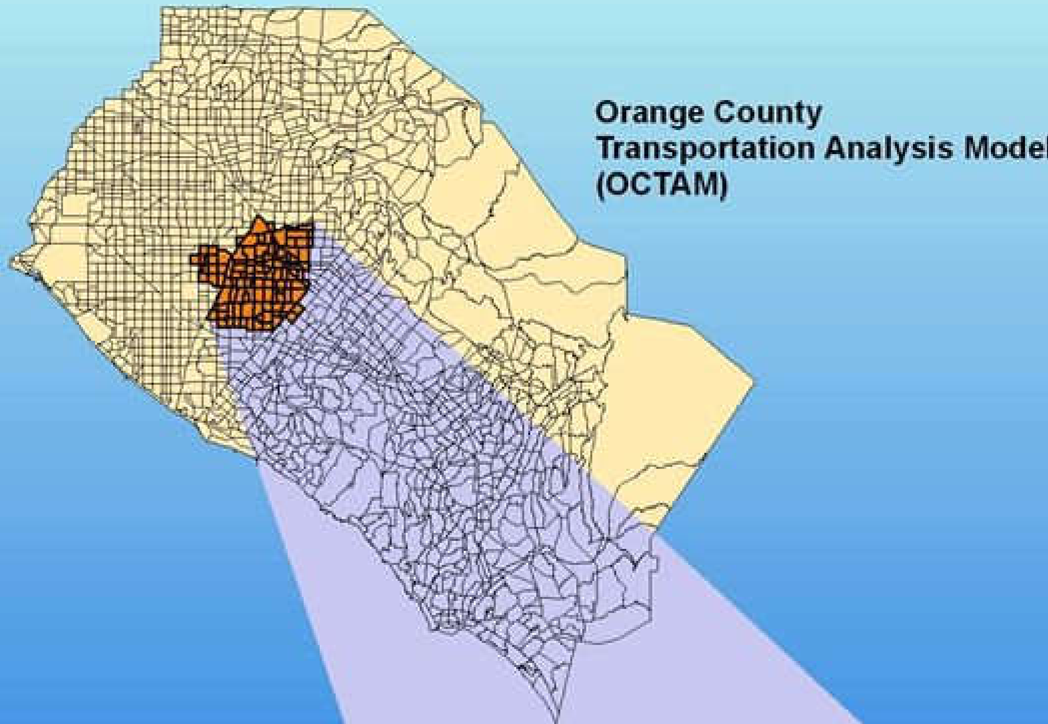
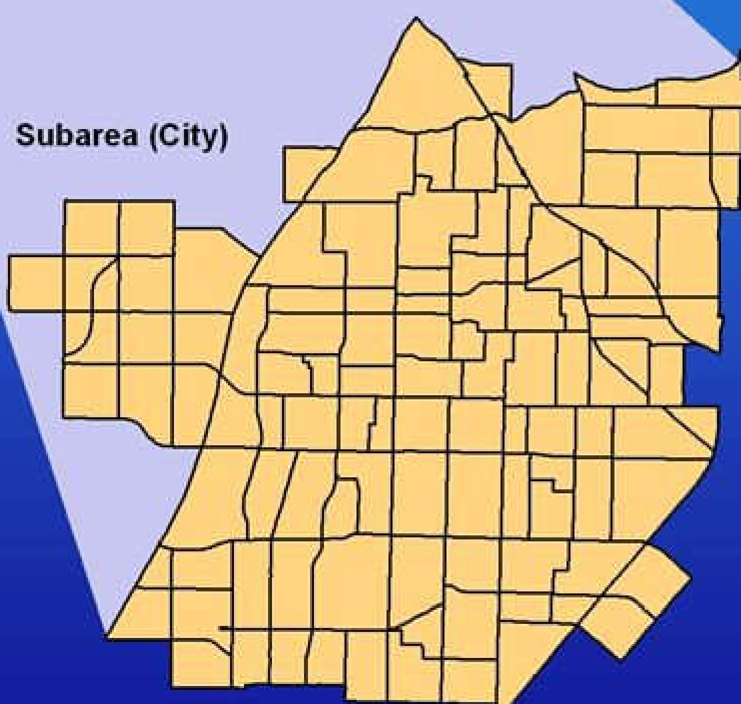
Appendix G: Orange County Subarea Modeling Guidelines

Note: *The primary purpose of these guidelines are to promote consistency in transportation modeling within Orange County.*



ORANGE COUNTY SUBAREA MODELING GUIDELINES MANUAL



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1. INTRODUCTION

1.1 Purpose

The primary purpose of the Subarea Modeling Guidelines Manual is to provide a framework for developing suitable subarea models from the Orange County Transportation Analysis Model (OCTAM). An intent is to promote modeling practices that build on the investment in OCTAM and help agencies develop sub-area models that adequately reflect regional travel while containing greater levels of sensitivity for local project applications.

This manual will be periodically updated with improved modeling procedures and updated databases. A secondary goal of this manual is to encourage consistency in transportation modeling between local subarea models in Orange County and OCTAM, as well as with the Southern California Association of Governments' (SCAG) regional model..

Notes:

1. All references to "OCTAM" are to the current version unless stated otherwise. As of October 2020, the current version is OCTAM 5.0.
2. OCP (Orange County Projections) data is generally updated every four years.
   - OCP-2004 was adopted by the Orange County Council of Governments (OCCOG) on February 26, 2004 and by the Orange County Board of Supervisors on May 11, 2004.
   - OCP-2006 was approved and adopted by the OCCOG on November 20, 2006.
   - OCP-2010 Modified was approved and adopted by the OCCOG on January 26, 2012.
   - OCP-2014 Modified was approved and adopted by the OCCOG on June 23, 2016.
   - OCP-2018 was approved and adopted by the OCCOG on September 27, 2018.
3. Demographic data from SCAG's Regional Transportation Plan (RTP) is used by OCTAM outside of Orange County. As of October 2020, the current version of the RTP data is the 2016 RTP.

1.2 Background

Transportation modeling in Southern California began in the early sixties by the California Department of Transportation (Caltrans), formerly the Division of Highways. Caltrans provided modeling support services to other agencies within the region, including SCAG, for future transportation and air quality planning. In the early eighties, SCAG, the designated Metropolitan Planning Organization, began its own modeling group and assumed responsibility for regional transportation modeling.

In the late seventies, the Orange County Transportation Commission[1], County of Orange Environmental Management Agency[2], and Caltrans jointly developed a sub-regional transportation model for the Orange County Multi-Modal Transportation Study (MMTS). The MMTS model was an extraction of the Caltrans regional model, supplemented with a higher level of detail in Orange County. The model was used to develop the first comprehensive transportation blueprint for Orange County.

These early transportation models were based on the Urban Transportation Planning System (UTPS) computer programs developed by the Urban Mass Transportation Administration (UMTA)[3]. The UTPS computer programs were specifically written for processing on IBM mainframe computers. The costs for processing on an IBM mainframe system were expensive, hence, only larger agencies had sufficient resources to use transportation models in their planning activities.

The advent of personal computers and availability of several transportation modeling software packages has provided the opportunity for smaller government agencies, as well as the private sector to develop their own transportation models. This resulted in the need to establish modeling guidelines to promote consistency in traffic forecasts within Orange County.

1.3 Current Modeling Practice in Orange County

There are two levels of transportation modeling in Orange County: regional and subarea. The Orange County Transportation Authority (OCTA) is responsible for regional transportation modeling in Orange County. This responsibility was transferred from the County of Orange to OCTA in May 1995. OCTA's role as the regional modeling agency is to evaluate multi-modal transportation alternatives to support regional planning activities in Orange County. Some major transportation programs, either directly or indirectly, supported by OCTAM include: the Orange County Master Plan of Arterial Highways (MPAH), the Orange County Long-Range Transportation Plan, urban rail and corridor planning studies, input to SCAG's Regional Transportation Plan, State Transportation Improvement Program, State Implementation Plan, as well as transportation funding programs involving local (Measure M), state, and federal funds.

