Appendix 2.3.2
Travel Demand Forecasting Memo

MEMORANDUM

Date: August 21, 2015

To: Saravana Suthanthira, Alameda CTC

From: Francisco Martin and Mackenzie Watten, Fehr & Peers

Subject: Alameda Countywide Multimodal Arterial Plan
Travel Demand Forecasting Results – Final

OK14-0023

1.0 INTRODUCTION

Alameda CTC is leading the development of a Countywide Multimodal Arterial Plan to better understand the existing and future role and function of the countywide arterial system in supporting all modes for all users. To evaluate the future role and conditions of the Study Network, forecasts of future travel behavior are required. These forecasts require the use of multiple data sources, most significantly the Alameda Countywide Travel Demand Model ("Alameda CTC Model"). The *Alameda Countywide Multimodal Arterial Plan – Travel Demand Forecasting Methods White Paper-Final* (Fehr & Peers, June 23, 2015) described the travel behavior forecasting assumptions, methodology, and approach. This memorandum documents the projections of the Plan's multimodal performance measures for the arterial network.

2.0 MULTIMODAL PERFORMANCE MEASURES

The Alameda CTC model is capable of estimating multimodal travel behavior for many locations in Alameda County. It has been calibrated and validated with year 2010 vehicle, transit, and bicycle counts. The Alameda CTC model includes scenario years roughly corresponding to "existing" (year 2010), "near-term" (year 2020), and "long-term" (year 2040).

The full list of performance measures and performance indicators[1] to be estimated as part of the Multimodal Arterial Plan development have been documented in the memo titled *Alameda Countywide Multimodal Arterial Plan – Performance Measures and Evaluation Approach* (Fehr & Peers, January 22, 2015). This memorandum will primarily focus on the two major direct model applications for performance measures: PM peak hour vehicle volume and congested speed (measure 1.1A). The majority of the other performance measures indirectly use vehicle volume and congested speed as inputs.

2.1 EXISTING PERFORMANCE MEASURE CALCULATIONS FROM MODEL

The forecast approach outlined in later sections requires existing observed data as an input. Existing PM peak hour volume count and congested speed data was not available for all the Study Network segments. Observed data provided generally ranged between years from 2012 and 2014. The base year (2010) Alameda CTC model was used to identify PM peak hour volume and speed data for Study Network segments missing observed data.

The existing PM peak hour volume and speed data that was available was used to develop jurisdiction (or planning-area where observed data is not available within a jurisdiction) adjustment factors to apply to the base year model volume and speed forecasts. The PM peak hour adjustment factor calculations take the following form:

$$Existing\ Volume\ Adjustment\ Factor_{Jurisdiction} = Total\ Volume\ from\ Observed\ Data_{Jurisdiction} \div Total\ Volume\ from\ Model\ for\ Segments\ with\ Observed\ Data_{Jurisdiction}$$

$$Existing\ Speed\ Adjustment\ Factor_{Jurisdiction} = Speed\ from\ Observed\ Data_{Jurisdiction} \div\ Speed\ from\ Model\ for\ Segments\ with\ Observed\ Data_{Jurisdiction}$$

Table 1 details the data coverage by each jurisdiction and planning area along with the year of the data provided. The magnitude of coverage varies by jurisdiction. Congested speed data coverage is consistently lower than the count data coverage.

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[1] Performance measures assess the existing and future year transportation conditions of the Study Network. Area-wide performance indicators are generally applied after preferred short- and long-term improvements are identified for the Arterial Network (subset of the Study Network that represents *arterials of countywide significance)* to evaluate and to ensure that the preferred improvements achieve the Plan's vision and goals.

Table 1
Observed Data Coverage by Jurisdiction and Planning Area

Jurisdiction/ Planning Area	Study Network Locations	Observed Volume Locations	Volume Coverage	Observed Speed Locations	Speed Coverage	Year of Observed Data
Incorporated Jurisdictions						
Alameda	280	247	89%	30	11%	2014
Albany	58	10	18%	4	7%	2014
Berkeley	386	92	24%	105	28%	2010-2014
Dublin	237	168	71%	19	9%	2014
Emeryville	46	36	79%	1	3%	2012
Fremont	468	287	62%	51	11%	2014
Hayward	447	70	16%	49	11%	2013-2014
Livermore	449	27	7%	54	13%	2013
Oakland	1,500	333	23%	344	23%	2014
Piedmont	18	0	0%	2	12%	2014
Pleasanton	292	260	90%	31	11%	2014
San Leandro	232	24	11%	48	21%	2011
Union City	122	44	37%	9	8%	2013
Unincorporated Areas						
Ashland	61	14	23%	9	15%	2014
Castro Valley	116	38	33%	15	13%	2014
Cherryland	35	0	0%	4	12%	2014
San Lorenzo	36	5	14%	1	3%	2014
Sunol	12	1	9%	1	9%	2014
Unincorporated County	106	33	32%	9	9%	2012-2014
Planning Areas						

Jurisdiction/ Planning Area	Study Network Locations	Observed Volume Locations	Volume Coverage	Observed Speed Locations	Speed Coverage	Year of Observed Data
North	2,288	718	32%	486	22%	-
Central	990	456	47%	105	11%	-
South	711	441	63%	69	10%	-
East	949	151	16%	127	14%	-

Table 2 presents the existing conditions adjustment factors by each jurisdiction and planning area. The volume adjustment factors are usually greater than 1 and the speed adjustment factors are usually less than 1. This result makes sense given that the majority of the observed data was from 2014. One would expect a comparison of the 2014 observed data with the "2010" model data to show the observed data to be higher, and thus require an adjustment factor greater than 1. Additionally the Alameda CTC model development documentation showed that the model was underestimating PM peak hour volumes on the order of 5%.

The inverse relationship makes sense for speed – higher volumes (2014 versus 2010) would cause *lower* congested speeds, in addition model speeds do not account for traffic signal delays or other operational delays that are captured in observed speed data.

Table 2
Existing Conditions Adjustment Factors by Jurisdiction and Planning Area

Jurisdiction/ Planning Area	Study Network Locations	Existing Volume Adjustment Factor	Existing Speed Adjustment Factor
Incorporated Jurisdictions			
Alameda	280	1.14	0.89
Albany	58	1.01	0.87
Berkeley	386	1.09	1.03
Dublin	237	1.09	0.84
Emeryville	46	1.07	0.88
Fremont	468	1.09	0.95
Hayward	447	1.07	0.90

Jurisdiction/ Planning Area	Study Network Locations	Existing Volume Adjustment Factor	Existing Speed Adjustment Factor
Livermore	449	1.04	0.99
Newark	121	1.13	0.88
Oakland	1500	1.04	0.89
Piedmont	18	1.08	0.99
Pleasanton	292	1.07	0.96
San Leandro	232	1.01	0.97
Union City	122	1.11	0.84
Unincorporated Areas			
Ashland	61	0.96	0.87
Castro Valley	116	1.06	1.08
Cherryland	35	1.10	0.85
San Lorenzo	36	0.96	1.02
Sunol	12	1.08	1.00
Unincorporated County	106	1.13	1.09
Planning Areas			
North	2,288	1.08	0.93
Central	990	1.08	0.98
South	711	1.10	0.92
East	949	1.05	0.96

For Study Network segments without available peak hour data, the adjusted peak hour data pivoting from the base year Alameda CTC model was calculated as follows:

$$Existing\ Adjusted\ Model\ Volume_{Facility} = Base\ Year\ Raw\ Model\ Volume_{Facility} \times Existing\ Volume\ Adjustment\ Factor_{Jurisdiction}$$

$$\begin{aligned} &Existing\ Adjusted\ Model\ Speed_{Facility} \\ &\qquad = Base\ Year\ Raw\ Model\ Speed_{Facility} \\ &\qquad \times Existing\ Speed\ Adjustment\ Factor_{Jurisdiction} \end{aligned}$$

These adjustments were applied to the 2010 base year model, calibrating them to observed data that generally ranges between years 2012 and 2014. For the purposes of this study it is assumed that the adjusted existing conditions volume and speed data still represent year 2010 conditions. This represents a conservative assumption as most of the data represents post 2010 conditions.

Figure 1 displays the existing volumes for all Study Network segments. **Figure 2** displays the existing speeds for all Study Network segments.

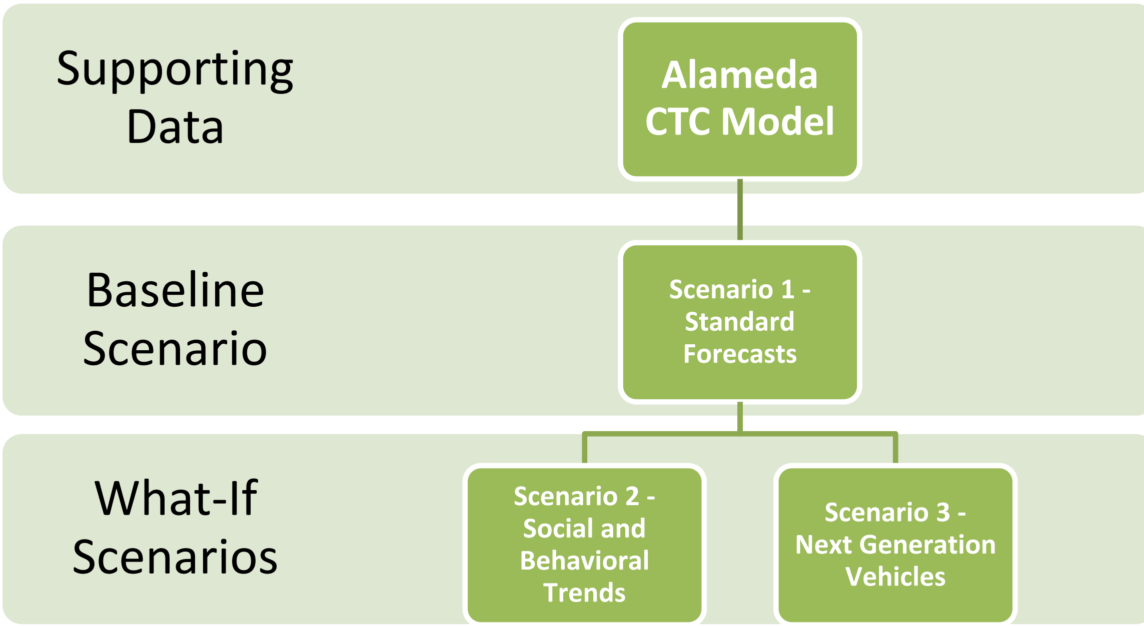
3.0 FORECAST SCENARIOS

To evaluate how well the arterials are performing to meet the established Plan goals, multimodal performance measures will be estimated for future year conditions along the Study Network. This plan will focus on "near-term" (year 2020) and "long-term" (year 2040) scenario years. The year 2020 analysis will be based on a single set of standard forecasts. The year 2040 analysis will consider three separate analysis scenarios:

- Scenario 1 will provide a **standard forecasting analysis** scenario,
- Scenario 2 will provide a supplemental forecasting scenario accounting for lower vehicle miles of travel (VMT) per capita associated with **social and behavioral trends** and the future of mobility, and
- Scenario 3 will account for roadway capacity impacts associated with the expected increase of **next generation vehicles** within the vehicle fleet in Alameda County. This scenario will not influence travel demand but will influence transportation operations. As such it will use the travel estimates from the standard forecasting scenario (Scenario 1 above).

Scenarios 2 and 3 will start with the standard baseline forecasts as developed as part of Scenario 1 and adjust according to factors described below. **Figure 3** presents a flowchart illustrating the relationship between the three scenarios.

Figure 3 – Scenario Flowchart



3.1 SCENARIO 1 – STANDARD FORECASTS

The standard forecasts scenario used the latest Alameda CTC model as received "off-the-shelf" from Alameda CTC without additional edits or adjustments to model parameters.

Study Network volume forecasts for scenario year 2040 were developed by deriving Alameda CTC Model growth rates between the base year (2010) and year 2040 model volumes and applying the growth rates to existing conditions data by jurisdiction. **Table 3** presents the PM peak hour volume growth factors by jurisdiction and planning area.

Table 3
PM Peak Hour Volume Growth (2010-2040) Factors by Jurisdiction and Planning Area

Jurisdiction/ Planning Area	Study Network Locations	Volume Growth Factor
Incorporated Jurisdictions		
Alameda	280	1.09
Albany	58	1.31
Berkeley	386	1.16

Jurisdiction/ Planning Area	Study Network Locations	Volume Growth Factor
Dublin	237	1.61
Emeryville	46	1.53
Fremont	468	1.21
Hayward	447	1.33
Livermore	449	1.32
Newark	121	1.24
Oakland	1,500	1.38
Piedmont	18	1.07
Pleasanton	292	1.23
San Leandro	232	1.43
Union City	122	1.20
Unincorporated Areas		
Ashland	61	1.62
Castro Valley	116	1.19
Cherryland	35	1.61
San Lorenzo	36	1.25
Sunol	12	1.62
Unincorporated County	106	1.58
Planning Areas		
North	2,288	1.31
Central	990	1.33
South	711	1.21
East	949	1.36

For Study Network segments the 2040 PM peak hour volume was then calculated as follows:

$$2040\ Forecasted\ Volume_{\ Facility} = Existing\ Volume_{Facility} \times 2040\ Growth\ Factor_{jurisdiction}$$

Figure 5 presents the 2040 PM peak hour volume standard forecasts for all Study Network segments.

For Study Network segments the 2020 PM peak hour volume was then calculated via interpolation as follows:

$$\begin{aligned} 2020\ Forecasted\ Volume_{\ Facility} \\ &= Existing\ Volume_{Facility} \\ &+ \left(\frac{\left(2040\ Forecasted\ Volume_{\ Facility} - Existing\ Volume_{Facility}\right)}{(2040 - 2010)}\right) \\ &\times (2020 - 2010) \end{aligned}$$

Figure 4 presents the 2020 PM peak hour volume forecasts for all Study Network segments. The estimated of growth to 2020 and 2040 closely match the growth estimated for Alameda County screenlines in the Alameda CTC model development documentation.

Congested speed forecasts were estimated using the forecasted volumes calculated above in conjunction with the Bureau of Public Roads (BPR) speed equation. This was assessed to be a more accurate approach to forecast speed as opposed to using the congested speed estimated in the travel model itself, as it is a function of the volume in the model.

The BPR congested speed equation is:

$$Future\ Year\ Speed = \frac{\text{Existing Speed}}{[1 + 0.15(\text{Future Year Volume} - \text{to} - \text{Capacity Ratio})^4]}$$

For 2020 and 2040 the forecasted speeds were calculated at each facility using the congested speed function above.

Figures 6 and 7 present the 2020 and 2040 congested speed for all Study Network segments respectively.

3.2 SCENARIO 2 – SOCIAL AND BEHAVIORAL TRENDS

Recent research has indicated that social and behavioral trends such as an increase in urban living, less auto ownership, and shifting lifestyle and generational travel preferences may significantly change relative to current planning thought. These factors influence travel behavior and could result in lower vehicle volumes and VMT. This forecast scenario prepares forecasts for scenario year 2040 assuming certain social and behavioral trends in Alameda County. Please refer to the *Alameda Countywide Multimodal Arterial Plan – Travel Demand Forecasting Methods White Paper-Final* (Fehr & Peers, June 23, 2015) in **Attachment A** for more details.

Table 4 presents the PM peak hour volume and VMT adjustment factors applied for Scenario 2 to account for social and behavioral trends.

Table 4
Scenario 2 PM Peak Hour Volume and VMT Adjustment Factors

Planning Area	Adjustment Factor Applied to Scenario 1
North	-5%
Central	-5%
South	-10%
East	-7%

For Study Network segments the 2040 PM peak hour volume for Scenario 2 was then calculated as follows:

$$2040\ Scenario\ 2\ Forecasted\ Volume_{\ Facility} = 2040\ Scenario\ 1\ Forecasted\ Volume_{Facility} \times Adjustment\ Factor_{Planning\ Area}$$

Figure 8 presents the 2040 PM peak hour volume forecasts for all Study Network segments for Scenario 2.

Congested speed forecasts were estimated using the Scenario 2 forecasted volumes in conjunction with the Alameda CTC travel demand model volume delay function. This was assessed to be a more accurate approach to forecast speed as opposed to using the congested speed estimated in the travel model itself, as it is a function of the unadjusted model volume. For 2040 Scenario 2 the forecasted speeds were calculated using the congested speed function described above.

Figure 9 presents the 2040 congested speeds for all Study Network segments for scenario 2.

