis.

Many factors affect VMT, including the average distance people drive to work, school, and shopping, as well as the proportion of trips that are made by non-automobile modes. Areas that have a diverse land use mix and facilities for non-automobile modes, including transit, walking, and biking, tend to generate lower VMT than auto-oriented suburban areas where land uses are typically segregated. Further, cities and regions where the jobs/housing ratio is balanced generate a lower VMT than areas where most residents commute long distances to work. From an environmental perspective, development that generates less

per capita VMT reflects less auto usage, and correspondingly, lower fuel consumption and production of GHG emissions.

In California, the use of VMT instead of delay-based metrics (like Level of Service (LOS)) to assess transportation-related environmental impacts has been adopted as part of updates to California Environmental Quality Act (CEQA).[1] As a result, transportation-related environmental impacts are now based on the per capita miles of vehicle travel associated with a project instead of the project's effects on local traffic congestion. VMT allows for an analysis of a project's impact to be reviewed on a broader regional scale rather than only in the vicinity of the proposed project, allowing for a better understanding of the full extent of a project's transportation-related impact. It should be noted that SB 743 pertains to CEQA only and local jurisdictions are still permitted to use other metrics, such as LOS, to analyze the effects on a project on the local transportation network for other planning purposes outside the scope of CEQA. Therefore, since travel occurs across cities and counties, VMT was evaluated at three levels - citywide, San Mateo Countywide, and for the larger Bay Area region.

As shown in Table 11, although Land Use Alternative A would result in the lowest total VMT, this alternative would have the highest citywide per capita VMT compared to Alternatives B and C. This is likely because Land Use Alternative A has a lower density land use pattern that would result in fewer housing units near transit. Conversely, Land Use Alternative C would generate the most total VMT, but would have the lowest citywide per capita VMT compared to Land Use Alternatives A and B. Land Use Alternative C would result in a higher density land use pattern that would place more housing near transit, enabling more residents the option of commuting by bus or Caltrain. The results also indicate the land use alternatives would have lower VMT per capita in 2040 compared to 2019. Since the land use alternatives would add more housing and jobs near transit and would also result in increased congestion in 2040, more people would choose to travel by transit, walking, and biking due to increased access to these modes and to avoid roadway congestion compared to 2019.

As shown in Table 12, VMT per employee varies less among the land use alternatives than the VMT per capita since the number of 2040 employees is similar among all three land use alternatives. Furthermore, as more residents are added in the City of San Mateo, particularly in Land Use Alternative C, this would result in lower VMT per employee compared to Land Use Alternatives A and B. This is likely because Land Use Alternative C would provide the most new housing units, providing the greatest likelihood that San Mateo workers can find a place to live in San Mateo, resulting in less net out-commuting and lower commute trip lengths.

Table 11 2040 Residential Vehicle Miles Traveled (VMT) – VMT per Capita

Scenario	City		County		Region	
	Total VMT	VMT/ Capita	Total VMT	VMT/ Capita	Total VMT	VMT/ Capita
2019	2,915,599	16.5	19,178,787	15.9	176,872,069	15.3
Alternative A	3,314,113	14.5	22,901,378	15.2	239,122,502	16.3
Alternative B	3,430,467	14.4	23,029,242	15.2	239,677,063	16.3
Alternative C	3,569,586	14.3	23,148,970	15.2	238,539,410	16.2

Note: 2019 County VMT per capita is higher than the regional VMT likely because San Mateo County has longer trip lengths compared to the San Francisco Bay Area region which includes denser urban areas like Sa n Francisco and Oakland. As San Mateo County increases in density over the next 20 years, the model projects that per capita VMT will reduce countywide.

Table 12 2040 Employment Vehicle Miles Traveled (VMT) – VMT per Job

Scenario	City		County		Region	
	Total VMT	VMT/Employee	Total VMT	VMT/Employee	Total VMT	VMT/Employee
2019	2,915,599	16.9	19,178,787	18.0	176,872,069	17.2
Alternative A	3,314,113	15.5	22,901,378	18.1	239,122,502	17.3
Alternative B	3,430,467	15.3	23,029,242	18.0	239,677,063	17.3
Alternative C	3,569,586	15.0	23,148,970	17.9	238,539,410	17.2

[1] The purpose of CEQA is to disclose potential environmental impacts of a proposed project and identify ways to avoid or reduce environmental damage through feasible mitigation or project alternatives, based on specific criteria according to an environmental checklist. VMT is one of several transportation-related criteria used in CEQA's environmental checklist.

