CSTDM09 - California Statewide Travel Demand Model

Model Development

Local Transit Functions

System Documentation Technical Note
Internal Working Document

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Table of Contents

1. Introduction

Travel demand models typically include a representation of public transit, which is a key policy tool, with potential impacts beyond affecting congestion levels, including providing social equity and reducing greenhouse gas emissions. Coding public transit networks is a difficult and time-consuming task, especially for future scenarios.

A hybrid method is used to represent short distance (under 100 mi) transit in the California Statewide Travel Demand Model (CSTDM). Rail services available for travel are explicitly coded into the CUBE network. Local “bus service” is represented indirectly through a model relating bus times to auto time from CUBE. This document describes this latter model.

Using a hybrid approach provides an appropriate level of detail for a regional model such as the CSTDM. The high cost, long-term capital rail projects can be recreated explicitly: the coding burden for these is relatively low, and their impact high -- in 2009, there were 39 lines of rail transit in California, with average weekday ridership of approximately 1.12 million. By comparison, the Los Angeles Metro bus system has daily ridership of 1.18 million, but 191 bus routes. Similarly, the three major Bay agencies (Muni, AC Transit and VTA) combine for daily bus ridership of 0.84 million, but across 262 bus routes.

In the entire state of California, bus services are provided through more than 50 local transit operators. These operators provide transit services on more than 1500 local bus routes, with level of services that varies from the frequent mass services in densely populated urban areas to rather sparse, low frequency services providing limited service among more remote locations in rural counties. Figure 1 presents an example of the extensive bus network operated in the area of downtown Sacramento, the State Capital. Several different lines provide transit services in the area, each one with dozens of different bus stops in which users may access/egress the services along the bus routes.

The bus routes shown in the example are only a very limited subset of the whole bus network system operated in California (Figure 2).

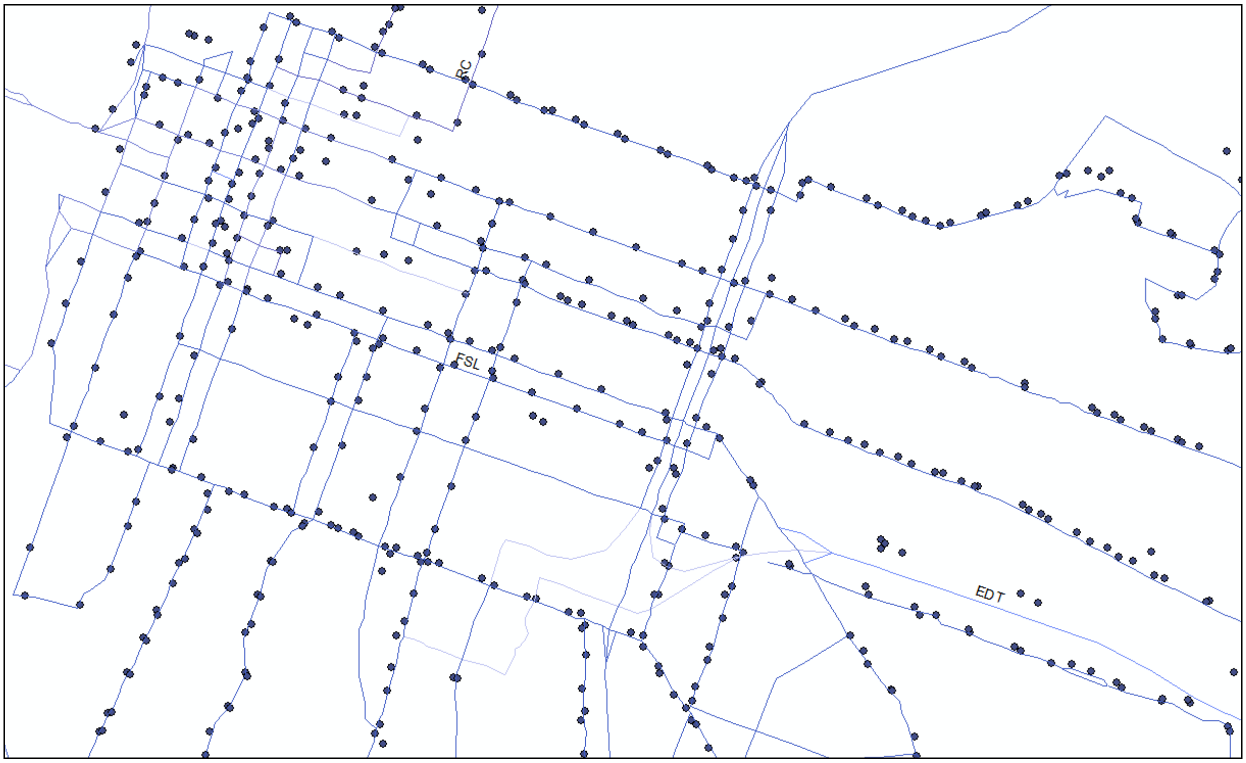

Figure 1: Local transit lines and bus stops in downtown Sacramento, the State Capital

Local bus services are clearly important, and in many areas are the only form of transit provided, but coding them in detail would be tedious and beyond the scope of a statewide model such as the CSTDM. Moreover, the characteristics of local bus services change frequently to adapt to modifications in travel demand, changes in the land use and the urban form of cities, funding and subsidies for public transportation.

For all the reasons above, the definition of a valid alternative to the explicit coding of the bus network, which also reduces the efforts required for updating the network, is a valuable solution to adopt in such a large-scale modeling framework.

The hybrid approach that is described in this document is based on the estimation of econometric models for the local transit attributes (in-vehicle and out-of-vehicle time) using observed data. It is based on a service variable, as well as network and zonal properties, and provides a broad sense of policy response, while keeping the effort required for transit coding consistent with the benefit.

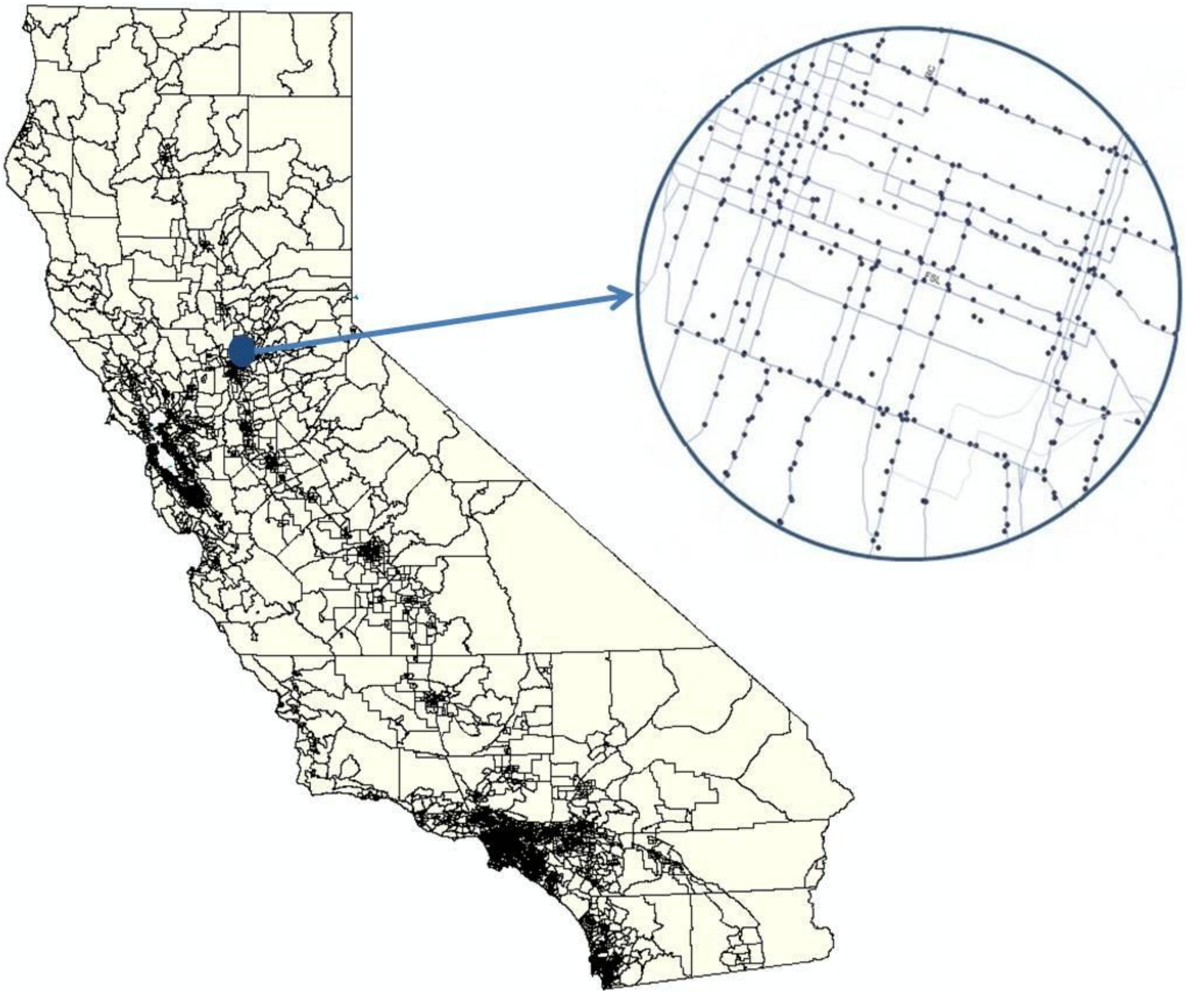

FIGURE 2: Distribution of local transit services in California.