3.2 SCENARIO 3 – NEXT GENERATION VEHICLES

Next generation vehicles such as self-driving or autonomous vehicles (AVs), are already being road tested in several states and will be available for sale within five to 10 years. Research has shown that AVs affect performance of transportation network elements based on their relative proportion to other types of vehicles. This scenario analyzes the likely penetration of AVs in Alameda County and how that will affect the performance of the transportation network.

Scenario 3 will assume that the Study Network contains 20% more capacity (vehicles per hour per lane) than the standard forecast Scenario 1 to account for the significant fleet penetration (50-85%) of next generation vehicles. It is assumed that the Scenario 3 long-term (year 2040) volume forecasts will be the same as Scenario 1 forecasts, the only difference between both scenarios is that Scenario 3 assumes 20% higher Study Network capacity than Scenario 1.

The 20% higher Study Network capacity will be assessed in the performance measure evaluation, not within the Alameda CTC Model. Therefore, the increased capacity will affect the PM peak hour congested speed (measure 1.1A) and reliability (measure 1.1B) calculations for Scenario 3, all other Scenario 3 performance measure calculations will be the same as Scenario 1 results.

For 2040 Scenario 3 the forecasted speeds were calculated using the congested speed function described in Section 3.1 above. **Figure 10** presents the Scenario 3 year 2040 congested speeds along the Study Network.

4.0 NEXT STEPS

Once short-term (2020) and long-term (2040) volume and speed forecasts are approved, the consultant team will utilize the data to assess future year transportation conditions by applying approved performance measures. Please contact Francisco Martin at 510-587-9422 if you have any questions or comments.

Attachments:

Figure 1 – PM Peak Hour Two-Way Vehicle Volume, Existing Conditions
Figure 2 – PM Peak Hour Two-Way Congested Speed, Existing Conditions
Figure 4 – PM Peak Hour Two-Way Vehicle Volume, Year 2020 Conditions
Figure 5 – PM Peak Hour Two-Way Vehicle Volume, Year 2040 Conditions-Scenario 1
Figure 6 – PM Peak Hour Two-Way Congested Speed, Year 2020 Conditions
Figure 7 – PM Peak Hour Two-Way Congested Speed, Year 2040 Conditions-Scenario 1
Figure 8 – PM Peak Hour Two-Way Vehicle Volume, Year 2040 Conditions-Scenario 2
Figure 9 – PM Peak Hour Two-Way Congested Speed, Year 2040 Conditions-Scenario 2
Figure 10 – PM Peak Hour Two-Way Congested Speed, Year 2040 Conditions-Scenario 3

Attachment A – Alameda Countywide Multimodal Arterial Plan – Travel Demand Forecasting Methods White Paper – Final

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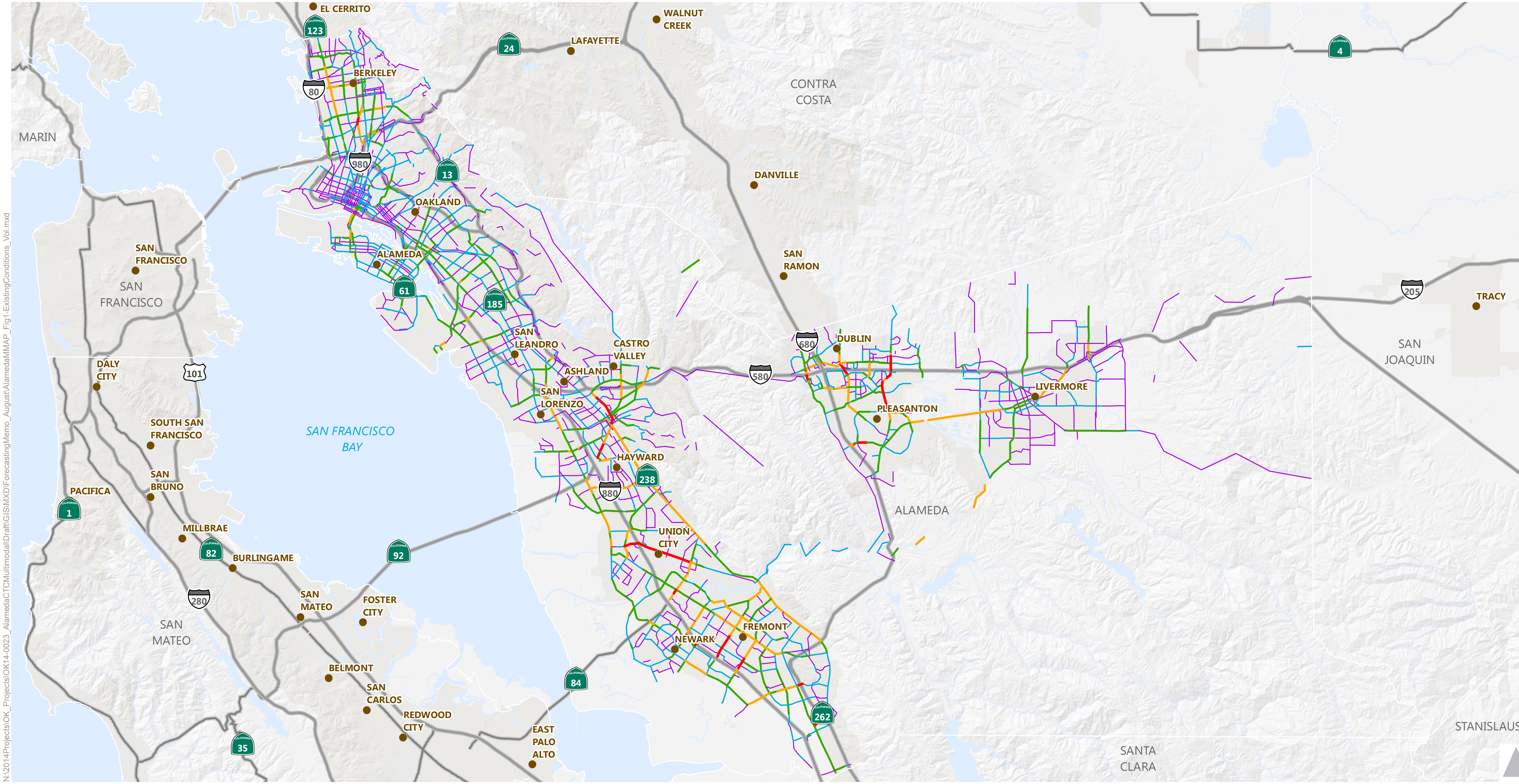


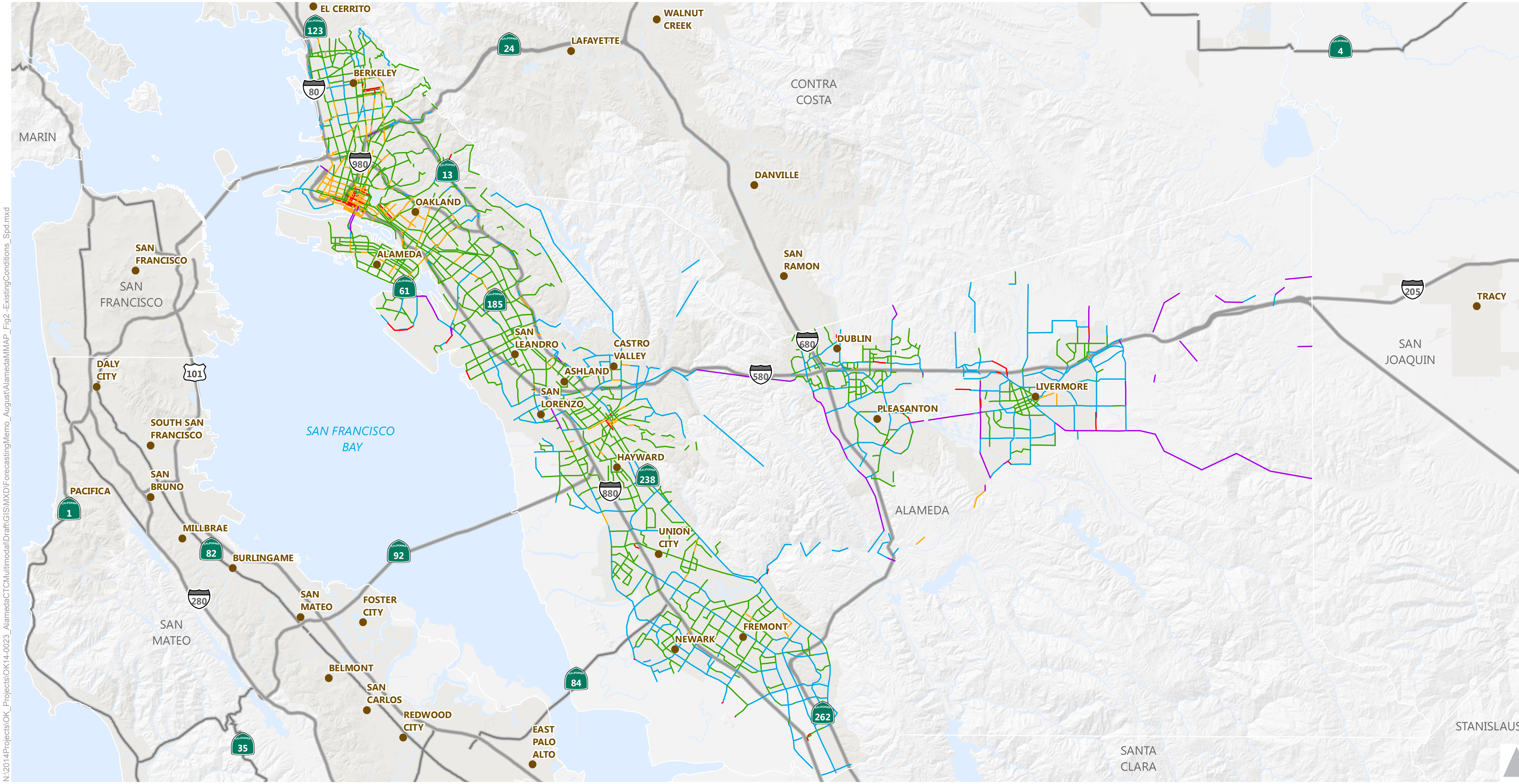
Alameda Countywide Multimodal Arterial Plan

PM Peak Hour Vehicle Volumes

< 500 | 501 - 1,500 | 1,501 - 2,500 | 2,501 - 4,000 | > 4,000

Figure 1

PM Peak Hour Two-Way Vehicle Volume Existing Conditions



Alameda Countywide Multimodal Arterial Plan

PM Peak Hour Congested Speed

< 10 | 10 - 20 | 20 - 30 | 30 - 40 | > 40 (MPH)

Figure 2

PM Peak Hour Two-Way Congested Speed
Existing Conditions

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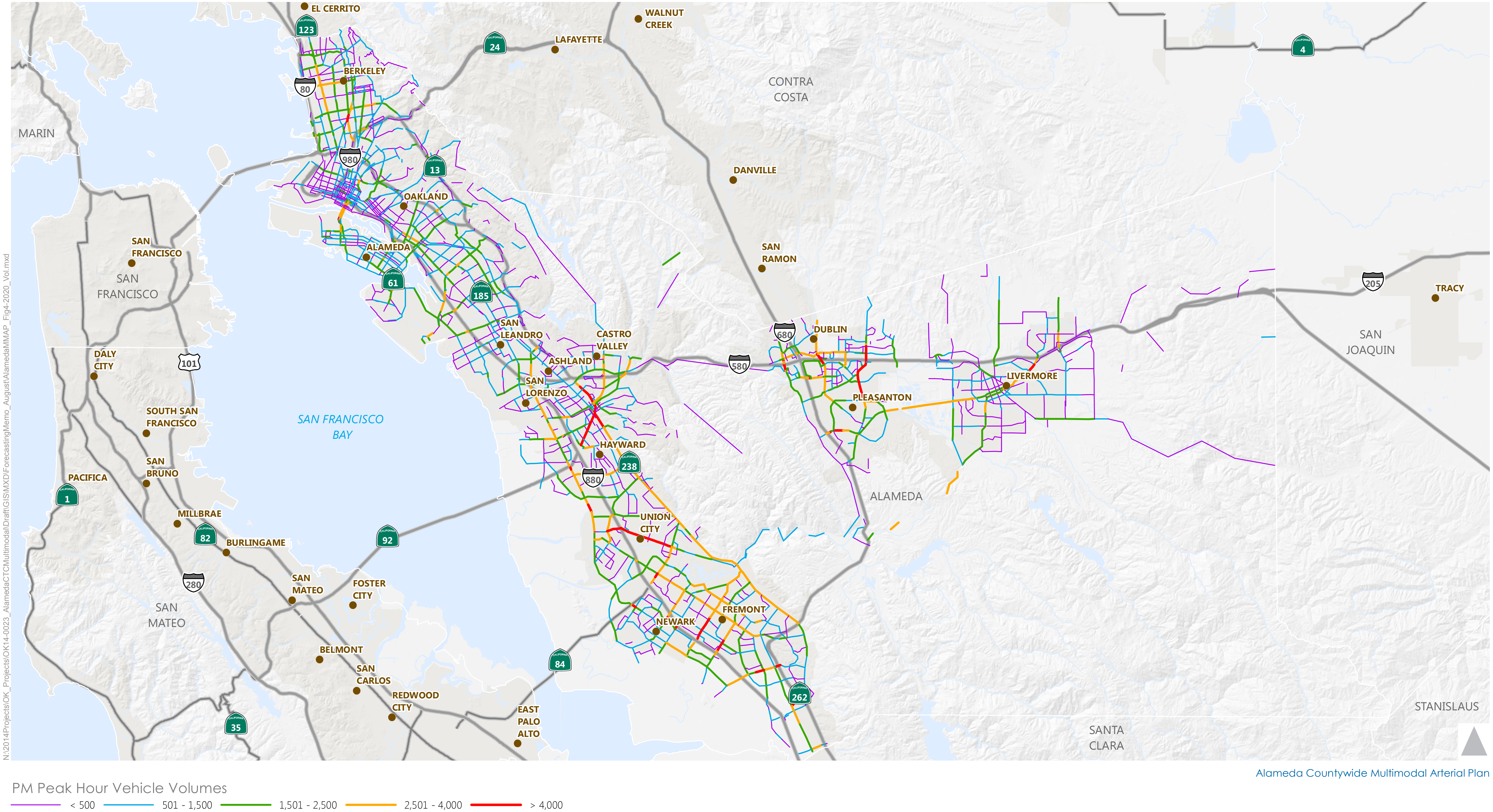
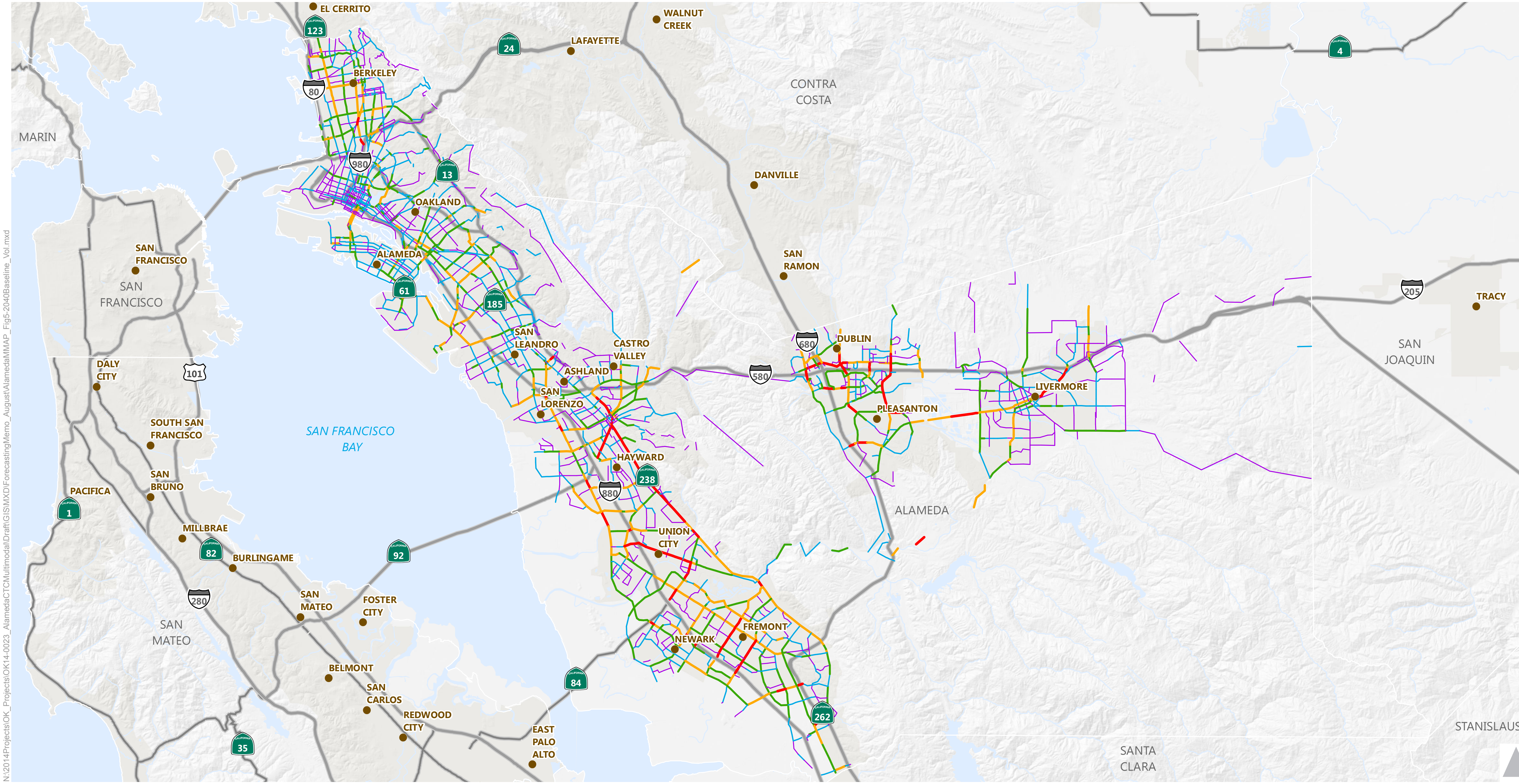


