FINAL REPORT
APRIL 2017

ORANGE COUNTY

GOODS MOVEMENT

OCTA

FEHR & PEERS

CAMBRIDGE SYSTEMATICS

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SUMMARY

This report represents a comprehensive look at goods movement within and through Orange County. While Orange County has been viewed as largely a "pass through" area for freight, the reality is that a significant level of freight activity is generated within Orange County. The Southern California Association of Governments (SCAG) database shows that Orange County has more than 34 million square feet of occupied warehouse space and four intermodal facilities. Orange County is also poised to take advantage of the emerging trend in localized, real-time manufacturing (such as 3D printing) due to: an educated workforce, proximity to the San Pedro ports, and proximity to the San Diego/Mexico market.

In December 2015, the federal FAST (Fixing America's Surface Transportation) act was adopted. It provides the first dedicated funding source for freight, with both a formula and discretionary element. California adopted its first statewide freight plan in 2016 and is currently in the process of identifying critical urban and rural freight corridors for funding eligibility. These actions suggest that Orange County should be more deliberate in identifying its freight system and needs, to both see how it fits within the broader context and to be eligible for funding opportunities. This document identifies several actions, in Chapter 2, that address this:

- Identifying a first/last-mile truck route designation in the Regional Transportation Plan (RTP) and/or Master Plan of Arterial Highways (MPAH).
- Identifying standards for these fist/last mile facilities.
- Consider freight needs/benefits in determining priorities for funding major road improvements.
- Include truck parking, with electrified idling, in future local and regional long-range plans, and consider parking projects for federal funding.

Despite the progress in federal and state funding for freight-related projects, the total pool is limited and Orange County has been hurt by a loss in sales tax revenue due to the trend of increased on-line shopping. When an Orange County resident makes an on-line purchase, state law dictates that the sales tax goes to the location where the order is filled, which is often outside Orange County. One of the actions suggested in this report is for The Orange County Transportation Authority (OCTA) to work with other urban agencies in California and throughout the country to explore and promote changes to how the sales tax location is determined. Other potential funding-related actions include exploring a county-wide fee program specific to freight and supporting a pending federal bill (Lowenthal) for a 1% transportation freight tax towards freight-related infrastructure.

Emissions rates from heavy-duty trucks are almost double the rate of all vehicles, as they account for 15% of Orange County mobile-source emissions while representing 7% of the vehicle-

miles-travelled (VMT), (Source: EMFAC2014). While vehicle emission regulations are within the control of state and federal agencies, OCTA can promote and facilitate the implementation of more electrification in private yards and truck stops within Orange County to reduce idling under diesel power.

Although Orange County does not have large areas of undeveloped, low-cost land that is suitable for warehousing and distribution, it does have the skilled labor and location (near San Pedro ports and I-5) to compete for segments of more specialized manufacturing and emerging freight technologies. This report identified a few related actions:

- Collaborating with local agencies to identify ways to recruit/promote 3D printing and other "light" manufacturing via favorable guidelines, zoning, and promotions.
- Encourage and/or facilitate partnerships between public and private entities to test, enhance, refine, and promote alternative transportation technologies.

The data available to understand the magnitude and pattern of freight movement in Orange County (and nationally) is limited. Moreover, there aren't consistent databases or protocols to track trends over time. Therefore, this report recommends working with Caltrans to expand the network of Weigh-in-Motion (WIM) stations in Orange County and to maintain them as operable.

Freight is receiving increased attention throughout the country, both in the technical and political arenas. Orange County is positioned to be very relevant in this increasingly technical element of the economy. This report serves as a platform for OCTA to be more deliberate in shaping the county's future policies and funding with respect to freight.

CHAPTER 1. CONTEXT

Introduction

The Orange County Transportation Authority (OCTA) commissioned this study to understand the context of goods movement in Orange County, regional and national trends, and potential near-term actions that OCTA may consider. Note: The terms "goods movement" and "freight" are used interchangeably in this report, as there is not an adopted professional nomenclature. Specifically, this study:

- Establishes a deeper understanding of freight movement in Orange County, including the use of big data to quantify origins/destinations of trucks
- Provides an understanding of the primary freight generators in Orange County via both truck and land use data
- Identifies industry trends with respect to warehousing and distribution
- Suggests which technologies (such as automated deliveries) are likely to have a meaningful impact in a 20-year horizon
- Recommends strategies for OCTA to consider promoting or facilitating

The findings in this report should be useful for long-range planning and identifying potential funding applications for state/federal grants related to goods movement.

This chapter presents a summary of the current condition of goods movement in Orange County, both in a regional context and local details. The bulk of the information presented is based upon technical data, which the authors acknowledge is not complete with respect to goods movement, given that much of the supply-chain is completely within the private sector, for which data is not generally available. However, the information in this document presents a comprehensive look at goods movement within Orange County.

