RCTC TRUCK STUDY AND REGIONAL LOGISTICS MITIGATION FEE

Technical Memorandum 1: Existing and Future Conditions

Warehouse-Related Land Use Data & Truck Travel Patterns

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In partnership with

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1. INTRODUCTION

The RCTC Truck Study and Development and Implementation of Regional Logistics Mitigation Fee is intended to verify the anticipated rate of growth in warehousing and logistics-related development in Riverside County, and to quantify the associated level of traffic impacts on the Riverside County highway system as a result of the expected growth in warehousing and logistics activities. In quantifying impacts, the study is also intended to determine the amount that each new warehousing or logistics development should pay in lieu of completing actual freeway improvements to mitigate the cumulative regional traffic impacts specifically associated with truck trips generated by new warehousing and logistics developments. The findings of this study are intended to provide the basis for potentially implementing a program to collect impact fees that will contribute to mitigating the truck traffic impacts associated with new warehousing and logistics developments in Riverside County. Such a program can help to ensure that all new logistics-related development approved in Riverside County will bear a proportional fair share of the cost of building transportation infrastructure to address future transportation needs.

This technical memorandum represents the first in a series of documents that will verify the rate of new warehousing and logistics related developments in Riverside County, the associated truck trip generation rates and cumulative regional traffic impacts, the cost to mitigate these impacts, and the fair share basis for collecting a potential fee. In this document, the existing conditions of the warehousing industry and truck travel patterns in Riverside County were reviewed for five primary activities:

1) Creating an inventory of existing warehouse-related land uses
2) Developing a projection of future warehouse-related land use (2040)
3) Analyzing a range of potential trip generation rates to apply in calculating fees
4) Tabulating existing truck volumes on major roadways
5) Generating information regarding truck origins/destinations

This document also presents the results of existing and future baseline model runs to help quantify existing and future conditions on the Riverside County highway system.

The objective of this technical memorandum is to provide the reader with an understanding of the various warehousing-related trucking activities, the historic trends of these types of activities, and the anticipated future of this industry in Riverside County. With this information as a basis, subsequent study tasks will quantify specific truck-related

infrastructure needs associated with growth in warehousing-related uses, and the potential for an impact fee to address these needs. The inventory and verification of available data sources as presented in this technical memorandum is ultimately intended to demonstrate the adequacy of these data to support the technical evaluation efforts to be undertaken in subsequent tasks. In particular, the review of existing conditions data sources provides the ability to verify the following specific aspects of the data related to the needs of subsequent evaluation tasks:

- The available data provides appropriate levels of disaggregation for warehouse-related land uses to match the level of confidence in trip generation rates and forecasted growth in development
- Trip generation rates are available to be applied for the purpose of identifying the fair share of trips attributable to warehousing and logistics development activities
- The data provides the ability to define necessary adjustments in the forecasting model to match measured truck volumes and Origin-Destination (O-D) patterns

It should be noted that the contents of this document are technical and detailed in nature, and are presented with the primary purpose of providing a transparent assessment of available data sources to support the determination of a fee representing the fair share to mitigate the cumulative regional impacts of designated new developments. Unlike other types of transportation studies, where the assessment of underlying data sources and determination of assumptions might be conducted at a technical staff level, and only the methodology used and associated findings are presented in the study documentation, impact fee studies necessitate a more transparent approach to considering data sources and determining assumptions. For this reason, this technical memorandum effectively provides an additional level of background information presenting a more detailed consideration of the range of data sources available to support the evaluation to be conducted in subsequent tasks. In short, this technical memorandum is intended to describe what data sources are available and appropriate to support subsequent study tasks, with the specific assumptions and methodology to complete those tasks described in subsequent Technical Memoranda.

2. EXISTING LAND USE INVENTORY

Data from the County Business Patterns[1] (CBP), Southern California Association of Governments (SCAG), and Infogroup provide alternative means to identify land uses related to warehousing. These datasets use different systems to classify industries; the North American Industry Classification System (NAICS) and the Standard Industrial Classification (SIC). The U.S. Census Bureau uses the NAICS structure. Similarly, SCAG uses the NAICS structure as the basis for developing regional employment forecasts as part of its long range planning responsibilities. While the SIC has generally been replaced by NAICS, several data vendors are still using SIC-based data. The establishment data used for this study was purchased from Infogroup which uses SIC codes.

The NAICS applies a 6-digit hierarchical coding system to classify all economic activity into 20 industry sectors. Five sectors are mainly goods-producing sectors and 15 are entirely services-producing sectors. The SIC system is a 4-digit classification system. As would be expected, the 6-digit NAICS hierarchical structure allows greater coding flexibility than the 4-digit structure of the SIC system.

Each establishment has a primary NAICS/SIC code. This number indicates a company's primary line of business. What determines a company's primary SIC code is the code definition that generates the highest revenue for that company at a specific location in the past year. Warehousing is identified with a specific code in both the NAICS and SIC systems. However, many other classification codes, such as wholesaling and manufacturing, involve significant amount of warehousing activities. Therefore every establishment usually defines their activity with a secondary NAICS/SIC code as well. Infogroup verify the establishments' primary and secondary codes regularly through their survey. In this study, both the primary and the secondary warehousing uses were investigated to have a complete understanding of warehousing activities in Riverside County.

2.1. COUNTY BUSINESS PATTERNS (CBP)

Table 1 shows selected categories of NAICS, which are identified as primary or secondary warehousing uses. Although CBP data covers all establishments, it is only available at the county level.

[1] County Business Patterns is an annual series of reports by the U.S. Census Bureau that provides subnational economic data by industry. This series includes the number of establishments, employment during the week of March 12, first quarter payroll, and annual payroll.

Table 1. Description of Selected NAICS Categories

Industry Code	Brief Description
31-33 (Manufacturing)	Establishments engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products. Assembling of component parts of manufactured products is considered manufacturing, except in cases where the activity is appropriately classified as Construction. *(Example: Food Manufacturing, Textile Product Mills, Apparel Manufacturing, Wood Product Manufacturing, Chemical Manufacturing.)*
42 (Wholesale Trade)	Establishments engaged in wholesaling merchandise, generally without transformation, and rendering services incidental to the sale of merchandise. Includes the outputs of agriculture, mining, manufacturing, and certain information industries, such as publishing. *(Example:, Furniture and Home Furnishing Merchant Wholesalers, Household Appliances and Electrical and Electronic Goods Merchant Wholesalers.)*
48-49 (Transportation & Warehousing)	Industries providing transportation of passengers and cargo, warehousing and storage for goods, scenic and sightseeing transportation, and support activities related to modes of transportation. Establishments in these industries use transportation equipment or transportation related facilities as a productive asset. Modes of transportation include air, rail, water, road, and pipeline. *(Example: Freight Trucking Companies, Warehousing and Storage, Couriers and Delivery Services.)*

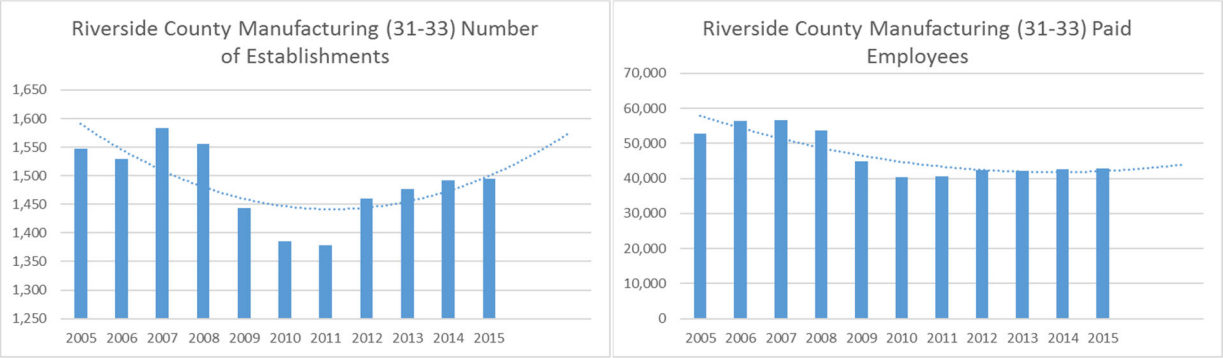
Source: North American Industry Classification System United States, Executive Office of the President Office of Management And Budget, 2017

There is no readily available information to separate the warehousing activity into establishments primarily registered as manufacturing or wholesale under the CBP database. Since this data is only available at the county level, it is not possible to make a detailed analysis. The historic comparison at the county level can only provide a high-level insight as a basis for comparison to support verification and validation of other data sources.

Figure 1 through 3 are a series of graphs detailing both the number of establishments and the number of employees for the uses identified in **Table 1** in Riverside County between 2005 and 2015 based on CBP data and categorized by NAICS sectors. The number of manufacturing establishments and employees declined in Riverside County during the 2008 to 2012 recession. Although they have rebounded somewhat, they have not yet returned to their pre-recession levels (see **Figure 1**). In contrast, Transportation & Warehousing employment rose more than 50% during the 2005 to 2015 period (see **Figure 2**). Wholesale Trade increased modestly over the same period (see **Figure 3**).

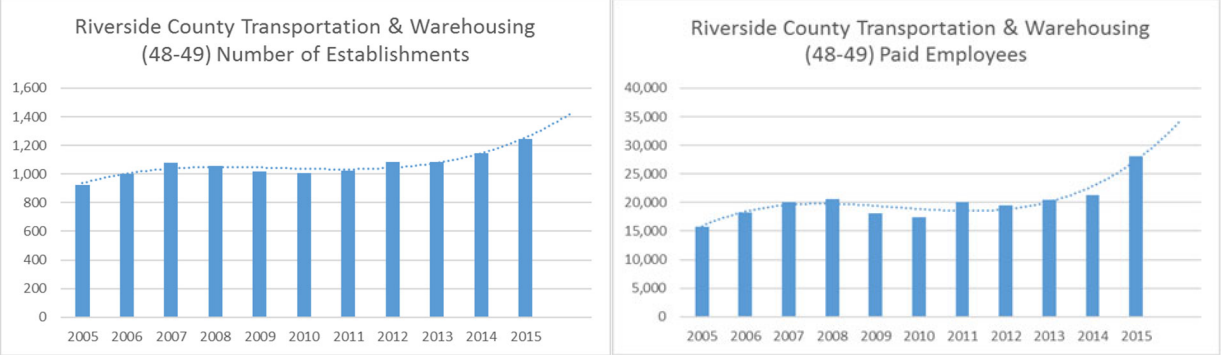
MANUFACTURING

Figure 1. Manufacturing Establishments and Employment in Riverside County, 2005-2015



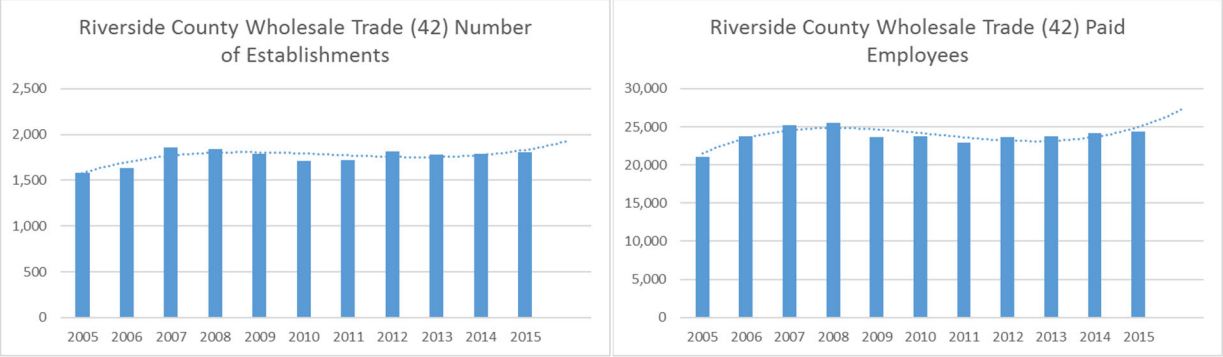
TRANSPORTATION & WAREHOUSING

Figure 2. Transportation & Warehousing Establishments and Employment in Riverside County, 2005-2015



WHOLESALE

Figure 3. Wholesaling Establishments and Employment in Riverside County, 2005-2015



Source: Census County Business Pattern data 2005-2015

As of 2015, the most recent year for which data are available, these three sectors continue to be dominated by small establishments, with at least 85% of establishments in each category having fewer than 20 employees. Countywide, there are only 17 establishments with 500 or more employees (five in manufacturing, eight in transportation and warehousing, and four in wholesale trade), and only five with 1,000 or more employees (one in manufacturing and four in transportation & warehousing).

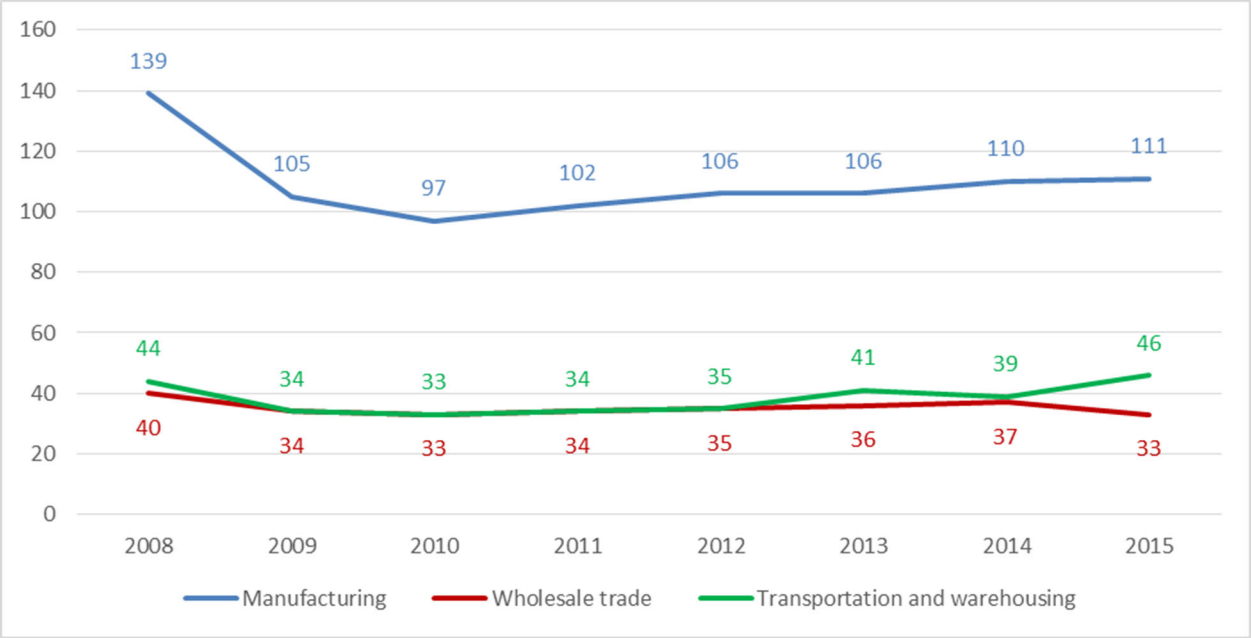
Table 2: Distribution of Establishments by Industry Category, 2015

Employees	Manufacturing	Transportation and warehousing	Wholesale trade	Sum
1 to 4 employees	587	761	983	2,331
5 to 9 employees	265	204	335	804
10 to 19 employees	216	121	258	595
20 to 49 employees	207	78	143	428
50 to 99 employees	109	37	54	200
100 to 249 employees	87	23	20	130
250 to 499 employees	19	15	9	43
500 to 999 employees	4	4	4	12
1,000 employees or	1	4	0	5
All establishments	**1495**	**1247**	**1806**	**4,548**

Large manufacturing and wholesale establishments have significantly higher warehousing activities than smaller ones. Therefore, it is worthwhile to examine the pattern in growth of large establishments in Riverside County (**Figure 4** and **Table 3**). Although the overall number of establishments with 100 or more employees has decreased since 2008 in the manufacturing and wholesale trade sectors, it has increased in the transportation & warehousing sector. Additionally, the number of establishments with 1,000 or more employees in the transportation & warehousing sector grew from one to four during this period.