Alameda Countywide Multimodal Arterial Plan

Figure 4

PM Peak Hour Two-Way Vehicle Volume
Year 2020 Conditions



Alameda Countywide Multimodal Arterial Plan

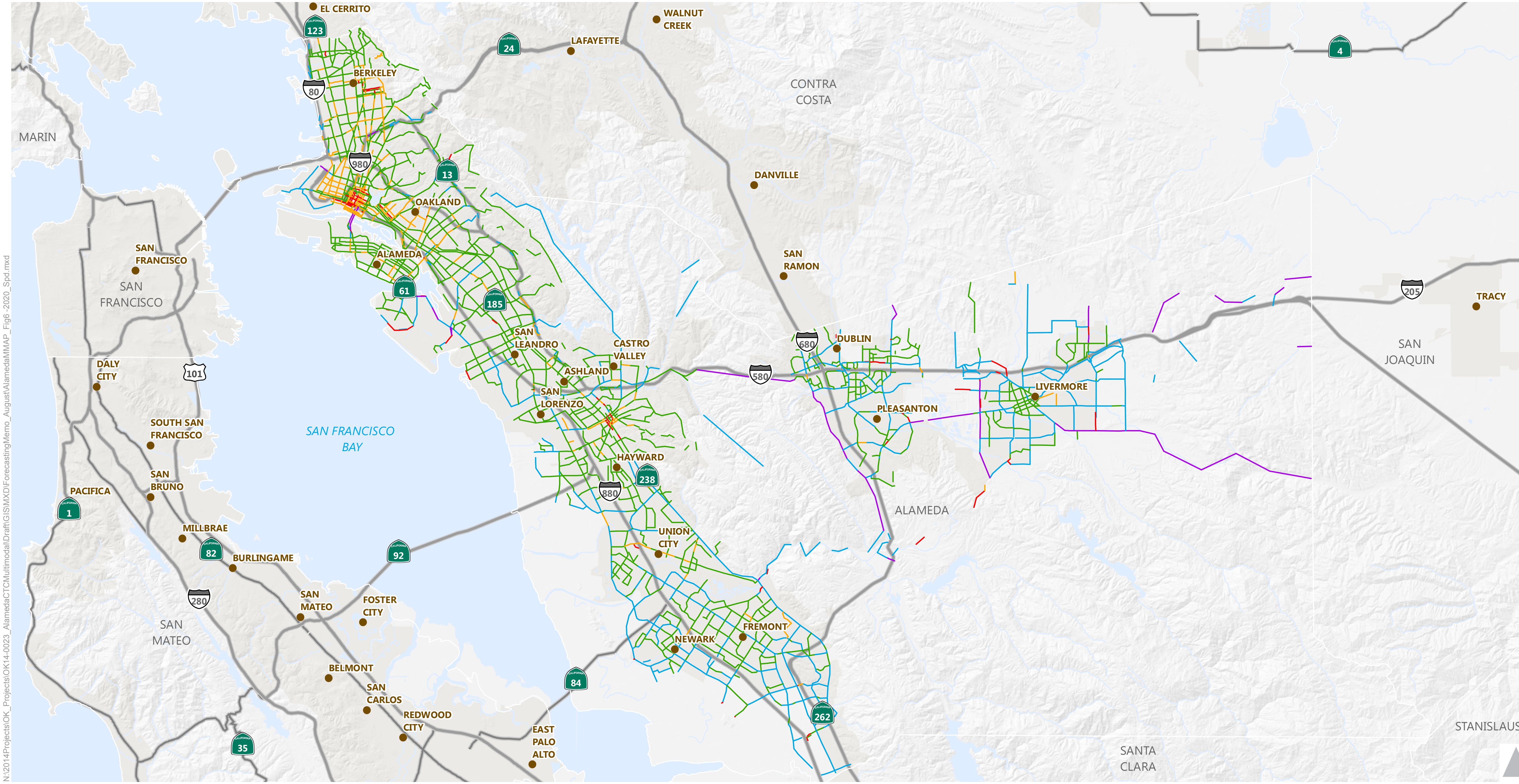
PM Peak Hour Vehicle Volumes

< 500 | 501 - 1,500 | 1,501 - 2,500 | 2,501 - 4,000 | > 4,000

Figure 5

PM Peak Hour Two-Way Vehicle Volume
Year 2040 Conditions - Scenario1

ALAMEDA County Transportation Commission



Alameda Countywide Multimodal Arterial Plan

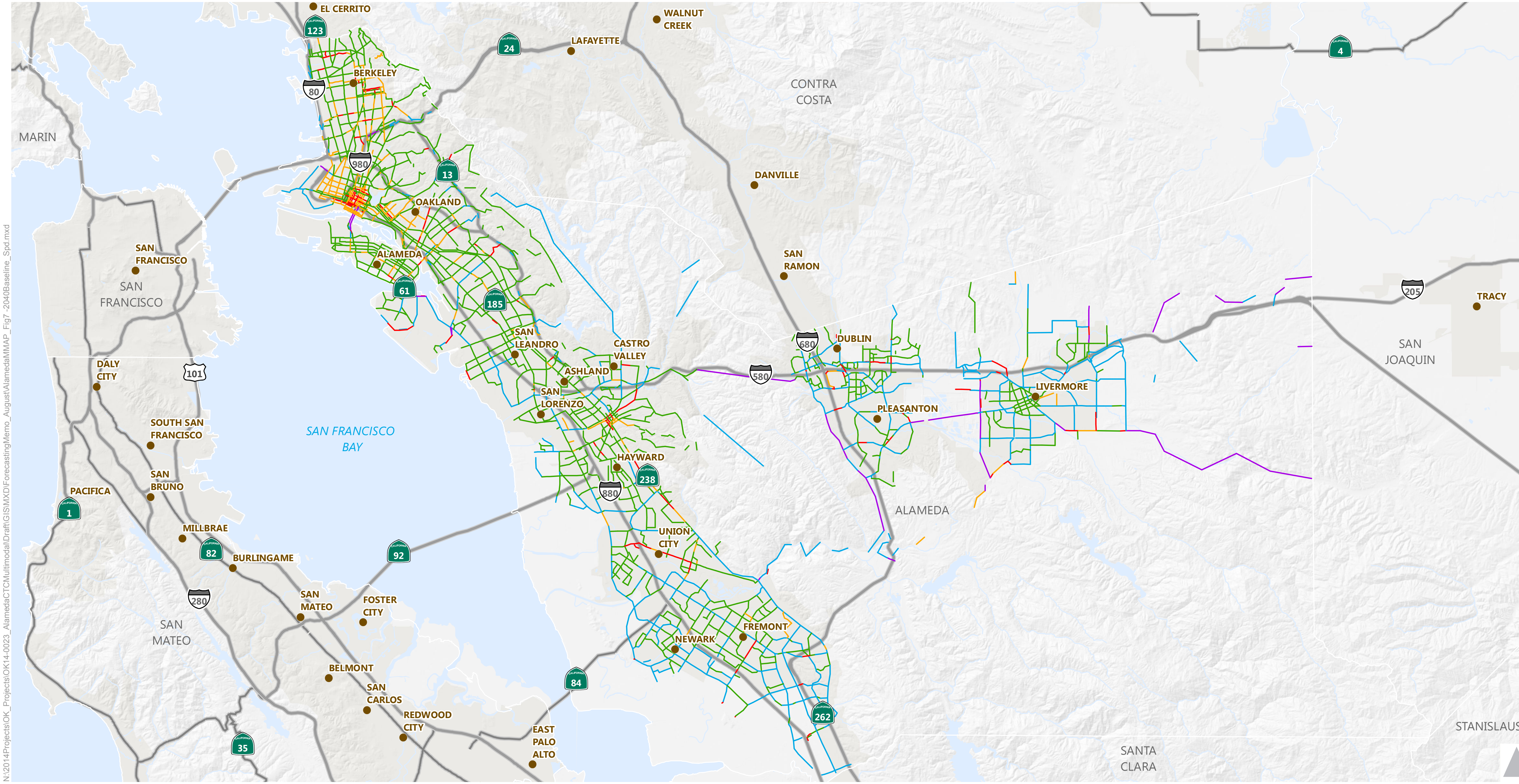
PM Peak Hour Congested Speed

< 10 | 10 - 20 | 20 - 30 | 30 - 40 | > 40 (MPH)

ALAMEDA County Transportation Commission

Figure 6

PM Peak Hour Two-Way Congested Speed
Year 2020 Conditions



PM Peak Hour Congested Speed

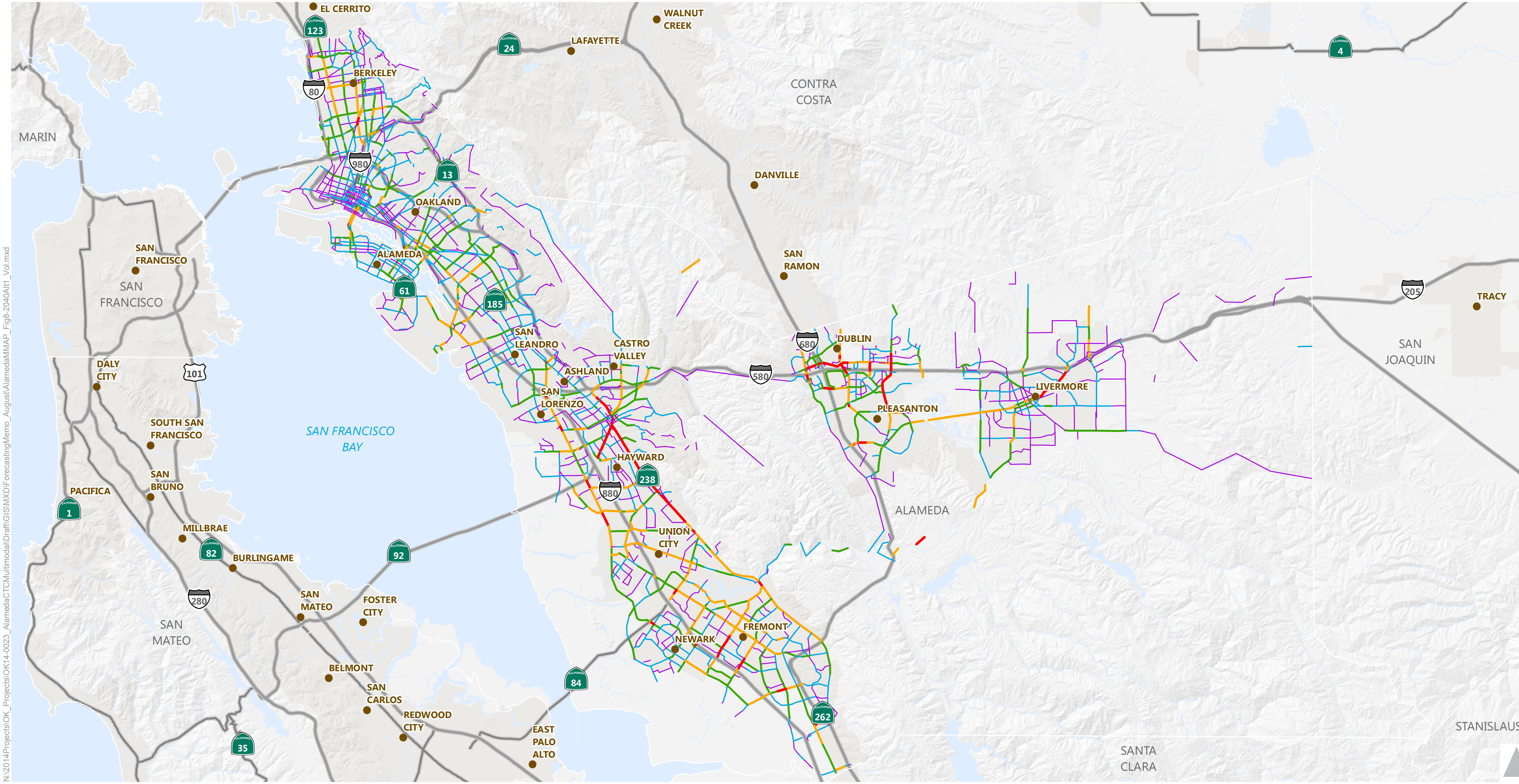
< 10 | 10 - 20 | 20 - 30 | 30 - 40 | > 40 (MPH)

Alameda Countywide Multimodal Arterial Plan

Figure 7

PM Peak Hour Two-Way Congested Speed

Year 2040 Conditions - Scenario 1



Alameda Countywide Multimodal Arterial Plan

PM Peak Hour Vehicle Volumes

< 500 | 501 - 1,500 | 1,501 - 2,500 | 2,501 - 4,000 | > 4,000

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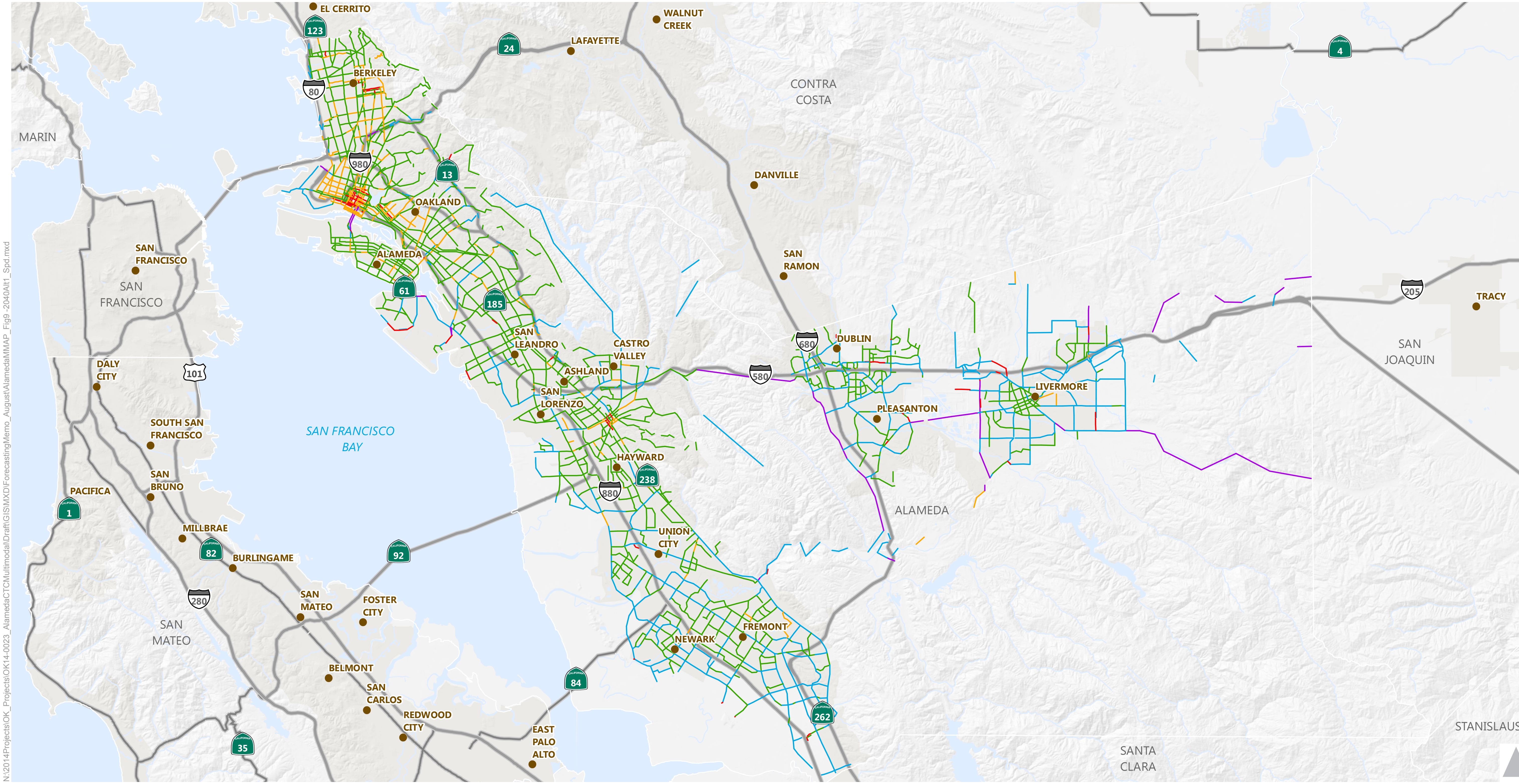
Figure 8