Socio-Economic Conditions Related to Goods Movement

Orange County consists of 790.57 square miles[1] of land area and 34 incorporated cities. As of January 1, 2016[2], the California Department of Finance estimated the County's population at 3,183,011 persons (ranking 6th in the nation and

[1] U.S. Census Bureau, Population, Housing Units, and Land Area – County, California and U.S., 2010

[2] California Department of Finance, County Population Estimates for January 1, 2016, May 2016. Available: http://www.dof.ca.gov/Forecasting/Demographics/Estimates/e-1/documents/E-1_2016PressRelease.pdf (last accessed on August 29, 2016)

3rd in California) and 1,075,705 housing units (also ranking 6th in the nation and 3rd in California). California Employment Development Department (EDD) estimated the County's labor force at 1,630,000, employment at 1,555,300, and unemployment rate at 4.6 percent (July 2016[3]). U.S. Bureau of Economic Analysis (BEA) estimated the total personal income for Orange County at $173 million (ranking 5th in the nation and 2nd in California)[4]. Population and personal income drive demand for consumer goods, such as food supplies, construction materials, furniture, electronics, plastic products, etc. for homes and offices.

Comparisons of Orange County's population density, housing density, per capita income, unemployment rate and taxable retail and food services related sales to that of California and U.S. are provided in **Table 1-1**. This shows that Orange County would have much more intensive land use and truck trip generations and terminations per square mile than California and the U.S. as a whole to meet the demands for goods of its population and businesses. Due to a wide income disparity, the rank of Orange County drops significantly in terms of per capita income, although it is one of the wealthiest counties in the nation in terms of total personal income.

Orange County has many location advantages that make it suitable as an international trade hub and a manufacturing base. The location advantages in particular include proximity to nationally significant San Pedro Bay Ports of Long Beach/Los Angeles Ports and the westernmost California – Mexico border crossings at San Ysidro and Otay Mesa, closeness to the nationally significant import hub of the Inland Empire across Riverside and San Bernardino Counties, proximity to the Union Pacific Railroad's Intermodal Container Transfer Facility (ICTF) yard, intermodal yards in Los Angeles, City of Industry and San Bernardino, and proximity to airports such as Los Angeles International Airport, Santa Ana's John Wayne Airport, Long Beach Airport and Ontario International Airport. In terms of international trade volumes, the ports are dominant, and a relatively small amount of international cargo is handled at border crossings and the airports. According to the Maritime Administration, The Long Beach/Los Angeles Ports handle 10.4 million loaded containers (both imports and exports), which is over 32% of the nation's total loaded containers and over 73% of the U.S. Pacific Coast's total loaded containers[5].

[3] California Employment Development Department (EDD), New Release dated August 19, 2016. Industry Employment & Labor Force Information – July 2016 (Preliminary) – Not Seasonally Adjusted. http://www.labormarketinfo.edd.ca.gov/file/lfmonth/oran$pds.pdf (last accessed on August 29, 2016)

[4] U.S. Bureau of Economic Analysis (BEA), Total Personal Income by County, 2014

[5] U.S. Department of Transportation, Maritime Administration, U.S. Waterborne Container Trade by U.S. Customs Port, 2015.

Table 1-1. Comparisons of Population Density and Per Capita Income, Orange County versus California versus U.S.

Factor	Orange County	California	U.S.
2010 Population Density (in persons per square mile)*	3,807.7 (32nd rank in nation, 2nd rank in California)	239.1	87.4
2010 Housing Density (in units per square mile)*	1,326.8 (40th rank in nation, 2nd rank in California)	87.8	37.3
2014 Per Capita Income (in dollars per employee)**	$55,096 (211th in nation, 9th rank in California)	$49,985	$46,049
2016 Unemployment Rate (Not Seasonally Adjusted)***	4.6 percent	5.9 percent	5.1 percent
2014 Total Taxable Retail and Food Services related Sales (in billions of dollars)****	$41 billion	$420 billion	$5,212 billion

Source: *U.S. Census Bureau, Population Density and Housing Density – County, California and U.S., 2010, **U.S. Bureau of Economic Analysis (BEA), Per Capita Income – County, California and U.S., 2014, ***California Employment Development Department's (EDD) Labor Market Information for Orange County, August 19, 2016, Available at: http://www.labormarketinfo.edd.ca.gov/file/lfmonth/oran$pds.pdf

According to the 2015 International Trade Forecast by Woods Center for Economic Analysis and Forecasting (WCEAF) at California State University Fullerton:

"Merchandise exports for Orange County have exceeded $23 billion over the last four years and are vital to the economic growth of the county. Orange County is ranked 15th in the nation among metro areas based on its economic output, and 45th largest in the world, coming ahead of Singapore which is ranked 46th. In 2014, merchandise exports accounted for 11.0% of its Gross Metropolitan Product. In terms of merchandise exports, Orange County ranks ahead of San Jose-Sunnyvale-Santa Clara and San Diego-Carlsbad MSA."