At the local level, a few cities in Orange County have developed traffic models to analyze the land use and transportation components of their general plans, as well as development proposals, funding programs, and environmental documentation. City models typically contain detailed information to reflect local transportation conditions, and rely on OCTAM to provide regional travel patterns. OCTA provides local agencies

[1] Consolidated into the Orange County Transportation Authority in 1991.
[2] Now defunct, through major reorganization by the County of Orange.
[3] Reorganized to the Federal Transit Administration.

with regional modeling data and assists cities in evaluating proposed transit alternatives through cooperative project agreements.

Development of a subarea model is not required for all local projects. Significant resources are required to develop and maintain a subarea model and OCTAM can be applied to a wide variety of local projects including MPAH amendments, corridor studies, circulation elements, general plan amendments, arterial system gap closures, and other scenarios. Being a regional model, OCTAM may have challenges in analyzing certain local projects, especially small-scale projects with nuanced details. For these cases, a local agency may decide to perform limited refinements to OCTAM or develop a subarea model. If local jurisdictions move forward with the development of a subarea model, they must coordinate closely with OCTA regional modeling staff to promote consistency with OCTAM.

Subarea models throughout Orange County to date have typically not included mode choice or transit components. Projects of regional significance, projects that span multiple jurisdictions, projects that require evaluation of transit alternatives, or other complex projects should be conducted through OCTAM. As subarea models are improved and developed in greater detail, mode choice and transit components may be integrated into subarea models. While these subarea models may be able to forecast localized activity, regional transportation implications may not be accurately captured in subarea models. As a result, any study that evaluates regional transportation activity shall use OCTAM and be closely coordinated with OCTA regional modeling staff. Note that use of OCTAM necessitates an approved “OCTAM User Agreement” which includes additional requirements.

1.3.1 OCTAM Regional Model Overview

OCTAM is a regional model that is based on the traditional four-step sequential modeling methodology with “feedback loops” procedures. The model incorporates multi-modal analytical capabilities to analyze the following modes of travel: local and express bus transit, urban rail, commuter rail, toll roads, carpools, truck traffic, as well as non-motorized transportation which includes pedestrian and bicycle trips. The model responds to changes in land use types, household characteristics, transportation infrastructure, and travel costs such as transit fares, parking costs, tolls, and auto operating costs. OCTAM is a state-of-the-practice travel demand forecasting model designed to address transportation issues mandated by state and federal legislation. OCTAM is currently based on the TransCAD software and the current validation report is available upon request.

Senate Bill (SB) 375

California passed Senate Bill 375 in 2008 in reaction to the passage of the Global Warming Solutions Act (Assembly Bill 32) in 2006 which was a landmark climate change legislation. SB 375 calls on the state’s urban regions to develop plans for more efficient land use and development, in order to reduce the greenhouse gases that contribute to global warming. SB 375 relies on Metropolitan Planning Organizations

(MPOs) for implementation. MPOs must develop Sustainable Community Strategies (SCSs) to achieve quantifiable targets, set by the state, for reducing greenhouse gas emissions through more efficient development and better coordination. SB 375 recognizes the regional ‘blueprint’ planning innovation developed by MPOs during the past decade to produce collaborative regional/local plans that achieve preferred scenarios for future regional development.

The Southern California Association of Governments (SCAG), acting as the MPO, provided subregions with the option of developing subregional SCSs as required under SB 375. Ultimately, local governments have jurisdiction over land use and development, and as such, SB 375 does not require that local governments comply with the SCSs nor does it redirect or create new funding sources to support sustainable planning practices or projects. While local governments are not required under law to comply with SB 375, compliance is considered to be smart planning practice and as such, subarea models may consider integration of components that address SB 375.

SB 375 compliance may be achieved through smart growth principles aimed at reducing dependency on auto travel. Smart growth components have been incorporated into transportation models in an attempt to address SB 375. The principles include density of development, diversity of development, design of development and destination accessibility of development which are smart growth characteristics that influence mobility and travel impacts. These components have generally been incorporated into models through application of modules that integrate these “4D” elasticities.

Assembly Bill (AB) 1358

The Complete Streets Act (AB 1358) was signed into law in September 2008 and was introduced to ensure that the transportation plans of California communities meet the needs of all users of the roadway including pedestrians, bicyclists, users of public transit motorists, children, the elderly, and the disabled. This legislation requires that all modes of transportation be given equal consideration when Caltrans or any other government body in California spends funds on a road project. The objective of AB 1358 is to make roads safer for all travelers. Complete streets strategies identified in AB 1358 offer communities a tool to meet the standards set in AB 32, enacted in 2006, which requires the reduction of greenhouse gas emissions. OCTAM currently does not consider specific strategies associated with complete streets evaluation and willing to consider local strategies for incorporation into subarea models. Any treatments to accommodate complete streets should be documented clearly.

State Bill (SB) 743

On September 27, 2013, California Governor Jerry Brown signed SB 743 into law that identified a number of changes to transportation impact analysis as part of CEQA compliance. These changes will include elimination of auto delay, level of service (LOS), and other similar measures of vehicular capacity or traffic congestion as a basis for determining significant impacts in many parts of California (if not statewide).

New metrics that focus on vehicle-miles traveled (VMT) should be used for transportation impact analysis developed by the Office of Planning and Research. According to the legislative intent contained in SB 743, these changes to current practice were necessary to more appropriately balance the needs of congestion management with statewide goals related to infill development, promotion of public health through active transportation, and reduction of greenhouse gas emissions.

1.3.2 Subarea Model Overview

The cities' subarea models in Orange County are generally categorized as land use based traffic models designed to evaluate their general plan land use and traffic circulation system. These subarea models are typically based on a three-step sequential modeling methodology, which include trip generation, distribution and assignment. The sequential structure of these models is similar in concept to the regional model, with the exception of a mode choice model. Hence, the model estimates vehicle trips directly and does not address transit trips. These models focus on peak-hour link and intersection turn volumes, as well as average daily traffic (ADT).

1.3.3 Regional - Subarea Model Comparison

Table 1-1 compares and contrasts the salient features between the regional and subarea model structure. The principle differences between these models are highly attributable to application differences between socioeconomic data versus land use data, and mode choice issues. These differences are discussed further in **Section 1.4, Model Consistency Issues**.

Table 1-1 Salient Features Between Regional and Local Subarea Models

CATEGORY	OCTAM REGIONAL MODEL	LOCAL SUBAREA MODELS
Model Input Data	1. Socioeconomic data: population, workers, income, housing unit type, household size, school enrollment, university/college enrollment, retail, service and total employment. 2. Highway Networks: stratified into drive alone, 2-person carpool, 3 or more person carpool, and toll roads. 3. Transit Networks: local & express bus, urban & commuter rail, with walk & auto access.	1. Land uses by various categories converted to socioeconomic data. 2. Highway Network: most subarea models use a single purpose mixed-flow network.
Trip Generation	Regression/cross-classification with 14 trip purposes, of which one is work-at-home. The other 13 are split into peak and off-peak, with an auto ownership model to address accessibility using income, household size, and total employment accessible by transit.	Land use trip rates by land use categories or socioeconomic based trip rates by socioeconomic variable. Some recently developed models use a form of linear regression.
Trip Distribution	1. Gravity model – Home-based work based on composite impedance using estimated travel times, costs, and modal characteristics (logsum from trip distribution mode choice), all other trip purposes use estimated travel time. 2. The 13 trip purposes from trip generation are separated into peak and off-peak time periods and combined to 10 basic peak and off-peak trip purposes by consolidating the Home-based work sub-categories. 3. Each trip purpose is then distributed on their respective time period network, resulting in a total of 20 different trip distribution models.	1. Gravity model based on travel time. 2. Typically, three trip purposes. 3. Home-based work distributed on peak network, all others on off-peak network. Typical models rely on the OCTAM trip distribution patterns. Growth factors are applied through a FRATAR process to reflect changes in land use.
Mode Choice	Nested logit model with the following modes: Drive alone; 2-person carpool; 3-or-more person carpool; local & express bus, urban rail; commuter rail; transit with park-and-ride, kiss-and-ride, and walk access.	May or may not include mode choice.
Trip Assignment	Four time periods: AM, Midday, PM, and Night. Combined for Average Daily Traffic and factored for peak-hour. Additionally, toll road choice is included in this step.	Recent models have incorporated the same time periods as OCTAM.
Post-Processing	Forecast Volumes: Future forecast arterial volumes are post-processed at the daily level based on NCHRP 255 procedures pivoting off of existing count volumes. Intersection peak hour turn movement volumes follow a similar procedure Active transportation models	Forecast Volumes: Daily arterial and intersection turn movement volumes generally follow similar procedures as OCTAM although there are varied applications. No active transportation components currently incorporated into local models

1.4 Model Consistency Issues

The purpose of this section is to inform those not intimately familiar with regional and subarea modeling issues, on the underlying assumptions of these models so they can better understand how to evaluate results that these models produce. The intent of this section is to educate and not critique these models.