PM Peak Hour Two-Way Vehicle Volume

Year 2040 Conditions - Scenario 2



Alameda Countywide Multimodal Arterial Plan

PM Peak Hour Congested Speed

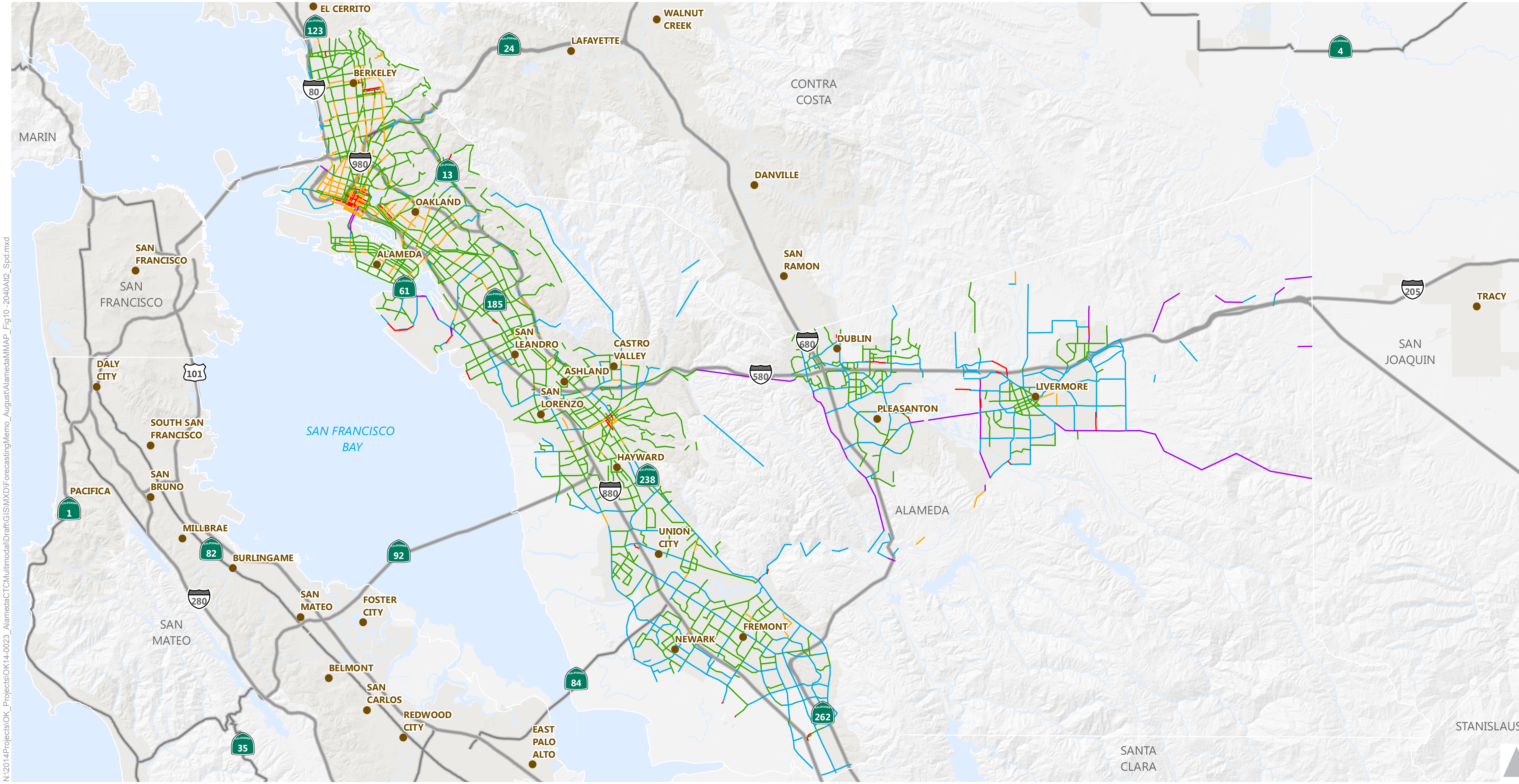
< 10 | 10 - 20 | 20 - 30 | 30 - 40 | > 40 (MPH)

ALAMEDA County Transportation Commission

Figure 9

PM Peak Hour Two-Way Congested Speed

Year 2040 Conditions - Scenario 2



Alameda Countywide Multimodal Arterial Plan

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PM Peak Hour Congested Speed

< 10 | 10 - 20 | 20 - 30 | 30 - 40 | > 40 (MPH)

ALAMEDA County Transportation Commission

Figure 10

PM Peak Hour Two-Way Congested Speed

Year 2040 Conditions - Scenario 3

FEHR PEERS

ATTACHMENT A

Alameda Countywide Multimodal Arterial Plan – Travel Demand Forecasting Methods White Paper - Final

MEMORANDUM

Date: June 23, 2015

To: Saravana Suthanthira, Alameda CTC

From: Francisco Martin and Mackenzie Watten, Fehr & Peers

Subject: Alameda Countywide Multimodal Arterial Plan
Travel Demand Forecasting Methods White Paper – Final

OK14-0023

1.0 INTRODUCTION

Alameda CTC is leading the development of a Countywide Multimodal Arterial Plan to better understand the existing and future role and function of the countywide arterial system in supporting all modes for all users. This Plan will provide a framework for the integrated management of major arterial corridors and will identify a priority list of short- and long-term multimodal improvements and strategies.

To evaluate the future role and conditions of the Study Network, forecasts of future travel behavior are required. These forecasts require the use of multiple data sources, most significantly the Alameda Countywide Travel Demand Model ("Alameda CTC Model"). This white paper describes the travel behavior forecasting assumptions, methodology, and approach.

The white paper first briefly describes the Alameda CTC Model. Then it provides forecast details for the Plan's multimodal performance measures, including those directly and indirectly forecasted using the Alameda CTC Model. The paper then details the three scenarios for which forecasts will be prepared. The first scenario, the Standard Baseline Forecasts Scenario, represents forecasts using current and approved travel behavior projections consistent with *Plan Bay Area* as represented by the Alameda CTC Model.

The other two scenarios represent "what-if" scenarios to evaluate the Study Network if travel behavior and technological trends significantly change in the future. The second scenario, the Social and Behavior Trends Scenario, examines how trends in demographics may change travel behavior. The third scenario, the Next Generation Vehicles Scenario, considers the implications of emerging technology on arterial capacity. These "what-if" scenarios incorporate travel behavior trends not fully captured by the Alameda CTC Model and require off model adjustments.

2.0 ALAMEDA CTC MODEL

The Alameda CTC Model is a collection of mathematical models that represent the Bay Area's land use and transportation networks that allows the Alameda CTC to anticipate and forecast the potential impacts of local land development decisions, transportation network infrastructure planning, and transportation land use and network policy on the major transportation infrastructure in the County. The model is periodically updated to be consistent with the most recent land use and socio-economic database as prepared by ABAG and transportation infrastructure investments as approved in the MTC's Regional Transportation Plan, and travel behavior assumptions as prepared by the Metropolitan Transportation Commission's (MTC) regional travel demand model.

The most recent Alameda CTC model update was completed in July 2014 and includes land use and transportation network assumptions to reflect MTC's *Plan Bay Area*. Additionally, the model was updated with numerous features that will benefit the Multimodal Arterial Plan:

- The model was updated to contain more detail in transit rich corridors, near transit stations, and in designated Priority Development Areas (PDAs)
- Enhancements to more accurately model bicycle trips through bicycle network infrastructure coding and a distinct bicycle trip assignment application
- Validation of the model to updated year 2010 traffic, transit, and bicycle counts
- Inclusion of transit park-and-ride vehicles in the highway assignment

The Alameda CTC model includes scenario years roughly corresponding to "existing" (year 2010), "near-term" (year 2020), and "long-term" (year 2040).

3.0 MULTIMODAL PERFORMANCE MEASURES

The Alameda CTC model is capable of estimating multimodal travel behavior for many locations in Alameda County. It has been calibrated and validated with year 2010 traffic vehicle, transit, and bicycle counts.

The full list of performance measures and performance indicators[1] to be estimated as part of the Multimodal Arterial Plan development have been documented in the January 22, 2015 memo titled *Alameda Countywide Multimodal Arterial Plan – Performance Measures and Evaluation Approach*.

3.1 PERFORMANCE MEASURES CALCULATED FROM MODEL

Some of proposed performance measures and indicators will be directly and indirectly estimated using the Alameda CTC model. Direct calculation implies that the performance measure is calculated using Alameda CTC model; indirect calculation implies that an Alameda CTC model output will be used as an input to calculate a specific performance measure. Please refer to the *Alameda Countywide Multimodal Arterial Plan – Performance Measures and Evaluation Approach* memo for more detail. Performance measures and indicators were approved by the Commission on February 26, 2015.

In addition to the performance measures directly estimated from the model, the model will be used indirectly in other performance measure and indicator calculations. For example, pedestrian and bicycle comfort indices will not be directly estimated by the model, but use vehicle volume forecasts directly estimated from the model as an input.

[1] Performance measures assess the existing and future year transportation conditions of the Study Network. Area-wide performance indicators are generally applied after preferred short- and long-term improvements are identified for the Arterial Network (subset of the Study Network that represents *arterials of countywide significance)* to evaluate and to ensure that the preferred improvements achieve the Plan's vision and goals.

3.1.1 Existing Performance Measure Calculations from Model

Existing PM peak hour volume count and travel speed data was not available for all the Study Network segments. The base year (2010) Alameda CTC model will be used with adjustments as described below. to identify PM peak hour volume and speed data for Study Network segments missing observed data.

The existing PM peak hour volume and speed data that is available will be used to develop jurisdiction (or planning-area where observed data is not available within a jurisdiction) adjustment factors to apply to the base year model volume and speed forecasts. The PM peak hour adjustment factor calculation will take the following form:

$$
\begin{aligned}
&Existing\ Volume\ Calibration\ Factor_{Jurisdiction} \\
&\quad = Total\ Volume\ from\ Available\ Count\ Data_{Jurisdiction} \\
&\quad \div Total\ Volume\ from\ Model\ for\ Segments\ with\ Available\ Count\ Data_{jurisdiction}
\end{aligned}
$$

For Study Network segments without available PM peak hour volume data, the adjusted PM peak hour volume from the base year Alameda CTC model will be calculated as follows:

$$
\begin{aligned}
&Existing\ Calibrated\ Model\ Volume_{Facility} \\
&\quad = Base\ Year\ Raw\ Model\ Volume_{Facility} \\
&\quad \times Existing\ Volume\ Calibration\ Factor_{jurisdiction}
\end{aligned}
$$

The Alameda CTC Model is used to directly calculate adjusted PM peak hour traffic volumes for Study Network segments without available observed data. The adjusted PM peak hour volumes are then used as inputs to calculate the following performance measures (an indirect model application) for existing conditions:

- 1.1B – Reliability
- 1.3 – Pedestrian Comfort Index
- 1.4 – Bicycle Comfort Index
- 5.1 – Collision Rates

Adjusted PM peak hour automobile speed (measure 1.1A) for Study Network segments without available observed speed data will be calculated using a similar process as the adjusted volume calculation described above. Existing PM peak hour transit speed (measure 1.2A) and transit reliability (measure 1.2B) will not be estimated using the Alameda CTC Model since AC Transit and LAVTA provided existing transit speed and reliability data for the majority of their transit network.

Transit speed and reliability will not be evaluated for Study Network segments in which transit operators did not provide data for.

The Alameda CTC Model can also be utilized to directly estimate non-auto transportation mode share (measure 1.6), vehicle miles of travel (VMT) per capita (measure 5.3) and greenhouse gas (GHG) emissions per capita (measure 5.4) for existing conditions.

3.2 PERFORMANCE MEASURES NOT CALCULATED FROM MODEL

The following performance measures or indicators will be evaluated as part of the Multimodal Arterial Plan development but will not be directly or indirectly calculated from the Alameda CTC Model:

- 1.2C Transit Infrastructure Index
- 1.5 Truck Route Accommodation Index
- 1.7 Pavement Condition Index
- 2.1 Benefit to Communities of Concern
- 3.1 Transit Connectivity
- 3.2 Pedestrian Connectivity
- 3.3 Bicycle Connectivity
- 3.4 Network Connectivity
- 4.1 Operating Cost Effectiveness
- 4.2 Implementation Challenge Score
- 4.3 Coordinated Technology

4.0 FORECAST SCENARIOS

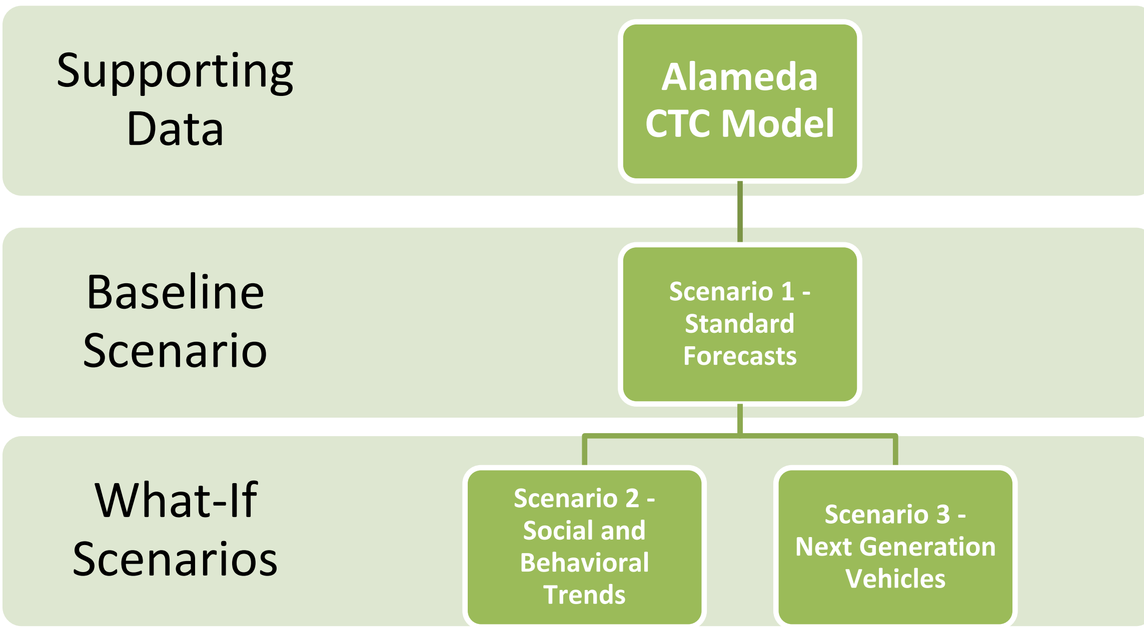
To evaluate how well the arterials are performing to meet the established Plan goals, multimodal performance measures will be estimated for future year conditions along the Study Network. This plan will focus on "near-term" (year 2020) and "long-term" (year 2040) scenario years. The year 2020 analysis will be based on a single set of standard forecasts. The year 2040 analysis will consider three separate analysis scenarios:

- Scenario 1 will provide a **standard forecasting analysis** scenario,
- Scenario 2 will provide a supplemental forecasting scenario accounting for lower VMT per capita associated with **social and behavioral trends** and the future of mobility, and
- Scenario 3 will account for roadway capacity impacts associated with the expected increase of **next generation vehicles** within the vehicle fleet in Alameda County. This scenario will not influence travel demand but will influence transportation operations. As

such it will use the travel estimates from the standard forecasting scenario (Scenario 1 above).

