

# Database and Travel Demand Model

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The CMP legislation requires every CMA, in consultation with the regional transportation planning agency (the Metropolitan Transportation Commission (MTC) in the Bay Area), cities, and the county, to develop a uniform database on traffic impacts for use in a countywide travel demand model.<sup>20</sup> Further, the legislation mandates the countywide model to be consistent with the assumptions of the regional travel demand model developed by MTC and the most current land use and socioeconomic database adopted by the Association of Bay Area Governments (ABAG) for Alameda County. In its role as the CMA, Alameda CTC must approve computer models used for sub-areas, including models used by local jurisdictions for land use impact analysis. All models must be consistent with the countywide model and standardized modeling assumptions.

The purpose of this requirement is to bring a uniform technical basis for analysis to congestion management decisions. This includes consideration of the benefits of transit service and travel demand management (TDM) programs, as well as projects that reduce congestion on the CMP network. The modeling requirement is also intended to assist local agencies in assessing the impacts of new development on the transportation system.

Use of the Alameda Countywide Travel Demand Model is essential for the CMP planning process. The Alameda County CMP is a forward-looking program, promoting a philosophy of early action to prevent conditions from deteriorating. The countywide model allows Alameda CTC to anticipate and forecast the potential impacts of local land development decisions on the Metropolitan Transportation System network.

## 2014-2015 Updated Countywide Travel Demand Model Features

Alameda CTC updated its Countywide Travel Demand Model in December 2014, and further refined the model in August 2015. The updated model includes the following key features:

- It uses Cube software.
- The base year of the model is 2010, and the future years are 2020 and 2040.
- Five time periods are included in the model: a.m. peak 1-hour (7:30-8:30 a.m.); p.m. peak 1-hour (4:30-5:30 p.m.); a.m. peak 4-hour (6:00-10:00 a.m.; new in 2014 update); p.m. peak 4-hour (3:00-7:00 p.m.); and daily.

<sup>20</sup> California Government Code Section 65089(c).

- This updated model has 1,580 traffic analysis zones (TAZs) in Alameda County (175 new TAZs were added in the 2014 update), 1,256 TAZs outside of Alameda County, and 31 gateway zones.
- The model added 175 new TAZs based on five principles:
  - To maintain TAZ consistency with the U.S. Census 2010 tract boundaries;
  - To create smaller zones near major rail stations, ferry stops, and bus stops;
  - To have MTC's proposed micro analysis zones (MAZs) nest within the TAZs;
  - To add TAZs around transit park-and-ride lots to allow the model to assign park-and-ride vehicles to the roadway network; and
  - To create smaller TAZs caused by the definition of the CMP roadway network
- The updated model maintains the use of MTC's zone system in the remaining six Bay Area counties but enlarges the full model region and zones to include San Joaquin County. The model also created 85 smaller zones near rail stations and ferry terminals to better delineate walk access to transit markets.
- The Alameda CTC model was revised to produce an updated base year 2000 calibration and 2010 validation with selected model enhancements, including:
  - Calibration of the auto ownership models to American Community Survey 2005-2009 county-level data;
  - Addition of bicycle network infrastructure (bike lanes and paths) in the network's travel time skims, mode choice, and bicycle assignments;
  - Development of a toll-modeling procedure to estimate express lane vehicle volumes; and
  - Performance of a 2010 validation task including validating for screen-line volumes for the a.m. and p.m. peak hours, peak periods, and daily; and to year 2010 observed transit boardings.
- The Alameda CTC model assumes all projects included in the 2040 horizon year of Plan Bay Area 2013. Further, the model roadway network includes additional detail in Alameda County and in adjacent parts of Santa Clara and Contra Costa counties. The model also includes stop, station, and route detail in the transit network for Alameda

County and maintains the MTC roadway and transit networks in the remaining Bay Area counties.

- Alameda CTC socioeconomic data inputs are consistent at both the MTC zone level and the ABAG census tract level for the Plan Bay Area 2013 scenario for the year 2040. Data at the MTC zone level in Alameda was allocated to the smaller Alameda CTC model zones using local land use development patterns, working within the constraint of 1 percent deviation from the ABAG control totals for the county. Alameda CTC also incorporated the updated San Joaquin County land use dataset developed as a part of the San Joaquin Council of Governments Transportation Regional Plan 2011.
- The Alameda CTC model used U.S. Census 2010 population and households for the model base year of 2010.
- Alameda CTC is in the process of updating the model to incorporate Plan Bay Area 2040 land use and socioeconomic data and transportation networks. This work will be complete by summer 2018.

Documentation of specific features and assumptions for various components of the updated 2014 model are available on the [Alameda CTC website](#).