This section will address two basic modeling consistency issues: 1) socioeconomic data versus land use data, and 2) modeling methodology. Section 1.4.1, Socioeconomic Versus Land Use Data Issues, discusses the differences between socioeconomic and land use forecasts and how they can be modeled to satisfy their respective objectives. Section 1.4.2, Modeling Methodology Issues, describes the four-step sequential modeling process and identifies issues involved with each step of the process. Resolution of these issues is addressed in Section 3, Subarea Modeling Methodology.

1.4.1 Socioeconomic Versus Land Use Data Issues

Regional transportation models, such as the OCTAM and the SCAG model, use socioeconomic data to estimate trip generation, mode choice, as well as several sub-models to address complex travel behavior and multi-modal transportation issues. Local traffic models use city/county general plans and development plans, which are generally described in terms of land use data, to estimate trip generation. There are some fundamental differences in objectives on how socioeconomic and land use data are applied in their respective models.

Socioeconomic Data

Socioeconomic data projections are based on a market based approach, which links international, national, and state economic and demographic trends to regional growth at the county level. In Orange County, sub-county level data is developed by the Center for Demographic Research (CDR) at California State University, Fullerton, in coordination with cities' and county's general plans, as well as major land developers.

The CDR develops and maintains the Orange County Projections (OCP) for population, housing, and employment data at the lowest level geography, in a Geographic Information System (GIS), such that it can readily be aggregated to the OCTAM traffic analysis zones (TAZ). In addition to the three basic socioeconomic variables, the CDR develops additional modeling variables used in OCTAM. A complete list of the OCTAM modeling variables is included in **Appendix A**.

Land Use Data

The land use projections used in Orange County cities' traffic models are based on general plan land use data. Cities are required by state planning laws and regulations to assess the impact of their general plan land uses on the traffic circulation system. The land use designations are often influenced by policy decisions and may not be closely correlated with socioeconomic trends, especially across political jurisdictions. Actual land development, however, is driven by market forces that may or may not coincide with general plan land use designations, and often result in general plan amendments to accommodate these market demands.

In many jurisdictions, land use data often over states employment projections and intensity of use. A *Manual of Transportation-Air Quality Modeling for Metropolitan Planning Organizations* (Deakin/Harvey/Skabardonis, 1993) identified that it is not unusual for employment forecasts aggregated from local plans to total several times the growth estimates for the region. In addition, the *Travel Forecasting Guidelines* (JHK and Associates, 1992) indicated that there is a greater level of uncertainty with land use based models since not all non-residential building floor space is occupied and occupancy densities can vary widely within an area.

Bridging the Socioeconomic and Land Use Issue

While development of OCP is coordinated with cities'/county's general plans, it also contains major land use development plans which may not yet be included in general plans. Additionally, because of the dynamics of changing land uses and land use plans, the most current information may not be reflected in OCP, which is updated approximately once every four years. Furthermore, build out of general plans typically occurs beyond the 25-year OCP projections.

The above issues suggest that it would be difficult, if not impractical from a model implementation perspective, to maintain the exact same database between OCP and city/county land use data within the primary modeling area of a subarea model. These issues should be dealt with on a project by project basis with the affected jurisdictions. For purposes of the modeling guidelines manual, the focus will be on developing a process/procedure where given the same socioeconomic and land use data input assumptions, the regional and subarea models would produce reasonably similar results.

Before socioeconomic and land use data can be compared, the land use data must first be converted to equivalent housing units and employment estimates. The housing units must be converted to occupied dwelling units and non-residential land uses must be converted to total employment. Dwelling unit vacancy rates applied in OCP are shown in **Appendix B**. Typical employment conversion factors are shown in **Appendix C**, with ranges of values to reflect variation in occupancy rates and land use categories. The employment conversion rates are the results of work efforts by Austin-Foust Associates and Urban Crossroads, in coordination with OCTA.

1.4.2 Modeling Methodology Issues

The modeling consistency issues are addressed below for each step of the modeling process, i.e., trip generation, trip distribution, mode choice (if applicable), and trip assignment. Some issues are related to differences in planning requirements and the degree of technical sophistication in the modeling methodology.

Trip Generation

Regional Model: The OCTAM trip generation model is composed of two sub-models: a trip production model and a trip attraction model. The trip production model is a cross-classification model that was developed using a Multiple Classification Analysis technique.. The model is sensitive to household variables such as population, number of workers, median household income, household size, housing unit type, school enrollment and university/college enrollment. The model also includes an auto ownership accessibility variable to reflect how congestion and the transportation system affect trip generation. The model has the following nine basic trip purposes:

- Home-based work-direct (HBW-D)
- Home-based work-strategic (HBW-S)
- Home-based elementary and high school (HBSch)
- Home-based college and university (HBUniv)
- Home-based shop (HBS)
- Home-based other (HBO)
- Home-based social-recreational (HBSR)
- Non-home-based work (NHBW)
- Non-home-based other (NHBO)

The home-based work (direct and strategic) trips are further separated into low, medium, and high-income categories. All trip purposes are then segmented into peak and off-peak time periods. Prior to trip distribution, the direct and strategic home-based work trip purposes are combined into their respective income categories. The resulting twenty (20) trip purposes are then processed through the trip distribution models.

The trip attraction model uses multi-variable linear regression equations to estimate relative trip attractions for each OCTAM TAZ. Depending upon trip purpose, the variables include retail, service, and total employment, as well as population, single and multi-family dwelling units. The composite OCTAM trip generation methodology incorporates advanced state-of-the-practice techniques that respond to modeling issues raised by federal reviewing agencies and environmental special interest groups, such as trip inducement, accessibility, and non-motorized trips.

Subarea Model: Trip generation models developed by the cities convert their land use data to socioeconomic data and apply trip rates derived from relationships extrapolated from the regional model. Older trip generation models used by some cities in Orange County estimate trip generation by applying a separate trip rate factor to each land use category. The factors are typically taken from the Institute of Transportation Engineers (ITE) Trip Generation Manual or other relevant special traffic generation studies. Trip rates and land use categories incorporated into city models vary from city to city.

Issues: The two different approaches in trip generation could yield different results, due largely to the fundamental differences between the way in which regional socioeconomic data and city land use data are derived, and how they are applied in the different models. In large part, this issue has been addressed by converting land use data to socioeconomic data and applying appropriate trip rates. This approach has resulted in producing similar trip generation estimates between regional and subarea models, given the same input data assumptions.

Trip Attraction Balancing

Regional Model: The OCTAM trip generation model estimates trip productions and trip attractions independently of one another. Because they are calculated independently, it is unlikely that the total trip productions would match exactly with the total trip attractions. However, theoretically and mathematically, trip productions and trip attractions must be equal. As part of the OCTAM trip generation process, trip “balancing” is performed to insure that trip productions and trip attractions are equal. OCTAM balances trip attractions to match trip productions for all trip purposes.

Subarea Model: Trip generation estimated by local subarea models, typically assumes full “absorption” of the planned land use data. In order to accommodate the full intensity of planned land use data within the focus modeling area, trips are balanced outside the focus study area.