Scenarios 2 and 3 will start with the standard baseline forecasts as developed as part of Scenario 1 and adjust according to factors described below. **Figure 1** presents a flowchart illustrating the relationship between the three scenarios.

Figure 1 – Scenario Flowchart



4.1 SCENARIO 1 – STANDARD FORECASTS

The standard forecasts scenario will use the latest Alameda CTC model as received "off-the-shelf" from Alameda CTC without additional edits or adjustments to model parameters. PM peak hour volumes are generally higher than AM peak hour volumes throughout the County, therefore the Arterial Plan development process focuses on the PM peak hour only; AM peak hour forecasts will not be developed. Alameda CTC generally conducts their Congestion Management Program (CMP) Level of Service (LOS) monitoring by focusing on PM peak hour operations along the CMP network, which sets the precedent for focusing on the PM peak hour only as part of the Arterial Plan development approach.

Study Network volume forecasts for scenario year 2040 will be developed by deriving Alameda CTC Model growth rates between the base year (2010) and year 2040 model volumes and applying the growth rates to existing observed and adjusted volumes. The growth rates will be estimated for each jurisdiction and used to estimate year 2040 forecasts within the respective jurisdiction.

Year 2020 Study Network volume forecasts will be estimated using linear interpolation between existing and year 2040 volume forecasts. Interpolation will be used to ensure that the Project avoids scenarios where 2020 volume forecasts are unreasonably different (e.g., lower) than 2040 volume forecasts. The 2020 version of the Alameda CTC model will be reviewed at a Planning Area level to ensure that the linear interpolation assumed is reasonable.

4.1.1 Future Year (2020 and 2040) Performance Measure Calculations from Model

The Alameda CTC Model will be used to estimate year 2020 and 2040 Study Network PM peak hour volume forecasts. Future year volume forecasts will then be used as inputs to calculate the following performance measures (an indirect model application) for year 2020 and 2040:

- 1.1B – Reliability
- 1.3 – Pedestrian Comfort Index
- 1.4 – Bicycle Comfort Index
- 5.1 – Collision Rates

Future year PM peak hour automobile congested speed (measure 1.1A) will be estimated by applying a standard time delay function, which is typically incorporated into travel demand models to calculate congested travel speeds. The travel delay function will utilize existing peak hour speeds and the future year volume forecasts to estimate year 2020 and 2040 PM peak hour congested speed (measure 1.1A), which is an indirect model application.

Future year PM peak hour transit speed (measure 1.2A) will be estimated by applying the existing conditions PM peak hour transit speed-to- automobile speed ratio to the 2020 and 2040 PM peak hour automobile congested speed (measure 1.1A) estimate. Year 2020 and 2040 transit reliability (measure 1.2B) will be estimated by utilizing year 2020 and 2040 PM peak hour transit speed (measure 1.2A) estimates. Therefore, both the transit speed and transit reliability measures are indirectly estimated from the Alameda CTC Model for future year conditions.

The Alameda CTC Model can also be utilized to directly estimate non-auto transportation mode share (measure 1.6), demand for active transportation (measure 5.2), vehicle miles of travel (VMT) per capita (measure 5.3) and greenhouse gas (GHG) emissions per capita (measure 5.4) for year 2020 and 2040 conditions.

4.1.2 "What-if" Scenarios - Trends Beyond Standard Forecasts

In addition to the standard forecasts analysis, the Multimodal Arterial Plan will prepare two unique scenarios that capture travel behavior trends and impact of next generation vehicles based on the latest research that are not reflected yet in the standard travel demand forecasting models including ABAG/MTC planning or the Alameda CTC Model.

The current planning tools are mostly based on existing or near-term trends that do not fully capture changes in trends beyond the standard forecasting approach. The first alternative forecasting analysis will examine how volume forecasts generated by the Alameda CTC Model could reasonably change given changes in factors that influence travel behavior, and result in lower VMT. These factors include social and behavioral trends such as an increase in urban living, less auto ownership, and shifting lifestyle and generational travel preferences as explained in the sections below. The second alternative analysis scenario that captures the impact of next-generation vehicles (connected or autonomous in nature) will utilize the standard forecast estimates and estimate the impact of next-generation vehicles to arterial per lane capacity. It's important to note that these analysis scenarios are intended as a planning exercise – research on these trends is still in its infancy and there are a number of assumptions that will be used to quantify effects to the countywide Study Network. As such, approximate adjustments will be used as much as possible to not give a false sense of precision.

For purposes of this Plan development, the two supplemental forecasting analysis scenarios with variants for demographic, economic, and technologic trends will focus on the "long-term" (year 2040) scenario. Based on available research, "near-term" (year 2020) scenario will likely not have large changes due to these trends.

The following sections will describe each "what-if" scenario, the national research on the trends, the local context of those trends, and proposed assumptions for applications of the local context to the what-if" scenario.

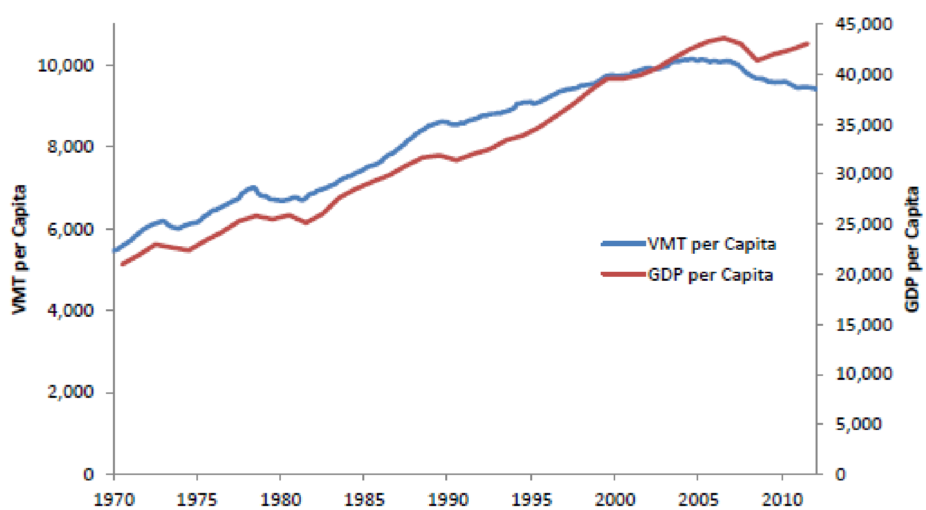
4.2 SCENARIO 2 – SOCIAL AND BEHAVORIAL TRENDS

Recent research has indicated that social and behavioral trends such as an increase in urban living, less auto ownership, and shifting lifestyle and generational travel preferences may significantly change relative to current planning thought. These factors influence travel behavior and could result in lower VMT. This scenario analyzes how existing planning tools such as the Alameda CTC Model currently reflect these trends, and to what extent future conditions would change if further changes were assumed.

4.2.1 National Research

As shown in **Figure 2**, after 50 years of steady growth, total national vehicle miles traveled (VMT) per capita leveled off in 2004 and declined by eight percent between 2004 and 2012[2]. Research has focused on the reasons for the decline and whether the leveling and subsequent drop in VMT will be temporary or the beginning of a sustained downward trend. Research has narrowed the possible reasons for the decline to macroeconomic factors, technology and social networking, and shifting lifestyle and generational trends that influence society's transportation priorities.

Figure 2 – Annual VMT and GDP per Capita 1970-2012



Source: Federal Highway Administration Office of Highway Policy Information; World Bank.

[2] Federal Highway Administrative Office of Highway Policy Information, 2012.

4.2.1.1 Macroeconomic factors

The economic decline of the Great Recession around 2008 does not fully explain the VMT decline observed. Driving began to plateau in 2004, at least three years before the onset of the recession. In the meantime, GDP per capita continued to climb until the onset of the Great Recession[3]. Although the macroeconomic decline reversed in 2010, VMT per capita has continued to decline. Factors to explain this include lower vehicle ownership (by nearly five percent between 2006 and 2011)[4], declining employment rate (approximately five percent between 2000 and 2012)[5], decrease in median household income (10 percent decrease between 2000 and 2012)[6], and a shift from housing development in suburban or urban fringe areas to infill ("previously developed") areas near city centers and inner ring suburbs[7].

4.2.1.2 Technology and social networking

Some of the "conventional" wisdom on the reasons for VMT decline has been overstated. Internet shopping accounts for only 10 percent of all purchases, and only 80 percent of internet purchases generated additional VMT due to delivery vehicles. Telecommuting effects are still small: only 4.3 percent of employees worked from home in 2010, as compared with 3.5 percent in 1970. Many studies have found that connected applications and the sharing economy tended to be associated with only slight changes in travel demand (both increase and decrease). Information and communications technologies appear to be as a complement to travel and not a substitute for it.[8]

4.2.1.3 Shifting lifestyle and generational trends

A large amount of research has been focused on the shifting lifestyle of generational trends between Baby Boomers (those born between 1946 and 1964) and Millennials (those born between 1983 and 2000). These two groups represent the two largest age cohorts alive today. Millennials are transitioning into adult life in a poor job market while Baby Boomers are

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[3] World Bank, 2012.
[4] Cohn, D'Vera. "Data show a dent in Americans' love for cars." *Pew Research Center*. 1 July 2013. http://www.pewresearch.org/fact-tank/2013/07/01/data-show-a-dent-in-americans-love-for-cars/
[5] Bureau of Labor Statistics, 2012.
[6] U.S. Census Bureau, 2012.
[7] Thomas, J. "Residential Construction Trends in America's Metropolitan Regions," U.S. Environmental Protection Agency, January 2009 and January 2010.
[8] Volpe National Transportation Systems Center. "Driven to Extremes – Has Growth in Automobile Use Ended?" FHWA Office of Highway Policy Information, May 2013.

transitioning into their golden years and experiencing issues retiring due to devaluation of various assets.

Baby Boomers are expected to be more active and mobile than the present senior population, just as the present senior population is more mobile than the generation before them. Aligning with overall trends, per capita VMT declined by nearly 10 percent between 2001 and 2009 for Baby Boomers. Car mode share declined between 2001 and 2009 for both Baby Boomers and seniors aged 75 and older.[9]

Millennials have entered their adult lives during the onset of the Great Recession. Research has shown that economic factors have had a strong influence on their travel decisions. Younger generations travel fewer miles and make fewer trips than was the case for previous generations at the same stage in their lives. [10]

Car ownership is down overall – adults between the ages of 21 and 34 bought just 27 percent of all new vehicles sold in the US, down from a peak of 38 percent in 1985. Surveys of Millennials indicate a strong preference towards living in medium or big cities, where land use and social scenes tend to be more dynamic with a mixture of activities and socioeconomic groups.[11]

4.2.1.4 National Research Conclusion

The national research above indicates that VMT growth will slow significantly and may even stabilize at pre-2000 VMT per capita levels. **Putting the above factors together this white paper forecasts that VMT per capita (nationally), which grew by 17 percent between 1990 and 2004 and declined by eight percent between 2004 and 2012, will remain static or decline and will be between 90% and 95% of the 2012 VMT per capita, even through 2040**. This estimate is based on the national research listed above and may be different given local context (see next section). Additionally this research is in its infancy and should be considered approximate assumptions and for the sake of high level planning. Further research and monitoring of trends may adjust these assumptions.

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[9] National Household Travel Survey (NHTS), 2009.
[10] Blumenberg E., Taylor B., Ralph K., Wander M., Brumbaugh S. "*What's Youth Got to Do with It? Exploring the Travel Behavior of Teens and Young Adults.*" (2013) University of California Transportation Center.
[11] Lachmann M., Leanne B., Deborah L. "*Generation Y: Shopping and Entertainment in the Digital Age.*" Urban Land Institute, 2013.

4.2.2 Local Context

The research reviewed above is national in scope and may not directly apply to Alameda County. The current planning projections produced by ABAG, MTC, and Alameda CTC already partially account for the demographic trends described above. This has been accounted for in the standard forecasting scenario (Scenario 1 above). This scenario will explore how trends may go above and beyond that which has been projected for the purposes of creating a "what-if" scenario.

The regional Sustainability Community Strategy (SCS) prepared by MTC and ABAG for the Bay Area, *Plan Bay Area*, includes sections on "Aging Baby Boomers Expected to Change Travel and Development Patterns" and "Demand for Multi-Unit Housing in Urban Areas Close to Transit Expected to Increase". Clearly, trends in demographics and travel behavior are expected and accounted for in regional planning projections. Review of demographics from the Alameda CTC model (which implements the MTC/ABAG SCS) at a Planning Area and PDA area level reflects these trends.

Table 1 presents the percentage of growth from 2010 to 2040 located in PDA areas by Planning Area. Consistent with the national research[12], there is a shift towards growth in urban environments in Alameda County.

Table 1
Percentage of Growth (2010 to 2040) in PDA by Planning Area (Alameda CTC Model)

Planning Area	% Growth in PDA		
	Total HH	Total Pop	Total Emp
North	91%	88%	84%
Central	77%	72%	55%
South	78%	75%	56%
East	60%	55%	36%
Total	*81%*	*77%*	*65%*

[12] Thomas, J. "Residential Construction Trends in America's Metropolitan Regions," U.S. Environmental Protection Agency, January 2009 and January 2010.

Table 2 presents the household vehicle ownership distribution by Planning Area from the Alameda CTC model. Consistent with the national research[13], there is a shift towards less auto ownership in Alameda County.

Table 2
Household Vehicle Ownership Distribution by Planning Area (Alameda CTC Model)

Planning Area	Scenario Year 2010			Scenario Year 2040			Growth (percent points)		
	0-Vehicle	1-Vehicle	2+-Vehicle	0-Vehicle	1-Vehicle	2+-Vehicle	0-Vehicle	1-Vehicle	2+-Vehicle
North	19%	44%	37%	26%	42%	32%	7%	-2%	-6%
Central	9%	36%	55%	12%	38%	50%	3%	2%	-5%
South	6%	27%	67%	7%	29%	64%	2%	2%	-4%
East	4%	24%	71%	6%	27%	67%	2%	3%	-5%
Total	12%	36%	51%	17%	37%	46%	*5%*	*0%*	*-5%*

Table 3 presents the household worker distribution by Planning Area from the Alameda CTC model. Consistent with the national research[14], there is a shift towards less workers per household in Alameda County, which means there will tend to be reduced number of trips and reduced VMT.

Table 3
Household Worker Distribution by Planning Area (Alameda CTC Model)

Planning Area	Scenario Year 2010			Scenario Year 2040			Growth		
	0-Worker	1-Worker	2+-Worker	0-Worker	1-Worker	2+-Worker	0-Worker	1-Worker	2+-Worker
North	32%	38%	30%	36%	36%	27%	4%	-1%	-3%
Central	25%	40%	35%	29%	39%	31%	4%	-1%	-3%
South	16%	37%	47%	19%	37%	45%	2%	0%	-2%
East	19%	34%	47%	19%	35%	46%	0%	0%	0%
Total	26%	38%	37%	29%	37%	34%	*3%*	*-1%*	*-2%*

[13] Lachmann M., Leanne B., Deborah L. "*Generation Y: Shopping and Entertainment in the Digital Age.*" Urban Land Institute, 2013.
[14] Bureau of Labor Statistics, 2012.

Changes in other factors mentioned in the national research, including goods and service delivery, telecommuting, social networking, and internet shopping, is likely not directly accounted for in the Alameda CTC Model. The research indicated a change in plus or minus two percent VMT per capita for the various factors – this will be incorporated into the adjustment factors listed in the next section.

Detailed tables detailing the trends described above, cross classified by Planning Area and PDA are presented at the end of this memo.

4.2.3 Scenario 2 Conclusion

As mentioned previously, the factors listed above are byproducts of land use, built environment, and multimodal options available. It's clear that the Bay Area planning projections partially include the trends described by the national research. The projections differ to the degree already captured in model by Planning Area.