"Orange County's two main export sectors in 2014 were Computers & Electronic Products with $5.8 billion (24.9% of merchandise exports) and Transportation Equipment with $5.0 billion (21.6% of merchandise exports)."

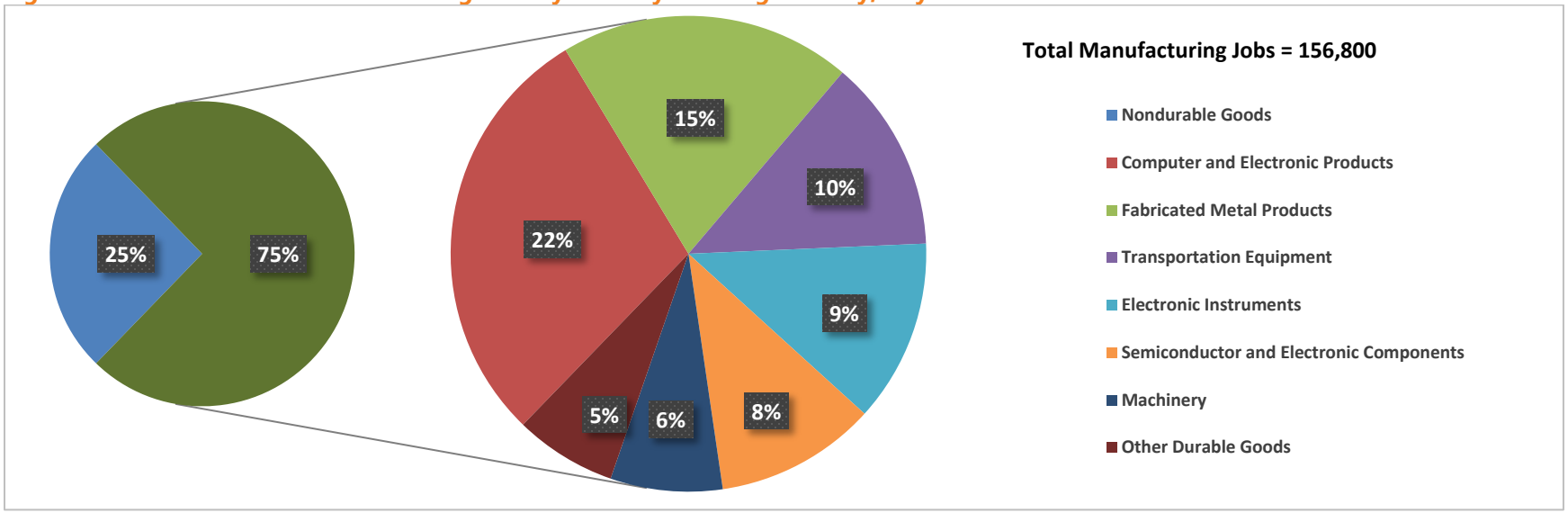
In July 2016, Orange County had 258,900 jobs in goods producing sectors, of which 156,800 jobs were in manufacturing[6]. Durable goods manufacturing made up 75 percent of the total manufacturing jobs. Among durable goods manufacturing, the leading industries are shown in **Figure 1-1**. Other durable goods include biotechnology products. Major employers in Orange County include Boeing Co at Seal Beach, Broadcom Corp at Irvine, Edwards Lifesciences Corp in Irvine, Raytheon Co in Fullerton, Verizon Wireless at Irvine, and Vitamin Shoppe in Costa Mesa.[7]

[6] California Employment Development Department's Labor Market Information – Historical Data for current employment statistics (CES) in Orange County, Available at: http://www.labormarketinfo.edd.ca.gov/ (last accessed on August 29, 2016)

[7] Major Employers in Orange County, Available at: http://www.labormarketinfo.edd.ca.gov/majorer/countymajorer.asp?CountyCode=000059 (last accessed on August 29, 2016)

NOTE: The list of major employers was extracted from the America's Labor Market Information System (ALMIS) Employer Database, 2016 2nd Edition. Employer information is provided by Infogroup, Omaha, NE.

Figure 1-1. Distribution of Manufacturing Jobs by Industry in Orange County, July 2016



Source: California Employment Development Department's Labor Market Information – Historical Data for current employment statistics (CES) in Orange County, Available at: http://www.labormarketinfo.edd.ca.gov/ (last accessed on August 29, 2016)

Both international trade and manufacturing in Orange County are supported by a large trade, transportation and utilities sector with nearly 264,400 jobs as of July 2016, of which retail trade made up about 57 percent (151,800 jobs), wholesale trade made up about 32 percent (85,000 jobs), transportation and warehousing made up about 9 percent (24,400 jobs) and the utilities made up less than 2 percent (3,200 jobs).