Issues: The balance between OCTAM productions and attractions is highly influenced by the employment to housing ratio of the input socioeconomic data. An imbalance between productions and attractions may vary by trip purpose and this may result in a defacto reduction in trip rates or employment if employment growth projections cannot be fully absorbed based on estimated trip productions and attractions.

Trip Distribution

Regional Model: The OCTAM trip distribution model is based on the gravity model concept and consists of twelve (12) trip purposes, where each trip purpose is divided into peak and off-peak components, resulting in twenty-four(24) different trip distribution models. The travel impedance in the OCTAM gravity model is based on travel time for all trip purposes except for the HBW trips. All HBW trips use composite impedance, where level of service for all travel modes are considered in the impedance function. The “logsum” from the mode choice model is used to develop the composite impedance, which provides an internally consistent relationship between the distribution and mode choice models.

Subarea Model: Historically, local subarea trip distribution models in Orange County are based on three trip purposes and apply the gravity model concept, using travel times for impedance. Typically, in these models, the home-based work trip purpose is distributed under peak-period traffic conditions and other trip purposes are distributed under off-peak traffic conditions. Trip distribution varies considerably between cities’ models. In general, calibration of these models has taken a heuristic approach whereby travel time factors (friction factors) are adjusted to balance trip generation and trip assignment screenline results.

However, subarea models developed recently have followed the methodology in this guidelines manual, where OCTAM zonal trip tables are adjusted based on zonal changes in trip generation produced by the city's model.

Issues: OCTAM recognizes that for each trip purpose some of the trips occur during the peak-period and some during the off-peak period. For example, according to the SCAG 1991 Origin and Destination Survey, approximately 75 percent the home-based work trips occur during the peak period and 25 percent during the off-peak period. A significant number of non-work trips also occur during the peak-period. These differences in assumptions, along with different trip purposes, different zone structure, and different zonal impedance factors, could contribute towards significantly different trip tables between OCTAM and the subarea models.

Subarea models developed under the guidelines manual addresses this issue by maintaining the trip distribution patterns of the parent OCTAM model.

Mode Choice

Regional Model: OCTAM incorporates a mode choice model which includes a peak and off-peak model for each of the following six (6) trip purposes: home-based work, home-based school, home-based university, home-based other, non-home-based work, and non-home-based other. These models are sensitive to changes in transit level of service, HOV facilities, auto ownership, and travel costs such as tolls, transit fares, parking costs, price of fuel, etc. **Table 1-2** shows all of the modes included in the mode choice model.

Table 1-2 OCTAM Modes of Travel

Transit Modes	***Auto Modes***
1. Auto Access – Express Bus	1. Drive Alone
2. Auto Access – Urban Rail	2. 2-Person Carpool
3. Auto Access – Commuter Rail	3. 3-Person Carpool
4. Auto Access – Local Bus	
5. Walk Access – Express Bus	
6. Walk Access – Urban Rail	
7. Walk Access – Commuter Rail	
8. Walk Access – Local Bus	
9. Non-Motorized	

Mode choice produces separate trips for vehicle trips that use toll roads and vehicle trips that avoid paying tolls. However, the default configuration for OCTAM traffic assignment is to not use the toll trips from mode choice. Vehicle trips using toll roads are determined in traffic assignment using a generalized cost function.

Subarea Model: In the past, local traffic models estimated vehicle trips directly through their land use trip generation process. Chapter 3 proposes options on how various modes estimated by OCTAM (except transit) can be summarized for application in subarea models. Chapter 3 also proposes options on how transit forecast can be obtained for cities interested in analyzing transit.

Issues: Transit modeling issues generally extend far beyond the jurisdictional boundaries of a city and, as such, are more appropriately analyzed from a regional perspective. The complexities and dynamics of changes in transit level of service require frequent maintenance of the transit network. Adding mode choice modeling capabilities to a subarea model would significantly increase the complexity of the model and various model consistency issues must be addressed to maintain consistency.

Trip Assignment

Regional Model: OCTAM uses an iterative equilibrium assignment methodology that simultaneously assigns single occupant vehicles, 2-person carpool, and 3 or more person carpool trips on the highway and toll network (using a generalized cost function). Vehicle trips are assigned separately to four (4) different time period networks: AM-Peak Period (6:00 a.m. to 9:00 a.m.), PM-Peak Period (3:00 p.m. to 7:00 p.m.), Mid-day Period (9:00 a.m. to 3:00 p.m.), and Night Period (7:00 p.m. to 6:00 a.m.). The purpose of this approach is to accurately reflect the different levels of congestion during the day for air quality analysis and to better measure system performance between alternatives; such as, vehicle emissions, vehicle miles traveled (VMT), average speed, and congestion delays. This approach also provides the framework for peak-hour and peak-spreading analyses.

OCTAM transit trips are assigned to two different networks, peak and off-peak. The peak period trips are assigned to the AM transit network and the off-peak period trips are assigned to the Mid-day network. Future transit trip assignment may include assigning transit trips to four (4) time period networks.

OCTAM incorporates speed feedback allowing travel times resulting from traffic assignment to be fed back to trip distribution. The model is then run iteratively until speeds input to trip distribution are reasonably consistent with speeds resulting from traffic assignment.

Subarea Model: Historically, local subarea models are generally structured for AM and PM peak-hour and ADT analyses. The models focus on roadway and intersection capacity analyses, which are ultimately used to identify deficiencies in the roadway system and the required mitigation. Some of the more recent subarea models have toll diversion and HOV capabilities but differ on how they are applied. Historical subarea models often incorporated an incremental capacity restraint assignment methodology although recent models incorporate an equilibrium assignment. Trip assignment methodologies vary considerably between cities' models. This wide variation is typically a reflection of when the model was developed and by whom.

Issues: Differences in toll road and HOV methodology between OCTAM and subarea models could result in different forecasts. OCTAM assigns trips to the highway network, with options to use the toll roads or non-toll facilities (using a generalized cost function). Subarea models use one of two different divergence methodologies: 1) toll costs are directly incorporated into each toll link, 2) a generalized cost utility function is used to estimate proportional shares between a toll and non-toll path.

The OCTAM mode choice model directly estimates HOV trips. Some subarea models use a factoring approach to estimate HOV trips. These differences in methodology could produce different results. Differences in assignment methodology could also result in differences in traffic forecasts. OCTAM uses an iterative equilibrium methodology and, as noted, some subarea models use an iterative incremental methodology.

2. MODEL INPUT DATA CONSISTENCY

This chapter outlines the model input data consistency recommendations for traffic analysis zone (TAZ) boundaries, socioeconomic and land use data, as well as the transportation modeling networks. The Orange County Congestion Management Program requires consistency in socioeconomic data and land use data.

2.1 Traffic Analysis Zones

Socioeconomic and land use data are grouped into TAZs, which are generally based on census tract boundaries. Regional models use census tracts as the general criteria for establishing TAZ boundaries, primarily because census tract level socioeconomic data are readily available from the U.S. Census Bureau and regional planning agencies. A major update to the OCTAM TAZ system was completed in 2005 to better reflect the 2000 Census Block Group boundaries and corresponding detailed data incorporated into OCTAM. This effort increased the number of zones used in OCP-2004 (OCTAM 3.2), 1,657, to the new system of 1,741 zones used since OCP-2006 (OCTAM 3.3, 3.4, 4.0). The new zonal boundaries also took into account changes in land use in redeveloped areas and future development plans throughout the county. Retention of existing boundaries was a priority especially if these followed the traditional geographic boundaries such as railroads, rivers, freeways, and major arterials. Since the primary purpose of OCTAM is to accurately forecast regional traffic activity without regard to jurisdictional boundaries, political borders, such as city boundaries, are rarely explicitly considered in the development of TAZs.