The national research indicates that VMT per capita will remain static or decline and will be between 90% and 95% of the 2012 VMT per capita, even through 2040. Based on the evaluation of trends in social, demographics and travel behavior in each Planning Area as detailed in tables 2 to 4, the project team determined qualitatively the degree these trends have been already captured in the model for 2040 as high, medium, and low, as shown in **Table 4**.

Based on the research that states that there will be a 5% to 10% reduction of VMT per capita over the 2012 levels, an additional adjustment factor was identified for each of the Planning Areas based on the degree to which the research trends were already captured. As the North and Central Planning Areas were identified to have a high amount of trends already captured, a reduction of downward adjustment factor of 5% was identified for VMT reduction. The South and East Planning Areas were identified to have a low amount of trends already captured, and thus higher downward adjustment factors were identified.

Considering that the South Planning Area will have a direct mass transit connection to Silicon Valley, a major regional employment center, it is expected to have higher VMT reduction (10%). The East Planning Area with the proposed transit improvements will have a VMT reduction (7%) that is comparable to the South Planning Area and higher than the North and Central Planning Areas.

Table 4 also presents these adjustment factors to be applied to Scenario 1 Year 2040 vehicle volume forecasts to develop Scenario 2 2040 vehicle volume forecasts. Study Network vehicle volume forecasts are used as inputs into various future year performance measure calculations, as described in Section 4.1.1 above. These factors reflect the incremental change in travel behavior (relative to the partially captured model factors) due to demographics and the future of mobility. These factors combined with the model projections create a 2040 scenario consistent with the national research of 90% to 95% of the 2012 VMT per capita.

Table 4
Scenario 2 Traffic Volume Adjustment Factors

Planning Area	Degree Already Captured in Model				Adjustment Factor Applied to Scenario 1 (Year 2040 Only)
	Shift to PDAs	Vehicle Ownership	Labor Participation	Other Factors (Goods Delivery, Social Networking, etc.)	Proposed Adjustment Factor
North	High	High	High	None	-5%
Central	Medium	Medium	High	None	-5%
South	Medium	Medium	Medium	None	-10%
East	Low	Medium	Low	None	-7%

These adjustment factors are approximate to represent the nature of the national research and the concept of a "what-if" scenario. Performance measures and indicators listed in **Table 1** will be estimated for Scenario 2 using a similar process as Scenario 1 calculations described in Section 4.1.1.

4.3 SCENARIO 3 – NEXT GENERATION VEHICLES

Next generation vehicles such as self-driving or autonomous vehicles (AVs), are already being road tested in several states and will be available for sale within five to 10 years. Research has shown that AVs affect performance of transportation network elements based on their relative proportion to other types of vehicles. This scenario analyzes the likely penetration of AVs in Alameda County and how that will affect the performance of the transportation network.

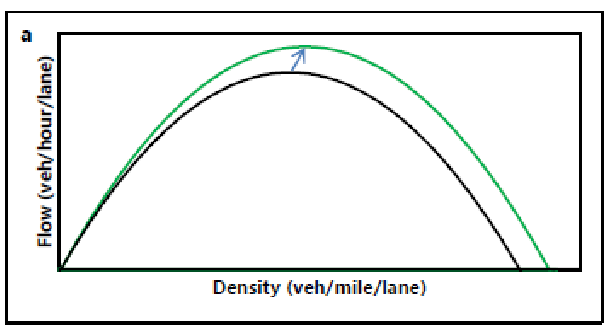
4.3.1 National Research

The research is varied by facility type – those locations with fewer conflicts (such as freeways and highways) will be the first to receive benefits as market penetration grows. Multimodal arterials would likely require substantial market penetration of AVs before noticeable impacts on roadway capacity are observed. The research has narrowed its focus to the effect of AVs on roadway capacity, VMT, and parking.

4.3.1.1 Effect on Roadway Capacity

AVs present an opportunity for increased roadway capacity due to their potential to minimize following distances between vehicles and improve time negotiating merging and intersection right-of-way. In the short-term (year 2020), AVs will have negligible impacts to roadway capacity. In the long term (year 2040), when AVs reach almost significant amounts (50-85%[15]) of penetration of the fleet, operating efficiencies will begin to improve. Some research indicates per-lane highway roadway capacities could improve by up to 50%. As shown on **Figure 3**, **research on capacity improvements for non-highway roadway facilities is more limited, but early research indicates capacity improvements on the order of 20%[16] with significant amounts (50-85%) of penetration of the fleet. These assumptions appear conservative and therefore reasonable to use for this alternative scenario.**

Figure 3 – Potential Flow Capacity Shift with Autonomous Vehicles



Source: Caltrans PATH program

[15] Patcharinee Tientrakool, Ya-Chi Ho, and Nicholas F. Maxemchuk. "Highway Capacity Benefits from Using Vehicle-to-Vehicle Communication and Sensors for Collision Avoidance." Vehicle Technology Conference (VTC Fall). San Francisco, California, September 2011.

[16] Steven E. Shladover. "Highway Capacity Increases from Automated Driving." California PATH Program, July 2012.

4.3.1.2 Effect on VMT

A number of complex factors with varying levels of interaction will affect changes to travel behavior patterns, resulting in either an increase or decrease in overall vehicle-miles traveled (VMT). Research has also shown that the increase in AVs can lead to more travel/VMT[17], while others indicate that AVs may increase travel/VMT[18] [19].

Given the uneven results and lack of research on the topic, the next generation vehicle scenario will not consider the effect on VMT.

4.3.1.3 Effect on Parking

AVs will have automatic parking capabilities that move a vehicle from a traffic lane into a parking space by performing a parallel, perpendicular or angle parking maneuver. AVs and their automated parking capabilities can potentially affect the need to provide on-street parking for arterial segments that have right-of-way constraints and would thus make it difficult to provide on-street parking. Automatic parking will allow passengers to be dropped off at destinations that do not provide off-street parking or adjacent on-street parking spaces and AVs would then have the capability to park itself at an on-street parking space within a few blocks of the passenger's destination.

4.3.2 Local Context

The national research on next generation vehicles is limited and mostly still at research in nature. As such, there is no local context to provide except that there are test facilities either available or being opened across the region for testing next generation vehicles. The facilities included in the national research (highways and arterials) are likely similar to the type of facilities that exist in a mature urban environment like Alameda County.

4.3.3 Scenario 3 Conclusion

The research above indicates that the improved driver experience provided by AVs could produce as much as a 50 percent increase for highway facilities and roughly 20 percent for non-highway

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[17] http://www.autonews.com/article/20130612/OEM11/130619945/for-some-driving-is-more-stressful-than-skydiving#
[18] http://trb.metapress.com/content/j81w2542q372x2p5/
[19] http://www.nzta.govt.nz/resources/research/reports/469/docs/469.pdf

facilities[20] in operating efficiency and capacity utilization, in addition to better on-street parking demand management.

These rates vary by facility types where AVs would be permitted, the multimodal options available as well as AV market penetration. Although the net operational improvements to arterials may not significantly reduce the need to expand infrastructure to keep pace with population growth, the benefit of AVs on the road would most likely take the form of increased mobility for all, increased safety, reduced incident-related congestion, and reduced environmental costs per VMT.

Based on the research described above, Scenario 3 will assume that the Study Network contains 20% more capacity (vehicles per hour per lane) than the standard forecast Scenario 1 to account for the significant fleet penetration (50-85%) of next generation vehicles. These adjustment factors are approximate to represent the nature of the national research and the concept of a "what-if" scenario. These adjustments are intended for a high level planning study.

As part of Scenario 3, Fehr & Peers will not conduct a new Alameda CTC Model run assuming 20% higher capacity along arterials or any capacity adjustments along freeways. It is assumed that the Scenario 3 future year (2020 and 2040) volume forecasts will be the same as Scenario 1 forecasts, the only difference between both scenarios is that Scenario 3 assumes 20% higher Study Network capacity than Scenario 1. The 20% higher Study Network capacity will be assessed in the performance measure evaluation, not within the Alameda CTC Model. Therefore, the increased capacity will affect the PM peak hour congested speed (measure 1.1A) and reliability (measure 1.1B) calculations for Scenario 3, all other Scenario 3 performance measure calculations will be the same as Scenario 1 results.

Please contact Francisco Martin at 510-587-9422 if you have any questions or comments.

Attachments:
Demographic and Future of Mobility Trends Capture in Model: Full Detail

[20] Steven E. Shladover. "Highway Capacity Increases from Automated Driving." California PATH Program, July 2012.

Growth by Planning Area

All Planning Areas

Planning Area	2010			2040			Growth		
	TOTHH	TOTPOP	TEMP	TOTHH	TOTPOP	TEMP	TOTHH	TOTPOP	TEMP
North	247,345	618,495	316,745	328,378	836,168	444,864	81,033	217,673	128,119
Central	123,482	367,390	124,352	149,463	449,340	171,302	25,981	81,950	46,950
South	104,301	325,896	124,019	130,813	417,993	171,193	26,512	92,097	47,174
East	71,252	202,753	119,131	100,717	276,537	172,814	29,465	73,784	53,683
Total	*546,380*	*1,514,534*	*684,247*	*709,371*	*1,980,038*	*960,173*	*162,991*	*465,504*	*275,926*

All Planning Areas

PDA	2010			2040			Growth		
	TOTHH	TOTPOP	TEMP	TOTHH	TOTPOP	TEMP	TOTHH	TOTPOP	TEMP
Regional Center	12,952	23,459	97,173	28,663	50,608	130,395	15,711	27,149	33,222
City Center	34,067	83,293	68,869	58,094	139,740	101,730	24,027	56,447	32,861
Mixed-Use Corridor	96,275	242,129	58,453	114,488	294,133	76,006	18,213	52,004	17,553
Urban Neighborhood	49,325	133,585	30,267	63,270	176,602	47,943	13,945	43,017	17,676
Transit Neighborhood	45,729	140,723	30,065	54,647	171,802	39,650	8,918	31,079	9,585
Suburban Center	16,401	51,218	71,654	37,067	101,650	103,144	20,666	50,432	31,490
Transit Town Center	45,990	136,363	40,001	76,160	235,522	75,814	30,170	99,159	35,813
Sub-Total PDA	*300,739*	*810,770*	*396,482*	*432,389*	*1,170,057*	*574,682*	*131,650*	*359,287*	*178,200*
Non-PDA	245,641	703,764	287,765	276,982	809,981	385,491	31,341	106,217	97,726
				% Growth in PDAs			81%	77%	65%

Growth by Planning Area

North

	2010			2040			Growth		
	TOTHH	**TOTPOP**	**TEMP**	**TOTHH**	**TOTPOP**	**TEMP**	**TOTHH**	**TOTPOP**	**TEMP**
North	247,345	618,495	316,745	328,378	836,168	444,864	81,033	217,673	128,119
Central									
South									
East									
Total	*247,345*	*618,495*	*316,745*	*328,378*	*836,168*	*444,864*	*81,033*	*217,673*	*128,119*

North

	2010			2040			Growth		
	TOTHH	**TOTPOP**	**TEMP**	**TOTHH**	**TOTPOP**	**TEMP**	**TOTHH**	**TOTPOP**	**TEMP**
Regional Center	12,952	23,459	97,173	28,663	50,608	130,395	15,711	27,149	33,222
City Center	11,039	21,329	35,060	21,314	41,636	50,877	10,275	20,307	15,817
Mixed-Use Corridor	80,390	196,675	49,326	93,981	233,932	60,956	13,591	37,257	11,630
Urban Neighborhood	46,786	125,613	29,702	57,185	157,322	46,808	10,399	31,709	17,106
Transit Neighborhood	4,159	10,192	7,844	5,120	12,855	8,760	961	2,663	916
Suburban Center	0	0	0	0	0	0	0	0	0
Transit Town Center	22,837	65,958	23,316	45,328	137,768	51,648	22,491	71,810	28,332
Sub-Total PDA	*178,163*	*443,226*	*242,421*	*251,591*	*634,121*	*349,444*	*73,428*	*190,895*	*107,023*
Non-PDA	69,182	175,269	74,324	76,787	202,047	95,420	7,605	26,778	21,096
				% Growth in PDAs			91%	88%	84%

Growth by Planning Area

Central

	2010			2040			Growth		
	TOTHH	TOTPOP	TEMP	TOTHH	TOTPOP	TEMP	TOTHH	TOTPOP	TEMP
North									
Central	123,482	367,390	124,352	149,463	449,340	171,302	25,981	81,950	46,950
South									
East									
Total	*123,482*	*367,390*	*124,352*	*149,463*	*449,340*	*171,302*	*25,981*	*81,950*	*46,950*

Central

	2010			2040			Growth		
	TOTHH	TOTPOP	TEMP	TOTHH	TOTPOP	TEMP	TOTHH	TOTPOP	TEMP
Regional Center	0	0	0	0	0	0	0	0	0
City Center	10,708	27,559	14,382	17,537	44,155	23,080	6,829	16,596	8,698
Mixed-Use Corridor	15,885	45,454	9,127	20,507	60,201	15,050	4,622	14,747	5,923
Urban Neighborhood	2,539	7,972	565	6,085	19,280	1,135	3,546	11,308	570
Transit Neighborhood	17,615	54,163	12,344	21,040	65,494	19,897	3,425	11,331	7,553
Suburban Center	0	0	0	0	0	0	0	0	0
Transit Town Center	5,694	16,347	3,887	7,274	21,255	6,884	1,580	4,908	2,997
Sub-Total PDA	*52,441*	*151,495*	*40,305*	*72,443*	*210,385*	*66,046*	*20,002*	*58,890*	*25,741*
Non-PDA	71,041	215,895	84,047	77,020	238,955	105,256	5,979	23,060	21,209
				% Growth in PDAs			77%	72%	55%

Growth by Planning Area

South

	2010			2040			Growth		
	TOTHH	**TOTPOP**	**TEMP**	**TOTHH**	**TOTPOP**	**TEMP**	**TOTHH**	**TOTPOP**	**TEMP**
North									
Central									
South	104,301	325,896	124,019	130,813	417,993	171,193	26,512	92,097	47,174
East									
Total	*104,301*	*325,896*	*124,019*	*130,813*	*417,993*	*171,193*	*26,512*	*92,097*	*47,174*

South

	2010			2040			Growth		
	TOTHH	**TOTPOP**	**TEMP**	**TOTHH**	**TOTPOP**	**TEMP**	**TOTHH**	**TOTPOP**	**TEMP**
Regional Center	0	0	0	0	0	0	0	0	0
City Center	12,320	34,405	19,427	19,243	53,949	27,773	6,923	19,544	8,346
Mixed-Use Corridor	0	0	0	0	0	0	0	0	0
Urban Neighborhood	0	0	0	0	0	0	0	0	0
Transit Neighborhood	23,955	76,368	9,877	28,487	93,453	10,993	4,532	17,085	1,116
Suburban Center	3,541	10,966	16,528	6,605	20,702	28,954	3,064	9,736	12,426
Transit Town Center	17,459	54,058	12,798	23,558	76,499	17,282	6,099	22,441	4,484
Sub-Total PDA	*57,275*	*175,797*	*58,630*	*77,893*	*244,603*	*85,002*	*20,618*	*68,806*	*26,372*
Non-PDA	47,026	150,099	65,389	52,920	173,390	86,191	5,894	23,291	20,802
				% Growth in PDAs			78%	75%	56%

Growth by Planning Area

East

	2010			2040			Growth		
	TOTHH	**TOTPOP**	**TEMP**	**TOTHH**	**TOTPOP**	**TEMP**	**TOTHH**	**TOTPOP**	**TEMP**
North									
Central									
South									
East	71,252	202,753	119,131	100,717	276,537	172,814	29,465	73,784	53,683
Total	*71,252*	*202,753*	*119,131*	*100,717*	*276,537*	*172,814*	*29,465*	*73,784*	*53,683*

East

	2010			2040			Growth		
	TOTHH	**TOTPOP**	**TEMP**	**TOTHH**	**TOTPOP**	**TEMP**	**TOTHH**	**TOTPOP**	**TEMP**
Regional Center	0	0	0	0	0	0	0	0	0
City Center	0	0	0	0	0	0	0	0	0
Mixed-Use Corridor	0	0	0	0	0	0	0	0	0
Urban Neighborhood	0	0	0	0	0	0	0	0	0
Transit Neighborhood	0	0	0	0	0	0	0	0	0
Suburban Center	12,860	40,252	55,126	30,462	80,948	74,190	17,602	40,696	19,064
Transit Town Center	0	0	0	0	0	0	0	0	0
Sub-Total PDA	*12,860*	*40,252*	*55,126*	*30,462*	*80,948*	*74,190*	*17,602*	*40,696*	*19,064*
Non-PDA	58,392	162,501	64,005	70,255	195,589	98,624	11,863	33,088	34,619
				% Growth in PDAs			60%	55%	36%