Figure 4 and **Table 3** demonstrate a general growth trend in each of these three market sectors following the effects of the Great Recession causing declines, particularly in the manufacturing sector. These data also demonstrate considerable diversity in the size of the businesses within this sector in terms of total employees, with a general trend toward more numerous small businesses compared to large businesses. The general trend for growth in these market sectors that directly and indirectly include warehousing and logistics related activities, as well as the diversity in business sizes, support inclusion of the full range of these activities in each sector be considered to assess the extent of associated transportation impacts and mitigation needs.

Figure 4. Change in number of establishments with 100+ employees in Riverside County, 2008-2015.



Although building area is very desirable for the purpose of this study, Census does not provide any information about the square footage of warehouses or other establishments. Census, and therefore by reference other regional socio-economic forecasts like those developed by SCAG, are based on employees.

Table 3. Growth in Establishments with 50+ Employees, 2008-2015

Manufacturing								
Employees	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
100-249	106	80	74	80	82	81	84	87
250-499	24	19	20	17	19	20	21	19
500-999	7	5	2	4	4	4	4	4
1000+	2	1	1	1	1	1	1	1
Total	139	105	97	102	106	106	110	111
Transportation and warehousing								
Employees	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
100-249	25	15	17	20	22	28	25	23
250-499	13	16	11	8	7	8	9	15
500-999	5	2	4	3	5	3	3	4
1000+	1	1	1	3	1	2	2	4
Total	44	34	33	34	35	41	39	46
Wholesale trade								
Employees	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
100-249	29	21	19	20	22	22	23	20
250-499	7	9	9	11	10	12	11	9
500-999	3	3	3	2	2	1	2	4
1000+	1	1	2	1	1	1	1	0
Total	40	34	33	34	35	36	37	33

2.2. INFOGROUP GEOCODED DATABASE (SIC CODE)

Infogroup's[2] database provides information about businesses' location, size, and industry classification code. Although the data does not provide a complete list of all establishments, it has sufficient quality and coverage that it can be used to gain an extensive understanding of land uses and concentration of activities in various parts of the county.

Commercial establishments are organized by SIC code. In addition, the data is further broken down by number of employees at each establishment. Using this data, it is possible to get an idea of both the scope and scale of various industries in Riverside County. For informational purposes, a short description of each of the SIC categories relevant to this analysis is provided below.

Table 4. Description of Selected SIC Categories

Industry Code	Brief Description
20-39 (Manufacturing)	Establishments engaged in the mechanical or chemical transformation of materials or substances into new products. Usually described as plants, factories, or mills and characteristically use power driven machines and materials handling equipment. Establishments engaged in assembling component parts of manufactured products are also considered manufacturing if the new product is neither a structure nor other fixed improvement. Also included is the blending of materials, such as lubricating oils, plastics resins, or liquors.
42 (Transportation & Warehousing)	Establishments furnishing local or long-distance trucking or transfer services, or those engaged in the storage of farm products, furniture and other household goods, or commercial goods of any nature. The operation of terminal facilities for handling freight, with or without maintenance facilities, is also included.
50-51 (Wholesale Trade)	Establishments primarily engaged in selling merchandise to retailers; to industrial, commercial, institutional, farm, construction contractors, or professional business users; or to other wholesalers; or acting as agents or brokers in buying merchandise for or selling merchandise to such persons or companies.

Source: U.S. Department of Labor, Occupational Safety & Health Administration

As shown on **Figure 5**, manufacturing establishments of all sizes (by primary or secondary SIC) are most heavily concentrated in Corona and Riverside along major freeway corridors, although the figure also demonstrates these activities are broadly distributed across the urbanized areas of Riverside County. Other areas with high concentrations include Mira Loma, Murrieta and Temecula. Corona, Riverside and Temecula are the only cities that contain manufacturing establishments with more than 500 employees.

[2] Infogroup is a private vendor of data on businesses.

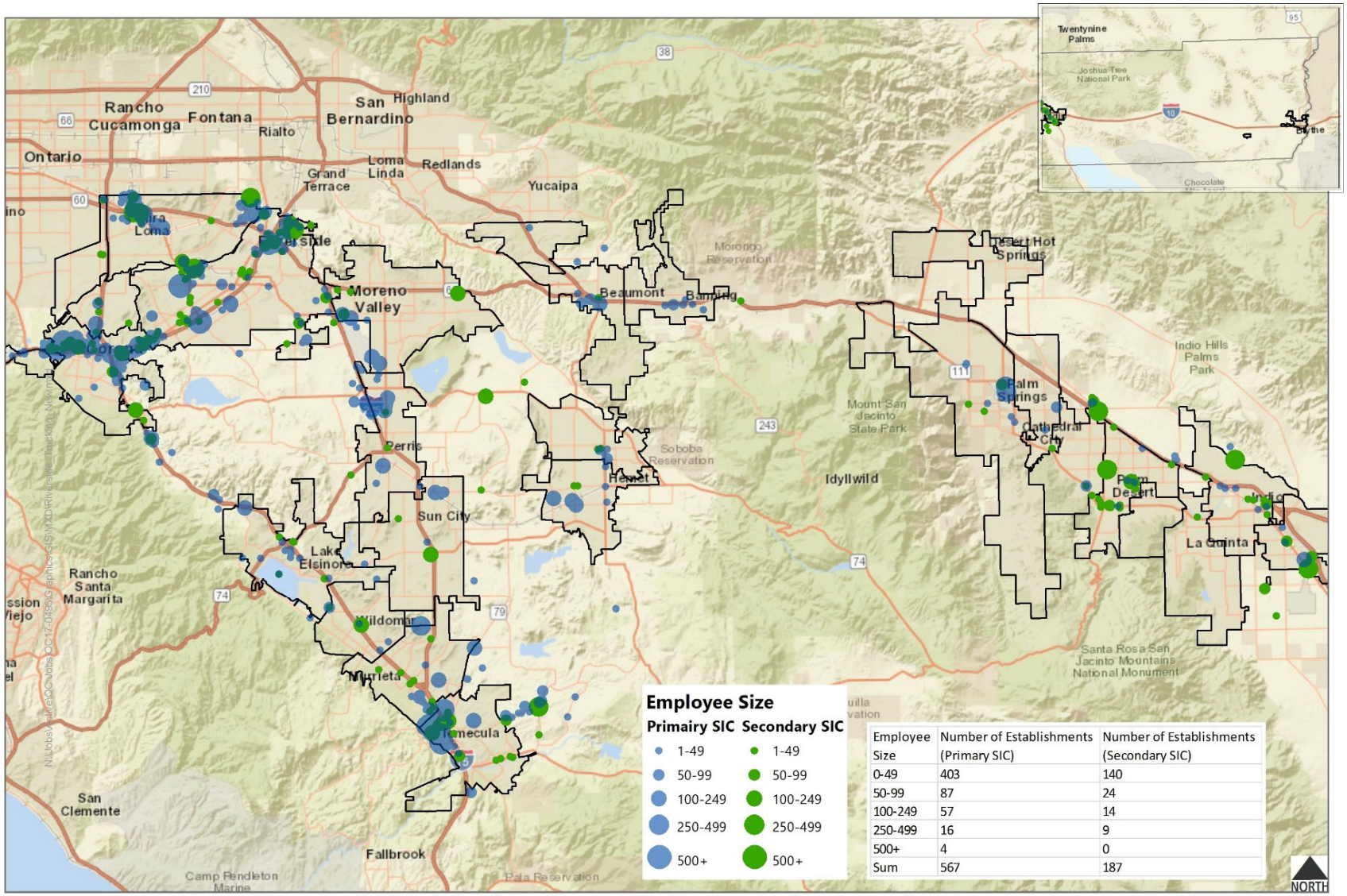
Represented on **Figure 6**, transportation & warehousing establishments with fewer than 50 employees are dispersed throughout the county, with the highest concentrations of establishments in Riverside, Corona and Temecula. Based on the primary SIC, only one establishment exceeds 50 employees and it is located in Mira Loma. Based on the secondary SIC, seven additional warehouse establishments have more than 50 employees; they are located in Corona, Mira Loma, Palm Desert and Riverside.

A total of 2,237 establishments countywide are characterized in wholesale trade as a primary function (**Figure 7**). This is several times larger than either manufacturing (567) or warehousing & transportation (483). Wholesale establishments of all sizes are similarly dispersed across the urbanized areas of the county, with some degree of concentration in Corona, Riverside and Temecula. There are six large wholesale establishments classified under primary code 50 and 51, with more than 500 employees in Coachella, Moreno Valley and Temecula. Based on the secondary SIC, there are also large wholesale establishments in Corona and Perris. In addition, there are 10 wholesale establishments with more than 500 employees in Perris.

It should be noted that there is no manufacturing, warehousing & transportation, or wholesale establishments of significance currently identified in the dataset within Blythe or the greater Palo Verde Valley. For this reason, the study effort will primarily focus on development activity in Western Riverside County and the Coachella Valley.

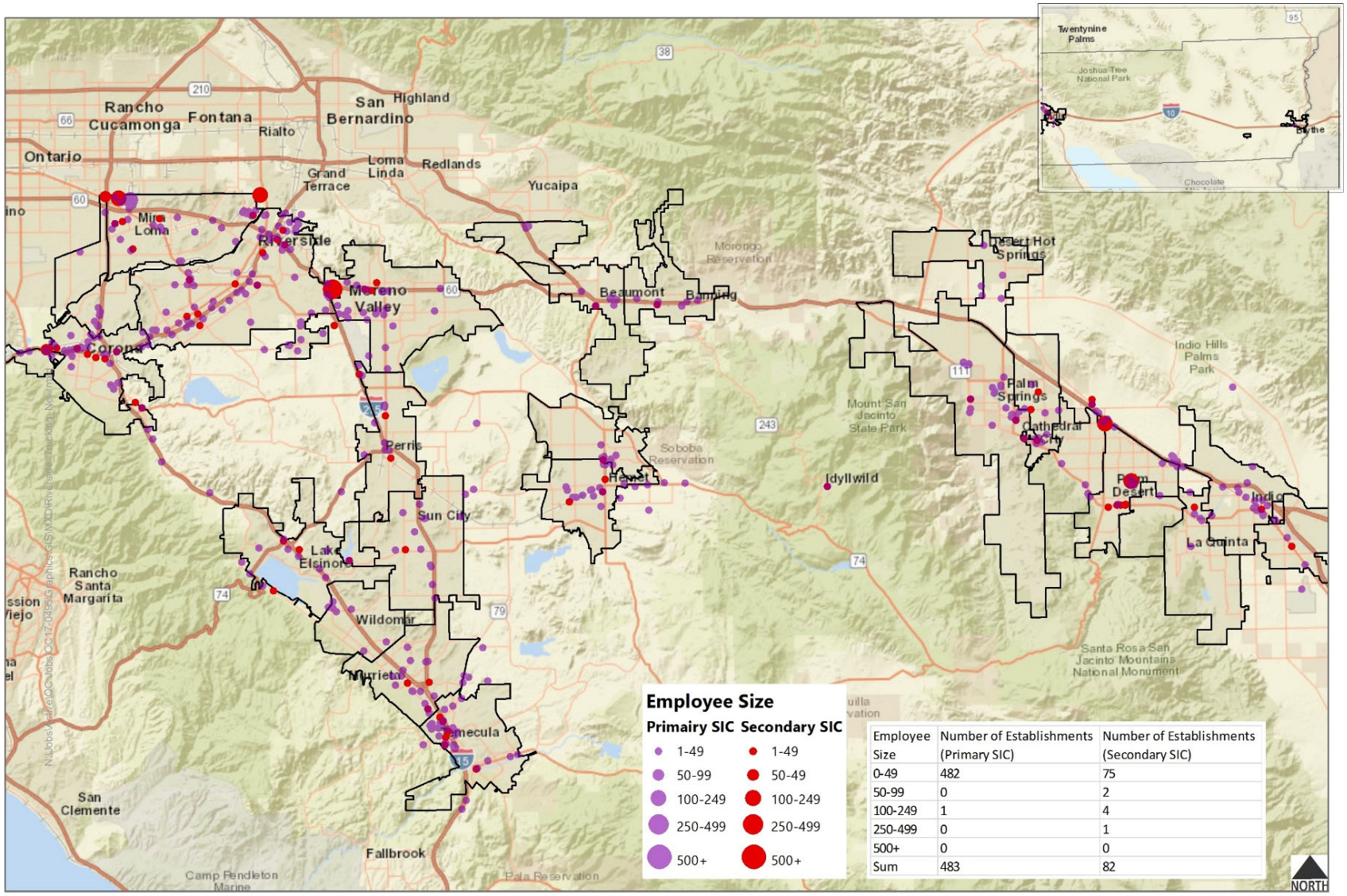
The overall number of establishments in each category is broadly consistent with the CBP numbers for Wholesale Trade, but not for Manufacturing and Transportation & Warehousing, where CBP shows a significantly larger number of establishments countywide. This is to be expected, given that CBP aims to be comprehensive, whereas Infogroup seeks to provide a sample and may take a more conservative approach in defining establishments. The Infogroup data is, however, useful in providing some idea of where establishments are or are not concentrated within the county. For each category, however, Infogroup appears to capture about a third of the establishments identified by CBP. Recognizing the limitations of the respective datasets, each provides useful information to validate and augment data derived from established regional sources, like SCAG, for the purposes of completing this study.

Figure 5. Distribution of Employment in Riverside County, Manufacturing



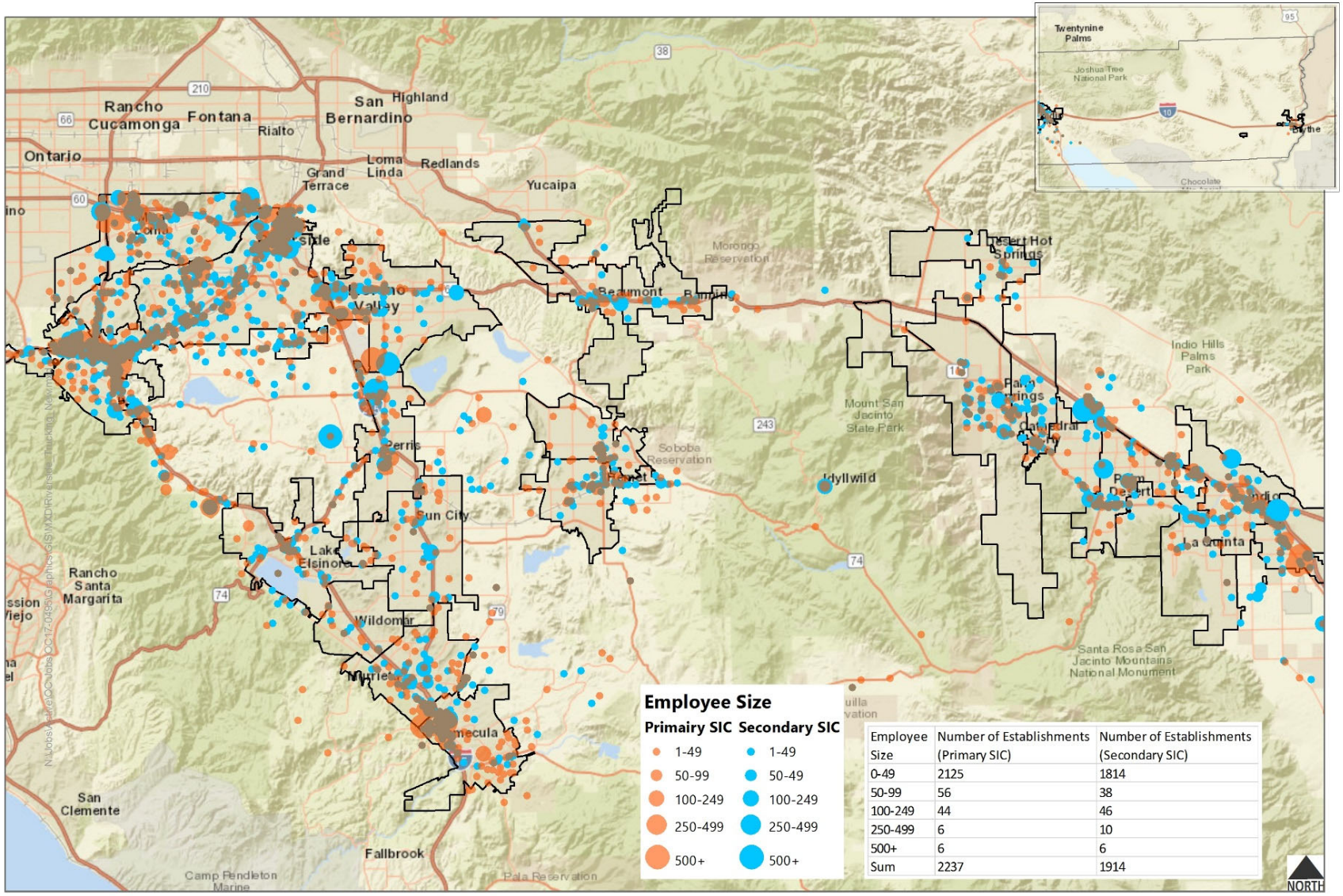
Employee Size	Number of Establishments (Primary SIC)	Number of Establishments (Secondary SIC)
0-49	403	140
50-99	87	24
100-249	57	14
250-499	16	9
500+	4	0
Sum	567	187

Figure 6. Distribution of Employment in Riverside County, Transportation & Warehousing



Employee Size	Number of Establishments (Primary SIC)	Number of Establishments (Secondary SIC)
0-49	482	75
50-99	0	2
100-249	1	4
250-499	0	1
500+	0	0
Sum	483	82

Figure 7. Distribution of Employment in Riverside County, Wholesale Trade



2.3. SCAG WAREHOUSE STUDY

SCAG's Industrial Warehouse Study provides estimates of existing and future warehouse square footage. Unfortunately at the time of preparing this report, this study was not officially released and therefore associated data were not able to be access for this study. The information presented here are based on land use data provided in the SCAG Heavy Duty Truck Model (HDT) developed for the 2016 RTP.