The TAZs in most subarea models were developed as subsets of the OCTAM regional model and therefore, are generally consistent with the OCTAM TAZs. However, it should be noted that subarea models developed with older versions of OCTAM may not be consistent with the current version because of changes in census tract boundaries, and due to the strict regional requirement that TAZs must be fully compatible with census tract boundaries. As part of 2005 update effort, Orange County TAZs were updated from previous versions of OCTAM and numerous zones within Orange County were added or modified. Subarea models that were found to be consistent with older OCTAM versions should coordinate with OCTA to obtain the refined zone structure prior to incorporating updated OCTAM information (networks, OCP data, trip tables, etc) into subarea models.

TAZs of subarea models are often derived from city general plan land use coverages. In some cities, the census tract boundaries and the city's jurisdictional boundaries are not coterminous, causing similar inconsistencies with TAZ boundaries. These conditions make it difficult and time consuming to compare the regional socioeconomic data with city land use data.

For purposes of consistency, TAZs should be developed using a basic contiguous building block system, such that data from one TAZ system could be easily compared with data from another TAZ system by simply aggregating the lowest common denominator zonal data. TAZs in a Subarea model must be a subset, equivalent, or aggregation of OCTAM. In cases of aggregation, the TAZ must also be contiguous with Community Analysis Area (CAA) and Regional Statistical Area (RSA) boundaries. In addition, the subarea model should define a “primary” modeling area where modeling results would be used in traffic studies. Typically, this would include all or a portion of the city’s jurisdictional boundary.

OCTA will provide current OCTAM TAZ related information in a readily usable format for subarea model development. TAZ, CAA, RSA, and other Geographic Information System (GIS) shapefiles will be made available as necessary and appropriate.

2.2 Socioeconomic/Land Use

The Orange County socioeconomic data used in OCTAM is based on the Orange County Projections (OCP), which are formally adopted by the Orange County Council of Governments (OCCOG) and the Orange County Board of Supervisors. The cities’ land use data is based on their general plan land use and generally consistent with OCP. There are some fundamental differences in assumptions between the regional socioeconomic data and the cities’ land use data, i.e., housing units and employment cannot be compared directly between the two databases. Housing units in the OCP socioeconomic data are defined as “occupied units”, whereas, the land use data definition are “total units”. When comparing housing units, appropriate vacancy rates (**Appendix B**) should be applied to the cities’ land use data.

The non-residential categories in the land use data must first be converted to an equivalent employment estimate before they can be compared with the OCP employment data. The conversion rates shown in **Appendix C** can be used for purposes of this comparison, or an acceptable alternative. **Table 2-1** and **Table 2-2** are examples of formats for comparing socioeconomic and land use data. Comparisons can be made for the OCTAM base year and horizon year projections.

It should be noted that socioeconomic/land use data are updated periodically as new demographic information and economic indicators becomes available, and as changes are made to general plan zoning. The OCP socioeconomic data is generally updated every four years in coordination with the Regional Transportation Plan (RTP) update cycle. Whereas, local general plans/zoning changes may occur more frequently. How these changes affect subarea models depend upon the location and degree of change.

The OCP datasets are developed in concert with local jurisdictions through a well-defined process that has been implemented for all OCP development cycles. The OCP development process is a top-down, bottom-up approach to develop countywide population, housing and employment totals. The Center for Demographic Research (CDR) at California State University, Fullerton meets with and collects detailed input information from each jurisdiction as well as SCAG. The process for the development of population, housing and employment estimates begins with development of the assumptions integrated into the forecasts which are reviewed and approved by the CDR Technical Advisory Committee (TAC). Initial countywide projections are developed and subsequently approved by the TAC and the Management Oversight

Committee (MOC). Prior to development of TAZ level projections, the OCCOG approves the countywide population, housing and employment forecasts. Development of the TAZ level projections includes the following steps:

- Develop base year estimates
- Jurisdictional review
- Adjust base year estimates
- Allocated countywide population, housing and employment to split TAZs
- Develop secondary variables by split TAZs
- Distribute draft projections
- Meet with jurisdictions
- Jurisdictional review
- Adjust projections
- Jurisdictional approval
- Approval by CDR TAC and MOC
- OCCOG TAC approval
- OCCOG approval

CDR and SCAG coordinate to ensure consistency between OCP and SCAG's RTP demographic dataset. After the OCP data is approved by OCCOG, SCAG will incorporate it into their next version of the RTP. Based on the historic OCP and RTP update schedules, SCAG approves the RTP two years after OCP is approved.

When developing a new version of OCTAM, OCTA uses the current version of the OCP inside Orange County and current version of the RTP outside of Orange County. OCTA develops refined base year and future year models with the revised data, validating base year forecasts associated with the revised demographic base year. OCTA will make current OCP datasets available to jurisdictions for subarea model development purposes. It is recommended that to the extent feasible, subarea models use the current and consistent set of OCP and RTP data outside of the primary modeling area.

Table 2-1 Socioeconomic/Land Use Data Comparison (Primary Modeling Area)

OCTAM TAZ	Subarea TAZ	*Occupied Housing Units*			*Retail Employment*			*Service Employment*			*Other Employment*		
		OCTAM	Subarea	%Diff.	OCTAM	Subarea	%Diff.	OCTAM	Subarea	%Diff.	OCTAM	Subarea	%Diff.
Total Primary Area													

Table 2-2 Socioeconomic/Land Use Data Comparison (External Modeling Area)

RSA	CAA	*Occupied Housing Units*			*Retail Employment*			*Service Employment*			*Other Employment*		
		OCTAM	Subarea	%Diff.	OCTAM	Subarea	%Diff.	OCTAM	Subarea	%Diff.	OCTAM	Subarea	%Diff.
Total External Area													

2.3 Transportation Modeling Networks

The OCTAM and the subarea model highway and transit (if applicable) networks are strongly recommended to be consistent. Consistency checks should be made to compare the number of lanes on freeways and arterials. This evaluation should include high occupancy vehicles (HOV) lanes, toll lanes and auxiliary lanes. How HOV lanes, toll lanes and auxiliary lanes are addressed in the model may vary based on the subarea model requirements. All freeway ramps within the primary area should be included in the subarea network with all ramp movements coded. While OCTAM highway and transit networks do not incorporate most intersection control treatments, flexibility remains to incorporate intersection control treatments as appropriate in subarea networks. Network speed and capacity assumptions should be consistent with OCTAM although flexibility exists to refine assumptions based on local conditions. Network speed and capacity assumptions should be documented.

The consistency for arterial highways should be based on number of lanes, divided verses undivided, and smart street designation. Review of the OCTAM network assumptions by the cities should assist in facilitating resolution of network consistency issues. OCTA maintains a single future network, which assumes full buildout of the Measure M2 plan including the MPAH.

It should be noted that some arterial facilities are currently constructed above and beyond their MPAH classification and should be coded as such in the existing and future subarea networks. Arterials where “road diets” are planned are exceptions, in the future network these should be coded according to their MPAH classification. Subarea network development should not solely rely upon OCTAM networks but should be verified through aerial photography or field reconnaissance to ensure accuracy throughout the subarea study area. Development of the existing and future subarea networks should be documented clearly.

3. RECOMMENDED SUBAREA MODELING METHODOLOGY

One intent of the subarea modeling methodology guidelines is to promote consistency in subarea model development and application. The goal of this chapter is to establish procedures that would lead to models with consistent assumptions on socioeconomic/land use data and transportation system networks.

While this chapter provides a definitive analytical approach, Chapter 4 allows for optional procedures and methodologies, provided guideline criteria are satisfied. This flexible framework allows creativity and advancement in state-of-the-practice while maintaining an acceptable level of transportation modeling consistency in Orange County.

As mentioned previously, OCTAM is built in the TransCAD software platform and most files are in TransCAD format. OCTA will not be able to provide support for other model software platforms. When developing a subarea model, the methodology is recommended be fully documented and include all the information necessary to replicate validation of the base year subarea model.