The simplified methodology is applied for the representation of local bus services in the short distance (shorter than 100 miles) personal travel model. The methodology is also used to compute the travel times and the measures of accessibility by bus to access public transportation rail services, thus providing a realistic representation of the multimodal trips involving the use of both rail and bus services.

2. Overview of process

To develop the Local Transit Functions, four key steps were needed:

- Transfer and service areas were designated, and their levels of service and fares were gathered;
- Data on available transit service between test zone pairs and the corresponding network travel and zonal attributes was gathered;
- Models were estimated for both in vehicle time (IVT) and out of vehicle time (OVT); and
- The needed CUBE scripts were developed to produce the components of composite travel time including the possibility for rail in transit trips.

The fourth step is described in the main Transit Network Coding and Extraction of Transit and Road Travel Skims document; the first three are the core of this technical note.

3. Definition of transit service provided

The methodology is based on the estimation of econometric models that express the local transit attributes (in-vehicle and out-of-vehicle times) as a function of other more easily measurable transportation variables and land use patterns. The model is developed for different times of the day, consistently with the time periods used in the development of the CSTDM framework, to account for the variability of transit services during the day.

At the basis of the development of the model is the definition of the *catchment areas* (transfer and service areas) for local transit. The catchment area is a measure of the geographical accessibility to transit services. Each of the 5191 TAZs in the modeling framework is assigned to a catchment area depending on the distance from the available transit lines in the area. TAZs that do not have access in a reasonable range to any local transit services are not included in any catchment area.

The local transit functions use four key inputs:

1. Transfer areas: the areas within which a person can travel (they include the possibilities of transfers among different operators in a region);
2. Service areas: the areas within which transit service is generally provided by a single operator (they are subdivisions of the larger transfer areas served by multiple transit operators);
3. Level of Service: a single number representing the quantity of local bus service provided by the transit operator; and
4. Fare: a composite value, expressed in US dollars, indicating the typical fare paid by a customer.

3.1. Transfer and Service Areas

Transfer and Service Areas concur to the definition of the catchment areas for transit. A transfer area measures the accessibility to transit services in a region. It is a measure of the portion of a region in which transit trips are possible (using any of the operators that offer local transit services). A service area is a smaller region that is usually served by only one operator. The characteristics of the transit services and the level of service are considered homogenous inside each service area.

Multiple service areas are sometimes found in the largest transfer areas, as a result of the presence of multiple operators providing services in a geographically vast area.

Service areas are indicated through the addition of a digit to the number of the transfer areas they belong to (for example, service areas 7.0, 7.1, 7.2 and 7.3 form the transfer area no. 7 in the "Sacramento region").

As an example of the transfer and service area concept, see the figure below.

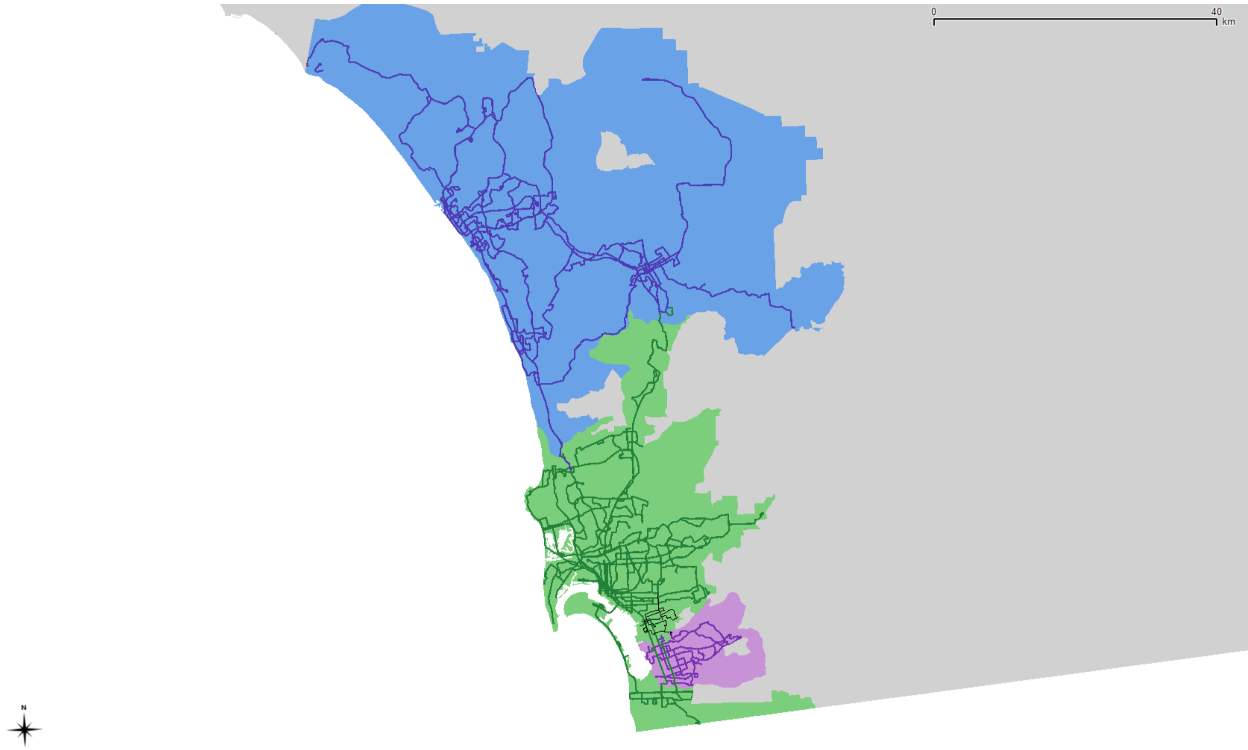

Figure 3: Transfer Area and Service Areas in the San Diego Region

This figure illustrates the San Diego Transfer Area, which extends along the coast from Marine Corps Base Camp Pendleton south to Mexico. The bus lines from the year 2000 are shown. The Local Transit Functions will produce skims with valid local transit times anywhere within the colored areas. This Transfer Area contains three Service Areas: the blue area represents the North County Transit District, the green represents the San Diego Metropolitan Transit System, and the purple represents Chula Vista Transit.

Eventually, in more isolated urban areas and rural counties, transfer and service areas are identical. In these cases, transit trips are possible only among the TAZs of the same service area, and there are no possibilities for connecting trips that extend into other contiguous service areas. The four major urban areas (Los Angeles, San Francisco Bay Area, Sacramento and San Diego) are the only areas in which a single transfer area contains multiple service areas. In these regions, multiple operators can be used for creating longer trips that originate in one service area and are directed to a destination in a different service area. This two-level approach handles the major urban areas served by many operators (for instance, permitting local bus service from San Mateo into San Francisco). However, it prevents a traveler taking a local bus between e.g. Sacramento and San Francisco, even if the overall transit skim process does permit this transit trip by taking the AMTRAK Capitol Corridor train in addition to the local bus services.