## Land Use Database Development

The database included in the updated 2014 countywide travel model is based on three sets of inputs:

- The Plan Bay Area 2013 employment, population, and household projections provided by ABAG at the census tract level for all model future years (2020 and 2040). ABAG and MTC converted these tract-level projections to the regional TAZ (RTAZ) level.
- The U.S. Census 2010 dataset served as the source of the household and population data for the model base year of 2010. Census blocks are typically smaller than the countywide TAZs; therefore, households in Census blocks can be aggregated to TAZs used in the Countywide Travel Demand Model.
- The distribution factor in the Projections 2009 dataset was used to distribute the Plan Bay Area Sustainable Communities Strategy (SCS) data for allocation of households and jobs from the larger MTC model RTAZs to the smaller Alameda CTC model TAZs.

The process of developing the land use and socioeconomic database for the countywide model allocated ABAG's SCS land use and socioeconomic data from MTC's regional TAZs to Alameda CTC's countywide model TAZs review and redistribution by the Alameda County jurisdictions. The jurisdictions' totals are requested to stay within a 1 percent variation from the ABAG totals, but they are permitted to redistribute them if appropriate. Countywide totals after redistribution remain within plus or minus 1 percent of ABAG county totals, as required by MTC. By aggregating the projections made for each zone, Alameda CTC produced projections of socioeconomic characteristics for unincorporated areas of the county, the 14 cities, and the four Alameda County planning areas.

For the 175 newly added TAZs to the countywide model TAZ system, all SCS land use data for all model years were further disaggregated to distribute the data to the newly added zones. The proportion of employment in each TAZ compared to the parent TAZ (from which it is split) is assumed to be equal to the proportion of the new TAZ's size compared to the parent TAZ's size.

## Model Development

The framework established for the model encompasses the following components:

- Trip generation (number of trips forecast by traffic analysis zone);
- Trip distribution (distribution of forecast trips between each traffic analysis zone);
- Modal split of inter-zonal trips (distribution of trips by mode within each traffic analysis zone); and
- Assignment (forecast of trips originating in or destined to external zones).

These are typical model components found in any model that produces simulations of travel demand, based on different assumptions about land use and demographic and transportation characteristics.

The countywide model was developed using Citilabs' Cube software, which is an interactive transportation

planning program that produces numerical and graphic representations of travel supply and demand. The model is structured to provide forecasting detail that adequately addresses the evaluation needs of both countywide and corridor-specific transportation strategies. The countywide model has been developed and validated by:

- Defining a traffic analysis zone structure detailed enough to depict changes in land use and demographics that would affect travel demand on arterials and intra-county transit systems; and
- Establishing highways and transit networks detailed enough for those types of travel demand.

Development and validation of the model were based on the following concepts:

- Consistency with the assumptions and procedures established and used by MTC to produce regional travel demand forecasts. Specifically, the model maintains the same variables in the equations that comprise the trip-generation, trip-distribution, and mode-split components of MTC's previous travel demand model framework based on the MTC BAYCAST-90 model.
- Where necessary (to produce validated forecasts of travel on arterials or intra-county transit services), enhance the capacity of MTC's models by incorporating the simulation of certain types of travel not modeled by MTC. Specifically, this includes the addition of new transit sub modes.

The 2014 model update validated the model to 2010 traffic and transit count data and includes the enhanced ability to forecast bicycle and pedestrian volumes by adding more detailed TAZs and more detailed roadway, transit, and non-motorized networks.

In addition, the currently active model incorporates land use and demographics of the nine-county Bay Area based on the ABAG's SCS projections, U.S. Census 2010, and the San Joaquin County Travel Model for San Joaquin County. This allows the model to produce travel demand forecasts that incorporate influences of regional travel demand on transportation facilities in Alameda County. Travel originating or terminating

outside the nine-county Bay Area and San Joaquin County is also taken into account, based on the data from the Caltrans statewide model.

## Planning Areas

Alameda County has been subdivided into four areas of analysis, or planning areas and include local jurisdictions as follows:

- North Planning Area: Albany, Berkeley, Emeryville, Oakland and Piedmont
- Central Planning Area: Hayward, San Leandro and unincorporated Alameda County
- South Planning Area: Fremont, Newark and Union City
- East Planning Area: Dublin, Pleasanton, Livermore and unincorporated Alameda County

These planning areas also correspond to the five MTC super districts in Alameda County,<sup>21</sup> as part of the traffic analysis zone structure developed for the countywide travel model which refined the 1,454 zone structure MTC uses<sup>22</sup> for its nine-county regional travel model.

Traffic analysis zones are small geographical subdivisions of a region. Socioeconomic variables, such as households and employment data, are collected at the traffic analysis zone level for input into the travel demand models. Ultimately, the auto vehicle trips and number of individual trips on transit (“person trips”) are assigned from each traffic analysis zone onto the highway and transit networks.

The countywide model required disaggregating or splitting the MTC zones into more, smaller traffic analysis zones. Within Alameda County, MTC’s zone system was refined to better suit the more detailed highway and transit networks in the countywide model. The traffic analysis zones nest within the larger MTC zones. This ensures accurate disaggregation of MTC’s person trip

tables to the traffic zones, and allows direct comparisons between the Alameda countywide model outputs and those of the MTC model. As a result of this zone refinement effort, the model contains:

- 1,580 TAZs within Alameda County
- 159 TAZs in buffer areas (52 in West Contra Costa County, 48 in South Contra Costa County, 26 in San Joaquin County, and 33 in Santa Clara County)
- 1,097 TAZs in the remainder of the Bay Area, same as MTC’s RTAZs
- 31 gateway zones

Maps of the 1,580 TAZs within Alameda County, grouped by the four planning areas, are available on the [Alameda CTC website](#).