3.1 Subarea Modeling Approach

The proposed modeling methodology encourages consistency between the OCTAM regional model and the subarea model by instituting a hierarchical modeling approach. OCTAM provides the basic trip tables from which subarea models would refine upon to reflect the level of detail necessary to address specific local traffic issues. This concept establishes an OCTAM base year subarea trip table by converting the OCTAM trip tables to the subarea TAZ system. Likewise, an OCTAM forecast year (horizon year) subarea trip table would be converted to the subarea TAZ system. Since these subarea trip tables are a direct conversion of the OCTAM trip tables, they should produce similar results when assigned to the subarea network. These trip tables will serve as the basis for evaluating and comparing changes in subarea modeling methodologies and assumptions with OCTAM.

A conceptual flow chart of the proposed subarea modeling methodology is shown in **Appendix E**.

3.1.1 Tiered Zone Structure

Historically, subarea models have incorporated a three-tiered zone structure approach:

- Tier-1 (Consolidated Area): This area is far removed from the focus of the subarea model, where the network and zone structure are highly conceptualized. In general, OCTAM TAZs in this area are aggregated to Community Analysis Areas (CAA) within Orange County, and to Regional Statistical Areas (RSA) for areas outside of Orange County.

- Tier-2 (Buffer Area): Tier-2 serves as a transition between the coarse grained Tier-1 and the primary focus area of the subarea model. OCTAM TAZs are normally used in this area.
- Tier-3 (Primary Area): Tier-3 would typically include the jurisdictional boundary of a city, plus an extended area, with the intent of producing reasonably similar results with a neighboring city's traffic model on adjacent roadway links. Within the primary modeling area, OCTAM TAZs are subdivided into smaller zones to provide the detail necessary to address local traffic circulation issues. The subarea TAZs within the extended primary modeling area should be consistent with the adjacent city's model.

As model processing speed have improved and more detailed components are incorporated into subarea models, the former tiered structure is no longer the recommended approach for the subarea model structure. While there are benefits to a tiered structure, and subdividing/disaggregating zones in the primary area is likely necessary, OCTA remains flexible in defining the appropriate model structure for subarea models. As processing speeds have improved and subarea models may incorporate a mode choice component, it is feasible to develop a subarea model that applies OCTAM directly with primary area subdivided zones.

3.1.2 Highway Network

Current OCTAM base year and future year networks will be provided and discretion is left up to subarea models as to the most appropriate and efficient way to develop the networks.

Subarea models should appropriately account for HOV facilities as well as toll facilities. Subarea models that are directly impacted by the toll roads in Orange County should model them as toll roads. The toll road trip assignment should be consistent with OCTAM unless it can be demonstrated that better procedures and/or data are available to replace the OCTAM assumptions and procedures. OCTA will provide highway network assumptions, including speed and capacity tables by facility type for peak and off-peak periods to assist in the development of subarea model highway networks.

3.1.3 Transit Network

As the regional public transit agency in Orange County, OCTA is responsible for all transit planning and modeling. Local agencies may want to assess local transit alternatives that would be funded through local and/or private sources. Subarea models have the option of incorporating the OCTA mode choice model as appropriate.

Application of a mode choice model requires detailed coordination of a transit network. OCTA will make its current base year and future year transit networks available for subarea model application as appropriate. In addition, documentation defining transit network coding conventions can be provided. The OCTAM transit networks are very detailed and can be difficult to develop, update, maintain and apply. Revising transit networks for subarea model application should be done with caution.

3.2 Trip Generation

A socioeconomic based trip generation procedure is recommended. The procedure is a two-step process: 1) convert city land use data to socioeconomic data, and 2) apply appropriate trip rates. In the first step, city land use data are converted to socioeconomic data based on the housing vacancy rates shown in **Appendix B**, and employment conversion factors such as those shown in **Appendix C**. Initially, the mid-range employment conversion factors in **Appendix C** can be used, and if warranted, adjustments within the range may be necessary to reflect local conditions. The second step of the process is to apply appropriate socioeconomic trip rates, such as those shown in **Appendix D**, by OCTAM trip purposes. Under some conditions, adjustment to the vacancy rates presented in Appendix B and socioeconomic trip rates presented in Appendix D is warranted. Deviations from the rates presented should be justified through appropriate analysis and documentation.

The subarea modeling methodology concept that has generally been applied in Orange County is to use the local trip generation model to develop production and attraction factors, which will be used to update the OCTAM based subarea trip tables. Production and attraction growth factors would be developed based on changes in productions and attractions estimated by the subarea trip generation model. These factors would then be applied to the trip distribution component of the subarea model, using the FRATAR redistribution algorithm to adjust the trip table. This procedure would theoretically preserve the regional trip distribution patterns, while providing subarea models with the ability to analyze land use alternatives.

3.3 Trip Distribution

Application of the OCTAM trip distribution model for subarea models is highly recommended. The OCTAM trip distribution model would be made available either through OCTA staff resources or by OCTA approved consultants (funded by the requesting agency) under OCTA oversight. In the past, the trip distribution component of the subarea model has been based on the FRATAR redistribution procedure. While still allowed, it is not the recommended approach.

If FRATAR redistribution is pursued, the first step of the process is to transform the OCTAM trip tables to the subarea zonal structure by compressing and expanding the OCTAM TAZs to the appropriate subarea TAZs. In cases where OCTAM TAZs are subdivided into two or more subarea TAZs, the OCTAM trip ends will be proportioned based on the productions and attractions developed by the subarea trip generation model. If the FRATAR redistribution routine is applied in the subarea model, it should be applied with caution as direct application of FRATAR models may significantly alter regional trip distribution activity. Implications of subarea model FRATAR redistribution should be fully evaluated prior to application. Application of the OCTAM trip distribution model may eliminate the need to apply the FRATAR redistribution procedure.

In order to evaluate land use alternatives, production and attraction growth factors need to be developed using the subarea trip generation process. The growth factors would then be applied using a FRATAR trip redistribution process. Under certain conditions, it may be necessary to run a new OCTAM benchmark to supplement the FRATAR redistribution process. The OCTAM trip distribution model should be rerun if any of the following conditions occur:

1. A change in land use of more than 100% in the subarea TAZ(s) corresponding to the relevant OCTAM TAZ. A significant change in land use quantities can influence zonal distribution patterns.
2. Instances where the OCTAM TAZ has no trips and the corresponding subarea TAZ(s) has land use activity.
3. Addition of a freeway or major arterial highway; generally a roadway that would provide a significant change in travel time. Addition of a missing link in a gridded network probably would not fit this definition.

These guidelines are not hard and fast rules, and likely to change as the procedures are refined over time. Each guideline should be evaluated on its own merit.

3.4 Mode Choice (If Applicable)

Based on the level of analysis required to address specific local traffic circulation issues, there may not be a need for subarea models to incorporate a sophisticated mode choice model such as the one included in OCTAM. If a local agency desires to evaluate modal alternatives, they should coordinate with OCTA as OCTA is responsible for countywide transit planning efforts. Development of mode choice models may not be necessary for subarea models although the option to include a mode choice model exists to evaluate local transit applications as appropriate. As noted, OCTA retains jurisdiction over regional transit modeling and subarea models should not publish transit ridership forecasts for any regional transit components. Due to the sensitive nature of mode choice models and transit patronage forecasting in particular, caution should be used when applying a mode choice model for a subarea model.

The OCTAM mode choice model would be made available either through OCTA staff resources or by OCTA approved consultants (funded by the requesting agency) under OCTA oversight. The OCTAM vehicle trip tables with any combination of the following modes can also be provided: single occupant vehicles, 2-person carpool, 3-or-more person carpool, and transit(if requested). Transit trips can be provided by OCTAM sub-modes including local bus, express bus, urban rail, and commuter rail as well as by mode of access including walk and auto access.

The OCTAM mode choice trip tables provide the subarea model with the capability to respond to inquiries pertaining to mode choice issues, albeit limited in ability to explore the full range of modal alternatives. The procedure is to first translate the OCTAM mode choice output to the subarea zone structure then calculate mode split percentages for each origin and destination pair or trip interchange. How the mode split percentages are calculated depends on whether the subarea trip generation model is based on person or vehicle trips.