Warehouses are classified as High-Cube and Low-Cube in the SCAG HDT model. The high-cube warehouse is generally defined as a building with over 200,000 square feet of floor area and with a ceiling height of 24 feet or higher. The primary use of high-cube warehouses is storage, consolidation, and distribution of manufactured goods.

A high-cube warehouse is distinguished from a low-cube, or traditional, warehouse by several factors. Most prominent among these is a relative lack of automation in low-cube warehouses, leading to a larger number of human employees. High-cube warehouses, on the other hand, takes advantage of a very high degree of automation.

In addition, the two types are differentiated by economies of scale. Low-cube, traditional warehouses tend to be smaller on a square footage basis, with lower degree of automation, but higher employee per square feet ratio. High-cube warehouses process larger shipments with fewer employees relative to the warehouse's square footage. This means that, as compared to high-cube warehouses, low-cube warehouses generate fewer truck trips per employee (owing to the relatively larger number of employees proportional to size) but more truck trips per thousand square feet (because of smaller size of warehouse and smaller size of shipments).

By way of example, automation may mean that employees at a high-cube warehouse are able to handle higher shipment volumes than their counterparts at low-cube warehouses. Not only are total shipment volumes likely to be higher, but each individual shipment is likely to be larger. This means that truck trips are divided over a smaller number of employees. A low-cube warehouse will handle, on average, smaller shipments, and need a comparatively larger number of employees to handle them. This means that those truck trips handled at a low-cube warehouse will be spread over a larger number of employees.

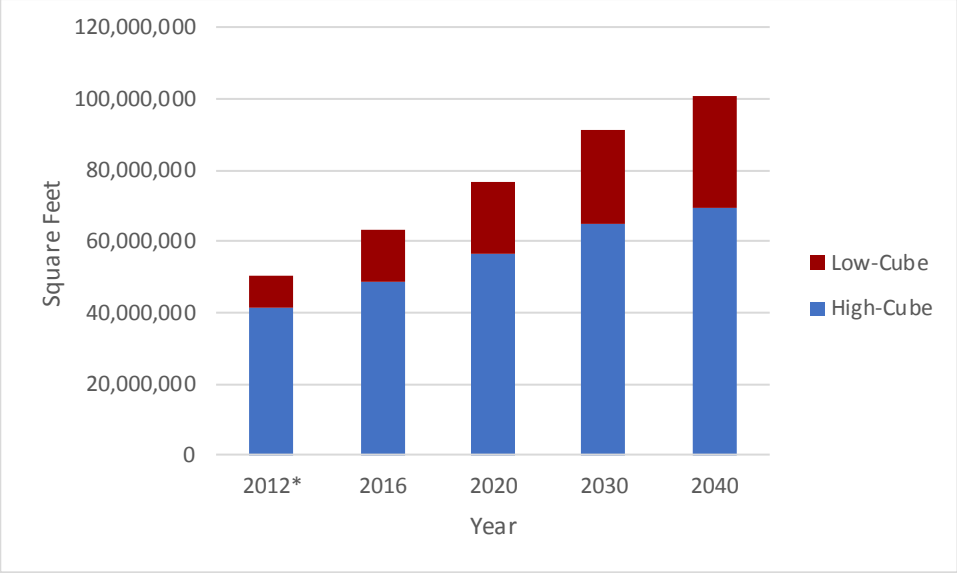
Based on information in 2016 SCAG HDT model, Riverside County is home to 76 million square feet of high-cube and low-cube warehouse space, and it is projected to grow through approximately 2030, before leveling off in expectation of market competition from other land uses. It is anticipated that in the long term, the attractiveness of other land uses and a lack of

easily developable land will exert downward pressure on the growth of warehouse square footage and employment in Riverside County. The changes predicted by this forecast are indicated in the figures below. By either measure (number of employment or square footage), the increase in warehouse capacity in Riverside County will be substantial during the 2012 to 2040 period, and constitutes both high-cube and low-cube warehouse growth. It is important to note that the comparison between 2012 and other years is not possible since the definition of "warehouse area" between 2012 baseline scenario and other scenarios are not consistent. The area shown in 2012 includes total available floor space, while the area shown in 2016 and years after includes only planned occupied floor space. Therefore the comparison analysis are only presented based on 2016 and 2040 scenarios for consistency.

As shown on **Figure 8** and **Figure 9**, although both high-cube and low-cube warehouse capacity are projected to increase substantially between 2016 and 2040, the increase for low-cube warehouse space is from 20,111 KSF to 31,232 KSF during this period (55%). This is significantly greater on a percentage basis (but lower in absolute terms) than the anticipated increase for high-cube warehouses space, from 56,393 KSF to 69,410 KSF (23%). As shown in detail on **Table 5**, and **Table 6**, this difference is somewhat less pronounced for employment, with low-cube warehouses increasing from 3,819 to 7,427 employees (94%), but with high-cube warehouses increasing from 3,256 employees to 6,185 by 2040 (90%).

It is important to remember that these forecasts are based on model data that must be considered in the context of modeling limitations. The addition or subtraction of just a few projects, particularly on the scale of high-cube warehouses, has the potential to make real-world conditions significantly different from the model's prediction. Despite the limitations in the model data, the anticipated growth in both high-cube and low-cube warehousing activity reiterates the appropriateness of considering all warehousing and logistics related uses as part of this study effort to assess the full transportation system impacts of this anticipated growth.

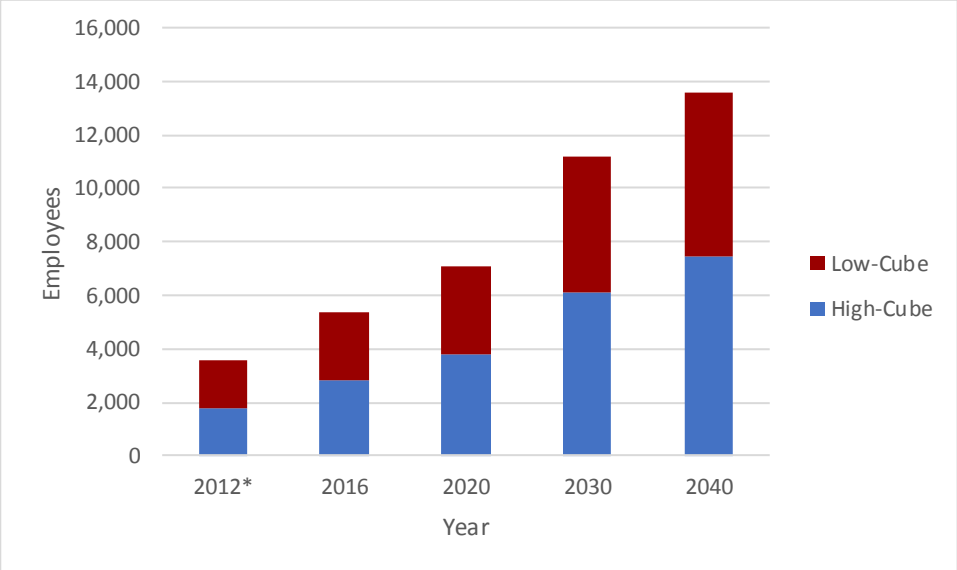
Figure 8. Warehouse Area Trend from 2012-2040 in Riverside County



* The area shown in 2012 includes total available floor space. The area shown in 2016 and years after includes planned occupied floor space.

Source: SCAG 2016 RTP

Figure 9. Warehouse Employment Trend from 2012 to 2040 in Riverside County



* The area shown in 2012 includes total available floor space. The area shown in 2016 and years after includes planned occupied floor space.

Source: SCAG 2016 RTP

Table 5 and **Table 6** show the employment ratio per 1000 square feet of each warehouse category. Based on SCAG information, the employee ratio for low-cube warehouse is at least twice higher than the ratio for high-cube warehouse. The tables also reflect a modest increase

over time in the ratio of employees per KSF for both high-cube and low-cube warehouses, although it not clear why this ratio is increasing in future year.

Table 5. High-Cube Warehouse Trends in Riverside County, 2012-2040

Year	Warehouse Area (square feet)	Employment	Employee/KSF
2012*	41,281,541	1,793	0.04
2016	48,837,363	2,810	0.06
2020	56,393,177	3,819	0.07
2030	64,664,947	6,120	0.09
2040	69,410,192	7,427	0.11

Table 6. Low-Cube Warehouse Trends in Riverside County, 2012-2040

Year	Warehouse Area (square feet)	Employment	Employee/KSF
2012*	8,833,418	1,804	0.20
2016	14,472,627	2,533	0.18
2020	20,111,826	3,256	0.16
2030	26,810,782	5,070	0.19
2040	31,231,977	6,185	0.20

* The area shown in 2012 includes total available floor space. The area shown in 2016 and years after includes planned occupied floor space.

Source: SCAG 2016 RTP

Table 7 shows the anticipated growth in high- and low-cube warehouse space in each Traffic Analysis Zone (TAZ) in Riverside County that has warehouse space. The rightmost column in the chart provides the sum in growth of both high- and low-cube warehouses during the period from 2016 to 2040.

SCAG's forecast anticipates that warehouse square footage growth will be highly concentrated. A single TAZ on the outskirts of Moreno Valley accounts for 56.3% of the expected growth between 2016 and 2040, and the 10 TAZs with the highest expected growth (on an absolute basis) will account for 90.3% of the county's overall warehouse growth in this period. Of the top 10, three are located in Moreno Valley, two are located in Coachella, and one each are located in Corona, Perris, Lake Elsinore, Jurupa Valley, and Hemet. The spatial distribution of this forecast reflects known warehousing and logistics development plans (like the World

Logistics Center in Moreno Valley) along with the influences of declining land availability in the region for warehouse and logistics related uses over time, especially high-cube uses that demand larger sites with transportation system accessibility. This influence of declining land availability is also reflected in the leveling off of the forecast rate of growth described previously, which accounts for the exhaustion of readily available land in later forecast years and the associated economics of locating highest and best value land uses making it less desirable to locate additional warehousing and logistics uses in Riverside County.

Table 7. Amount of Warehouse Space by TAZs in Riverside County (KSF)

TAZ_ID	High-cube 2016	Low-cube 2016	High-cube 2020	Low-cube 2020	High-cube 2030	Low-cube 2030	High-cube 2040	Low-cube 2040	Total Change from 2016-2040	Percent change from 2016 - 2040	Percent of total growth countywide
43344	5,417	2,323	10,834	4,646	16,778	7,201	20,136	8,628	21,024	271.63%	56.31%
43336	641	1,497	1,282	2,993	2,421	5,657	3,198	7,461	8,521	398.55%	22.82%
43338	101	231	202	462	297	696	355	822	845	254.52%	2.26%
43148	4,437	410	4,437	614	4,438	892	4,437	1,029	619	12.77%	1.66%
43571	-	-	-	-	382	-	594	-	594	0.00%	1.59%
43130	2,050	465	2,050	465	2,050	545	2,050	988	522	20.80%	1.40%
43364	-	182	-	182	221	232	331	293	442	242.86%	1.18%
43573	-	-	-	-	281	-	421	-	421	0.00%	1.13%
43302	655	-	1,072	-	1,072	-	1,072	-	417	63.66%	1.12%
43305	302	-	604	-	604	-	604	-	302	100.00%	0.81%
43264	-	-	-	-	200	-	300	-	300	0.00%	0.80%
43187	-	119	-	239	-	299	-	340	221	185.71%	0.59%
43575	156	37	311	75	311	75	311	75	193	100.00%	0.52%
43260	2,031	820	2,031	1,	2,032	1,002	2,031	1,002	180	6.38%	0.48%
43452	172	-	343	-	344	-	343	-	172	99.42%	0.46%
43345	-	-	-	-	-	109	-	163	163	0.00%	0.44%
43448	-	60	-	119	-	180	-	209	150	248.33%	0.40%
43286	-	-	-	-	-	87	-	149	149	0.00%	0.40%
43332	101	44	202	88	202	88	202	88	145	100.00%	0.39%
43249	3,197	1,716	3,197	1,860	3,198	1,864	3,197	1,860	144	2.93%	0.39%
43395	131	-	262	-	262	-	262	-	131	100.00%	0.35%
43415	2,992	244	2,992	244	2,993	328	2,992	369	124	3.86%	0.33%
43134	474	454	474	509	474	554	474	574	120	12.93%	0.32%
43454	119	-	237	-	237	-	237	-	119	99.16%	0.32%
43168	491	-	491	-	491	77	491	116	116	23.63%	0.31%

TAZ_ID	High-cube 2016	Low-cube 2016	High-cube 2020	Low-cube 2020	High-cube 2030	Low-cube 2030	High-cube 2040	Low-cube 2040	Total Change from 2016-2040	Percent change from 2016 - 2040	Percent of total growth countywide
43409	-	-	-	-	-	72	-	108	108	0.00%	0.29%
43366	-	-	-	-	-	59	-	89	89	0.00%	0.24%
43236	-	83	-	165	-	165	-	165	83	98.80%	0.22%
43399	-	81	-	162	-	163	-	162	81	100.00%	0.22%
43265	-	-	-	-	-	53	-	80	80	0.00%	0.21%
43488	-	78	-	155	-	156	-	155	78	98.72%	0.21%
43563	308	162	308	162	308	208	308	232	70	14.89%	0.19%
43246	328	487	328	547	328	548	328	547	61	7.36%	0.16%
43276	-	59	-	117	-	118	-	117	59	98.31%	0.16%
43429	-	57	-	115	-	115	-	115	57	101.75%	0.15%
43162	-	-	-	-	-	33	-	56	56	0.00%	0.15%
43181	821	61	821	61	822	95	821	112	51	5.78%	0.14%
43420	286	48	286	96	286	97	286	96	48	14.37%	0.13%
43261	-	120	-	163	-	163	-	163	43	35.83%	0.12%
43136	289	193	289	233	289	233	289	233	40	8.30%	0.11%
43310	-	40	-	80	-	80	-	80	40	100.00%	0.11%
43125	5,048	692	5,048	727	5,049	729	5,048	727	36	0.61%	0.10%
43474	-	32	-	65	-	65	-	65	32	103.13%	0.09%
43397	-	31	-	62	-	62	-	62	31	100.00%	0.08%
43188	380	145	380	175	380	175	380	175	30	5.71%	0.08%
43214	-	285	-	311	-	312	-	311	27	9.12%	0.07%
TOTAL	30,927	11,256	38,481	15,892	46,750	23,587	51,498	28,016	37,334	88.50%	100.00%

Source: SCAG Warehouse Study

Figure 10. High Cube Warehouse Area in Riverside County in 2016 by SCAG Tier I TAZ