In addition to international trade and manufacturing, tourism is also a major industry in Orange County due to the presence of scenic beaches that host events from international surf and beach volleyball competitions in Huntington Beach (aka, Surf City) to internationally renowned artists festivals in Laguna Beach, two major theme parks - Disneyland and Knotts Berry Farm, major league sporting venues – Anaheim Angels and Anaheim Ducks, and proximity to attractions in Los Angeles and San Diego such as Hollywood and Seaworld. This leads to a large number of restaurants, food services, and other eating and drinking places. Demand for food ingredients and stationery products in Orange County are thus expected to be higher than normal for U.S. counties of the same size.

Infrastructure Setting

The following section describes infrastructure that context and how it influences where goods flow and what mode is used.

Ports

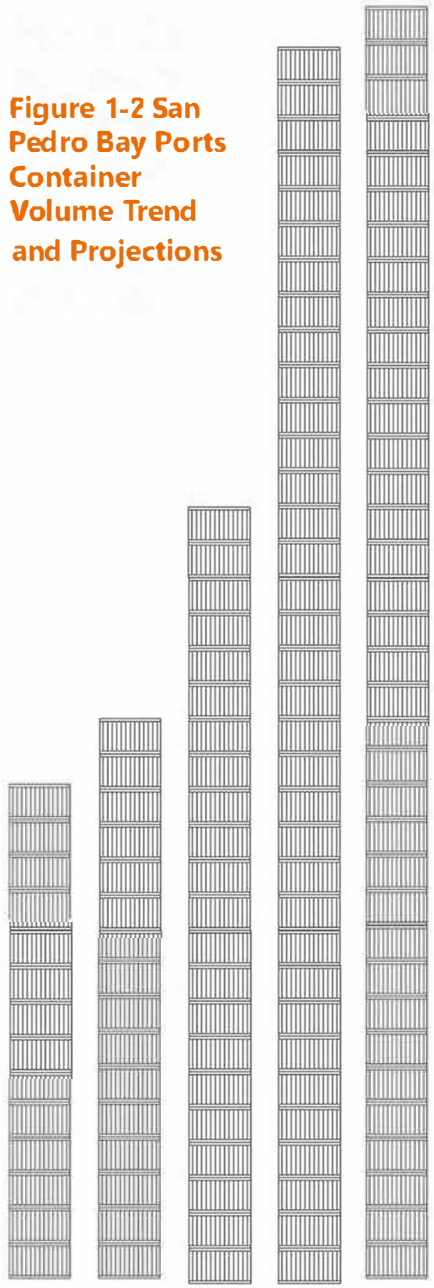
Sea Ports

Serving as the largest container port complex in the U.S., the San Pedro Bay Ports handled approximately 10.4 million containers in 2015, valued at approximately $400 billion. Total container volume for the San Pedro Bay Ports is expected to grow to 36 million by 2035, a 125 percent increase over the next two decades (**Figure 1-2**). SCAG is conducting the next phase of its east/west freight study that will provide an updated survey of LA/LB port activity.

Airports

The region is home to numerous air cargo facilities, including Los Angeles International Airport (LAX) and Ontario International Airport (ONT). Together they handled more than 99 percent of the region's air cargo, valued at more than $92 billion in 2014. As shown in **Table 1-2**, John Wayne Airport (SNA) only accounts for 1% of the air cargo generated in the LA Metropolitan Area.

Figure 1-2 San Pedro Bay Ports Container Volume Trend and Projections



SOURCE: PORTS OF LONG BEACH & LOS ANGELES. BASED ON FEB 2015 FORECASTS

Table 1-2. 2015 Airport Volume (Passenger and Freight), Total Volume and as Percent of Total

	From Los Angeles Metropolitan Area						To Los Angeles Metropolitan Area					
	PASSENGER		FREIGHT (POUNDS)		MAIL (POUNDS)		PASSENGER		FREIGHT (POUNDS)		MAIL (POUNDS)	
BUR	1,807,523	4%	50,300,273	2%	816,643	1%	1,803,765	4%	44,017,764	2%	1,498,850	2%
LAX	33,332,222	78%	1,738,425,963	76%	70,971,750	74%	33,235,109	78%	1,894,652,981	79%	61,527,051	72%
LGB	1,124,811	3%	32,850,138	1%	38,721	0%	1,120,845	3%	22,234,544	1%	1,686,713	2%
ONT	1,906,386	4%	433,792,420	19%	22,232,401	23%	1,903,310	4%	420,296,590	18%	21,111,071	25%
SNA	**4,515,475**	**11%**	**24,246,776**	**1%**	**2,068,884**	**2%**	**4,530,782**	**11%**	**13,573,950**	**1%**	**51**	**0%**
Total	42,686,417	100%	2,279,615,570	100%	96,128,399	100%	42,593,811	100%	2,394,775,829	100%	85,823,736	100%

SOURCE: BTS AIR CARRIERS T-100 SEGMENT FROM SCAG 2016 RTP/SCS

Warehousing/Distribution Centers

Occupied warehouse space within the Southern California region is shown in **Table 1-3**, and **Figures 1-3** and **1-4** map this information. **Figure 1-3** illustrates region-wide locations of warehouse and distribution centers, while **Figure 1-4** shows industrial land uses. Orange County has approximately 5% of the occupied warehouse space in the Southern California Association of Governments region. Preliminary findings from SCAG warehousing study shows increasing warehouse automation, 24/7 operation, and replacing single story facilities with multi-story buildings to increase the efficiency and use of scarce land.