A GIS shapefile of transit lines provided by the California Department of Transportation was used to develop the transfer and service areas. Each of the 5191 TAZs in the CSTDM framework is assigned to a catchment area, depending on the proximity from the TAZ centroid to the closest bus lines. The TAZ is assigned to the corresponding service and transfer area of the operator that runs the transit lines, if such distance does not exceed 3 miles. If this test fails (some TAZ centroids are often located far from any bus line), but at least one bus line crosses the TAZ, then the TAZ is also included in the corresponding transfer and service areas. Otherwise, the TAZ is not included in any catchment area (no transit services). A total of 32 Transfer Areas and 55 Service Areas were identified in California.

3.2. Level of Service and Fare

Once the Service Areas were designated, the Level of Service (LOS) could be calculated. The Level of Service is a value developed as part of this work, with the intent of providing a single number that represents the quality of transit services provided by a local operator. The equation used to calculate the Level of Service is as follows:

> Level of Service = Population served / Thousand Annual Revenue Service Miles Provided

The population served was taken from the zones described as part of the Service Area, and the data on service provision came from the National Transit Database provided by the Federal Transit Administration. This variable is a measure of the quantity and density of the service provided (related to the population served by transit in the service area). In this measure, the amount of service is limited to that provided by bus and trolleybus, and does not include rail (which is modeled explicitly) nor demand responsive transit (which is not covered by the CSTDM).

Travel within a Service Area is determined by the Level of Service of the operator in that Service Area. Observed values for LOS range from a low of 39.3 for San Francisco MUNI, to a high of 484 for Thousand Oaks. In model operation, the value of LOS is capped at 200, which affects Thousand Oaks, Santa Clarita and Gold Coast Transit (Ventura/Oxnard area). Several minor rural transit operators without data available were also assigned 200, and average LOS were computed for those service areas that are served by more than one operator. The weighted average LOS is 111, which is similar to the level provided by the Orange County Transportation Authority (OCTA), or the Santa Clara Valley Transportation Authority (VTA).

This measure LOS has a number of beneficial properties:

- the value is a single number, which is easy to establish and understand;
- it relates to the actual transit provided, and is a policy input;
- by being based on population, a future "status quo" scenario with the same per capita service is an easy default option (by maintaining the LOS index constant); and

- the value, which is lower for better service, can easily be used directly in model estimation, and offers multiple possibilities for policy evaluation.

Fares for local bus transit were computed as the average single trip fare for each operator in a service area.

When travel happens between two service areas that are included in the same transfer area, it requires the payment of the fare for both areas. Additionally, a 5 minute penalty is incurred for transfer between services, and a weighted average of the Level of Service is used, with 2/3 of the weight on the poorer quality service to account for the increased difficulties for transfers that involve the use of operators with poor LOS.

4. Collection of data

The econometric models for In-Vehicle Time (IVT) and Out-of-Vehicle Time (OVT) were estimated using observed data on transit travel time collected from internet sources. A total sample of 91,074 observations was obtained through the databases stored by transit agencies on the Google platform (which generate the information for travel solutions by transit available on http://maps.google.com/).

Transit data available from the internet are still not often used in transportation research. However, the quality of the information of these sources has considerably increased in recent years: as transit agencies put considerable efforts in promoting their services through online platforms, the availability of reliable information from these sources has sharply increased. Besides, the standardization required by the adoption of the common platform and interface, defined by the provider of the services, allows easier collection of information for multiple operators in geographically separated areas using the same procedure, and with similar margins of error. For the data extraction, a python code, denominated Graphserver, was available. The code is a tool developed for transit agencies to test their data to post online. The code is a useful basis for the analysis of Google Transit Data Feeds from multiple operators, and was used in the process of collection of the data.

A total of 91,074 records were extracted with complete transit travel times for interzonal trips having origins and destinations in the centroids of the TAZs withing the CSTDM region. Each record contained information on:

a. the time of the day of the travel record;
b. the transfer and service area of the selected itinerary;
c. the TAZ of origin;
d. the TAZ of destination;
e. the exact time of departure from the origin of the trip;
f. the exact time of arrival at the final destination;
g. the walking time from the origin to the first transit stop;
h. the time spent on board of the first bus;
i. the time for the first transfer (*if any*);
j. the time spent on board of the second bus (*if more than one buses are required*);
k. any additional transfer times and in-vehicle times for additional parts of the trip;
l. the walking time from the last bus stop to the final destination.

The data were collected from 29 different service areas across all four periods of time of the day used in the CSTDM Framework. The data were merged with information available from other sources (e.g. CalTrans, US DOT, other components of the CSTDM framework) to create the required datasets for the estimation of the IVT and OVT functions. The additional information included HOV3 auto travel times and distances for each itinerary (estimated on the CSTDM road network), the LOS in each service area, and residential and employment densities for each TAZ.

5. Estimation of the models

Two models are used for the Local Transit Functions. One represents In-Vehicle Time (IVT), and the other represents the Out-of-Vehicle Time (OVT). The model specification for the local transit functions is based on the assumption that local transit attributes are correlated with other transportation and land use variables used in the CSTDM framework.

The In-Vehicle Time (IVT) is expected to be directly correlated with the travel time of the private vehicles that share the road. Since HOV lanes and ramps (where available) can be used by buses, it is reasonable to expect that IVT is correlated with the congested travel time experienced by car users in high occupancy vehicles (HOV3 travel time) .

The possibility of a quadratic relation between IVT and HOV3 congested travel time was suggested, as a way to allow possible non-linear effects of HOV3 auto travel time on the in-vehicle transit time. IVT is also expected to depend on the LOS, which measures the quantity and density of service provided (as also affected by the investments in the transit system and other local conditions): as the LOS index increases, and less services per capita are provided, travel times are expected to increase too, as a result of longer detours and indirect routes needed to reach the desired destination.

Similar assumptions to those introduced for the local transit function for IVT where used for the model specification for the Out-of-vehicle Time (OVT). This measure of time represents the sum of all components of “out of vehicle” time associated with a transit trip:

1. the time to access the transit stop from the origin of the trip;
2. the waiting time at the first stop;
3. (eventual) transfer time(s) in any intermediate stop(s); and
4. the egression time from the last bus stop to reach the final destination.

OVT is expected to depend on the distance on the road network between the origin and the destination of the trip. Road distances are measured on the HOV3 congested network (which may differ from the SOV distances, depending on how common HOV lanes and ramps are in the network). Moreover, OVT is a function of the residential and employment densities of the TAZs.

5.1. In Vehicle Time function

The IVT function is a linear regression that was estimated with 91,074 observations. Several alternative model specifications were tested, and a number of parameters tried as inputs. Four different functions were estimated for the four times of the day (AM Peak, Midday, PM Peak and Off-Peak). However, due to their similar trends and goodness of fit, they were combined in only two final models that were respectively estimated for the Peak (6:00AM to 10:00AM and 3:00PM to 7:00PM) and the Off-Peak time (rest of the day). The sample sizes for the estimation of the final models were respectively 50,727 (Peak) and 40,347 (Off-Peak). Both models have quite good goodness of fit, with r-square respectively of 0.916 for the Peak model, and of 0.909 for the Off-Peak model. The estimated coefficients for the two models are reported in Table 1.

TABLE 1 In Vehicle Time (IVT) Functions for (a) Peak and (b) Off-Peak Time

a) *Peak Period Model (N=50727)*

Parameter	Estimated coefficient	Std. Error	t-statistic	p-value
HOV3_Time	**2.8921040**	.01478	195.69460	<0.001
HOV3_Time^2	**-.0174477**	.00040	-43.99996	<0.001
LOS*HOV3_Time	**.0057270**	.00011	52.59453	<0.001
R-Square	**0.915505**			
Std. Error of the Estimate	**14.44533**			

b) ***Off-Peak Period Model (N=40347)***

Parameter	Estimated coefficient	Std. Error	t-statistic	p-value
HOV3_Time	**2.7813943**	.01734	160.42225	<0.001
HOV3_Time^2	**-.0029318**	.00055	-5.29485	<0.001
LOS*HOV3_Time	**.0046781**	.00013	35.90664	<0.001
R-Square	**0.909412**			
Std. Error of the Estimate	**13.63288**			

The estimated models describe In Vehicle Time as a function of the HOV3 auto travel time (both variables are measured in minutes). This represents the effect of network speed, connectivity and road geometry, as well as the effects of traffic congestion on bus travel times. The squared term provides attenuation for longer trips, which is likely due to the presence of limited service or express long haul service.

The final term in the IVT models provides a policy sensitivity tool. As additional service is provided, the in-vehicle time is reduced. This is due to both the provision of more direct lines (operators providing a low level of service typically provide very circuitous routes to ensure a minimum access to all residents), and also the increased likelihood of there being a route serving the specific OD pairs, rather than travelling to a transfer point.