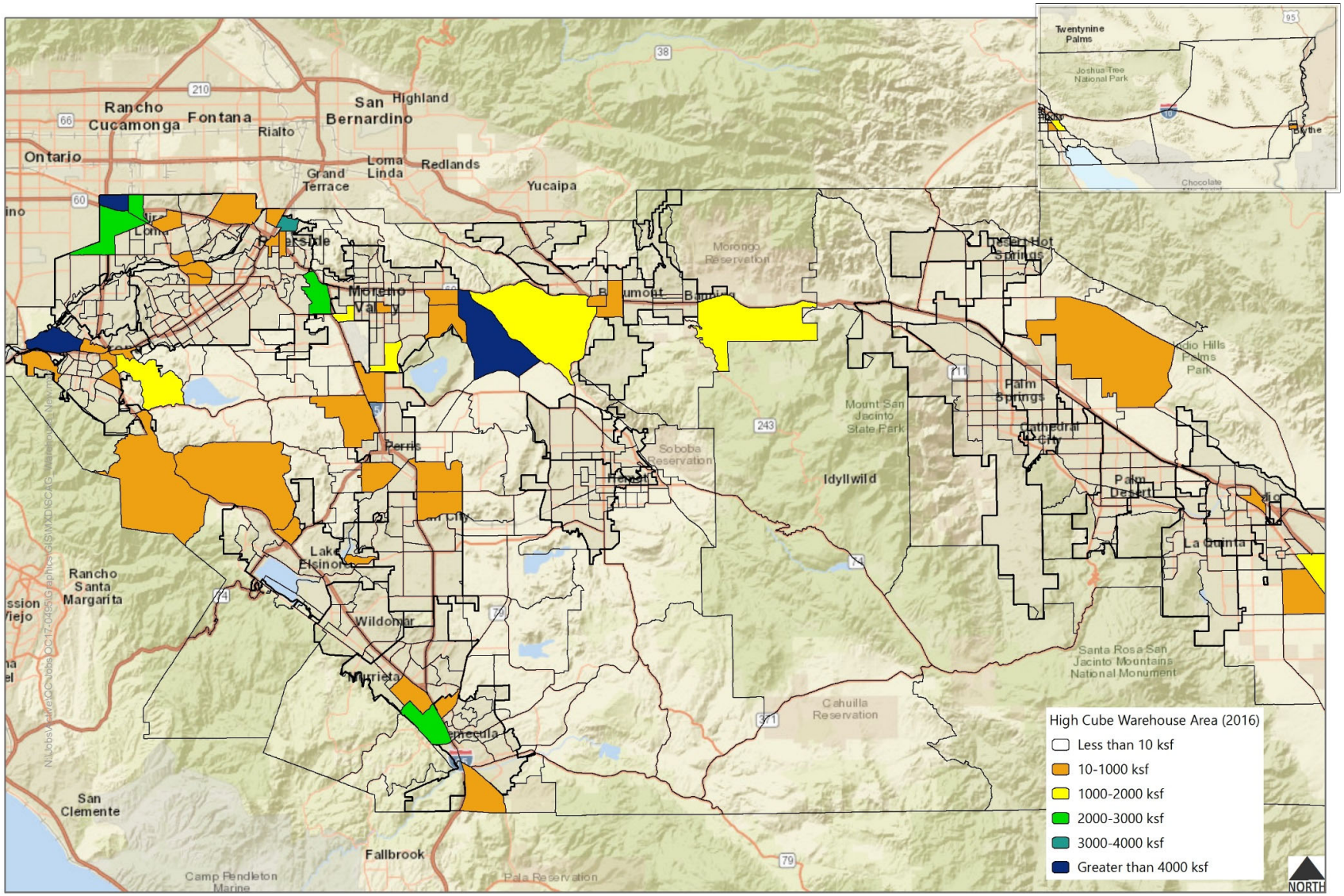


Figure 11. Low Cube Warehouse Area in Riverside County in 2016 by SCAG Tier I TAZ

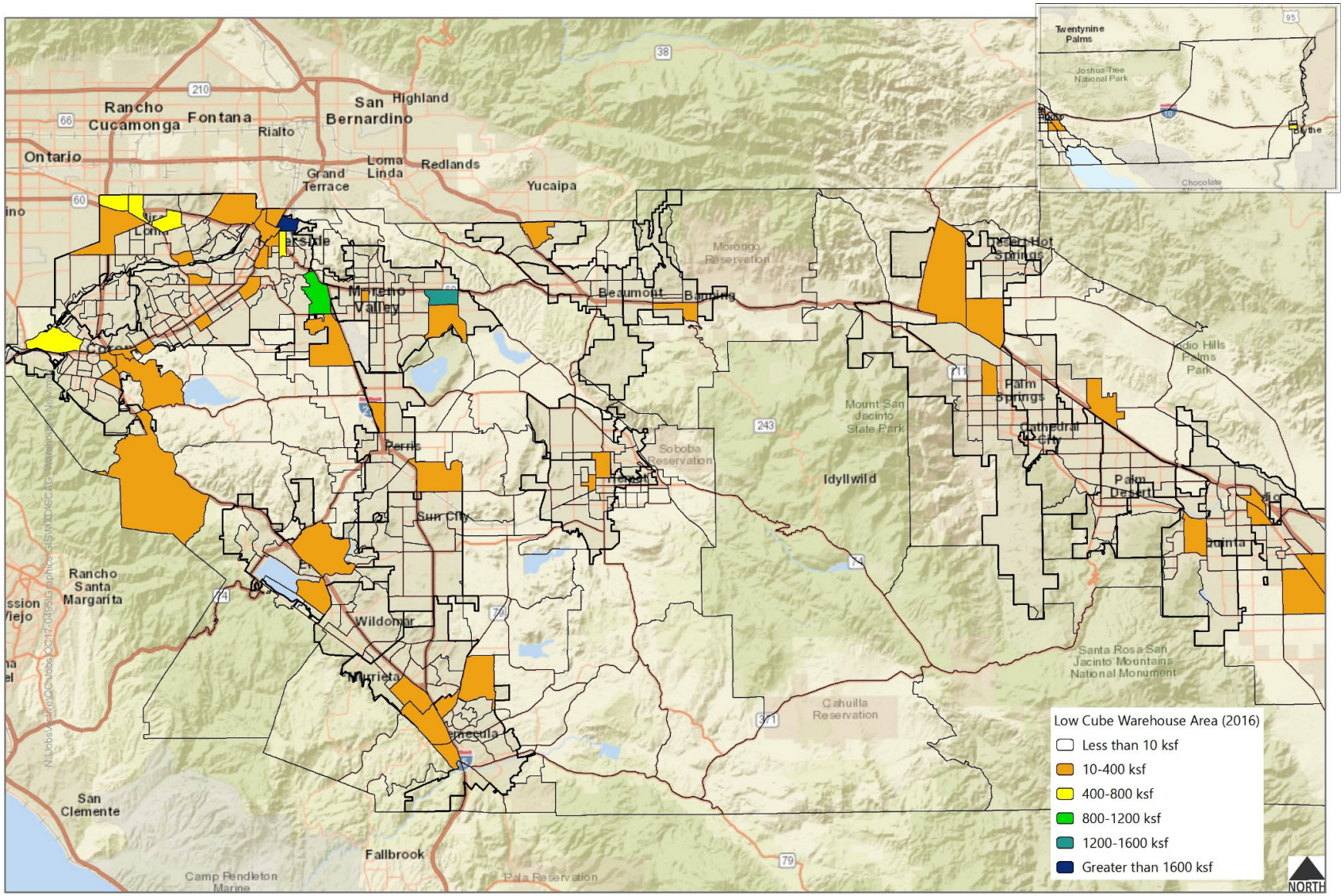


Figure 12. SCAG Expected High Cube Warehouse Area Growth in Riverside County 2016 to 2040 by SCAG Tier I TAZ

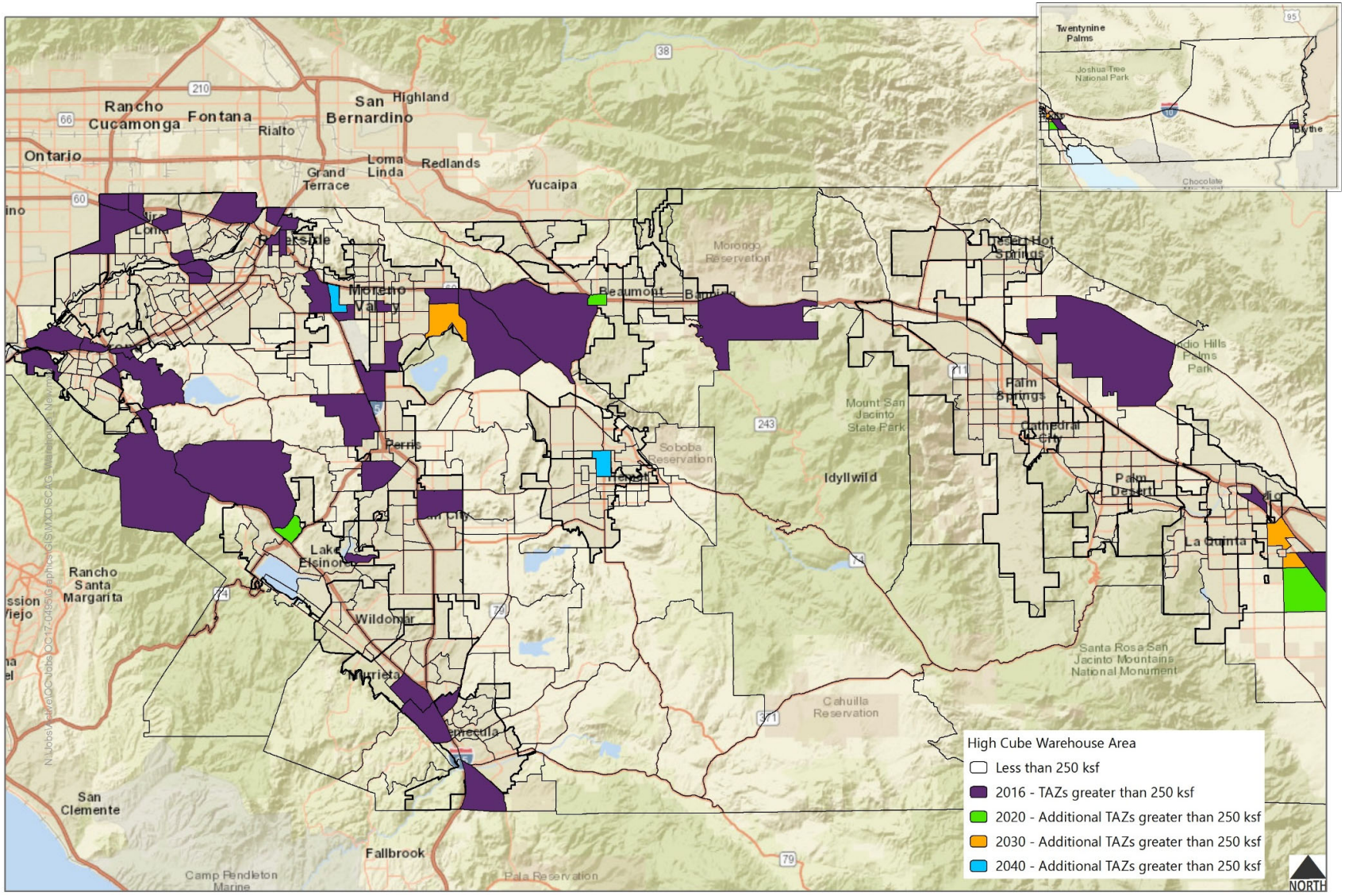
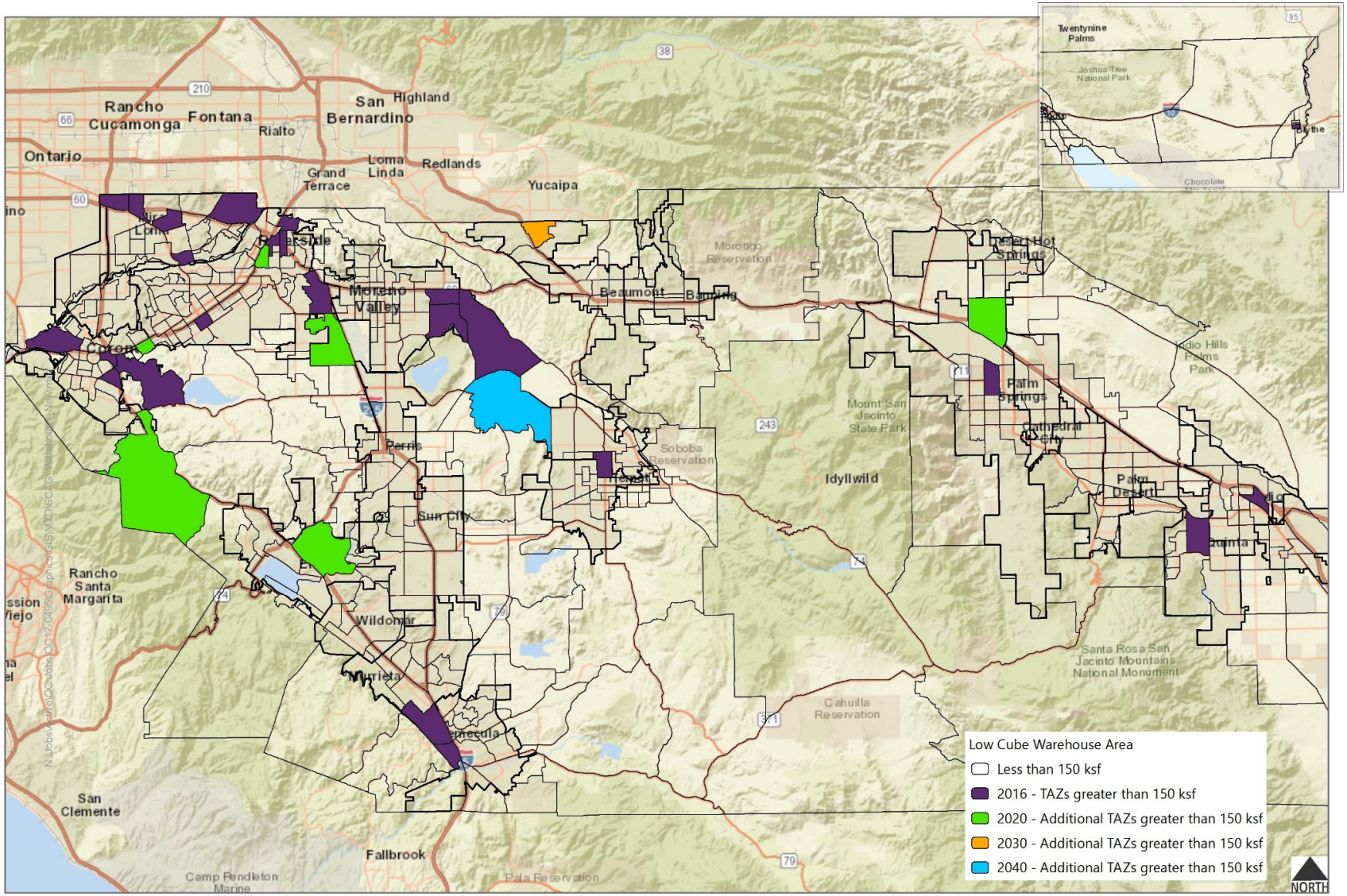


Figure 13. SCAG Expected Low Cube Warehouse Area Growth in Riverside County 2016 to 2040 by SCAG Tier I TAZ



3. TRUCK COUNTS

The SCAG RTP 2016 uses a comprehensive truck count database (2012-2013 counts) for HDT model calibration. This information helps to understand the magnitude of trucking activities on various segments of highway. This database has 74 locations on state and interstate facilities in Riverside County, as indicated in the following table. SCAG is currently conducting a project to update this database using 2016 counts. **Table 8** summarizes available truck counts on the state highway system in Riverside County. By comparing actual truck counts and GPS sample truck O-D information, it is possible to validate data derived from the SCAG regional model as well as estimate the share of truck traffic on each segment that is generated in Riverside County relative to the through traffic (trips with both origin and destination outside of the county)