## Transportation System Network

The countywide model road network includes the following road types:

- Freeways
- Freeway ramps and metered ramps
- State routes
- Arterial streets
- Collector streets that carry traffic through neighborhoods to adjacent neighborhoods
- Streets likely to be analyzed in a local traffic study

The transit network in the countywide model was developed from the MTC model network with refinements to match the additional zonal detail within Alameda County. The 2014 model update added bicycle network infrastructure (bike lanes and paths) to support the model enhancements to estimate bicycle trips.

<sup>21</sup> MTC superdistricts 18 and 19 comprise North County Planning Area, while superdistricts 17, 16, and 15 equate to Central County, South County, and East County Planning Areas, respectively.

<sup>22</sup> MTC is in the process of updating its zone system to expand the TAZs and to add a Micro Analysis Zone (MAZ) to better capture local bike and walk trips.

## Model Results

The model produces the following countywide travel information:

- Trip generation
- Trip distribution
- Modal split of inter-zonal trips for home-based work trips and total trips
- Forecast of trips originating or destined to external zones
- Peak-hour LOS and traffic-volume projections by segment (2010, 2020, and 2040)
- Directional miles of congestion, by type of facility (arterial, freeway)
- Mean highway speed
- Transit accessibility
- VMT, by facility and by LOS
- Travel times for selected origin-destination (O-D) pairs
- Greenhouse gas emission for primary pollutants
- The countywide model is generally consistent with the MTC model in terms of numbers and types of trips, distribution between the Bay Area counties, and travel modes;
- The model estimates reasonable numbers of vehicles and transit riders to and from Alameda County; and
- The countywide model estimates 2010 base year traffic on most screen lines and major regional facilities at a level of accuracy sufficient to support evaluation of peak-hour traffic patterns on the CMP network.

Model output traffic volumes for all roadway segments for all horizon years and all time periods by planning areas are posted on the [Alameda CTC website](#).

## Model Adequacy

The model has been tested and validated for 2010<sup>23</sup> conditions. The validation procedure compared the model outputs to observed traffic volumes and transit ridership data. During validation, adjustments were primarily made to model inputs, such as the road network and base-year land uses, rather than calibrated parameters such as trip-generation rates or distribution factors. Based on the model calibration, MTC consistency check, and the model validation, Alameda CTC made the following conclusions:

## Local Government Responsibilities and Conformance

Alameda CTC is responsible for monitoring conformance of local jurisdictions with the adopted CMP.<sup>24</sup> Among those requirements, Alameda CTC must find compliance with the development of the land use and socioeconomic database in the Countywide Travel Demand Model, which must be consistent with the regional land use database and assumptions of the regional travel demand model. Alameda CTC works with local jurisdictions to develop the countywide database by allocating ABAG's housing and job projections to a refined-scale zone system for countywide model traffic analysis. The county-level totals from the two allocations must be within plus or minus 1 percent, per MTC's established guidelines as described in Chapter 9.

Alameda CTC's land use database development process typically happens during the Countywide Travel Demand Model update. During this process, local jurisdictions are required to review a draft allocation of ABAG totals to the Countywide Travel Demand Model TAZs. Local jurisdictions then have 60 days to provide input on this draft allocation. The detailed process for

<sup>23</sup> During the next model update, the model base year is anticipated to be updated to 2010 to be consistent with the most recent U.S. Census.

<sup>24</sup> California Government Code Section 65089.3.

finding non-conformance and the resulting withholding of Proposition 111 funds is described in Chapter 9.

## Next Steps

Alameda CTC will continue to update or further refine the Alameda County Travel Demand Model as part of the requirements to update the land use database and network assumptions to the latest Regional Transportation Plan and Sustainable Communities Strategy, Plan Bay Area 2040. Further, Alameda CTC will look to update the database using the land use information and network characteristics submitted periodically by local jurisdictions as part of the land development impact analysis process of Alameda CTC. Future updates to the countywide model will include:

- Incorporating the recently adopted Plan Bay Area 2040 land use and transportation assumptions into the Alameda CTC Countywide Travel Demand Model.
- Incorporating the most recently adopted land use and transportation assumptions for San Joaquin County, which are included in their 2014 RTP/SCS.
- Evaluating options to enhance the forecasting ability of the Alameda CTC Countywide Travel Demand Model. This will include assessing options for modifying and refining the regional travel model for use in Alameda County as well as assessing more current industry alternatives. This will also include exploring enhancements to the agency's ability to estimate freight activity through the county and at the Port of Oakland.
- Upgrading the county model following the evaluation.
- Continuing to ensure consistency with the regional model requirements.