Figure 4 shows this function for various levels of service.

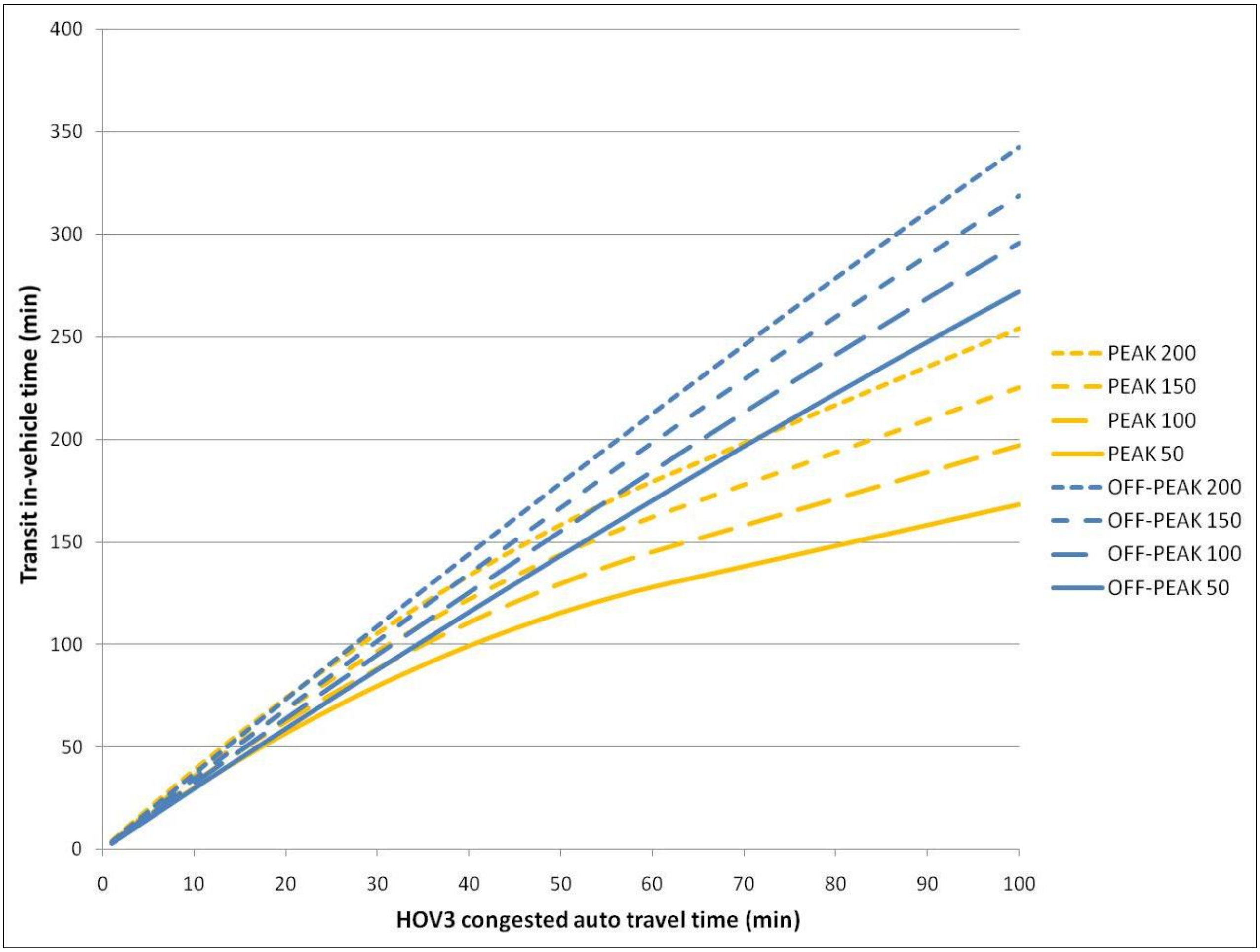

FIGURE 4: Transit In-Vehicle Time in dependence of HOV3 congested auto travel time for Peak and Off-Peak time

5.2. Out of Vehicle Time Function

The OVT function is also a linear regression. The available observations for the estimation of this function were 88,730 observations, after excluding 2344 records with missing values for at least one of the variables used in the model. Similarly to the in-vehicle time model, four different models were estimated for the four times of the day. However, also in this case, two final models were estimated respectively for the Peak and for the Off-Peak time. Table 2 reports the estimated coefficients for the OVT equations. The sample sizes are respectively 49,263 for the Peak model and 39,467 for the Off-Peak model. Both models have quite good measures of goodness of fit, with r-square respectively of 0.840 for the Peak model and of 0.830 for the Off-Peak model. R-square values are lower than in the IVT models, probably because out-of-vehicle time has many more possible causes, including a sparse network leading to long walks, infrequent headways and variable transfer times.

TABLE 2 Out Vehicle Time (OVT) Functions for (a) Peak and (b) Off Peak Time

a) *Peak Period Model (N=49263)*

Parameter	Estimated coefficient	Std. Error	t-statistic	p-value
SQ_LOS	**3.219780**	0.018315	175.79624	<0.001
LOS*HOV3_Dist	**0.006140**	9.9E-05	62.042392	<0.001
SQ_P2E_DENSITY	**-0.016737**	0.000669	-25.02035	<0.001
R-Square	**0.839672**			
Std. Error of the Estimate	**16.24132**			

b) *Off-Peak Period Model (N=39467)*

Parameter	Estimated coefficient	Std. Error	t-statistic	p-value
SQ_LOS	**3.087907**	0.021532	143.4103	<0.001
LOS*HOV3_Dist	**0.007235**	0.000124	58.35179	<0.001
SQ_P2E_DENSITY	**-0.007630**	0.000745	-10.2447	<0.001
R-Square	**0.829657**			
Std. Error of the Estimate	**16.78981**			

This model is highly dependent on the level of service provided. A better level of service can provide more closely spaced routes or better coverage, lower headways and more efficient transfers (or direct service without a transfer). Using the square root helps represent the effect of increasing service in a realistic way. Consider a route served by a single bus, taking an hour to traverse. Cutting the headway from 60 minutes to 30 involves adding only one more bus; cutting another 20 minutes involves adding an additional four. The second term in the function, which uses distance, relates to the increased likelihood of a transfer as a trip gets longer.

The dependence on the HOV3 distance is the result of the effects of the availability of fewer direct lines for longer trips (that therefore determine larger waiting and transfer times).

The third term uses the sum of the square roots of the P2E (sum of population and two times employment) densities for the TAZs of origin and of the destination. In this expression, the employment component is doubled to provide a more balanced representation between employment and population, consistently with the findings of the scientific literature on the stronger relationships between employment density and the use of transit. This measure implies that denser areas will have lower out-of-vehicle transit times, which is due to operators typically focusing service on core activity nodes, as well as the reduced walking distances likely in denser areas. The origin and destination are considered separately, which means that a more balanced OD pair provides a better service than from a very sparse suburb to a dense downtown. Figure 6 provides some examples of the OVT curves in dependence of the LOS index, for some values of neighborhood densities for the origin and the destination.

The function is shown in figure 5: the densities assumed are 5000 (a typical suburban density) at the origin; the destination is either 5000 for the crosstown trip or 100000 (similar to downtown Sacramento) for the CBD trip.