Table 8. SCAG 2013 Truck Classification Count Locations within Riverside County

Facility TYPE	ON STREET	CROSS STREET	CROSS STREET 2
Interstate	I 10 (REDLANDS FWY) EB	Main St	SH 111
Interstate	I 10 (REDLANDS FWY) EB	Main St	SH 111
Interstate	I 10 (REDLANDS FWY) WB	Main St	SH 111
Interstate	I 10 (REDLANDS FWY) WB	Main St	SH 111
Interstate	I 10 EB	WEST OF	MESA DR
Interstate	I 10 EB	Dillon Rd	Aqueduct Rd Intchg
Interstate	I 10 EB	WEST OF	MESA DR
Interstate	I 10 EB	Dillon Rd	Aqueduct Rd Intchg
Interstate	I 10 EB (Sonny Bono Memorial Fwy)	N Gene Autry Trl	Date Palm Dr
Interstate	I 10 EB (Sonny Bono Memorial Fwy)	N Gene Autry Trl	Date Palm Dr
Interstate	I 10 WB	WEST OF	MESA DR
Interstate	I 10 WB	Dillon Rd	Aqueduct Rd Intchg
Interstate	I 10 WB	WEST OF	MESA DR
Interstate	I 10 WB	Dillon Rd	Aqueduct Rd Intchg
Interstate	I 10 WB (Sonny Bono Memorial Fwy)	N Gene Autry Trl	Date Palm Dr
Interstate	I 10 WB (Sonny Bono Memorial Fwy)	N Gene Autry Trl	Date Palm Dr
Interstate	I 15 (ONTARIO FWY) NB	68th St	Detroit St
Interstate	I 15 (ONTARIO FWY) NB	68th St	Detroit St
Interstate	I 15 (ONTARIO FWY) SB	68th St	Detroit St

Facility TYPE	ON STREET	CROSS STREET	CROSS STREET 2
Interstate	I 15 (ONTARIO FWY) SB	68th St	Detroit St
Interstate	I 15 (TEMECULA VALLEY FWY) NB	Temescal Canyon Rd	Lake St
Interstate	I 15 (TEMECULA VALLEY FWY) NB	Baxter Rd	Clinton Keith Rd
Interstate	I 15 (TEMECULA VALLEY FWY) NB	Temescal Canyon Rd	Lake St
Interstate	I 15 (TEMECULA VALLEY FWY) NB	Baxter Rd	Clinton Keith Rd
Interstate	I 15 (TEMECULA VALLEY FWY) SB	Temescal Canyon Rd	Lake St
Interstate	I 15 (TEMECULA VALLEY FWY) SB	Baxter Rd	Clinton Keith Rd
Interstate	I 15 (TEMECULA VALLEY FWY) SB	Temescal Canyon Rd	Lake St
Interstate	I 15 (TEMECULA VALLEY FWY) SB	Baxter Rd	Clinton Keith Rd
Interstate	I 215 (ESCONDIDO FWY) NB	W Nuevo Rd	North D St
Interstate	I 215 (ESCONDIDO FWY) NB	Keller Rd	Clinton Keith Rd
Interstate	I 215 (ESCONDIDO FWY) NB	W Nuevo Rd	North D St
Interstate	I 215 (ESCONDIDO FWY) NB	Keller Rd	Clinton Keith Rd
Interstate	I 215 (ESCONDIDO FWY) SB	W Nuevo Rd	North D St
Interstate	I 215 (ESCONDIDO FWY) SB	Keller Rd	Clinton Keith Rd
Interstate	I 215 (ESCONDIDO FWY) SB	W Nuevo Rd	North D St
Interstate	I 215 (ESCONDIDO FWY) SB	Keller Rd	Clinton Keith Rd
Interstate	I 215 (RIVERSIDE FWY) NB	Center St	Columbia Ave
Interstate	I 215 (RIVERSIDE FWY) NB	Center St	Columbia Ave
Interstate	I 215 (RIVERSIDE FWY) SB	Center St	Columbia Ave
Interstate	I 215 (RIVERSIDE FWY) SB	Center St	Columbia Ave
State Route-Full Access	E PALM CANYON DR	N Gene Autry Trl	Golf Club Dr
State Route-Full Access	E PALM CANYON DR	N Gene Autry Trl	Golf Club Dr
State Route-Full Access	Grapefruit Blvd	Ave 48	Ave 49
State Route-Full Access	Grapefruit Blvd	At	Imperial / Riverside County Line
State Route-Full Access	Grapefruit Blvd	Ave 48	Ave 49
State Route-Full Access	Grapefruit Blvd	At	Imperial / Riverside County Line
State Route-Full Access	PINACATE RD	Antelope Rd	Palomar Rd
State Route-Full Access	PINACATE RD	Antelope Rd	Palomar Rd
State Route-Full Access	S 71 (CORONA EXPY) NB	EUCLID AVE	S 91 (RIVERSIDE FWY)
State Route-Full Access	S 71 (CORONA EXPY) NB	EUCLID AVE	S 91 (RIVERSIDE FWY)
State Route-Full Access	S 71 (CORONA EXPY) SB	EUCLID AVE	S 91 (RIVERSIDE FWY)
State Route-Full Access	S 71 (CORONA EXPY) SB	EUCLID AVE	S 91 (RIVERSIDE FWY)
State Route-Full Access	S 74 (PINES TO PALMS HIGHWAY)	Santa Rosa Rd	PALM CANYON DR

Facility TYPE	ON STREET	CROSS STREET	CROSS STREET 2
State Route-Full Access	S 74 (PINES TO PALMS HIGHWAY)	Santa Rosa Rd	PALM CANYON DR
State Route-Full Access	State Highway 74 / Pines to Palms Hwy	South of	Portola Ave
State Route-Full Access	State Highway 74 / Pines to Palms Hwy	South of	Portola Ave
State Route-Full Access	WINCHESTER RD	Thompson Rd	Pourroy Rd
State Route-Full Access	WINCHESTER RD	Thompson Rd	Pourroy Rd
State Route-Full Access	WINCHESTER RD	Thompson Rd	Pourroy Rd
State Route-Limited Access	S 60 (Moreno Valley Fwy) EB	Moreno Beach Dr	Redlands Blvd
State Route-Limited Access	S 60 (Moreno Valley Fwy) EB	Moreno Beach Dr	Redlands Blvd
State Route-Limited Access	S 60 (Moreno Valley Fwy) WB	Moreno Beach Dr	Redlands Blvd
State Route-Limited Access	S 60 (Moreno Valley Fwy) WB	Moreno Beach Dr	Redlands Blvd
State Route-Limited Access	S 60 (POMONA FWY) EB	Hall Ave	Market St
State Route-Limited Access	S 60 (POMONA FWY) EB	Hall Ave	Market St
State Route-Limited Access	S 60 (POMONA FWY) WB	Hall Ave	Market St
State Route-Limited Access	S 60 (POMONA FWY) WB	Hall Ave	Market St
State Route-Limited Access	S 91 (Riverside Fwy) EB	Chino Valley Fwy (SH 71)	Serfas Club Dr/ Auto Center Dr
State Route-Limited Access	S 91 (Riverside Fwy) EB	Chino Valley Fwy (SH 71)	Serfas Club Dr/ Auto Center Dr
State Route-Limited Access	S 91 (Riverside Fwy) WB	Chino Valley Fwy (SH 71)	Serfas Club Dr/ Auto Center Dr
State Route-Limited Access	S 91 (Riverside Fwy) WB	Chino Valley Fwy (SH 71)	Serfas Club Dr/ Auto Center Dr
State Route-Limited Access	State Hwy 86 NB	Dillon Rd	50th Ave
State Route-Limited Access	State Hwy 86 NB	Dillon Rd	50th Ave
State Route-Limited Access	State Hwy 86 SB	Dillon Rd	50th Ave
State Route-Limited Access	State Hwy 86 SB	Dillon Rd	50th Ave

Caltrans regularly conducts vehicle classification counts on different segments of the highway network. The 2015 counts are presented in **Table 9**.

Table 9. CALTRANS Truck Counts Database

ID	Route	Post mile	Leg	Description and Approximate Location	Vehicle AADT Total	Truck AADT Total	Truck % Total Vehicle	Truck AADT Total by number of Axles				% Truck AADT by number of Axles			
								2	3	4	5	2	3	4	5
1	10	R58.89	A	Dillon Rd. (Coachella)	25,000	8,693	35	1,110	198	94	7,291	12.8	2.3	1.1	83.9
2	10	R105.087	B	Jct. Rte. 177 North (Desert Center)	24,600	8,693	35	1,110	198	94	7,291	12.8	2.3	1.1	83.9
3	10	R105.087	A	Jct. Rte. 177 North (Desert Center)	23,700	8,721	37	1,128	169	96	7,328	12.9	1.9	1.1	84.0
4	10	R149.15	B	Jct. Rte. 78 South (Blythe)	25,300	8,730	35	1,053	177	133	7,367	12.1	2.0	1.5	84.4
5	10	R149.15	A	Jct. Rte. 78 South (Blythe)	27,000	8,881	33	1,174	197	108	7,402	13.2	2.2	1.2	83.3
6	15	22.277	B	Jct. Rte. 74 (Lake Elsinore)	125,000	9,331	7	4,736	664	307	3,624	50.8	7.1	3.3	38.8

Source: Caltrans 2015 Truck counts.

4. TRUCK O-D AND ROUTING

A sample of mobile device and GPS truck trajectory data for weekdays in September 2016 was purchased from Streetlight® for this study. This data was used to identify truck origin-destination (O-D) patterns between zones in Riverside County, and between Riverside County and other regions, in part to validate similar information derived from the SCAG model. This data is also particularly helpful in identifying the share of through trips (trips with origin and destination outside of Riverside County, but passing through the county).

For the purposes of the O-D analysis, the TAZs in SCAG model were aggregated into 22 zones representing Riverside County and 11 zones representing the SCAG region outside Riverside County. **Figure 14** shows the boundaries of these zones.

This Streetlight data is classified by truck weights: heavy-duty trucks and medium-duty trucks. Heavy-duty trucks are those with minimum gross weight of 26,000 pounds. The medium-duty trucks are those with gross weight between 14,000 and 26,000 pounds.

Table 10 and **Table 11** show the O-D distribution for these two truck categories within the SCAG counties. Trips with at least one end external to the region are excluded from these tables. The GPS data was used to create a detailed O-D distribution between the 33 identified zones, which will be used by the team to fine-tune the model forecasts. In this analysis intermediate stops (less than 30 minutes), which are presumably for fuel or food, are eliminated so that long-distance trips are not mistaken for a series of short-distance trips. These tables show the share of each O-D pair in entire SCAG region. For example,15% of heavy duty truck trips in the SCAG region originate in Riverside County. Additionally, 7.3% of heavy duty truck trips and 10.4% of medium duty truck trips in the SCAG region start and end in Riverside County. This is reasonable because smaller trucks tends to travel shorter distances to perform multiple local deliveries.

Table 10. Heavy-Duty Truck O-D Distribution in SCAG Region

O \ D	Imperial	Los Angeles	Orange	Riverside	San Bernardino	Ventura	Total
Imperial	0.8%	0.0%	0.0%	0.2%	0.1%	0.0%	1%
Los Angeles	0.0%	25.8%	2.0%	2.3%	6.0%	0.6%	37%
Orange	0.0%	2.1%	3.0%	0.5%	1.1%	0.1%	7%
Riverside	0.1%	2.4%	0.5%	7.3%	5.0%	0.1%	15%
San Bernardino	0.1%	6.3%	1.2%	5.1%	25.1%	0.2%	38%
Ventura	0.0%	0.6%	0.0%	0.1%	0.2%	1.0%	2%
Total	1%	37%	7%	16%	37%	2%	100%

Table 11. Medium-Duty Truck O-D Distribution in SCAG Region

O \ D	Imperial	Los Angeles	Orange	Riverside	San Bernardino	Ventura	Total
Imperial	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	1%
Los Angeles	0.0%	46.1%	2.2%	0.7%	1.6%	0.7%	51%
Orange	0.0%	2.2%	13.0%	0.5%	0.4%	0.0%	16%
Riverside	0.1%	0.7%	0.5%	10.4%	1.6%	0.0%	13%
San Bernardino	0.0%	1.6%	0.4%	1.6%	9.6%	0.0%	13%
Ventura	0.0%	0.7%	0.0%	0.0%	0.0%	3.9%	5%
Total	1%	51%	16%	13%	13%	5%	100%

Trips between zones for medium- and heavy-duty trucks are shown on **Table 12** and **Table 13**, respectively. For medium trucks, all 20 of the O-D pairs with the highest number of trips are the same zone (namely, short trips remaining within the same zone). The more frequent trip between two different zones is from Zone 14 to 21 (adjacent zones in the desert), which accounts for 31% of the traffic originating from Zone 14.

The situation is similar for heavy-duty trucks, where the 12 O-D pairs with the highest number of trips are the same zone. The most frequent trip between Zone 1 (northwestern Riverside County) and Zone 30 (southwestern San Bernardino County), accounting for 26% of trips from Zone 1. Beyond this, the most frequent trips are from Zone 17 to Zone 30 and from Zone 19 to Zone 31 (both 25% of trips originating from those respective links).

The distribution of trips on 29 selected segments of the highway network in Riverside County were also investigated. This analysis used a sample of GPS truck trip trajectories to understand the origin-destination of trips on a given facility. In this analysis, intermediate stops are included and counted as separate trips since these trips will contribute to congestion on local streets.

Table 14 shows the share of truck trips generated in Riverside County compared to the share of truck trips generated in SCAG area from the total truck traffic on each of the links. For heavy-duty trucks, Riverside County generated the most traffic on Links 17, 18, 19, 20, 21, and 23. Of these links, three are located on SR-60, two are located on I-215, and one is located on SR-91. Overall, Riverside is a comparatively bigger generator of medium-duty truck trips, although the busiest links are similar: Links 17, 18, 19, 21, 22, 23, and 24. Of these, three are on I-215, two are on SR-60, and two are on SR-91.

The patterns identified by these data are particularly useful for validating and refining other data sources as the basis for determining the fair share of trips generated by warehousing and logistics uses in Riverside County compared to those trips (or the portion of trips) generated by uses outside of the county.

Table 12. Distribution of Trips by Zone for Medium-Duty Trucks (% by Destination)

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	SUM
1	18	2	4	4			1				1						6	3	1	1			3	1		3	2		7	21	11	1		100
2	2	21	5	15		2	4		1	1	1	2						1	5	5			1			2	1		4	8	10	2		100
3	1		51	6	4					1	2						3							1		2	2		8	7	3	1		100
4	2	5	11	36	2	2	3		1	1	3						2	1	2	3						2	1		5	7	5			100
5			15	4	30	2			1	5	11						1							1		2	2		8	5	3			100
6		1	3	7	3	29	6		5	10	4									5				1		2	1		4	7	4	2		100
7		2	2	7		4	34	2	3	3	2	2							1	7				1		1	1		3	9	8	1		100
8	1	4	2	4		2	23	6	8	2	2	6	2						2	5			4			4	2	2	2	7	7			100
9			2	4		2	3		53	6	7	3	1							1									2	4	3			100
10			4	2	5	5	3		9	33	15	1							1	2						1			4	4	3	1		100
11			3	2	5	1			4	7	60																		3	3	2			100
12			1	2			1		3	1	1	45	7								4	2				2	1		1	7	11	1		100
13												3	61								24									1	1	3		100
14											2	6	7	25	2						31	12	1					2	2	3				100
15												3	6		50	10					14	3	1						1	2	2	4		100
16												1	2		9	76					2	2								1		2		100
17	8		13	5	1		1				1						22	1					1	2		3	2	2	6	20	5	1		100
18	10	5	5	11		1	2		1	1	1						3	11	3	2			2	1		2	2		5	14	11	1		100
19	2	6	4	9		1	4		1	2	2							2	13	3	1		2	2		3	2		4	10	19	3		100
20	2	4	4	10	1	5	12		2	3	2	1	1					1	3	17			1	1		2	1		4	8	9	1		100
21												2	25	2	1						60									1	1	2		100
22																					1	92						2						100
23																							50	9	9	5	12	3	6	2				100
24																							5	77	6	3	2		1	1			2	100
25																							9	11	62	1	10	1	2				2	100
26																							8	9	2	51	4	2	7	11	2			100
27																							9	3	7	2	61	8	7	1				100
28																							7	2	3	3	27	47	5	2				100
29			1																				3	1	1	2	5		80	2				100
30	2		2	1													1						3	3	1	8	2	1	5	51	10	3		100
31	1		2	2			1					2							1				1	2		2	1		2	17	53	4		100
32													1											2		1			1	5	4	78		100
33																								7	4								84	100

Values less than 1% are not shown in the table.