VEHICLE-HOURS TRAVELED (VHT)

The General Plan team used the model to estimate vehicle hours of travel (VHT) for 2019 and the land use alternatives in 2040. This metric is computed for all roadway travel to and from and within San Mateo by summing all daily vehicle travel multiplied by travel time and delay for four time periods of the day: two peak hours, midday, and night. Similar to how VMT measures the number of vehicle miles or the distance driven to and from, and within San Mateo, VHT is a metric that represents the total number of vehicle hours driven per day by persons traveling to, from and within San Mateo. Also similar to VMT, there are many factors that affect VHT, including the amount of travel by automobiles during peak commute periods when driving takes longer due to congestion or when there is an imbalance of housing and jobs requiring more and longer commutes. Therefore, a VHT measure is another way of describing how travel times are affected by changes in land use and density. Increasing VHT may also suggest increasing economic activity as more people travel to San Mateo to shop, dine, and work. Increased VHT could also suggest there is insufficient transit, pedestrian, and bicycle infrastructure to enable people to choose not to drive. While total VHT may increase with increased housing and jobs, VHT per capita may be lower if housing and jobs are located near transit and pedestrian and bicycle infrastructure.

As shown in Table 13, VHT is projected to increase from 2019 to 2040. The VHT analysis demonstrates that locating more housing and jobs near transit and non-motorized infrastructure, as in Land Use Alternatives B and C, could contribute to slower growth in VHT per service population (per capita plus employee). While Land Use Alternative A would produce the lowest total VHT since it has the lowest land use density, it would have the highest citywide VHT per service population compared to Land Use Alternatives B and C. On a per service population basis, VHT within San Mateo is lowest under Land Use Alternative C, which has the highest land use densities.

Table 13 2040 Vehicle Hours Traveled (VHT)

Scenario	VHT		
	Total VHT	VHT/Service Pop	Service Population
2019	79,137	0.45	174,992
Alternative A	130,817	0.59	222,388
Alternative B	135,379	0.58	233,335
Alternative C	135,143	0.55	245,253

AVERAGE SPEED

The average speed of the roadway system is a comparative indicator of how the road network responds to changing land use density, mode shift and traffic congestion. This metric represents the average daily 24-hour and peak hour speeds on all key roadway segments in San Mateo that are represented in the City travel model.

Table 14 provides average systemwide daily and peak hour speeds for all roads in San Mateo. As expected, average daily and peak hour traffic speeds decrease between 2019 and 2040 for all land use alternatives due to increasing land use densities resulting in more congestion. Land Use Alternative A would have the highest average speeds when compared to Land Use Alternatives B and C by a small margin. This is because Land Use Alternative A would add the fewest new residents. However, this trend flattens out with Land Use Alternative C as the jobs/housing ratio is more balanced resulting in lower net out-commuting from San Mateo.

Table 14 2040 Average Speeds

Scenario	Average Speed (MPH)		
	Daily	AM Peak Hour	PM Peak Hour
2019	34.1	23.3	23.1
Alternative A	26.4	10.8	10.4
Alternative B	25.8	10.2	10.1
Alternative C	25.9	10.3	10.0

VEHICLE-HOURS OF DELAY (VHD)

Similar to VHT, VHD is a systemwide metric that represents the total amount of time motorists throughout the city are delayed in traffic or waiting at intersections during peak congestion compared to ideal off-peak travel. VHD is a measure that compares the amount of time a driver is delayed during their trip between 2019 and between each 2040 land use alternative.

Usually, VHD increases with added land use creating additional congestion. As land uses intensify in the alternatives, congestion and delay would be expected to increase from Land Use Alternative A to Land Use Alternative C. However, as shown in Table 15, the rate of VHD does slow down as the higher density uses in Land Use Alternative C creates a better housing/jobs balance, shorter trip lengths, and the transportation system provides options for non-auto travel compared to Land Use Alternative B.

VHD per service population is slightly lower under Land Use Alternative C than it is under A or B. This is likely because Alternative C locates more new homes closer to transit, so trips between home, work, and/or services are shorter under Land Use Alternative C. This could also reflect that people would be more likely to choose to take transit, walk or bike under Land Use Alternative C both because transit is a feasible commute option and to avoid local traffic congestion.

Table 15 2040 Vehicle Hours of Delay (VHD)

Scenario	VHD		
	Total VHD	VHD/ Service Pop	Service Population
2019	15,633	0.09	174,992
Alternative A	45,640	0.21	222,388
Alternative B	48,852	0.21	233,335
Alternative C	48,012	0.20	245,253

POLICY CONSIDERATIONS

The General Plan Update could consider various policies and actions related to circulation and traffic, such as:

- Developing and adopting a Complete Streets Plan to accommodate green infrastructure, pedestrians, cyclists, drivers, and all users on streets that are safe, comfortable, and efficient.
- Collecting appropriate development impact fees to fund transportation improvements that help mitigate impacts on the circulation network.
- Requiring new and existing developments to include transportation demand management strategies and trip reduction targets and monitoring.
- Establishing the policy framework and infrastructure improvements necessary to support emerging transportation technologies.
- Working with regional partners to identify and fund transportation demand management strategies.
- Requiring new development to make specific types of bicycle, pedestrian, and roadway improvement to ensure the safety of all users.
- Conducting safety, education, and awareness efforts for bicyclists, pedestrians, and drivers.
- Utilizing data on activity of pedestrians and bicyclists to understand where the heaviest use and safety needs are and to prioritize improvement projects.