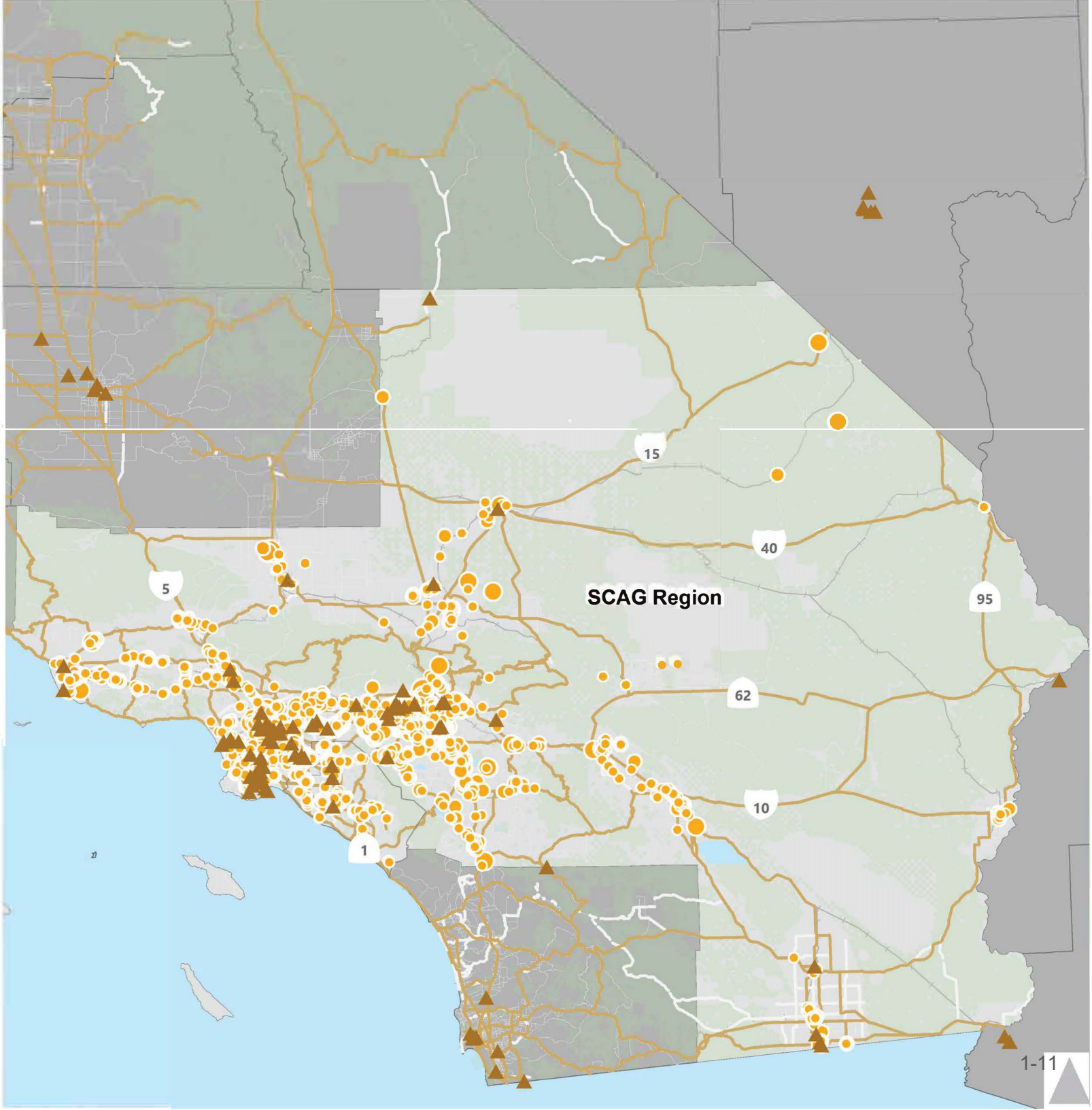
There are four intermodal centers in Orange County, including truck-air facilities at John Wayne Airport in Costa Mesa. Rail-truck intermodal facilities are also located in Orange, Buena Park, and Anaheim. The greatest concentration of warehousing and industrial activities in Orange County is along the SR-91, SR-57, and I-5 corridors, as well as along the western boundary with Los Angeles County.