Table 13. Distribution of Trips by Zone for Heavy-Duty Trucks (% by Destination)

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	SUM
1	11					2	3										5	1		1			6	3		7	3	2	4	26	12	5		100
2	7	7	2	2		4	7	1				3	2			1	2	3	3	9	3	1	2	2		3	1		3	8	13	4		100
3	4	1	20	2	2	1					2						3			1			7	2		4	5	2	9	17	7	3		100
4	4	4	6	15		1	1					1					2	1	2	4	1		2	2		4	4	2	6	16	10	5		100
5	12		9		22	1	1				5						6						2	2		2	1	1	5	16	7	4		100
6	8	1				15	6					1	1			1	1	1	1	5	1		2	4		3	3	1	3	15	13	6		100
7	10	2				5	14					2	1			1	4	1	2	5	2		2	3		3	1		2	14	14	6		100
8	5	2		1	1	2	6	5		1		7	5						2	8	4	1	3	4	2	6	6	1	6	8	6	2		100
9	3	1	2			4	4		23	3	3	5	2				2	2	2	3			2	2		2			2	13	13	3		100
10	10	2	1		2	9	5	1	3	13	9	1						1	2	6				1			2		2	9	12	4		100
11	4		3		6	3				3	25	1					4		2	2			1	2		2	1		3	15	12	4		100
12	3											16	8		4	5	1			1	7	2	3	3		4	3	1	3	12	13	4		100
13	2											10	15		6	7				1	10	3	3	3		3	2	1	2	10	12	4		100
14	4											9	7	12							12	19		3		1				7	12	4		100
15	4											6	8		17	17				1	11		2	2		2	2	1	2	9	8	2		100
16	2											5	6		12	29					9	2	2	2		3	2		1	9	7	3		100
17	12	1	1				1										13	2	1	2			4	4		6	3	2	4	25	8	5		100
18	9	2					2										3	7	2	2			7	4		6	3	1	4	16	19	7		100
19	6	2	1			1	1					1					3	2	13	4			3	4		4	2		3	14	25	5	1	100
20	7	3	1	2		4	3				1	1	1				3	1	3	13			3	4		4	3	1	4	17	12	4	2	100
21	3						1					7	11		8	9					15	3	3	4		3	2	1	2	9	10	2		100
22	1											2	4	2							5	69		1					1	3	4	2		100
23	1																						38	8	2	9	11	5	5	10	3	3	1	100
24	1																						11	44	3	7	5	2	3	9	4	3	4	100
25																							17	14	30	3	14	4	3	4	2		6	100
26	3																1						11	6		29	5	3	6	20	5	4		100
27	1																						15	4	2	6	32	12	9	8	2	3		100
28																							8	2		5	14	51	4	7		3		100
29	2		1														1						8	3		6	9	4	45	10	3	3		100
30	5																2						5	4		7	3	3	4	41	11	6		100
31	4											2	1					1	2	1	1		3	3		4	2		3	18	36	10		100
32	1																						3	2		2	2	1	2	9	7	65		100
33																							5	15	3	3	3	1	2	4	2	2	54	100

Values less than 1% are not shown in the table.

Table 14. Share of Each Region from the Truck Traffic by Link

State Route No.	Link	Heavy-Duty Trucks		Medium-Duty Trucks	
		Riverside	SCAG	Riverside	SCAG
74	1	21%	93%	40%	99%
91	2	26%	94%	37%	98%
71	3	21%	84%	28%	93%
60	4	22%	93%	26%	95%
15	5	18%	90%	25%	92%
215	6	34%	83%	39%	94%
10	7	33%	74%	41%	85%
62	8	28%	93%	42%	98%
15	9	1%	1%	1%	1%
79	10	2%	6%	7%	15%
86	11	27%	80%	32%	85%
111	12	32%	83%	31%	88%
78	13	21%	43%	23%	47%
10	14	0%	0%	0%	0%
95	15	13%	32%	23%	40%
177	16	26%	53%	41%	61%
60	17	55%	78%	61%	88%
60	18	55%	80%	65%	91%
215	19	52%	83%	60%	92%
60	20	45%	93%	52%	96%
91	21	44%	91%	62%	98%
91	22	43%	91%	63%	97%
215	23	48%	73%	66%	86%
215	24	26%	36%	66%	79%
15	25	26%	37%	56%	74%
215	26	18%	26%	55%	61%
10	27	43%	72%	55%	84%
10	28	41%	62%	63%	80%
10	29	32%	41%	33%	39%

Figure 14. Zones Used in the O-D Analysis

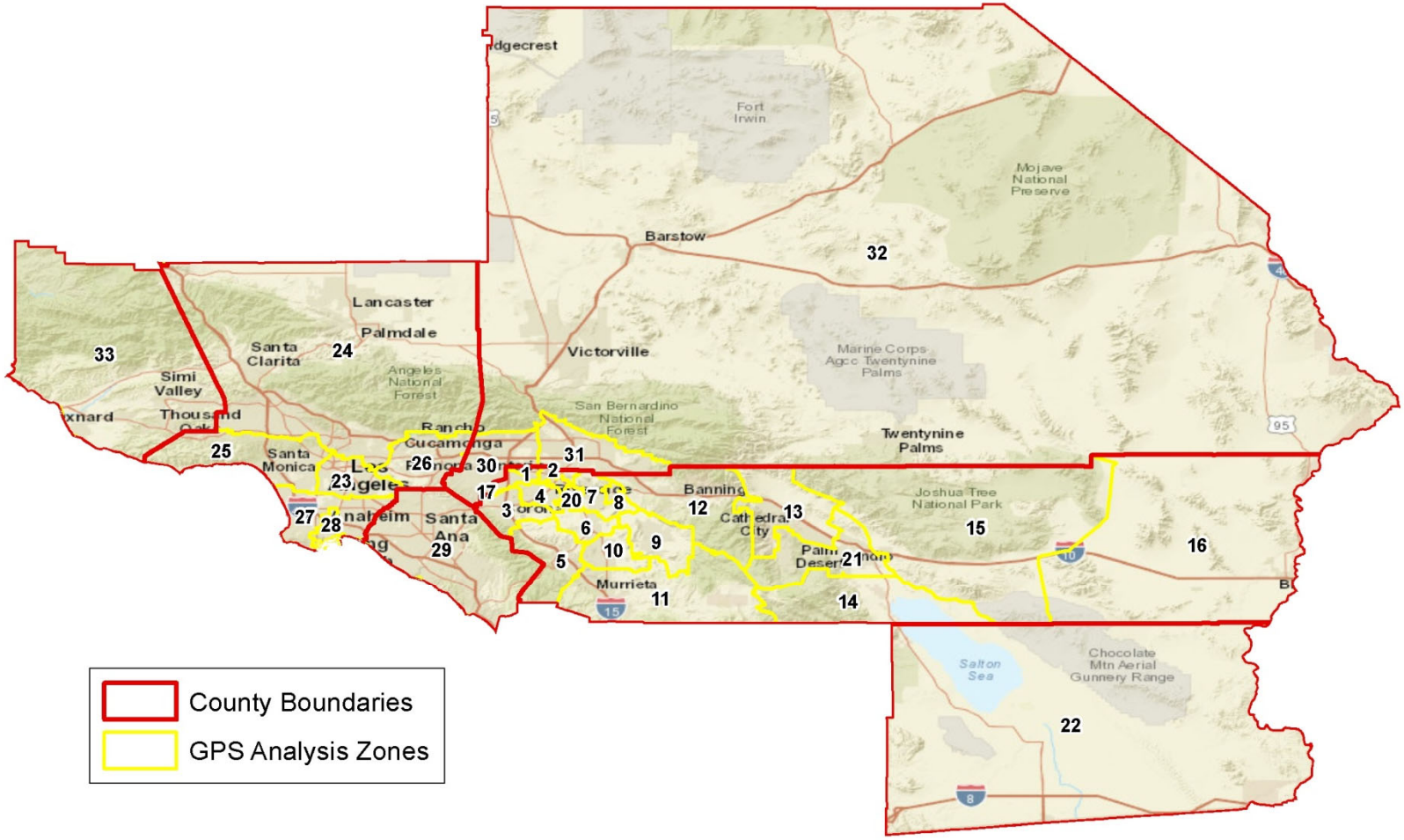
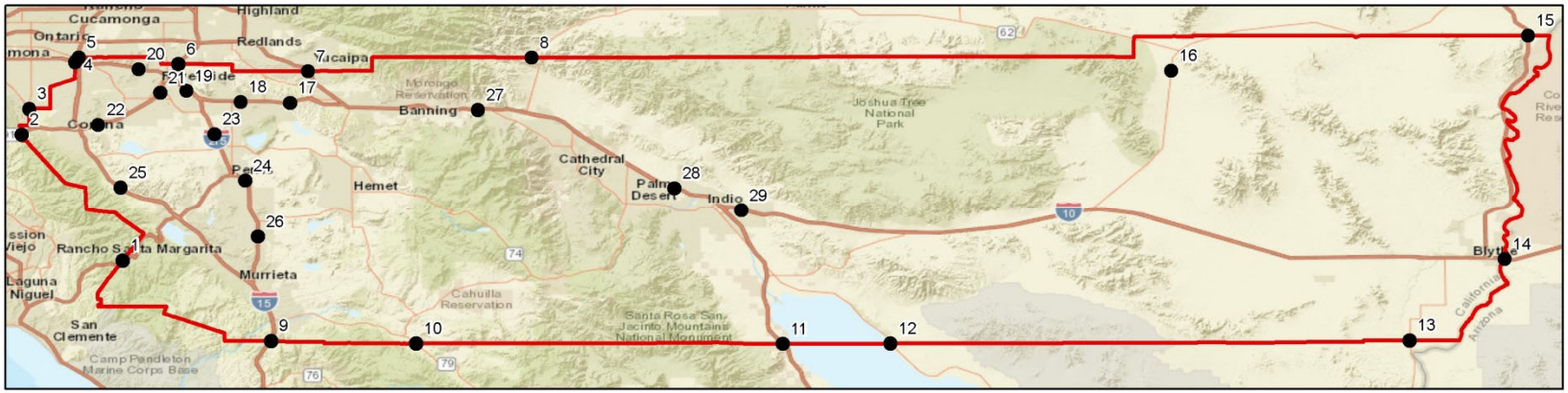


Figure 15. Selected Links for O-D Analysis



5. WAREHOUSE TRIP GENERATION METHODOLOGY

There are many possible approaches to estimate the number and length of trips generated by warehouse-related establishments in a given area. In this section, the most relevant and defensible of the currently available studies and methodologies are summarized. The recommendations follow the inventory of options.

5.1. CITY OF FONTANA TRUCK TRIP GENERATION STUDY

This study was completed in 2003 to evaluate the vehicle trip generation characteristics of several land use categories that typically generate significant volumes of truck traffic in the City of Fontana. This study identifies nine types of truck trip generating land uses, three of which are relevant to this study, namely: light warehouse, heavy warehouse, and industrial park. Below are the definitions for the three most relevant types of land use from the study, based on the Institute of Traffic Engineers (ITE) Trip Generation manual:

- Warehouse (ITE code 150) are primarily devoted to the storage materials; they may also include office and maintenance areas.
    - Light warehouses are 100,000 square feet gross floor area or less
    - Heavy warehouses are greater than 100,000 square feet gross floor area.
- Industrial park (ITE code 130) are areas containing a number of industrial or related facilities. They are characterized by a mix of manufacturing, service, and warehouse facilities with a wide variation in the proportion of each type of use. Many industrial parks contained highly diversified facilities, some with a large number of small businesses and others with one or two dominant industries.

Table 15 summarizes trip generation rates presented in the Fontana study for the above uses. The distribution of truck mix for each warehouse type is also presented. Based on this study, light warehousing generates more truck trips relative to heavy warehousing per employee (for example: 0.327*13%=0.065 >0.309* 13%=0.04 during AM period) however the share of 3+ axles trucks are significantly higher for heavy warehousing

Table 15. Trip Generation Rates by Warehouse Type (Fontana Study)

Warehouse Type	Period	Avg. trip rate per employee	Avg. trip per building KSF	Employee per building KSF	Truck %	Large Truck Mix %		
						2 Axles	3 Axles	4+ Axles
Light Warehouse	Daily	3.713	1.659	0.45	23%*	24.7	20.6	54.6
	AM Site	0.327	0.146		20%			
	PM Site	0.282	0.126		26%			
Heavy Warehouse	Daily	4.657	3.547	0.76	11%	16.95	22.71	60.34
	AM Site	0.309	0.235		13%			
	PM Site	0.417	0.318		10%			
Industrial Park	Daily	2.485	1.236	0.5	26%*	7.9	7.1	85
	AM Site	0.265	0.132		20%			
	PM Site	0.382	0.19		32%			

Source: Fontana Truck Trip Generation Study

* Daily truck percentages are derived by averaging the AM and PM peak hour truck percentage.

5.2. HIGH-CUBE WAREHOUSE VEHICLE TRIP GENERATION ANALYSIS

The South Coast Air Quality Management District (SCAQMD) and the National Association of Industrial and Office Properties (NAIOP) engaged ITE to conduct a high-cube warehouse vehicle trip generation analysis. The findings of this report are reflected in the most recent ITE Trip Generation Manual (10th Edition) published in September 2017.

This study defines high-cube warehouse (HCW) as a:

> building that typically has at least 200,000 gross square feet of floor area, has a ceiling height of 24 feet or more, and is used primarily for the storage and/or consolidation of manufactured goods (and to a lesser extent, raw materials) prior to their distribution to retail locations or other warehouses. A typical high-cube warehouse has a high level of on-site automation and logistics management. The automation and logistics enable highly-efficient processing of goods through the high-cube warehouse.

For the purpose of the analysis, high-cube warehouses are grouped into five types:

- Transload – usually pallet loads or larger handling products of manufacturers, wholesalers/distributors, or retailers with little or no storage durations
- Short-Term Storage – products held on-site for a short time

- Cold Storage – permanent cold storage in at least part of the building
- Fulfillment Center – storage and direct distribution of e-commerce product to end users
- Parcel Hub – Transload function for a parcel delivery company

This study describes the high-cube warehouse facilities in the context of existing ITE categories: "High-cube warehouses/distribution centers may be located in industrial parks or be free-standing. Intermodal truck terminal (Land Use 030), industrial park (Land Use 130), manufacturing (Land Use 140) and warehousing (Land Use 150) are related uses." A detailed description and comparison of each of the HCW categories regarding function, layout, building dimension, and level of automation is presented in the original report.

The vehicle trip generation for daily, AM and PM peak period and share of truck trip generation are estimated for the above categories of high-cube warehouse, and these data represent the most comprehensive effort to assess trip generation associated with high-cube warehouse to date thereby providing useful information to help validate other data sources. However, the study includes the following caveats related to the data and analyses contained within the report:

- Since the sample size for **fulfilment center** and parcel hub include only one establishment, the study recommends further data collection (a minimum of at least six sites) for these two categories to derive stable trip generation rates.

- The study produce statistically acceptable results based on limited data (nine sites) for **cold storage** category, which is generally higher than the rates developed previously based on an older data collection effort. The cold storage sites are classified subjectively based on the interpretation of the data submitter. It is recommended to confirm the applicability of the cold storage category based on the proportion of the HCW building space devoted to the cold storage. If some of the facilities are reclassified, the analysis needs to be re-evaluated. Further data collection might be needed, if a total of at least six sites are not identified under this category after reclassification.

- The study **combined the transload and short-term storage** categories for trip generation analysis. Although these categories are functionally different, their trip generation is not significantly different. Despite having relatively large sample size (95 sites) for this group, the study concluded that there is no meaningful statistic correlation between gross floor area and vehicle trip generation. It is recommended that an evaluation of further potential stratifications of the available data be undertaken and an appropriate set of data be selected for use as interim rates until further study is complete. For example, a set of 15 similar sites can be selected to

evaluate the consistency and correlation between the trip generation and one or more independent variables such as number of employment or floor area.