The mode split percentages would then be applied to the appropriate subarea person or vehicle trip table. This procedure will allow subarea models to estimate modal shares based on changes in travel demand resulting from an increase or decrease in trip generation. Major changes in the transportation system may require running the OCTAM mode choice model to properly reflect mode shift. Examples of major changes include significant changes in transit level of service, adding a major roadway or HOV facility and/or modeling transportation control measures that target single occupant vehicle trip reduction.

3.5 Trip Assignment

The two most common capacity restraint trip assignment methodologies used in Orange County are the equilibrium and incremental algorithms. Both of these methods are based on an iterative capacity restraint procedure. OCTAM and a few subarea models apply the equilibrium procedure, while other subarea models implement an incremental approach. It is recommended that subarea models maintain an assignment procedure consistent with OCTA, including assignment by consistent time periods as OCTAM. Alternative assignment procedures such as combined windowed/focused assignment procedures have successfully been implemented for subarea models to appropriately account for local assignment characteristics as well as regional assignment characteristics. Assignment procedures should be documented clearly with specific justification for implementation.

OCTA can provide OCTAM trip tables by six trip purposes (home-based work, home-based university, home-based school, home-based other, work-based other and other-based other). OCTAM time-of-day and production-attraction to origin-destination factors should be applied to establish consistency with OCTAM. For subarea model applications, “peaking factors” could be applied based on traffic counts reflecting local peak-hour traffic characteristics. Toll facility assignment procedures should be considered during the development of the subarea model assignment procedure. Toll assignment procedures should be documented clearly.

3.5.1 Post-Assignment Model Adjustment Methodology

Traffic counts used to verify the trip assignment model should be substantiated for accuracy and rationalized for continuity before they are used in the trip assignment calibration/validation process. It should be recognized that traffic counts themselves have daily and seasonal fluctuations and could vary by as much as fifteen percent (15%) within a given day.

During the model base year validation process, it is common practice to calibrate the network model volumes with actual traffic counts. Some of the network calibration process includes verifying proper network access from zone centroid connectors, capacity assumptions, network speeds, as well as zonal productions and attractions. Caution must be exercised when making these network adjustments to avoid introducing biases in the network that might adversely affect future year forecasts. In spite of these adjustments, there may still be a need to adjust the “raw” model output to account for atypical network conditions and minor model aberrations.

The *Transportation Research Board National Cooperative Highway Research Program Report 255* (TRB NCHRP, 1991) established guidelines and procedures for adjusting transportation model outputs and developed criteria for acceptable levels of modeling accuracy. Specific model adjustment procedures following the NCHRP Report 255 guidelines should be fully documented if they are applied in the subarea model.

OCTAM incorporates a post-assignment model adjustment procedure that is consistent with the NCHRP 255. In adjusting the OCTAM future year forecast, the methodology compares the traffic assignment of the base year model with the forecast year model, and applies either their absolute difference or ratio, to the base year count data. If the link volume of the base year model is less than the base year count, the incremental difference between the base year and future year model is applied to the base year count volume, otherwise the ratio of base year and future year model is used.

3.5.2 OCTAM Availability

If a local agency requires special OCTAM model runs, this can be accommodated in one of two ways. One, the local agency, in collaboration with OCTA, would develop a work plan and general schedule agreeable by both parties. The work efforts could range from local staff doing most of the work, under OCTA oversight, to OCTA doing the work with local staff support, or combination thereof.

Alternatively, the local agency requesting the model runs could contract directly with a consultant for services required. OCTA will also consider other proposals for making OCTAM more accessible to local agencies.

OCTA typically maintains base year and horizon year models. While interim year models and networks are not typically maintained, demographic data exists for the development of interim year forecasts.

4. OPTIONAL MODELING METHODOLOGY

The methodology presented in Chapter 3 is an integrated subarea modeling approach that promotes consistency with the OCTAM regional model. The methodology captures the full spectrum of the OCTAM capabilities, including use of the most current travel surveys and transportation data in the region.

However, this manual acknowledges that there are many ways in which subarea models can be constructed. This Chapter sets general guidelines for an optional subarea modeling methodology.

4.1 Input Assumptions

Model input data is recommended to be consistent with the requirements set forth in Chapter 2.

A subarea model's base (existing) year can potentially be different than the base year in OCTAM but additional work would be required and care must be taken during any base year comparisons.

4.2 Model Structure

OCTAM is based on the traditional sequential modeling approach, therefore, it is recommended that subarea models be structured under this modeling framework. However, there are many combinations of model structures within this framework. In addition, consideration has been given to development of activity-based transportation models within the SCAG region. It is recommended that subarea models remain consistent with the current state of the modeling practices employed by OCTA at the time of subarea model development.

APPENDIX A

OCTAM Socioeconomic Zonal Variables

OCTAM SOCIOECONOMIC ZONAL VARIABLES OCTAM 5.0

Total Occupied Dwelling Units (TOCDU): Occupied single-family housing units.

Resident Population (RPOP): Total persons living in households excluding institutionalized persons in census-defined group quarters.

Employed Residents (REM): Total employed persons 16 years and over (including part-time workers, self-employed workers and unpaid family workers).

Group Quarters Population (GQPOP): Only persons in non-institutionalized group quarters.

Total Employment (EMP): All employees including military personnel, civilian personnel and self-employed.

Retail Employment (RE): All employees in Retail employment.

Service Employment (SE): All employees in Service employment.

Public School Employment (PSCH): All employees in K-12 public school employment.

Other Employment (OTH): Total Employment excluding Retail, Service Employment, and Public School Employment.

School Enrollment (SEN): Total number of students attending public and private elementary, junior high, and high schools.

University Enrollment (UEN): Total number of students attending major public and private colleges and universities.

Acres: Total acreage of zone.

Median Household Income (MHHINC): Median household income in 2010 dollars.

APPENDIX B

Housing Unit Vacancy By City

Note: The vacancy rates used in Orange County Projections are United States Census data and applied at the census tract level.

HOUSING UNIT VACANCY BY CITY
OCTAM 4.0

CITY	2012 Vacancy	2040 Vacancy
ALISO VIEJO	3.5%	2.6%
ANAHEIM	6.1%	4.2%
BREA	3.5%	2.6%
BUENA PARK	3.8%	3.0%
COSTA MESA	5.2%	4.3%
CYPRESS	2.6%	1.9%
DANA POINT	11.0%	10.0%
FOUNTAIN VALLEY	2.7%	2.0%
FULLERTON	5.2%	4.1%
GARDEN GROVE	3.6%	2.9%
HUNTINGTON BEACH	4.9%	4.0%
IRVINE	5.7%	3.8%
LA HABRA	4.7%	4.2%
LA PALMA	2.8%	2.4%
LAGUNA BEACH	16.2%	15.4%
LAGUNA HILLS	5.2%	5.2%
LAGUNA NIGUEL	4.3%	3.4%
LAGUNA WOODS	13.1%	11.9%
LAKE FOREST	3.2%	2.6%
LOS ALAMITOS	3.3%	2.6%
MISSION VIEJO	3.0%	2.5%
NEWPORT BEACH	12.3%	11.0%
ORANGE	3.9%	3.3%
PLACENTIA	3.0%	2.3%
RANCHO SANTA MARGARITA	3.4%	2.8%
SAN CLEMENTE	7.9%	7.3%
SAN JUAN CAPISTRANO	4.6%	3.9%
SANTA ANA	4.8%	4.0%
SEAL BEACH	10.6%	9.7%
STANTON	4.1%	3.0%
TUSTIN	4.8%	3.7%
Unincorporated	3.8%	3.2%
VILLA PARK	2.0%	1.7%
WESTMINSTER	5.4%	4.6%
YORBA LINDA	3.4%	2.8%
Orange County	5.4%	4.3%

Source: Orange County Projections 2014 Modified

APPENDIX C

Typical Employment Conversion Factors

TYPICAL EMPLOYMENT CONVERSION FACTORS
(June 2001)