Table 1-3. Occupied Warehouse Space in the Southern California Association of Governments Region

County	Square Footage	Percent of Total
Imperial	7,273,270	1%
Los Angeles	310,696,717	45%
Orange	**34,488,034**	**5%**
Riverside	136,421,050	20%
San Bernardino	164,716,871	24%
Ventura	40,246,918	6%
Total	693,842,860	100%

SOURCE: SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS

Figure 1-3. Industrial Land Uses In the SCAG Region



SOURCE: STREETLIGHT (2015); ORANGE COUNTY ASSESSOR'S OFFICE (2010)

Figure 1-4. Industrial Land Uses

Truck Network

Warehouse Space

Intermodal Facility

Truck Traffic

Lower truck origins and destinations

Higher truck origins and destinations

SOURCE: STREETLIGHT (2015); ORANGE COUNTY ASSESSOR'S OFFICE (2010)

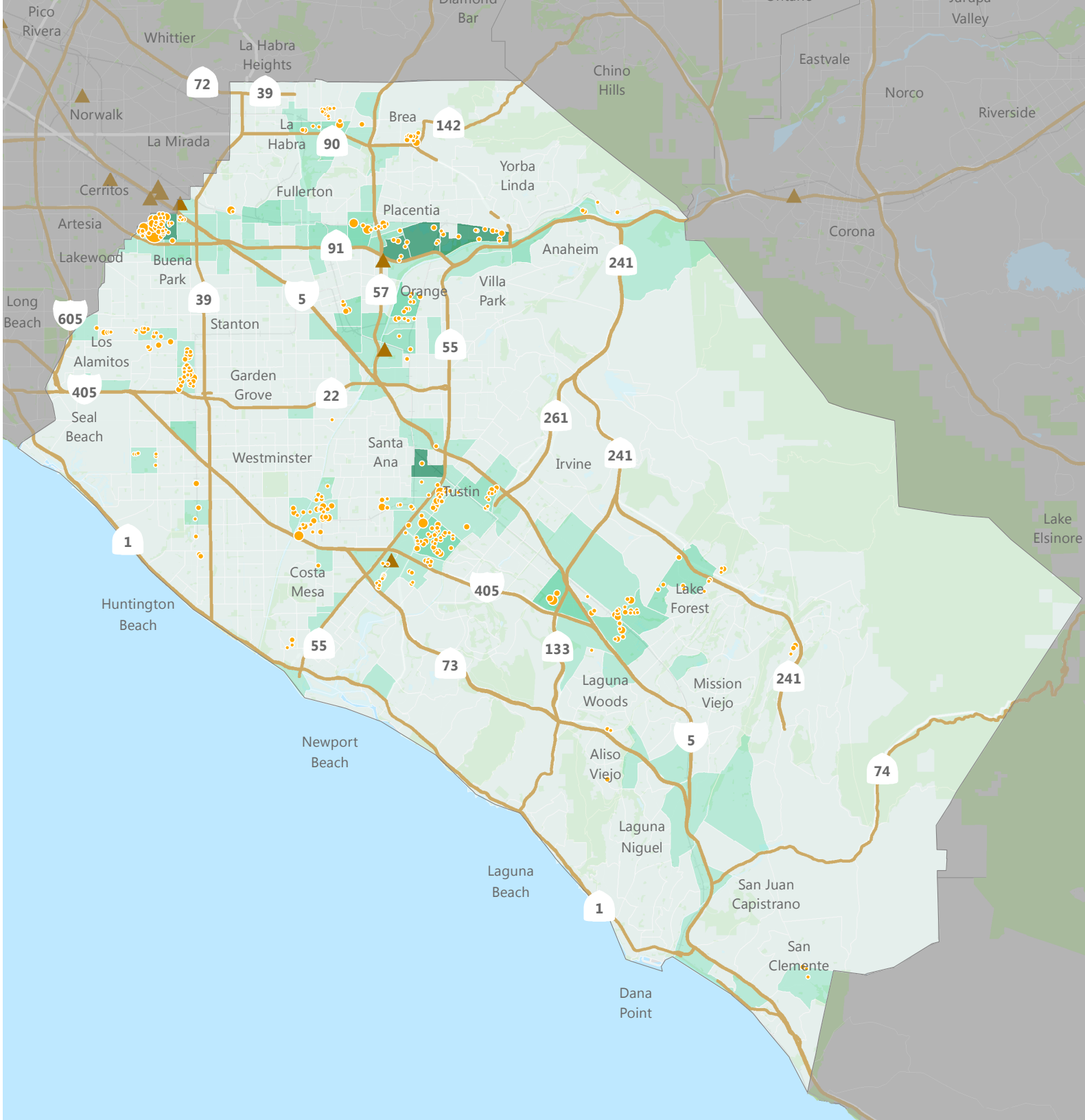


Figure 1-5 shows share of warehouse buildings by type for facilities larger than 50,000 sq. ft. in Orange County. The average year built for these facilities is 1981 with the oldest being refrigerated facilities in 1973.[8] Given the age of these facilities and their equipment, they are generally not as efficient as modern facilities recently built in Riverside or San Bernardino County. Modern facilities have higher operational capacity, thereby being able to handle higher volume within the same building footprint. Consequently, Orange County may experience even higher trucking activates related to these warehouses and distribution centers if they are modernized.