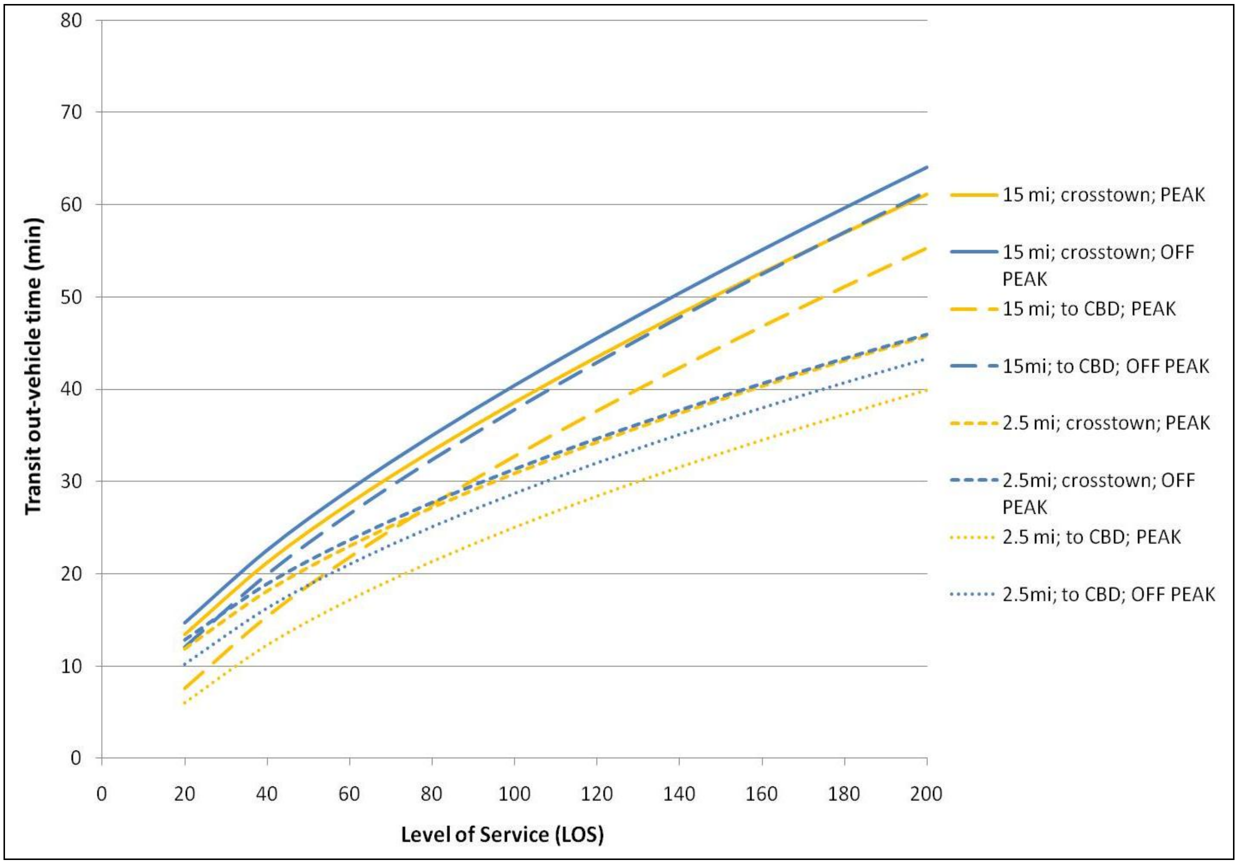

FIGURE 5: Transit Out-of-vehicle Time in dependence of LOS for Peak and Off-Peak Time

The combination of the IVT and OVT functions allows evaluating the effects of transit investments. In particular, the functional form and the estimated parameters suggest a diminishing return of the investments in service: doubling the service in a region allows improving transit travel times, although more limited reductions in travel times are obtained in those areas in which the LOS is already quite good.

6. Application

The local transit functions were integrated in the CSTDM framework using four CUBE scripts, one for each time of the day in the CSTDM Framework. This allowed the provision of a multi-modal transit system, including the possibility to take local bus to and/or from a rail station, or to take the local bus all of the way. The details of this coding are described in the Transit Skims document.

The model provides a reasonable representation of transit, and is sensitive to land use patterns and congestion in addition to the policy decisions to alter the level of local transit service provided, or to construct rail infrastructure.

The whole approach is optimized for an efficient allocation of resources in the development of the model, and for the generation of future scenarios. The CUBE scripts for the local transit functions are the same in each scenario. However, a separate input file is generated for each scenario to provide the required information on catchment areas, LOS and fares. Policy testing can be carried out varying the input information on the catchment areas, LOS and fares for each service area.

The following two images show the composite transit travel cost (including fare and weighting out of vehicle time) to zone 1402 in downtown Oakland. The color scale in both cases is the same; the orange is the fastest travel time and the purple the longest. Figure 6 shows the local bus only travel cost, and figure 7 shows the composite cost including the rail systems (which are shown as lines). Note the increased accessibility (and decreased cost) along the blue BART lines, such as into downtown San Francisco and eastward on the Pittsburg-Bay Point line.

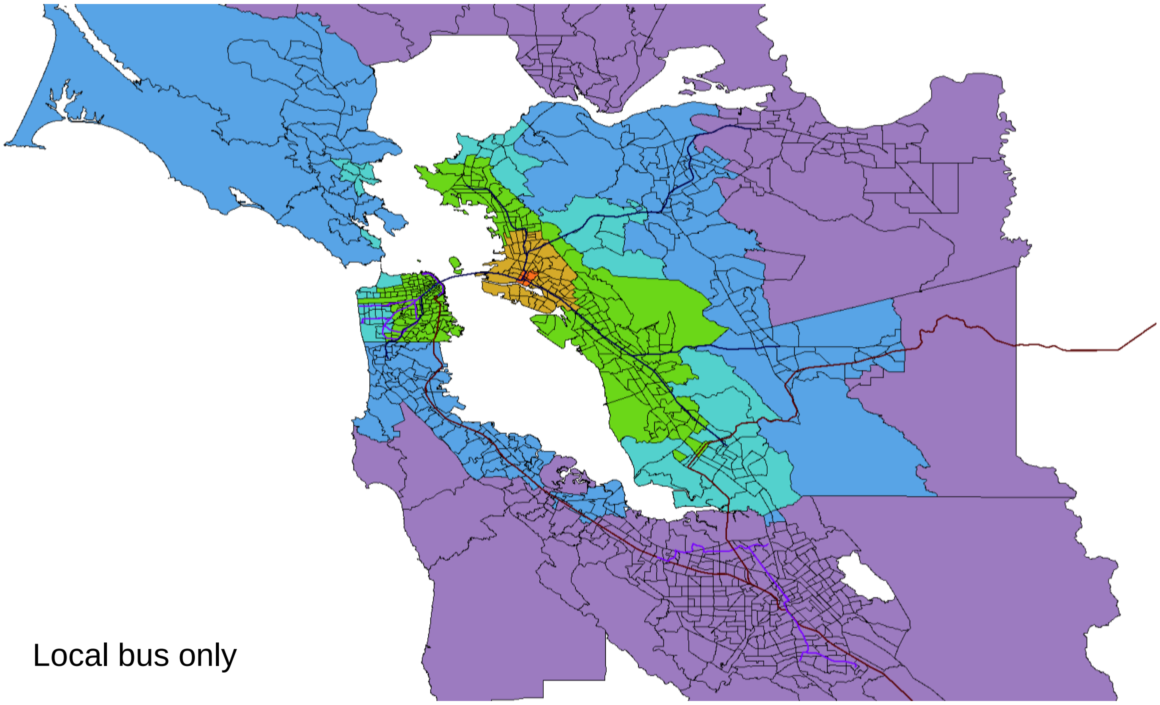

Figure 6: local bus only travel cost to zone 1402 in downtown Oakland

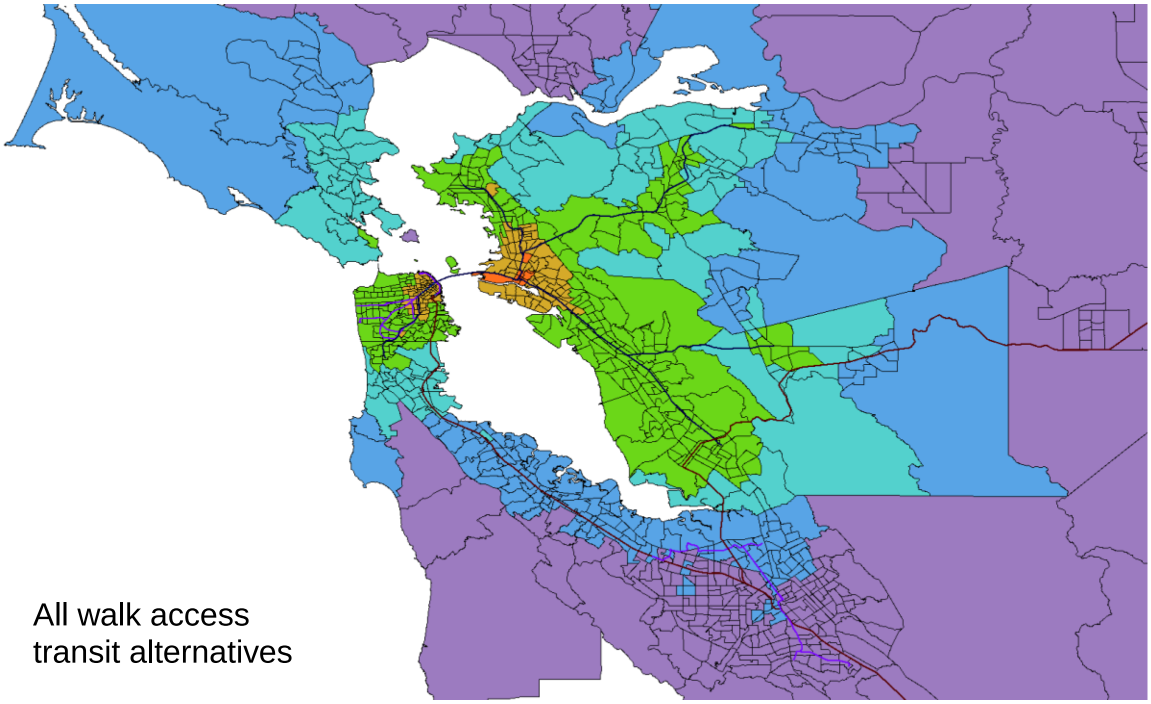

Figure 7: the composite cost including the rail systems to zone 1402 in downtown Oakland