Recognizing the above-mentioned cautions about the results of this study, the summary of this study is presented in the following tables. **Table 16** shows the percentage of trucks from total vehicles by each high-cube warehouse category, and the findings reflect notable differences in the trip generation characteristics between certain use types.

At Short-Term Storage, Transload & Cold Storage facilities, trucks represent approximately 30% of daily vehicle traffic, with disproportionately less of that traffic coming during AM and PM peak hours. At Parcel Hubs, trucks represent almost half of the AM peak traffic, but only approximately 38% over the course of the day and just over 29% during the PM peak hour. Trucks account for only a small percentage of the total vehicle traffic at Fulfillment Centers.

Table 16 shows the daily weighted truck trip generation rates for each high-cube warehouse category. Per square foot, Parcel Hubs generate the highest number of truck trips, but the highest *proportion* of truck trips are generated by Cold Storage facilities. This is also the case when only 5+-axle trucks are considered.

Table 16. Trip Generation Rates by Warehouse Type (NAIOP Study)

Warehouse Type	Period	Avg trip rate per 1,000 GSF*	Truck %	Large Truck Mix %	
				2,3,4, Axles	5+ Axles
Short-Term Storage, Transload	Daily	1.432	32%	48.7	51.3
	AM Site	0.082	29%	37.5	62.5
	PM Site	0.108	21%	56.5	43.5
Cold Storage	Daily	2.115	40%	10.4	89.6
	AM Site	0.103	37%	28.9	71.1
	PM Site	0.129	33%	26.2	73.8
Fulfillment Center	Daily	8.178	9%	66.2	33.8
	AM Site	0.841	3%	60.9	39.1
	PM Site	1.979	2%	62.9	37.1
Parcel Hub	Daily	10.638	38%	75.5	24.5
	AM Site	0.851	50%	90.3	9.7
	PM Site	0.803	29%	96.2	3.8

Source: ACQMD, 2016, GSF: Gross Floor Area

5.3. INSTITUTE OF TRANSPORTATION ENGINEERS (ITE) TRIP GENERATION MANUAL

The 9th Edition ITE Trip Generation Manual provides trip generation rates for warehousing (150), mini-warehousing (151), high-cube warehousing (152), and wholesale market (860). Each land use code provides one or more methods for estimating the trips generated by a land use. For example, warehousing (150) provides two options:

1. Employee-based estimation for weekday
2. Area-based estimation for weekday

The results of ITE's analysis for various uses in Riverside County are presented in **Table 17**. The ITE Trip Generation Manual provides the ability to estimate daily, AM peak, M peak, and weekend vehicle trips based on land use types, using independent variables of: floor area, acreage, or number of employees.

10th ITE Trip Generation Manual was released in September 2017. Since the new edition might not be adopted by RCTC yet, the trip generation rates from the 9th Edition is compared with respective rates from the 10th edition.

The information contained in the High-Cube Warehouse Vehicle Trip Generation Analysis and the ITE Trip Generation Manuals will be particularly useful in determining the proportional impact and fair share fee for differing types of high cube warehousing uses not readily distinguishable in the data derived from other aggregated sources, like Census and the SCAG demographic forecasts.

Table 17. ITE Daily Trip Generation Rates for Industrial Land Use (Site Generators)

Code	Land Use	Unit	Daily Rate (9th Ed.)	AM/PM Peak (9th Ed.)	Daily Rate (10th Ed.)	AM/PM Peak (10th Ed.)	Truck % (9th Ed.)
110	General Light Industrial	Employees	3.02	0.48 / 0.51	3.05	0.67 / 0.68	N/A
		KSF Gross Floor Area	6.97	1.01 / 1.08	4.96	0.92 / 0.83	
120	General Heavy Industrial	Employees	0.82	0.40 / 0.40			N/A
		KSF Gross Floor Area	1.5	*PM:* 0.68			
130	Industrial Park	Employees	3.34	0.43 / 0.45	2.91	0.42 / 0.42	13%
		KSF Gross Floor Area	6.83	0.80 / 0.84	3.37	0.41 / 0.40	
140	Manufacturing	Employees	2.13	0.39 / 0.40	2.47	0.43 / 0.45	N/A
		KSF Gross Floor Area	3.82	0.79 / 0.75	3.93	0.81 / 0.79	
150	Warehousing	Employees	3.89	0.55 / 0.58	5.05	0.68 / 0.68	20%
		KSF Gross Floor Area	3.56	0.42 / 0.45	1.74	0.22 / 0.24	
151	Mini-Warehouse	KSF Gross Floor Area	2.5	0.28 / 0.29	1.51	0.20 / 0.20	2%-15%
		KSF Net Rentable Area	1.65	0.18 / 0.22	1.65	0.18 / 0.22	
		Storage Units	0.25	0.03 / 0.03	0.18*	0.23* / 0.24*	
		Occupied storage units	0.2	0.02 / 0.02	0.19*	0.02* / 0.02*	
152**	High-Cube Warehouse	KSF Gross Floor Area	1.68	0.14 / 0.16			38%
154	High-Cube Transload & Short-Term Storage Warehouse	KSF Gross Floor Area	-	-	1.40	0.12 / 0.16	N/A
155	High-Cube Fulfillment Center Warehouse	KSF Gross Floor Area	-	-	8.18	0.22 / 0.27	N/A
156	High-Cube Parcel Hub Warehouse	KSF Gross Floor Area	-	-	7.75	0.88 / 0.71	N/A
157	High-Cube Cold Storage Warehouse	KSF Gross Floor Area	-	-	2.12	N/A	N/A

Source: ITE Trip Generation, 9th Edition

** Figures given by 100s of units; divided by 100 for consistency with 9th Edition figures.*

*** In the 10th Edition, Land Use Code 152 is replaced by Codes 154-157, which provide additional specificity.*

5.4. SCAG HEAVY-DUTY TRUCK TRIP GENERATION (2016 RTP)

SCAG's heavy-duty truck (HDT) model is a sub-model within the SCAG 2016 Regional Transportation Plan (RTP) model. The model classifies trucks into three HDT weight classes by gross vehicle weight (GVW): light-heavy (8,500 to 14,000 lbs. GVW); medium-heavy (14,001 to 33,000 lbs. GVW); and heavy-heavy (>33,000 lbs. GVW).

The SCAG 2016 RTP HDT Model applies freight-related socioeconomic data to estimate trip generation using three submodules – external (to the region) trip generation, internal (to the region) trip generation, and special generator trip generation.

- **The external trip generation module** estimates the internal-external (IE), external-internal (EI), and external-external (EE) truck trip table for all interregional truck trips based on commodity flow patterns that link Southern California with the rest of the country. The EI/IE HDT trips are generated using a combination of commodity flow data at the county level and 2-digit NAICS employment data at a county level. External cordons are used to forecast future year external HDT trips from the base year trip flow matrices. This module uses a TRANSEARCH database obtained from IHS/Global Insight. These data are provided as annual flows in tons and are converted to daily weekday flow using an annulation factor of 306 (6 days per week for 51 weeks) for all commodities. The flows are converted from tons to trucks using the specified payload factors varying by commodity types. These payload factors were developed using data from the 2002 Vehicle Inventory and Use Survey (VIUS).

- **The internal trip generation module** is based on trip rates (number of trips per employee or household) for ten different land use/industry sectors at the trip ends. These land use/industry sectors are households, agriculture/mining/construction, retail, government, manufacturing, transportation/utility, general warehousing, high cube warehousing, wholesale, and other (service). The socioeconomic data used by the internal HDT model is consistent with those data used by broader regional travel demand model. The trip rates for every land use were updated based on recent data collection efforts – establishment surveys and third-party truck GPS data. **Table 15** shows the trip generation rates for truck trips internal to the region. All trip rates are per employee, except for the warehouse category, for which trip rates are presented both per employee and KSF of area

- **Special generators** include the ports and intermodal facilities. Not only major-purpose trips are included, but also secondary trips like cargo trips from intermediate handling locations to final destinations. Additionally, there are empty movements of trucks

associated with port truck trips, for purposes of truck repositioning. Ports are modeled based on detailed port area zone system and specialized trip generation rates for autos and trucks by type (bobtail, chassis, and containers). Intermodal truck trips are HDT movements generated at the six regional intermodal facilities in the SCAG region.

Table 18. Internal Truck Trip Generation Coefficient for Various Land Use Categories

Category	Truck Type			All Trucks
	Light HDT	Medium HDT	Heavy HDT	
Households	0.0147	0.0046	0.0072	0.0265
Agriculture/Mining/Construction	0.0804	0.0778	0.0715	0.2297
Retail	0.0663	0.0662	0.0703	0.2028
Government	0.0296	0.0150	0.0148	0.0594
Manufacturing	0.0613	0.0655	0.0924	0.2192
Transportation/Utility	0.1579	0.1815	0.3199	0.6593
Wholesale	0.0916	0.0968	0.1316	0.32
Other (Service)	0.0095	0.0111	0.0151	0.0357
General Warehouse per Employee	0.1610	0.1850	0.3720	0.718
General Warehouse per KSF of Area	0.2819	0.2434	0.5421	1.0674
High Cube Warehouse per Employee	0.184	0.211	0.372	0.767
High Cube Warehouse per KSF of Area	0.0948	0.1272	0.3380	0.56

Based on information in the SCAG HDT model, the ratio of employee per KSF for general warehouse and is presented in **Table 19.**

Table 19. Employee per KSF Ratio in SCAG HDT model

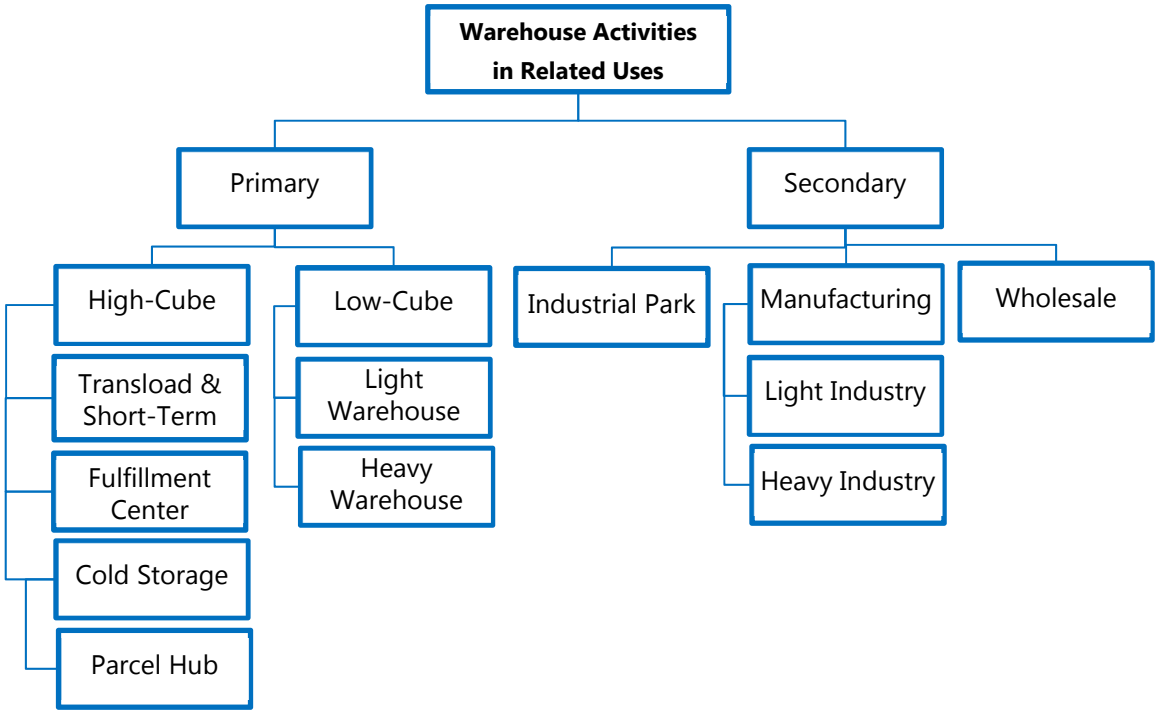
Employee per KSF Ratio	Light HDT Trip Rate	Medium HDT Trip Rate	Heavy HDT Trip Rate	Total Trucks
General Warehouse	1.75	1.32	1.46	4.52
High Cube Warehouse	1.94	1.66	1.10	4.70

The employee ratio in SCAG model seems very high compared to the ITE rates and the Fontana study. This issue was discussed with the SCAG modeling group who advised to only use the warehouse employee information from SCAG model since the 2016 RTP scenarios are based on employee variable and the warehouse square feet variable was not considered ready for use. For this reason, where necessary, employee per KSF conversion rates will be derived from the ITE Trip Generation Manual.

5.5. SUMMARY OF METHODOLOGICAL APPROACHES

Various approaches were reviewed in defining: 1) existing warehouse uses, 2) truck trip generation related to warehouse activities and 3) anticipated future warehouse growth in Riverside County. Although the equations used to estimate truck trips may differ significantly, a more important difference is the source of truck trips and the land use category that relates to each model. Unfortunately, these studies did not adopt a common definition of uses and with the rapid growth in automation in modern warehouses, the employee density may be declining while the related trucking activities may increase. However, in the absence of any other available information, the number of employee is still the primary variable to estimate trucking activities related to warehouse uses. For the purpose of this study effort, it is important to maintain the consistency between identified warehouse-related uses, their trip generation, and the future forecast of each use. **Figure 16** shows the taxonomy of various uses with major warehouse activities.

Figure 16. Taxonomy of Uses with Major Warehouse Activities



The studies that provide methods to estimate trip generation rates for various warehouse activities may aggregate some of these uses due to lack of information. Some methods are more conservative, choosing to include only heavy truck trip generators. Other methods take a more holistic approach, casting a broader net of trip types and weighting them for estimated

volume. No approach is inherently more correct than any other, but one may be more appropriate than others for a given purpose.

A desire for precision would suggest dis-aggregating land use types to the greatest degree possible. For example, distinguishing between high-cube and low-cube. However, this only useful if there is a valid forecast in the growth of these uses at the dis-aggregated level. Furthermore, in the context of impact fee programs, the concept of "rough proportionality" has been determined to be adequate as the basis for establishing a rational nexus and associated fair share fee. For these reasons, the use of more reliable, aggregated data is considered preferable for this study effort, with cross-reference to supplemental data sources to address specific study needs.

Table 20 is a summary of the trip generation data assessed in this report. These data represent the "universe" for trip generation for the purposes of this study effort, and elaborate the related land uses, available of data and applicability for study use.

Table 20. Summary of Uses Related to Warehouse Activities and Trip Generation Methodologies

Land use Category with Significant Warehouse Activity		Trip Generation Reference				SCAG Future Forecast (2040)
		Fontana Study	SCAG RTP (2012 Base Year)	SCAQMD	ITE	
Primary Warehouse Activity	High-cube transload / short-term warehouse			✓	✓	
	High-cube fulfillment center			✓	✓	✓
	High-cube cold storage			✓	✓	
	High-cube parcel hub			✓	✓	
	Light warehouse *	✓	✓		✓	✓
	Heavy warehouse **	✓	✓			
Secondary Warehouse Activity	Industrial park*	✓			✓	
	Light industry (manufacturing)	✓	✓		✓	✓
	Heavy industry (manufacturing)	✓				
	Wholesale		✓		✓	✓

✓ = available but not suitable for primary study use
✓ = available and suitable for supplemental reference
✓ = available and preferred for primary study use
*: Light warehouse also includes "low-cube" as defined by SCAG but not the Fontana Study
**: Heavy warehouse includes "high-cube" as defined by SCAG but not the Fontana Study

Table 21 summarize the trip generation rates presented in this study. It is important to use this table properly and understand the assumptions related to each reference, since there are fundamental differences.