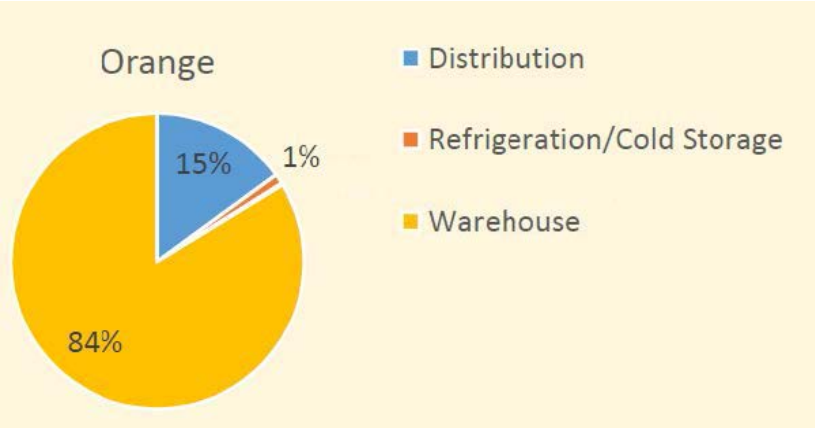


Figure 1-5. Warehouse Building Types in Orange County
SOURCE: "INDUSTRIAL WAREHOUSING IN THE SCAG REGION STUDY UPDATE," Akiko Yamagami.

[8] Yamagami, Akiko. "Industrial Warehousing in the SCAG Region Study Update." SCAG presentation to The Transportation Committee. Presented on September 1, 2016.

Rail

Orange County is traversed east/west by a Class I railroad; the Burlington Northern Santa Fe Railway (BNSF), whose railway mainline travels between Los Angeles and San Bernardino Counties through parts of northern Orange County, in the cities of Yorba Linda, Anaheim, Buena Park, Fullerton, and Placentia. In addition, the Los Angeles/San Diego Rail Corridor (LOSSAN) runs north/south through the county. According to the federal survey of interstate goods movement (Freight Analysis Framework), over 13 million tons of cargo was transported by rail from Southern California to other areas of the United States in 2012.

As a bridge between Los Angeles County and the Inland Empire, Orange County experiences a "pass through" of goods movement traffic via rail. **Figure 1-6** shows the regional rail network, including the BNSF San Bernardino subdivision that passes through Orange County.

Significant growth in freight rail traffic is expected on most segments of the Southern California regional rail system due to the region's economic growth. **Table 1-4** shows 2012 and projected 2040 peak day train volumes on BNSF segments that traverse the Orange County. For the LOSSAN corridor, daily

freight train traffic is expected to increase from 6 to 12 trains by 2025.

The SCAG multi-county goods movement action plan identified the mainline rail capacity limitations in Orange County as a major issue. Increases in railroad traffic will require ongoing infrastructure investment to maintain the facilities. Increased rail traffic also has an impact on roadway traffic and congestion, as more trains will result in increased wait times for vehicles at at-grade crossings—as much as 5,500 vehicle hours of delay per day at the regional level by year 2040.[9] As indicated in the SCAG 2016 RTP, the proposed rail improvement has several components: mainline rail improvements including double or triple tracking, and rail highway grade separations. The detailed rail improvements within Orange County are listed in **Table 1-5.**

[9] SCAG: THE 2016-2040 REGIONAL TRANSPORTATION PLAN/SUSTAINABLE COMMUNITIES STRATEGY - A Plan for Mobility, Accessibility, Sustainability and a High Quality of Life. Adopted April, 2016. Page 57.

Table 1-4. Peak Day Freight Train Volume within Orange County

Line Segments	2012	2040
BNSF San Bernardino Sub Hobart-Fullerton	36	80
BNSF San Bernardino Sub Atwood-West Riverside	40	91

SOURCE FOR ABOVE TABLE: SCAG 2016 RTP

SOURCES FOR ORANGE COUNTY RAIL INFORMATION: SCAG 2016 RTP, OCTA GOODS MOVEMENT PROGRAM

Figure 1-6. Southern California Regional Rail Network

BNSF San Bernardino Subdivision:
- Hobart to Fullerton
- Fullerton to Atwood
- Atwood to W Riverside
- W Riverside to Colton