Figure 8 illustrates the best transit alternative to the same central Oakland zone. Red indicates areas where walking to rail is the lowest composite cost, green where taking a local bus directly is the lowest composite cost, and blue where taking local bus to rail is the lowest composite cost.

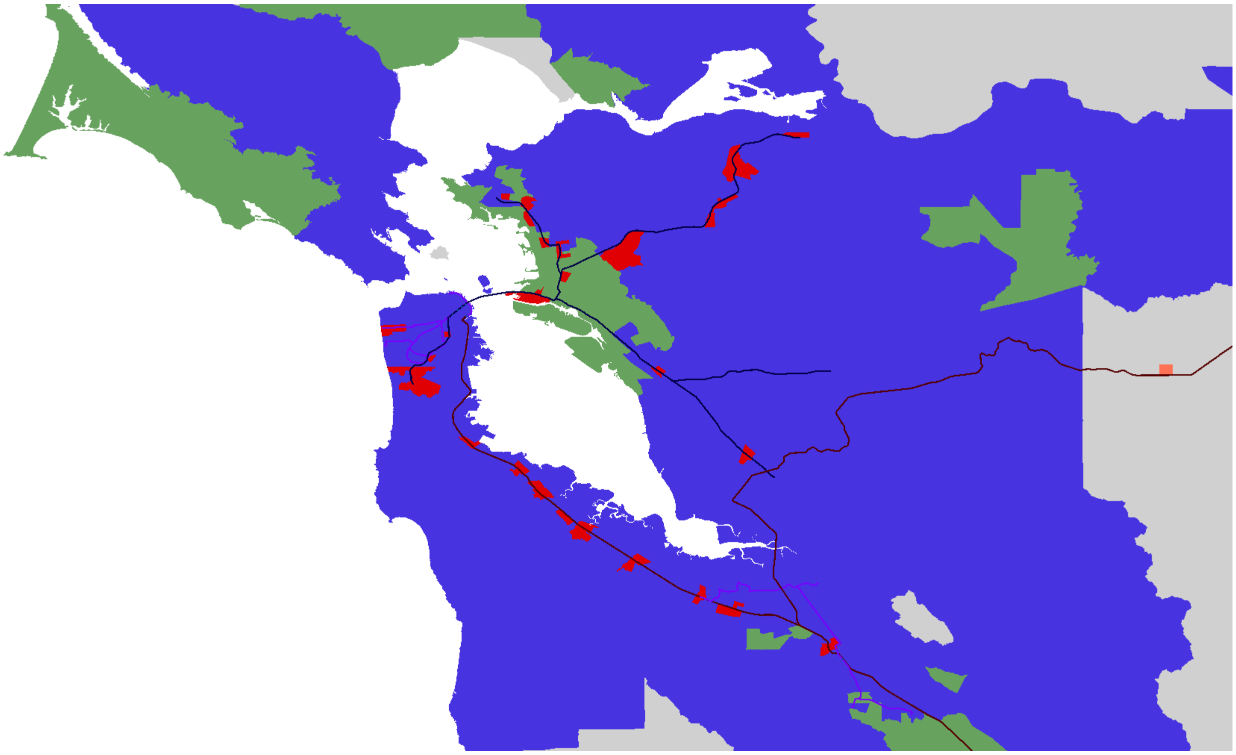

Figure 8: Best transit alternative to the same central Oakland zone

Appendix 1. Transfer Areas, Service Areas and Levels of Service

Transfer Area	Service Area	Agency	Level of Service
1	1	Del Norte County Public Transit	200.0
2	2	Humboldt Transit Authority	200.0
3	3	Lassen Transit Service Agency	200.0
4	4	Redding Area Bus Authority	186.5
5	5	Butte County Transit, Chico Area Transit, Oroville Area Transit	187.8
6	6	Gold Country Stage (Nevada County)	200.0
7	7	Sacramento Regional Transit District	127.8
	7.1	Yolobus, Unitrans	59.2
	7.2	Placer County Transit, Roseville Transit	128.9
	7.3	El Dorado County Transit Authority	200.0
8	8	Sonoma County Transit, Santa Rosa CityBus, Petaluma Transit	151.2
	8.1	San Mateo County Transit District (SamTrans)	95.5
	8.2	San Francisco Municipal Railways (Muni)	39.3
	8.3	Alameda-Contra Costa Transit District (AC Transit)	63.2
	8.4	Santa Clara Valley Transportation Authority (VTA)	103.2
	8.5	Golden Gate Transportation District	46.1
	8.6	Central Contra Costa Transit Authority, Eastern Contra Costa Transit Authority, Western Contra Costa Transit Authority	106.8
	8.7	Livermore / Amador Valley Transit Authority	86.5
	8.8	Vallejo Transit, Fairfield and Suisun Transit, Benicia Breeze	95.8
	8.9	The VINE (Napa County)	120.6

9	9	San Joaquin Regional Transit District	79.3
10	10	Modesto Area Express	187.9
11	11	Merced County Transit, BLAST, DART	123.8
12	12	Fresno Area Express	127.0
13	13	Kings County Area Public Transit Agency	123.1
14	14	Visalia City Coach, Porterville COLT	104.7
15	15	Golden Empire Transit (Kern County)	184.8
16	16	Amador Regional Transit System	200.0
17	17	Santa Cruz Metropolitan Transit District	78.2
18	18	Monterey-Salinas Transit	98.9
19	19	SLO Transit (San Luis Obispo)	175.4
20	20	Santa Barbara Metropolitan Transit District	68.8
21	21	Gold Coast Transit (Western Ventura County)	200.0
22	22	Thousand Oaks Transit, Simi Valley Transit	200.0
23	23	Los Angeles County Metropolitan Transportation Authority (LA Metro) and various minor LA area operators (Montebello, Culver City, Norwalk, Lompoc, Redondo Beach, Commerce, Corona, Laguna Beach)	49.5
	23.1	Omnitrans (San Bernadino County)	149.0
	23.2	Orange County Transportation Authority	112.9
	23.3	Riverside Transit Agency	134.2
	23.4	Long Beach Transit	91.4
	23.5	Santa Monica's Big Blue Bus	70.5
	23.6	Foothills Transit	77.3
	23.7	Antelope Valley Transit Authority	119.0
	23.8	Santa Clarita Transit	200.0
	23.9	Torrance Transit System, Gardena Municipal Bus Lines	93.8
24	24	Victor Valley Transit Authority	192.0

25	25	SunLine Transit Agency (Palm Springs / Coachella Valley)	149.0
27	27	San Diego Metropolitan Transit System	75.6
	27.1	North County Transit District	111.7
	27.2	Chula Vista Transit	138.4
28	28	Santa Maria Area Transit	138.4
29	29	Yuba-Sutter Transit Authority	119.1
30	30	Imperial Valley Transit	178.7
31	31	Tahoe Area Regional Transit	200.0
32	32	Trinity County Transit	200.0

The following figures show the statewide Transfer Areas, followed by the Service Areas for the four major urban Transfer Areas, with bus lines overlaid (7 - Sacramento, 8 - Bay Area, 23 - Los Angeles, 27 - San Diego).