Table 21. Summary Trip Generation Rates Related to Warehouse Activities

Land use Category with / Unit		Trip Generation Reference						
		Fontana Study		SCAG RTP [1]			SCAQMD	ITE (10TH ED)
		Per Employee	Per 1,000 GSF	Per Employee	Per 1000 SF	Per 1,000 GSF [2] (adjusted)	Per 1,000 GSF	Per 1,000 GSF*
Primary Warehouse Activity	High-cube transload /short-term warehouse	0.951	0.725	0.767	0.560	0.384	0.454	0.444
	High-cube fulfillment center						0.717	0.717
	High-cube cold storage						0.836	0.75
	High-cube parcel hub						4.007	2.918
	Light/General warehouse	0.732	0.327	0.673	1.065	0.897	-	0.348
Secondary Warehouse Activity	Industrial park	1.173	0.583	-	-	-	-	0.438
	Light industry/ manufacturing	1.722	2.513	0.219	-	-	-	0.992
	Heavy industry	1.469	2.926		-	-	-	-
	Wholesale	-	-	0.32	-	-	-	0.302

[1] Source: SCAG Internal HDT Truck Model Development Report, 2012

[2] Assuming 2000 square feet per employee in High cube warehouse and 750 square feet per employee in general warehouse

The SCAG HDT model is the only source that provides future forecast for warehousing uses. It provides aggregate level data for high-cube and low-cube warehouse uses, as well as data for secondary manufacturing and wholesale activities, and for consistency, it is the primary recommended data source for this study. Furthermore, the SCAG 2016 RTP model applies trip rates differentiated between general and high-cube warehouse and forecast truck trips from 10 land use types including general and high-cube warehouses. The rates presented in the Fontana study and most recent ITE manual (which incorporates findings from the SCAQMD study) provide supplemental information that can be used to modify the trip rates in the SCAG HDT model to provide further disaggregation of results, as needed.

6. DIAGNOSTIC TESTS OF SCAG MODEL

Best practice for traffic forecasting includes, among other things, checking the traffic model to make sure that it provides reasonable forecasts for the specific area(s) under study. The forecasting model that was selected for this study is the model developed by SCAG for the 2016 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS)[3]. This model was selected because it incorporates the current adopted transportation and land use plan (the 2016 RTP/SCS)[4] and because it covers a sufficiently large geographic area to capture both ends of truck trips to and from logistics warehouses in Riverside County. The SCAG model was validated on a region-wide basis prior to its use for the RTP/SCS[5]. The diagnostic checks conducted for the current study pertained to the model's ability to accurate represent truck trips on freeways in Riverside County.

This first test was to see whether the model replicated the distribution of truck trips based on origin and destinations within the county and in neighboring counties. Utilizing the O-D data described previously, the model results were compared. **Table 22** shows that the model replicates the distribution of truck trips derived from the O-D data very closely.

Table 22: Check of County-Level Truck Origin-Destination Distribution

Trip Type	O-D Survey	2016 SCAG Model
Heavy Trucks		
Internal to Riverside County	47%	46%
One trip-end in Riverside County	53%	54%
Medium Trucks		
Internal to Riverside County	78%	80%
One trip-end in Riverside County	22%	20%

[3] SCAG Standard Disclaimer: "The following modeling analysis was performed by WSP based upon modeling information originally developed by the Southern California Association of Governments (SCAG). SCAG is not responsible for how the Model is applied or for any changes to the model scripts, model parameters, or model input data. The resulting modeling data does not necessarily reflect the official views or policies of SCAG. SCAG shall not be held responsible for the modeling results and the content of the documentation."

[4] Note that the current versions of the two other candidate models, namely RivTAM and the CVAG model, are both based on the (now superseded) 2012 RTP/SCS.

[5] See: *SCAG Regional Travel Demand Model and 2012 Model Validation*, SCAG, March 2016

The next check was to determine how well the model represented traffic flows on Riverside County freeways in the AM and PM peak hours. **Figure 17** and **Figure 18 c**ompare the model's 2016 traffic volumes to counts of actual traffic taken from the Caltrans' Performance Measurement System (PeMS). The figures also show a shaded area that represents the allowable deviation based on Caltrans guidelines[6]. A model is considered generally valid if 75% of the points fall within the allowable deviation. Based on this criterion, the SCAG model is generally valid for Riverside Counties in both the AM peak period (77% within allowable deviation) and the PM peak hour (81%). The figures also show that the model tends to slightly over-estimate traffic, which is a tendency that can be corrected by factoring down the forecasts during post-processing. However, the results indicate a particularly acute overestimation for the traffic on SR-91. Subsequent investigation has determined anomalies in the PeMS data for these locations causing the appearance in the charts that the model is overestimating when in reality, the results are more likely in the same realm as other sampled locations.

The next check was to see how well the SCAG model forecasts truck traffic on freeways in Riverside County, which is particularly relevant to determining the effectiveness of the model for use in this study effort. This test was performed by dividing the Riverside County freeway network into sections, as illustrated in **Figure 19**, and comparing the model's 2016 truck volumes on each section with Caltrans' truck volume data. **Table 23** shows that the model generally does a good job of forecasting truck traffic on the study freeways. The only notable exceptions are for the sections of SR-60/I-215 and SR-91 within the City of Riverside, where the model is over-forecasting truck trips by about a factor of 3. Since the model matches the counts with regards to the percentage of trucks (see the right-most column in **Table 23**, the over-estimate of trucks in the vicinity of Riverside appears to be mainly due to the general over-estimation of trucks in that area, and is consistent with the over estimation of traffic in this area as described previously and illustrated in **Figure 17** and **Figure 18**.

Correcting the general over-forecast of traffic in the vicinity of the City of Riverside central business district should reduce the tendency to over-forecast trucks on those sections of the freeway system. With resolution of this apparent anomaly in the SCAG model, the overall findings of the diagnostic tests of the SCAG model indicate that, with some minor post-processing, it can provide very reasonable forecasts of traffic, and specifically truck traffic, on freeways in Riverside County, and therefore is suitable for use to support the subsequent study evaluation efforts.

[6] *Travel Forecasting Guidelines,* Caltrans, November 1992

Figure 17: Comparison of Model to Actual Traffic in the AM Peak Hour

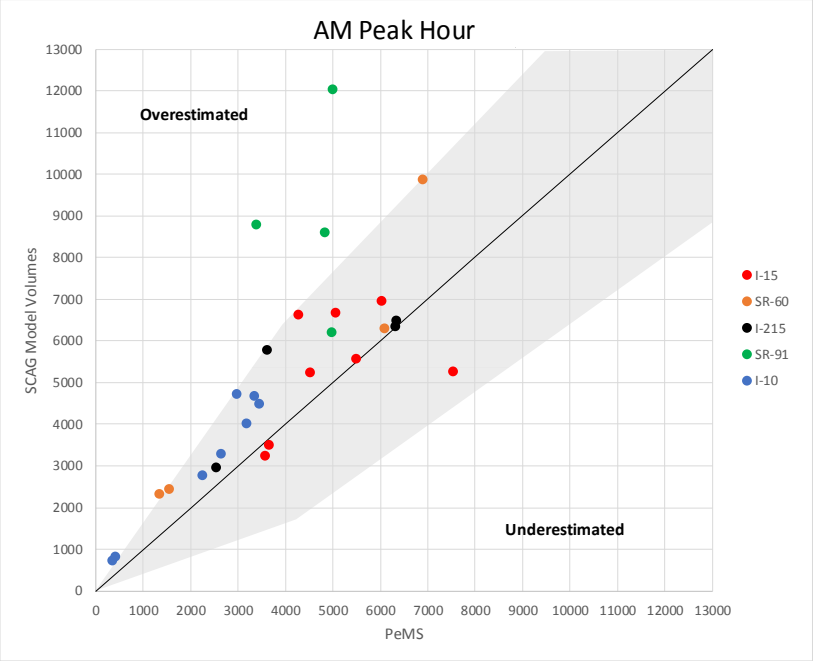


Figure 18: Comparison of Model to Actual Traffic in the PM Peak Hour

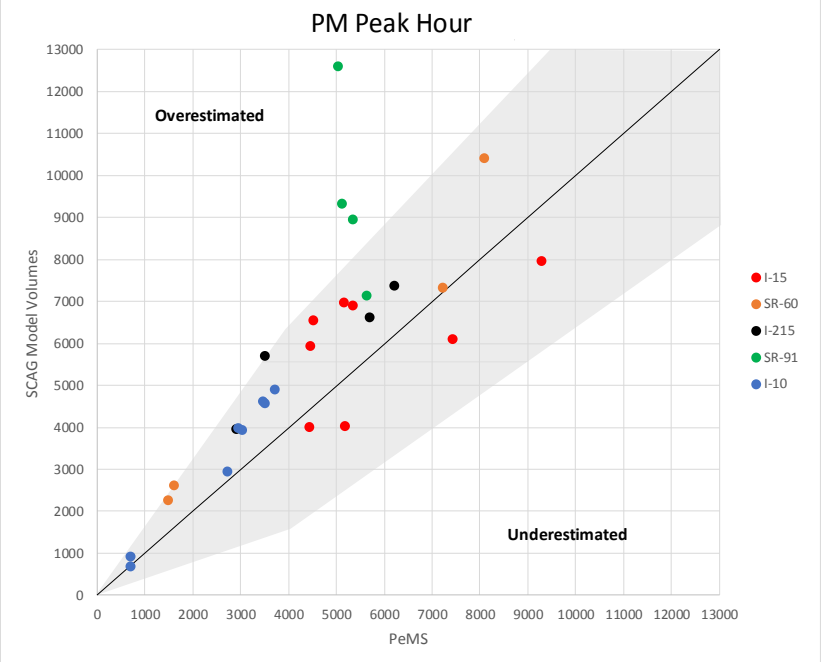


Figure 19: Freeway Sections Used to Check Truck Forecasts

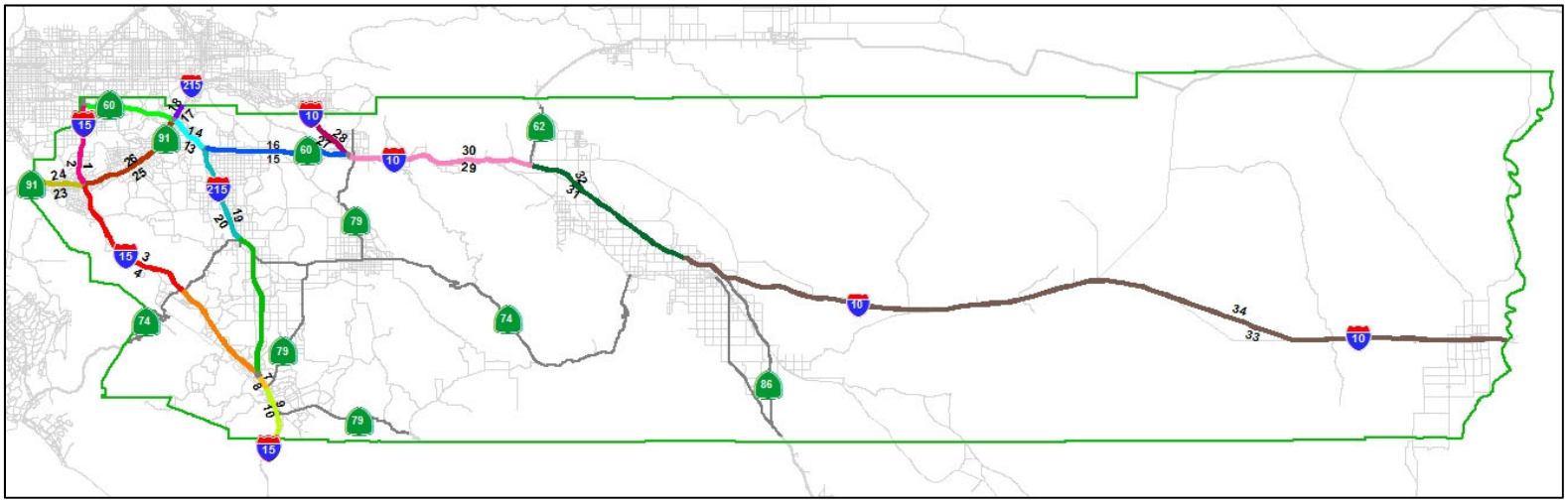


Table 23: Comparison of Model's Truck Volumes to Counts of Actual Truck Traffic

ID	Route	SCAG 2016 Model Daily Volumes			AADT 2015 (Census)			Counts		Difference in Heavy Truck Percentage
		Total Vehicles	Heavy Trucks	Heavy Trucks %	AADT	4+ Axle AADT	Heavy Truck %	Difference Heavy Trucks	Ratio	
1&2	I-15	185,621	9,165	4.9%	151,000	9,082	6.0%	83	1.01	-1.1%
3&4	I-15	139,861	10,033	7.2%	117,000	5,762	4.9%	4,271	1.74	2.2%
7&8	I-15	197,698	9,092	4.6%	190,000	5,857	3.1%	3,235	1.55	1.5%
9&10	I-15	153,487	6,932	4.5%	159,000	6,226	3.9%	706	1.11	0.6%
13&14	SR-60/I-215	210,042	19,361	9.2%	170,000	5,367	3.2%	13,994	3.61	6.1%
15&16	SR 60	66,192	10,448	15.8%	61,000	6,929	11.4%	3,519	1.51	4.4%
17&18	I-215	189,324	7,187	3.8%	153,000	9,747	6.4%	-2,560	0.74	-2.6%
19&20	I-215	121,827	5,590	4.6%	120,000	6,120	5.1%	-530	0.91	-0.5%
23&24	SR-91	276,622	23,815	8.6%	247,000	8,040	3.3%	15,775	2.96	5.4%
25&26	SR-91	191,400	13,614	7.1%	209,000	8,036	3.8%	5,578	1.69	3.3%
27&28	I-10	109,361	9,708	8.9%	93,000	7,821	8.4%	1,887	1.24	0.5%
29&30	I-10	131,961	18,801	14.2%	118,000	16,844	14.3%	1,957	1.12	0.0%
31&32	I-10	96,719	16,418	17.0%	84,000	15,939	19.0%	479	1.03	-2.0%
33&34	I-10	30,654	10,415	34.0%	23,700	7,424	31.3%	2,991	1.40	2.6%

7. DATA ADEQUACY FINDINGS AND RECOMMENDATIONS

The objective of this technical memorandum is to present an overview of warehousing and logistics related development activity in Riverside County, and the availability of appropriate data to assess the impact of this development over time. This document is also intended to provide transparency in the study process by presenting background information regarding the range of data sources available to support the evaluation to be conducted in subsequent tasks.

The review of available data has revealed that Riverside County can expect to see continued development of warehousing and logistics uses in the future, and that growth in warehousing and logistics uses, although focused in specific zones, will occur in cities across Western Riverside County and the Coachella Valley, thereby likely generating impacts across the freeway system. Growth is expected to continue for both low-cube and high-cube warehousing and logistics uses supporting consideration of the impacts associated with the full range of associated development as part of this study, although it is anticipated that the rate of this type of development will decline over time as land availability is reduced for these uses.

SCAG demographic forecasts are provided based on number of employees, although impact fees are most readily applied based on total building (or site) area. The SCAG forecasts follow the NAICS structure which includes several categories associated with warehousing and logistics uses. The NAICS breakdown of employment categories utilized by SCAG supports extraction of warehousing and logistics employment from other uses as the basis to estimate growth in warehousing and logistics use over time. And while the SCAG Warehouse Study information that is expected to incorporate information relating to the growth in building area of warehousing is not considered suitable for use at this time, the availability of various employee to building area ratios will support conversion of the SCAG growth forecasts into growth in building area for the purposes of determining a fee. Furthermore, the availability of trip generation rates for a range of differing warehouse and logistics use types (based on employees and building area) will support the ability to determine a fair share fee amount to reflect the differing levels of impact associated with a variety of different types of warehousing and logistics uses.

A comparison of model outputs, O-D study results and actual traffic counts indicates that the SCAG model does a good job of replicating existing truck travel patterns and traffic conditions on the Riverside County freeway system. Furthermore, anomalies in the model results appear to be explicable and able to be resolved with limited post processing of results. This finding

supports the use of the SCAG model as the primary evaluation tool for study evaluation, with supporting information able to be derived from a variety of other sources for validation and post processing of results to accomplish study needs.

The assessment associated with this study task has determined that a range of adequate, suitable data is available to support the determination of impacts associated with warehousing and logistics uses in Riverside County, and more specifically, the cost associated with mitigating the cumulative regional impacts of new warehousing and logistics development on the freeway system in Riverside County. The specific methodology for applying the various data sources to the study evaluation will be described in subsequent Technical Memoranda. In addition, these subsequent documents will present the study findings and results providing the framework for consideration to establish a regional logistics impact fee program.