Household Vehicle Ownership

All Planning Areas

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
North	46,684	108,165	92,390	85,817	138,221	104,103	39,133	30,056	11,713
Central	10,876	44,803	67,794	17,928	57,142	74,794	7,052	12,339	7,000
South	5,960	28,258	70,073	9,537	38,145	83,128	3,577	9,887	13,055
East	3,116	17,221	50,887	6,315	27,216	67,179	3,199	9,995	16,292
Total	*66,636*	*198,447*	*281,144*	*119,597*	*260,724*	*329,204*	*52,961*	*62,277*	*48,060*

All Planning Areas

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
Regional Center	5,934	5,785	1,231	17,316	9,206	2,142	11,382	3,421	911
City Center	5,779	14,787	13,500	14,832	24,355	18,900	9,053	9,568	5,400
Mixed-Use Corridor	18,002	43,643	34,599	25,446	51,452	37,420	7,444	7,809	2,821
Urban Neighborhood	8,529	23,095	17,709	13,575	29,394	20,302	5,046	6,299	2,593
Transit Neighborhood	3,383	15,320	27,024	5,157	19,639	29,849	1,774	4,319	2,825
Suburban Center	961	4,239	11,189	3,543	11,254	22,279	2,582	7,015	11,090
Transit Town Center	6,962	18,732	20,273	17,798	29,945	28,356	10,836	11,213	8,083
Sub-Total PDA	*49,550*	*125,601*	*125,525*	*97,667*	*175,245*	*159,248*	*48,117*	*49,644*	*33,723*
Non-PDA	17,086	72,846	155,619	21,930	85,479	169,956	4,844	12,633	14,337
				% Growth in PDAs			91%	80%	70%

Household Vehicle Ownership

North

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
North	46,684	108,165	92,390	85,817	138,221	104,103	39,133	30,056	11,713
Central									
South									
East									
Total	*46,684*	*108,165*	*92,390*	*85,817*	*138,221*	*104,103*	*39,133*	*30,056*	*11,713*

North

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
Regional Center	5,934	5,785	1,231	17,316	9,206	2,142	11,382	3,421	911
City Center	2,702	5,601	2,738	7,738	9,118	4,456	5,036	3,517	1,718
Mixed-Use Corridor	15,782	36,833	27,750	21,804	42,520	29,487	6,022	5,687	1,737
Urban Neighborhood	8,392	22,383	16,017	12,774	27,354	17,061	4,382	4,971	1,044
Transit Neighborhood	514	1,833	1,811	706	2,305	2,109	192	472	298
Suburban Center	0	0	0	0	0	0	0	0	0
Transit Town Center	5,246	11,351	6,215	15,184	19,775	10,310	9,938	8,424	4,095
Sub-Total PDA	*38,570*	*83,786*	*55,762*	*75,522*	*110,278*	*65,565*	*36,952*	*26,492*	*9,803*
Non-PDA	8,114	24,379	36,628	10,295	27,943	38,538	2,181	3,564	1,910
				% Growth in PDAs			94%	88%	84%

Household Vehicle Ownership

Central

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
North									
Central	10,876	44,803	67,794	17,928	57,142	74,794	7,052	12,339	7,000
South									
East									
Total	*10,876*	*44,803*	*67,794*	*17,928*	*57,142*	*74,794*	*7,052*	*12,339*	*7,000*

Central

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
Regional Center	0	0	0	0	0	0	0	0	0
City Center	1,523	4,875	4,308	3,978	8,131	5,430	2,455	3,256	1,122
Mixed-Use Corridor	2,220	6,810	6,849	3,642	8,932	7,933	1,422	2,122	1,084
Urban Neighborhood	137	712	1,692	801	2,040	3,241	664	1,328	1,549
Transit Neighborhood	1,689	7,064	8,858	2,583	8,952	9,509	894	1,888	651
Suburban Center	0	0	0	0	0	0	0	0	0
Transit Town Center	624	2,394	2,674	1,020	3,190	3,060	396	796	386
Sub-Total PDA	*6,193*	*21,855*	*24,381*	*12,024*	*31,245*	*29,173*	*5,831*	*9,390*	*4,792*
Non-PDA	4,683	22,948	43,413	5,904	25,897	45,621	1,221	2,949	2,208
				% Growth in PDAs			83%	76%	68%

Household Vehicle Ownership

South

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
North									
Central									
South	5,960	28,258	70,073	9,537	38,145	83,128	3,577	9,887	13,055
East									
Total	*5,960*	*28,258*	*70,073*	*9,537*	*38,145*	*83,128*	*3,577*	*9,887*	*13,055*

South

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
Regional Center	0	0	0	0	0	0	0	0	0
City Center	1,554	4,311	6,454	3,116	7,106	9,014	1,562	2,795	2,560
Mixed-Use Corridor	0	0	0	0	0	0	0	0	0
Urban Neighborhood	0	0	0	0	0	0	0	0	0
Transit Neighborhood	1,180	6,423	16,355	1,868	8,382	18,231	688	1,959	1,876
Suburban Center	152	865	2,522	366	1,820	4,420	214	955	1,898
Transit Town Center	1,092	4,987	11,384	1,594	6,980	14,986	502	1,993	3,602
Sub-Total PDA	*3,978*	*16,586*	*36,715*	*6,944*	*24,288*	*46,651*	*2,966*	*7,702*	*9,936*
Non-PDA	1,982	11,672	33,358	2,593	13,857	36,477	611	2,185	3,119
				% Growth in PDAs			83%	78%	76%

Household Vehicle Ownership

East

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
North									
Central									
South									
East	3,116	17,221	50,887	6,315	27,216	67,179	3,199	9,995	16,292
Total	*3,116*	*17,221*	*50,887*	*6,315*	*27,216*	*67,179*	*3,199*	*9,995*	*16,292*

East

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
Regional Center	0	0	0	0	0	0	0	0	0
City Center	0	0	0	0	0	0	0	0	0
Mixed-Use Corridor	0	0	0	0	0	0	0	0	0
Urban Neighborhood	0	0	0	0	0	0	0	0	0
Transit Neighborhood	0	0	0	0	0	0	0	0	0
Suburban Center	809	3,374	8,667	3,177	9,434	17,859	2,368	6,060	9,192
Transit Town Center	0	0	0	0	0	0	0	0	0
Sub-Total PDA	*809*	*3,374*	*8,667*	*3,177*	*9,434*	*17,859*	*2,368*	*6,060*	*9,192*
Non-PDA	2,307	13,847	42,220	3,138	17,782	49,320	831	3,935	7,100
				% Growth in PDAs			74%	61%	56%

Household Vehicle Ownership - Percentages

All Planning Areas

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
North	19%	44%	37%	26%	42%	32%	7%	-2%	-6%
Central	9%	36%	55%	12%	38%	50%	3%	2%	-5%
South	6%	27%	67%	7%	29%	64%	2%	2%	-4%
East	4%	24%	71%	6%	27%	67%	2%	3%	-5%
Total	*12%*	*36%*	*51%*	*17%*	*37%*	*46%*	*5%*	*0%*	*-5%*

All Planning Areas

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
Regional Center	46%	45%	10%	60%	32%	7%	15%	-13%	-2%
City Center	17%	43%	40%	26%	42%	33%	9%	-1%	-7%
Mixed-Use Corridor	19%	45%	36%	22%	45%	33%	4%	0%	-3%
Urban Neighborhood	17%	47%	36%	21%	46%	32%	4%	0%	-4%
Transit Neighborhood	7%	34%	59%	9%	36%	55%	2%	2%	-4%
Suburban Center	6%	26%	68%	10%	30%	60%	4%	4%	-8%
Transit Town Center	15%	41%	44%	23%	39%	37%	8%	-1%	-7%
Sub-Total PDA	*16%*	*42%*	*42%*	*23%*	*41%*	*37%*	*6%*	*-1%*	*-5%*
Non-PDA	7%	30%	63%	8%	31%	61%	1%	1%	-2%
				% Growth in PDAs					

Household Vehicle Ownership - Percentages

North

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
North	19%	44%	37%	26%	42%	32%	7%	-2%	-6%
Central									
South									
East									
Total	*19%*	*44%*	*37%*	*26%*	*42%*	*32%*	*7%*	*-2%*	*-6%*

North

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
Regional Center	46%	45%	10%	60%	32%	7%	15%	-13%	-2%
City Center	24%	51%	25%	36%	43%	21%	12%	-8%	-4%
Mixed-Use Corridor	20%	46%	35%	23%	45%	31%	4%	-1%	-3%
Urban Neighborhood	18%	48%	34%	22%	48%	30%	4%	0%	-4%
Transit Neighborhood	12%	44%	44%	14%	45%	41%	1%	1%	-2%
Suburban Center									
Transit Town Center	23%	50%	27%	34%	44%	23%	11%	-6%	-4%
Sub-Total PDA	*22%*	*47%*	*31%*	*30%*	*44%*	*26%*	*8%*	*-3%*	*-5%*
Non-PDA	12%	35%	53%	13%	36%	50%	2%	1%	-3%
					% Growth in PDAs				

Household Vehicle Ownership - Percentages

Central

	2010			2040			Growth		
	0-veh	1-veh	2+-veh	0-veh	1-veh	2+-veh	0-veh	1-veh	2+-veh
North									
Central	9%	36%	55%	12%	38%	50%	3%	2%	-5%
South									
East									
Total	*9%*	*36%*	*55%*	*12%*	*38%*	*50%*	*3%*	*2%*	*-5%*

Central

	2010			2040			Growth		
	0-veh	1-veh	2+-veh	0-veh	1-veh	2+-veh	0-veh	1-veh	2+-veh
Regional Center									
City Center	14%	46%	40%	23%	46%	31%	8%	1%	-9%
Mixed-Use Corridor	14%	43%	43%	18%	44%	39%	4%	1%	-4%
Urban Neighborhood	5%	28%	67%	13%	34%	53%	8%	6%	-13%
Transit Neighborhood	10%	40%	50%	12%	43%	45%	3%	2%	-5%
Suburban Center									
Transit Town Center	11%	42%	47%	14%	44%	42%	3%	2%	-5%
Sub-Total PDA	*12%*	*42%*	*47%*	*17%*	*43%*	*40%*	*5%*	*1%*	*-6%*
Non-PDA	7%	32%	61%	8%	33%	59%	1%	1%	-2%
					% Growth in PDAs				

Household Vehicle Ownership - Percentages

South

	2010			2040			Growth		
	0-veh	1-veh	2+-veh	0-veh	1-veh	2+-veh	0-veh	1-veh	2+-veh
North									
Central									
South	6%	27%	67%	7%	29%	64%	2%	2%	-4%
East									
Total	*6%*	*27%*	*67%*	*7%*	*29%*	*64%*	*2%*	*2%*	*-4%*

South

	2010			2040			Growth		
	0-veh	1-veh	2+-veh	0-veh	1-veh	2+-veh	0-veh	1-veh	2+-veh
Regional Center									
City Center	13%	35%	52%	16%	37%	47%	4%	2%	-6%
Mixed-Use Corridor									
Urban Neighborhood									
Transit Neighborhood	5%	27%	68%	7%	29%	64%	2%	3%	-4%
Suburban Center	4%	24%	71%	6%	28%	67%	1%	3%	-4%
Transit Town Center	6%	29%	65%	7%	30%	64%	1%	1%	-2%
Sub-Total PDA	*7%*	*29%*	*64%*	*9%*	*31%*	*60%*	*2%*	*2%*	*-4%*
Non-PDA	4%	25%	71%	5%	26%	69%	1%	1%	-2%
					% Growth in PDAs				

Household Vehicle Ownership - Percentages

East

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
North									
Central									
South									
East	4%	24%	71%	6%	27%	67%	2%	3%	-5%
Total	*4%*	*24%*	*71%*	*6%*	*27%*	*67%*	*2%*	*3%*	*-5%*

East

	2010			2040			Growth		
	0-veh	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**	**0-veh**	**1-veh**	**2+-veh**
Regional Center									
City Center									
Mixed-Use Corridor									
Urban Neighborhood									
Transit Neighborhood									
Suburban Center	6%	26%	67%	10%	31%	59%	4%	5%	-9%
Transit Town Center									
Sub-Total PDA	*6%*	*26%*	*67%*	*10%*	*31%*	*59%*	*4%*	*5%*	*-9%*
Non-PDA	4%	24%	72%	4%	25%	70%	1%	2%	-2%
					% Growth in PDAs				

Household Worker Distribution

All Planning Areas

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
North	78,722	93,663	74,844	118,768	119,534	89,866	40,046	25,871	15,022
Central	31,100	49,654	42,733	44,142	58,841	46,891	13,042	9,187	4,158
South	17,203	38,326	48,754	24,236	48,103	58,470	7,033	9,777	9,716
East	13,418	24,398	33,436	18,919	34,973	46,823	5,501	10,575	13,387
Total	*140,443*	*206,041*	*199,767*	*206,065*	*261,451*	*242,050*	*65,622*	*55,410*	*42,283*

All Planning Areas

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
Regional Center	7,253	3,922	1,775	17,533	7,496	3,643	10,280	3,574	1,868
City Center	10,716	12,168	11,173	18,750	21,320	18,027	8,034	9,152	6,854
Mixed-Use Corridor	28,045	37,939	30,252	36,822	43,968	33,531	8,777	6,029	3,279
Urban Neighborhood	15,424	19,365	14,546	20,891	24,242	18,125	5,467	4,877	3,579
Transit Neighborhood	9,556	17,666	18,507	12,899	20,773	20,971	3,343	3,107	2,464
Suburban Center	2,992	5,205	8,200	6,425	11,831	18,811	3,433	6,626	10,611
Transit Town Center	13,645	17,164	15,157	24,932	27,228	23,953	11,287	10,064	8,796
Sub-Total PDA	*87,631*	*113,429*	*99,610*	*138,252*	*156,858*	*137,061*	*50,621*	*43,429*	*37,451*
Non-PDA	52,812	92,612	100,157	67,813	104,593	104,989	15,001	11,981	4,832
				% Growth in PDAs			77%	78%	89%

Household Worker Distribution

North

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
North	78,722	93,663	74,844	118,768	119,534	89,866	40,046	25,871	15,022
Central									
South									
East									
Total	*78,722*	*93,663*	*74,844*	*118,768*	*119,534*	*89,866*	*40,046*	*25,871*	*15,022*

North

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
Regional Center	7,253	3,922	1,775	17,533	7,496	3,643	10,280	3,574	1,868
City Center	5,175	3,470	2,391	8,777	7,531	5,007	3,602	4,061	2,616
Mixed-Use Corridor	23,852	31,501	25,010	30,831	35,882	27,104	6,979	4,381	2,094
Urban Neighborhood	14,981	18,387	13,425	19,795	21,957	15,423	4,814	3,570	1,998
Transit Neighborhood	1,261	1,592	1,304	1,714	1,935	1,471	453	343	167
Suburban Center	0	0	0	0	0	0	0	0	0
Transit Town Center	8,988	8,275	5,546	18,203	15,390	11,687	9,215	7,115	6,141
Sub-Total PDA	*61,510*	*67,147*	*49,451*	*96,853*	*90,191*	*64,335*	*35,343*	*23,044*	*14,884*
Non-PDA	17,212	26,516	25,393	21,915	29,343	25,531	4,703	2,827	138
				% Growth in PDAs			88%	89%	99%

Household Worker Distribution

Central

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
North									
Central	31,100	49,654	42,733	44,142	58,841	46,891	13,042	9,187	4,158
South									
East									
Total	*31,100*	*49,654*	*42,733*	*44,142*	*58,841*	*46,891*	*13,042*	*9,187*	*4,158*

Central

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
Regional Center	0	0	0	0	0	0	0	0	0
City Center	3,284	4,322	3,099	6,154	6,835	4,556	2,870	2,513	1,457
Mixed-Use Corridor	4,193	6,438	5,242	5,991	8,086	6,427	1,798	1,648	1,185
Urban Neighborhood	443	978	1,121	1,096	2,285	2,702	653	1,307	1,581
Transit Neighborhood	4,610	7,154	5,855	6,408	8,245	6,384	1,798	1,091	529
Suburban Center	0	0	0	0	0	0	0	0	0
Transit Town Center	1,643	2,322	1,731	2,333	2,894	2,044	690	572	313
Sub-Total PDA	*14,173*	*21,214*	*17,048*	*21,982*	*28,345*	*22,113*	*7,809*	*7,131*	*5,065*
Non-PDA	16,927	28,440	25,685	22,160	30,496	24,778	5,233	2,056	-907
				% Growth in PDAs			60%	78%	122%