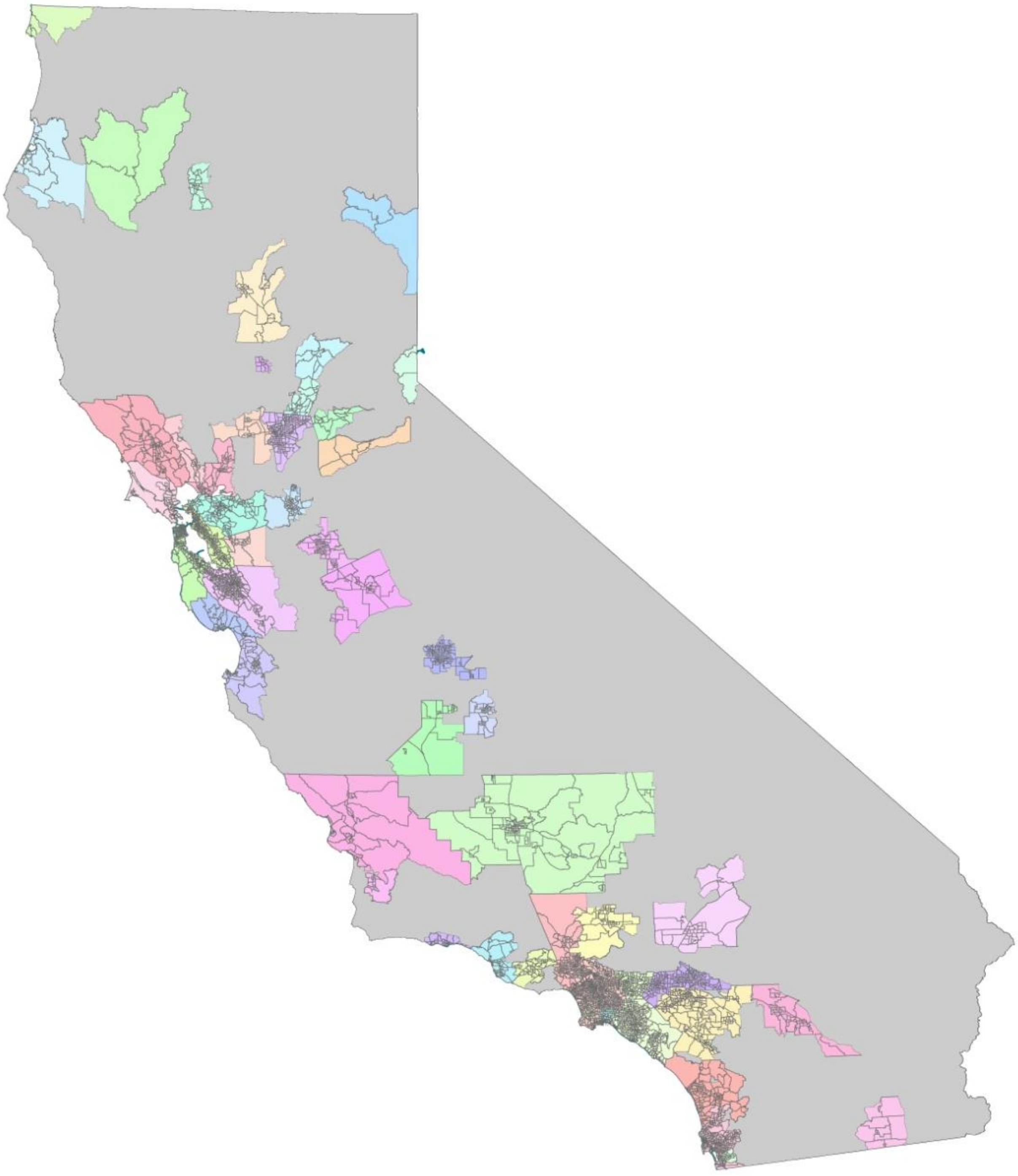

Figure 9: Statewide Transfer Areas

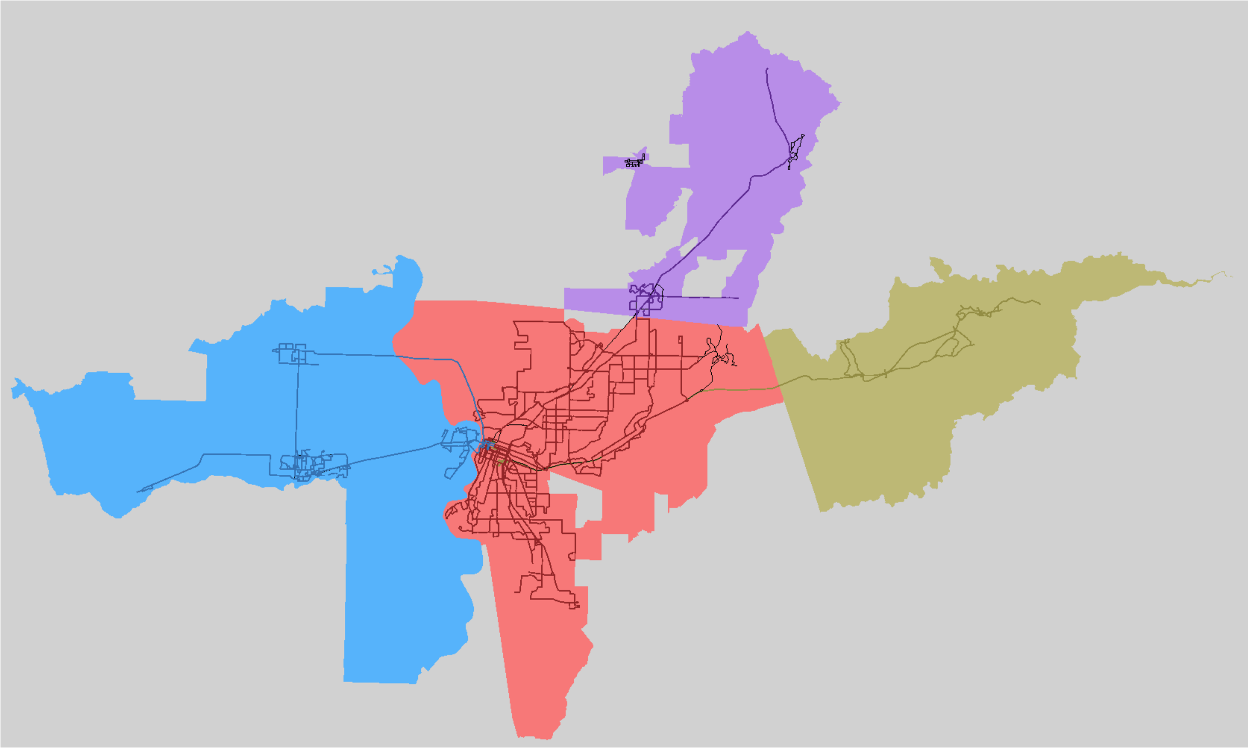

Figure 10: Service Areas in the Transfer Area "7 - Sacramento"