Land Use Category	Conversion Rates Range	Employment Type (Percentage Ranges)		
		Retail	Service	Other
Commercial	2.25 –2.75 employees/TSF[1]	60% - 90%	10% - 40%	0% – 5%
Office/Office Park	3.00 – 4.00 employees/TSF	0% – 5%	20% – 30%	65% - 80%
R&D/Light Industrial/Business Park	2.50 – 3.50 employees/TSF	0% – 5%	0% - 30%	60% - 100%
Heavy Industrial	2.00 – 2.50 employees/TSF	0%	0%	100%
Warehouse	1.00 – 2.00 employees/TSF	0%	0%	100%
Restaurant	3.00 – 5.00 employees/TSF	100%	0%	0%
Medical Office/Post-Office/Bank	3.50 – 4.50 employees/TSF	0% - 10%	70% - 100%	0% – 20%
Government Office/Civic Center	3.00 – 4.00 employees/TSF	0% – 5%	50% - 70%	25% – 50%
Hospital	2.50 – 3.00 employees/TSF	0%	70% - 80%	20% – 30%
Library/Museum	1.50 – 2.50 employees/TSF	0%	100%	0%
Hotel/Motel	0.75 – 1.25 employees/room	0% - 10%	70% - 80%	10% – 30%
Schools	0.08 – 0.12 employees/student	0%	0%	100%
Golf Course	0.50 – 0.70 employees/acre	0% - 10%	90% - 100%	0%
Developed Park/Athletic Fields	0.20 – 0.40 employees/acre	0%	80% - 100%	0% – 20%
Park	0.05 – 0.10 employees/acre	0%	80% - 100%	0% – 20%
Agricultural	0.01 – 0.05 employees/acre	0%	0%	100%

[1] Thousands of Square Feet

APPENDIX D

Socioeconomic Data Trip Rates

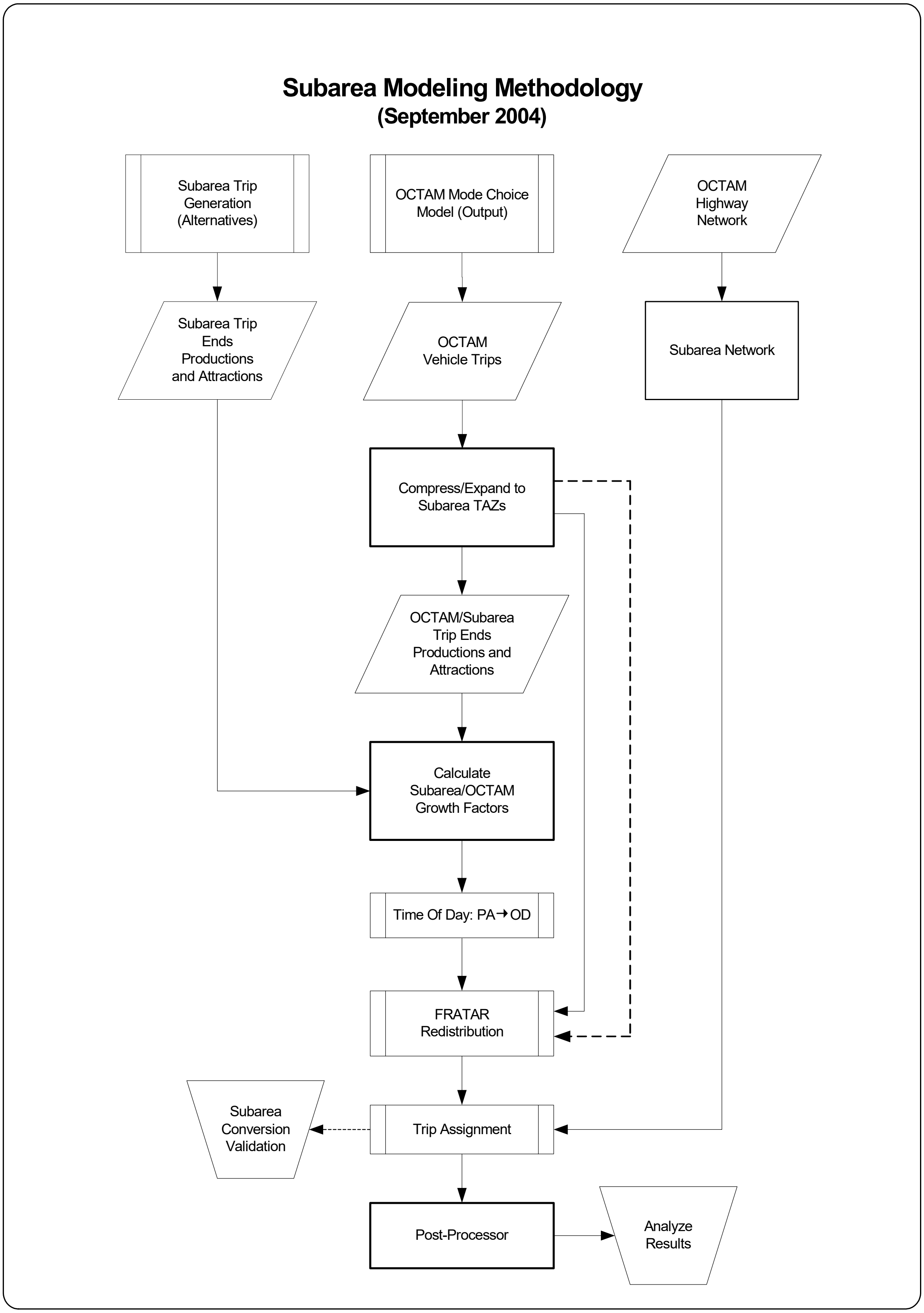
SOCIOECONOMIC DATA TRIP RATES
(June 2001)

VARIABLE	Single Family Residential	Multi Family Residential	Population	Employed Residents	Income (Million $)	Retail Employment	Service Employment	Other Employment	School Enrollment (Student)	Univ./College Enrollment
PRODUCTION TRIP RATES										
HBW	0.00	0.00	0.00	1.27	0.00	0.00	0.00	0.00	0.00	0.00
WBO	0.00	0.00	0.00	0.00	0.00	1.83	1.07	1.01	0.00	0.00
HBO	1.05	0.60	0.24	0.00	13.00	0.00	0.00	0.00	0.00	0.00
HBS	0.89	0.46	0.11	0.00	11.00	0.00	0.00	0.00	0.00	0.00
OBO	0.44	0.43	0.00	0.00	2.00	5.20	1.08	0.24	0.00	0.20
HBUniv	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HBSch	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ATTRACTION TRIP RATES										
HBW	0.10	0.10	0.00	0.00	0.00	1.24	1.24	1.26	0.00	0.00
WBO	0.25	0.25	0.00	0.00	0.00	3.44	0.60	0.54	0.00	0.20
HBO	0.40	0.39	0.00	0.00	1.00	3.46	0.90	0.10	0.00	0.00
HBS	0.00	0.00	0.00	0.00	0.00	5.54	0.00	0.00	0.00	0.00
OBO	0.41	0.45	0.00	0.00	2.00	4.84	1.10	0.20	0.00	0.20
HBUniv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.91
HBSch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.00
DAILY	**3.54**	**2.68**	**0.54**	**1.27**	**29.00**	**25.55**	**5.99**	**3.35**	**0.88**	**1.51**

Note: These trip rates were developed by Urban Crossroads in corroboration with Austin-Foust Associates and OCTA.

APPENDIX E

Subarea Modeling Methodology (Flow Chart)


Subarea Modeling Methodology
(September 2004)
Subarea Trip Generation (Alternatives)
OCTAM Mode Choice Model (Output)
OCTAM Highway Network
Subarea Trip Ends Productions and Attractions
OCTAM Vehicle Trips
Subarea Network
Compress/Expand to Subarea TAZs
OCTAM/Subarea Trip Ends Productions and Attractions
Calculate Subarea/OCTAM Growth Factors
Time Of Day: PA→OD
FRATAR Redistribution
Subarea Conversion Validation
Trip Assignment
Post-Processor
Analyze Results