Household Worker Distribution

South

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
North									
Central									
South	17,203	38,326	48,754	24,236	48,103	58,470	7,033	9,777	9,716
East									
Total	*17,203*	*38,326*	*48,754*	*24,236*	*48,103*	*58,470*	*7,033*	*9,777*	*9,716*

South

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
Regional Center	0	0	0	0	0	0	0	0	0
City Center	2,257	4,376	5,683	3,819	6,954	8,464	1,562	2,578	2,781
Mixed-Use Corridor	0	0	0	0	0	0	0	0	0
Urban Neighborhood	0	0	0	0	0	0	0	0	0
Transit Neighborhood	3,685	8,920	11,348	4,777	10,593	13,116	1,092	1,673	1,768
Suburban Center	523	1,282	1,736	1,032	2,262	3,313	509	980	1,577
Transit Town Center	3,014	6,567	7,880	4,396	8,944	10,222	1,382	2,377	2,342
Sub-Total PDA	*9,479*	*21,145*	*26,647*	*14,024*	*28,753*	*35,115*	*4,545*	*7,608*	*8,468*
Non-PDA	7,724	17,181	22,107	10,212	19,350	23,355	2,488	2,169	1,248
				% Growth in PDAs			65%	78%	87%

Household Worker Distribution

East

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
North									
Central									
South									
East	13,418	24,398	33,436	18,919	34,973	46,823	5,501	10,575	13,387
Total	*13,418*	*24,398*	*33,436*	*18,919*	*34,973*	*46,823*	*5,501*	*10,575*	*13,387*

East

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
Regional Center	0	0	0	0	0	0	0	0	0
City Center	0	0	0	0	0	0	0	0	0
Mixed-Use Corridor	0	0	0	0	0	0	0	0	0
Urban Neighborhood	0	0	0	0	0	0	0	0	0
Transit Neighborhood	0	0	0	0	0	0	0	0	0
Suburban Center	2,469	3,923	6,464	5,393	9,569	15,498	2,924	5,646	9,034
Transit Town Center	0	0	0	0	0	0	0	0	0
Sub-Total PDA	*2,469*	*3,923*	*6,464*	*5,393*	*9,569*	*15,498*	*2,924*	*5,646*	*9,034*
Non-PDA	10,949	20,475	26,972	13,526	25,404	31,325	2,577	4,929	4,353
				% Growth in PDAs			53%	53%	67%

Household Worker Distribution - Percentages

All Planning Areas

	2010			2040			Growth		
	0-worker	1-worker	2+-workers	0-worker	1-worker	2+-workers	0-worker	1-worker	2+-workers
North	32%	38%	30%	36%	36%	27%	4%	-1%	-3%
Central	25%	40%	35%	29%	39%	31%	4%	-1%	-3%
South	16%	37%	47%	19%	37%	45%	2%	0%	-2%
East	19%	34%	47%	19%	35%	46%	0%	0%	0%
Total	*26%*	*38%*	*37%*	*29%*	*37%*	*34%*	*3%*	*-1%*	*-2%*

All Planning Areas

	2010			2040			Growth		
	0-worker	1-worker	2+-workers	0-worker	1-worker	2+-workers	0-worker	1-worker	2+-workers
Regional Center	56%	30%	14%	61%	26%	13%	5%	-4%	-1%
City Center	31%	36%	33%	32%	37%	31%	1%	1%	-2%
Mixed-Use Corridor	29%	39%	31%	32%	38%	29%	3%	-1%	-2%
Urban Neighborhood	31%	39%	29%	33%	38%	29%	2%	-1%	-1%
Transit Neighborhood	21%	39%	40%	24%	38%	38%	3%	-1%	-2%
Suburban Center	18%	32%	50%	17%	32%	51%	-1%	0%	1%
Transit Town Center	30%	37%	33%	33%	36%	31%	3%	-2%	-2%
Sub-Total PDA	*29%*	*38%*	*33%*	*32%*	*36%*	*32%*	*3%*	*-1%*	*-1%*
Non-PDA	22%	38%	41%	24%	38%	38%	3%	0%	-3%
					% Growth in PDAs				

Household Worker Distribution - Percentages

North

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
North	32%	38%	30%	36%	36%	27%	4%	-1%	-3%
Central									
South									
East									
Total	*32%*	*38%*	*30%*	*36%*	*36%*	*27%*	*4%*	*-1%*	*-3%*

North

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
Regional Center	56%	30%	14%	61%	26%	13%	5%	-4%	-1%
City Center	47%	31%	22%	41%	35%	23%	-6%	4%	2%
Mixed-Use Corridor	30%	39%	31%	33%	38%	29%	3%	-1%	-2%
Urban Neighborhood	32%	39%	29%	35%	38%	27%	3%	-1%	-2%
Transit Neighborhood	30%	38%	31%	33%	38%	29%	3%	-1%	-3%
Suburban Center									
Transit Town Center	39%	36%	24%	40%	34%	26%	1%	-2%	1%
Sub-Total PDA	*35%*	*38%*	*28%*	*39%*	*36%*	*26%*	*4%*	*-2%*	*-2%*
Non-PDA	25%	38%	37%	29%	38%	33%	4%	0%	-3%
					% Growth in PDAs				

Household Worker Distribution - Percentages

Central

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
North									
Central	25%	40%	35%	29%	39%	31%	4%	-1%	-3%
South									
East									
Total	*25%*	*40%*	*35%*	*29%*	*39%*	*31%*	*4%*	*-1%*	*-3%*

Central

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
Regional Center									
City Center	31%	40%	29%	35%	39%	26%	4%	-1%	-3%
Mixed-Use Corridor	26%	41%	33%	29%	39%	31%	3%	-1%	-2%
Urban Neighborhood	17%	38%	44%	18%	38%	44%	1%	-1%	0%
Transit Neighborhood	26%	41%	33%	30%	39%	30%	4%	-1%	-3%
Suburban Center									
Transit Town Center	29%	41%	30%	32%	40%	28%	3%	-1%	-2%
Sub-Total PDA	*27%*	*40%*	*33%*	*30%*	*39%*	*31%*	*3%*	*-1%*	*-2%*
Non-PDA	24%	40%	36%	29%	39%	32%	5%	-1%	-4%
					% Growth in PDAs				

Household Worker Distribution - Percentages

South

	2010			2040			Growth		
	0-worker	1-worker	2+-workers	0-worker	1-worker	2+-workers	0-worker	1-worker	2+-workers
North									
Central									
South	16%	37%	47%	19%	37%	45%	2%	0%	-2%
East									
Total	*16%*	*37%*	*47%*	*19%*	*37%*	*45%*	*2%*	*0%*	*-2%*

South

	2010			2040			Growth		
	0-worker	1-worker	2+-workers	0-worker	1-worker	2+-workers	0-worker	1-worker	2+-workers
Regional Center									
City Center	18%	36%	46%	20%	36%	44%	2%	1%	-2%
Mixed-Use Corridor									
Urban Neighborhood									
Transit Neighborhood	15%	37%	47%	17%	37%	46%	1%	0%	-1%
Suburban Center	15%	36%	49%	16%	34%	50%	1%	-2%	1%
Transit Town Center	17%	38%	45%	19%	38%	43%	1%	0%	-2%
Sub-Total PDA	*17%*	*37%*	*47%*	*18%*	*37%*	*45%*	*1%*	*0%*	*-1%*
Non-PDA	16%	37%	47%	19%	37%	44%	3%	0%	-3%
					% Growth in PDAs				

Household Worker Distribution - Percentages

East

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
North									
Central									
South									
East	19%	34%	47%	19%	35%	46%	0%	0%	0%
Total	*19%*	*34%*	*47%*	*19%*	*35%*	*46%*	*0%*	*0%*	*0%*

East

	2010			2040			Growth		
	0-worker	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**	**0-worker**	**1-worker**	**2+-workers**
Regional Center									
City Center									
Mixed-Use Corridor									
Urban Neighborhood									
Transit Neighborhood									
Suburban Center	19%	31%	50%	18%	31%	51%	-1%	1%	1%
Transit Town Center									
Sub-Total PDA	*19%*	*31%*	*50%*	*18%*	*31%*	*51%*	*-1%*	*1%*	*1%*
Non-PDA	19%	35%	46%	19%	36%	45%	1%	1%	-2%
				% Growth in PDAs					

Median Household Income

All Planning Areas

	2010			2040			Growth		
	TOTHH	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**
North	247,345	10,839,466,303	43,823	328,378	12,986,234,633	39,547	81,033	2,146,768,330	-10%
Central	123,482	5,564,957,973	45,067	149,463	6,383,768,616	42,711	25,981	818,810,643	-5%
South	104,301	6,437,394,757	61,719	130,813	7,708,979,484	58,931	26,512	1,271,584,727	-5%
East	71,252	4,901,785,590	68,795	100,717	6,685,365,027	66,378	29,465	1,783,579,437	-4%
Total	*546,380*	*27,743,604,623*	*50,777*	*709,371*	*33,764,347,760*	*47,598*	*162,991*	*6,020,743,137*	*-6%*

All Planning Areas

	2010			2040			Growth		
	TOTHH	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**
Regional Center	12,952	320,447,688	24,741	28,663	693,535,118	24,196	15,711	373,087,430	-2%
City Center	34,067	1,444,820,596	42,411	58,094	2,290,231,822	39,423	24,027	845,411,226	-7%
Mixed-Use Corridor	96,275	3,870,840,891	40,206	114,488	4,354,480,197	38,034	18,213	483,639,306	-5%
Urban Neighborhood	49,325	1,748,470,194	35,448	63,270	2,178,029,900	34,424	13,945	429,559,706	-3%
Transit Neighborhood	45,729	2,264,730,903	49,525	54,647	2,602,577,947	47,625	8,918	337,847,044	-4%
Suburban Center	16,401	1,085,471,869	66,183	37,067	2,389,685,371	64,469	20,666	1,304,213,502	-3%
Transit Town Center	45,990	1,891,683,001	41,132	76,160	2,915,092,896	38,276	30,170	1,023,409,895	-7%
Sub-Total PDA	*300,739*	*12,626,465,142*	*41,985*	*432,389*	*17,423,633,251*	*40,296*	*131,650*	*4,797,168,109*	*-4%*
Non-PDA	245,641	15,117,139,481	61,542	276,982	16,340,714,509	58,996	31,341	1,223,575,028	-4%
					% Growth in PDAs				

Median Household Income

North

	2010			2040			Growth		
	TOTHH	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**
North	247,345	10,839,466,303	43,823	328,378	12,986,234,633	39,547	81,033	2,146,768,330	-10%
Central									
South									
East									
Total	*247,345*	*10,839,466,303*	*43,823*	*328,378*	*12,986,234,633*	*39,547*	*81,033*	*2,146,768,330*	*-10%*

North

	2010			2040			Growth		
	TOTHH	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**
Regional Center	12,952	320,447,688	24,741	28,663	693,535,118	24,196	15,711	373,087,430	-2%
City Center	11,039	368,792,710	33,408	21,314	672,498,888	31,552	10,275	303,706,178	-6%
Mixed-Use Corridor	80,390	3,250,747,254	40,437	93,981	3,591,850,252	38,219	13,591	341,102,998	-5%
Urban Neighborhood	46,786	1,606,439,661	34,336	57,185	1,859,290,115	32,514	10,399	252,850,454	-5%
Transit Neighborhood	4,159	182,517,247	43,885	5,120	213,343,980	41,669	961	30,826,733	-5%
Suburban Center	0	0		0	0		0	0	
Transit Town Center	22,837	635,416,410	27,824	45,328	1,289,147,654	28,440	22,491	653,731,244	2%
Sub-Total PDA	*178,163*	*6,364,360,970*	*35,722*	*251,591*	*8,319,666,007*	*33,068*	*73,428*	*1,955,305,037*	*-7%*
Non-PDA	69,182	4,475,105,333	64,686	76,787	4,666,568,626	60,773	7,605	191,463,293	-6%
					% Growth in PDAs				

Median Household Income

Central

	2010			2040			Growth		
	TOTHH	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**
North									
Central	123,482	5,564,957,973	45,067	149,463	6,383,768,616	42,711	25,981	818,810,643	-5%
South									
East									
Total	*123,482*	*5,564,957,973*	*45,067*	*149,463*	*6,383,768,616*	*42,711*	*25,981*	*818,810,643*	*-5%*

Central

	2010			2040			Growth		
	TOTHH	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**
Regional Center	0	0		0	0		0	0	
City Center	10,708	409,513,118	38,244	17,537	629,056,936	35,870	6,829	219,543,818	-6%
Mixed-Use Corridor	15,885	620,093,637	39,036	20,507	762,629,945	37,189	4,622	142,536,308	-5%
Urban Neighborhood	2,539	142,030,533	55,940	6,085	318,739,785	52,381	3,546	176,709,252	-6%
Transit Neighborhood	17,615	681,871,941	38,710	21,040	782,962,020	37,213	3,425	101,090,079	-4%
Suburban Center	0	0		0	0		0	0	
Transit Town Center	5,694	224,203,002	39,375	7,274	276,768,170	38,049	1,580	52,565,168	-3%
Sub-Total PDA	*52,441*	*2,077,712,231*	*39,620*	*72,443*	*2,770,156,856*	*38,239*	*20,002*	*692,444,625*	*-3%*
Non-PDA	71,041	3,487,245,742	49,088	77,020	3,613,611,760	46,918	5,979	126,366,018	-4%
				% Growth in PDAs					

Median Household Income

South

	2010			2040			Growth		
	TOTHH	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**
North									
Central									
South	104,301	6,437,394,757	61,719	130,813	7,708,979,484	58,931	26,512	1,271,584,727	-5%
East									
Total	*104,301*	*6,437,394,757*	*61,719*	*130,813*	*7,708,979,484*	*58,931*	*26,512*	*1,271,584,727*	*-5%*

South

	2010			2040			Growth		
	TOTHH	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**
Regional Center	0	0		0	0		0	0	
City Center	12,320	666,514,768	54,100	19,243	988,675,998	51,378	6,923	322,161,230	-5%
Mixed-Use Corridor	0	0		0	0		0	0	
Urban Neighborhood	0	0		0	0		0	0	
Transit Neighborhood	23,955	1,400,341,715	58,457	28,487	1,606,271,947	56,386	4,532	205,930,232	-4%
Suburban Center	3,541	232,878,176	65,766	6,605	430,634,481	65,198	3,064	197,756,305	-1%
Transit Town Center	17,459	1,032,063,589	59,114	23,558	1,349,177,072	57,270	6,099	317,113,483	-3%
Sub-Total PDA	*57,275*	*3,331,798,248*	*58,172*	*77,893*	*4,374,759,498*	*56,164*	*20,618*	*1,042,961,250*	*-3%*
Non-PDA	47,026	3,105,596,509	66,040	52,920	3,334,219,986	63,005	5,894	228,623,477	-5%
					% Growth in PDAs				

Median Household Income

East

	2010			2040			Growth		
	TOTHH	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**
North									
Central									
South									
East	71,252	4,901,785,590	68,795	100,717	6,685,365,027	66,378	29,465	1,783,579,437	-4%
Total	*71,252*	*4,901,785,590*	*68,795*	*100,717*	*6,685,365,027*	*66,378*	*29,465*	*1,783,579,437*	*-4%*

East

	2010			2040			Growth		
	TOTHH	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**	**TOTHH**	**MHHINC**	**MHHINC/HH**
Regional Center	0	0		0	0		0	0	
City Center	0	0		0	0		0	0	
Mixed-Use Corridor	0	0		0	0		0	0	
Urban Neighborhood	0	0		0	0		0	0	
Transit Neighborhood	0	0		0	0		0	0	
Suburban Center	12,860	852,593,693	66,298	30,462	1,959,050,890	64,311	17,602	1,106,457,197	-3%
Transit Town Center	0	0		0	0		0	0	
Sub-Total PDA	*12,860*	*852,593,693*	*66,298*	*30,462*	*1,959,050,890*	*64,311*	*17,602*	*1,106,457,197*	*-3%*
Non-PDA	58,392	4,049,191,897	69,345	70,255	4,726,314,137	67,274	11,863	677,122,240	-3%
					% Growth in PDAs				