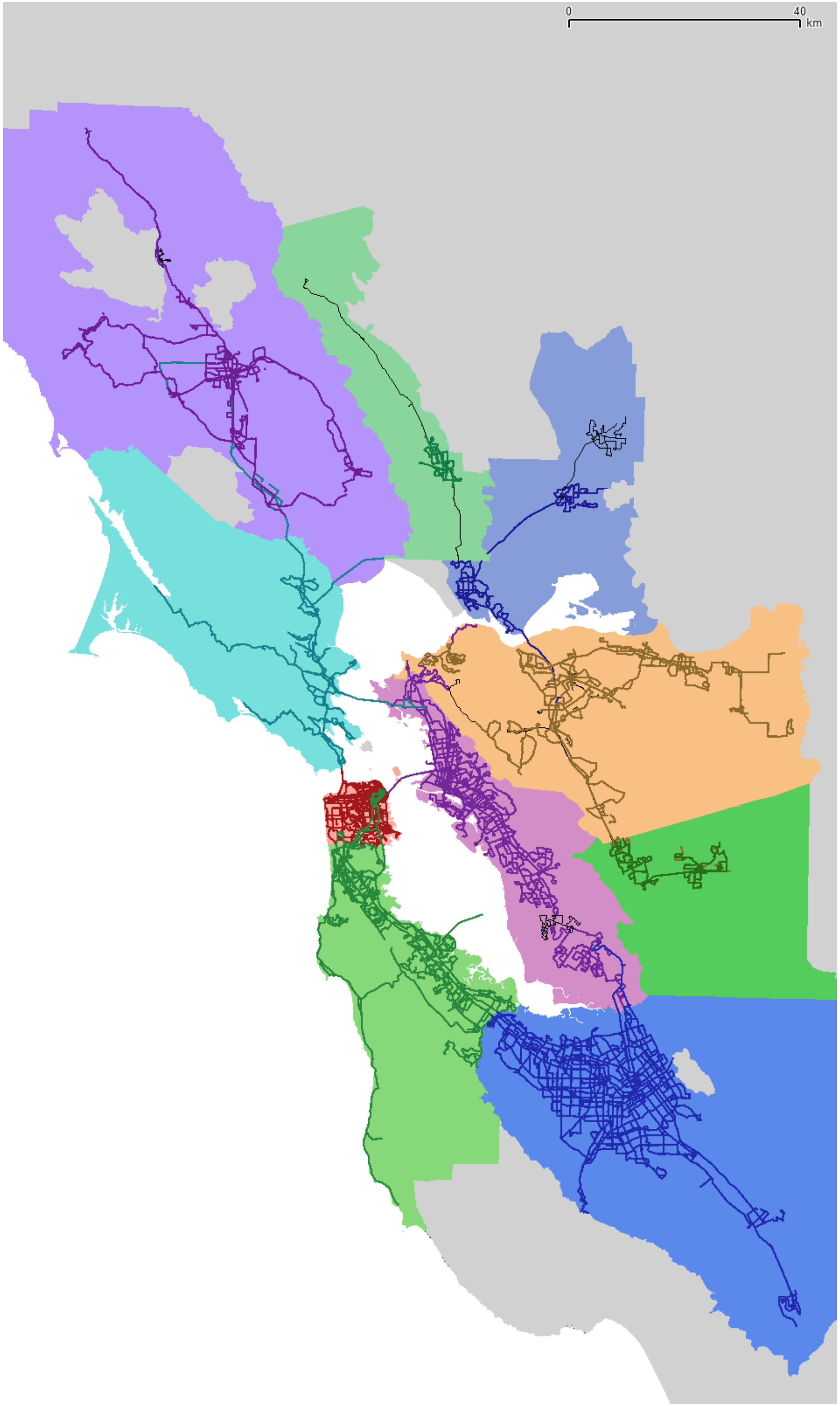

Figure 11: Service Areas in the Transfer Area "8 - San Francisco Bay Area"

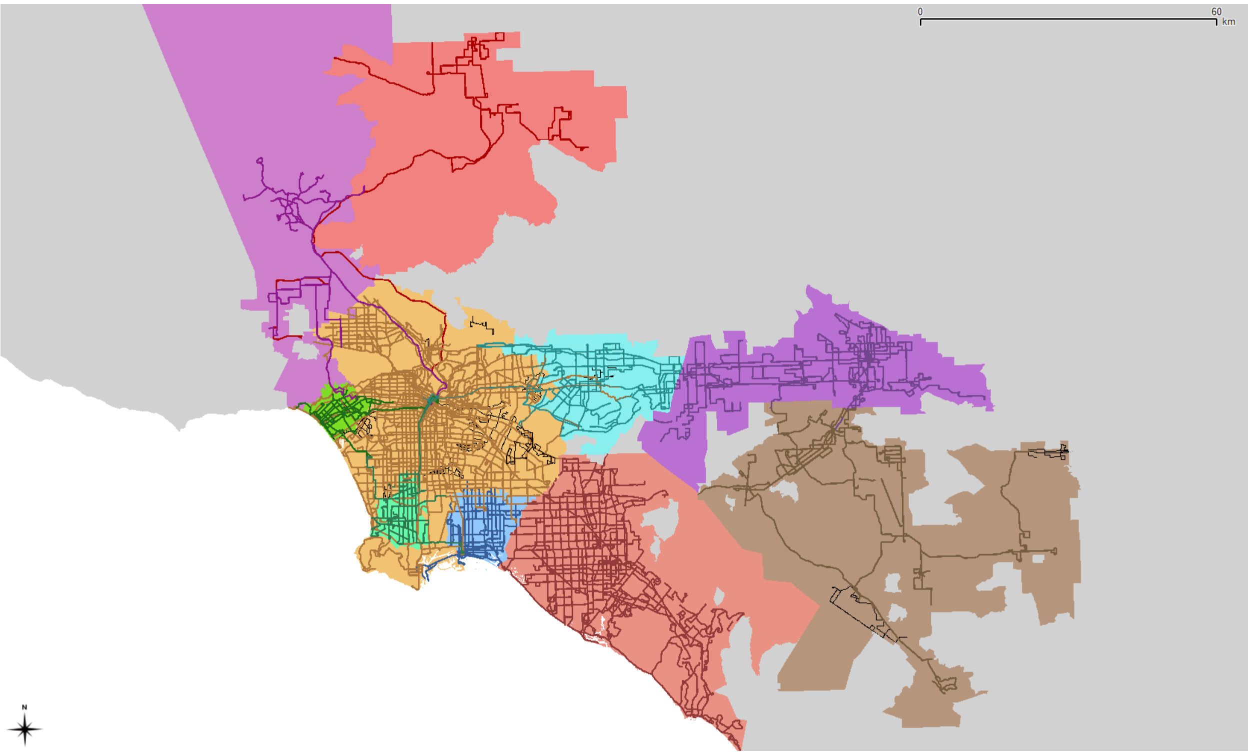

Figure 12: Service Areas in the Transfer Area "23 - Los Angeles"

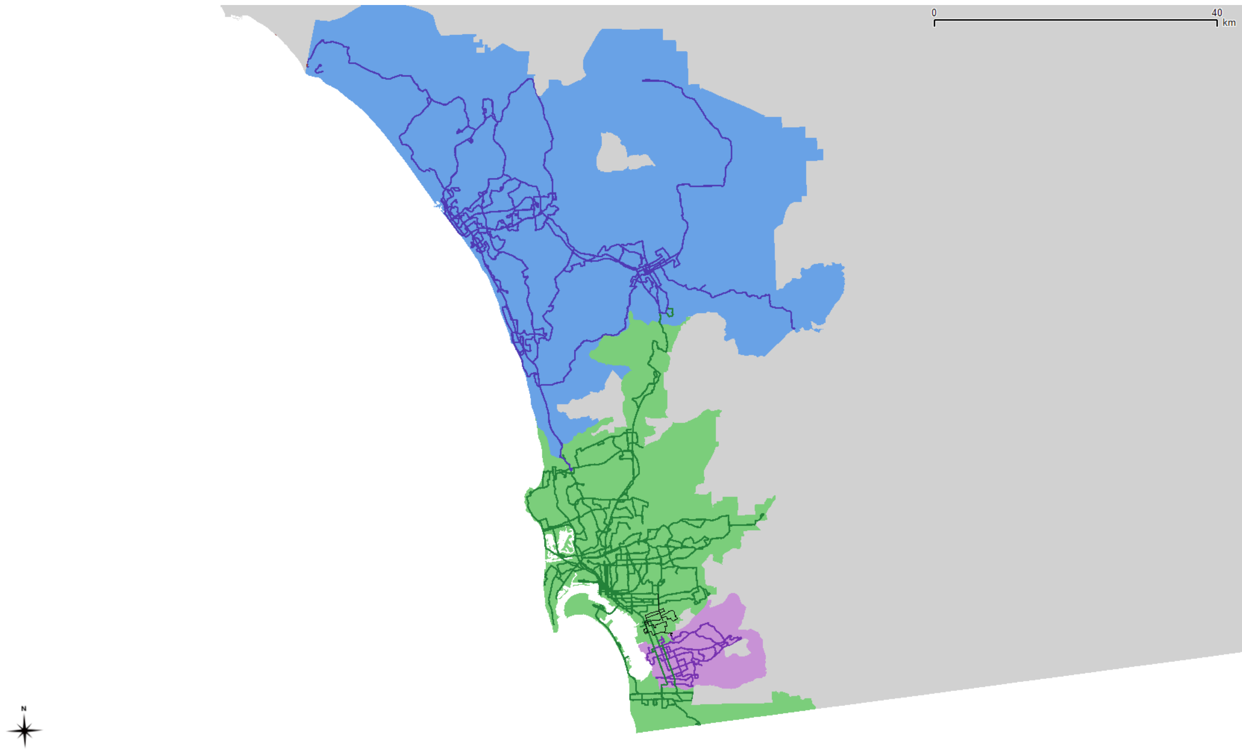

Figure 13: Service Areas in the Transfer Area "27 - San Diego”