BNSF Cajon Subdivision:
- Colton to Silverwood
- Silverwood to Barstow

UP Alhambra Subdivision:
- Yuma Junction to Pomona
- Pomona to W Colton

UP LA Subdivision:
- East LA to Pomona
- Pomona to W Riverside

UP Mojave Subdivision:
- W Colton to Silverwood
- Silverwood to Mojave

UP Yuma Subdivision:
- UP Yuma Subdivision

- UPEast Bank
- UP Coast Line
- UP Santa Clarita Line
- Main Line Rail
- Commuter Rail Network

Source: SCAG

Table 1-5. Rail Projects in Orange County

Type	Project	Description
Rail Mainline Improvement	BNSF Triple Tracking	10 miles of triple track from Fullerton to Orange/Riverside County line
	Fourth Main Track, Fullerton to Hobart	A fourth main track along the Hobart to Fullerton segment of BNSF San Bernardino (SB) subdivision
Financially Constrained Grade Separation	Raymond Avenue	Separated from BNSF SB subdivision - Under Construction
	State College	Separated from BNSF SB subdivision - Under Construction
	Placentia Avenue Undercrossing	Separated from BNSF SB subdivision - Completed
	Kraemer Boulevard	Separated from BNSF SB subdivision - Completed
	Orangethorpe Avenue	Separated from BNSF SB subdivision - Under Construction
	Lakeview Avenue	Separated from BNSF SB subdivision - Under Construction
	Tustin Avenue/Rose Drive	Separated from BNSF SB subdivision - Under Construction
	Jeffery Road	Separated from LOSSAN Corridor - Completed
	State College Blvd	Separated from LOSSAN Corridor - Planned *
	Santa Ana Blvd	Separated from LOSSAN Corridor - Planned *
	17th Street	Separated from LOSSAN Corridor - Planned *
Strategic (unfunded) Grade Separation	Jefferson St (Anaheim)	Separated from BNSF SB subdivision *
	Van Buren Ave (Placentia)	Separated from BNSF SB subdivision *
	Richfield Rd (Placentia)	Separated from BNSF SB subdivision *
	Kellogg Dr Undercrossing (Anaheim)	Separated from BNSF SB subdivision *

**THESE PROJECTS ARE NOT SHOWN ON FIGURE 1-6*
SOURCE: SCAG 2016 RTP

Trucks

Truck flows were also collected for the Southern California region using GPS and cellphone data[10] as shown in **Tables 1-6A, 1-6B, and 1-6C**. All data shown is average weekday, daily truck traffic for 2015. This information was used to identify where trucks travel to, from, and through Orange County. Trucks were classified in this data set as medium trucks (14,000-26,000 pounds) and heavy trucks (>26,000 pounds). These truck classifications are consistent with FHWA categories for medium and heavy trucks and correspond in the emissions analysis later in the chapter with "medium heavy-duty" and "heavy heavy-duty", respectively. Truck trips represent 2-3% of all vehicle trips in Southern California (source: SCAG travel model).

The vast majority of medium and heavy truck travel stays entirely within the Southern California region. This same data set found that approximately one percent of medium trucks travel outside of this Southern California region, and about 10 percent of heavy trucks travel outside of the Southern California region. A majority, approximately 70% (source: SCAG RTP), of the "through" cargo from the Southern California ports is shipped via rail.

Table 1-6A shows medium and heavy truck travel combined. Eleven percent of this combined truck travel stays within Orange County. Roughly four percent travels to or from Orange County and nine percent of travel is between other Southern California counties. The remaining 76 percent of travel is internal to other Sothern California counties.

Table 1-6B shows only medium truck travel within Southern California. A higher percentage of travel is internal to counties when only looking at medium trucks. Travel internal to Orange County accounts for 13 percent of medium truck travel.

Table 1-6C shows only heavy truck travel within Southern California. Heavy truck traffic experiences a larger portion of inter-county travel. Approximately 30 percent of heavy truck travel is between Southern California counties compared to 8 percent of medium trucks. This travel is fairly evenly split between Los Angeles County and San Bernardino County. Only three percent of heavy truck travel stays internal to Orange County.

Travel to and from LAX and the Port of Los Angeles was also included in the analysis. Approximately six percent of truck travel is between LAX and Orange County and four percent is between the Port of Los Angeles and Orange County.

[10] This data was aggregated by a big data vendor, Streetlight, and purchased for use in this study.

Truck Flows Within and Between Cities

Table 1-6A. 2015 Southern California Weekday Daily Truck Flows (All)

Origin \ Destination	Los Angeles	Orange	Riverside	San Bernardino	San Diego	Total
Los Angeles	42.1%	1.3%	0.6%	1.7%	0.1%	45.8%
Orange	1.3%	10.6%	0.3%	0.3%	0.1%	12.6%
Riverside	0.6%	0.3%	9.1%	1.7%	0.2%	11.8%
San Bernardino	1.7%	0.3%	1.8%	13.8%	0.1%	17.7%
San Diego	0.1%	0.1%	0.2%	0.1%	11.5%	12.0%
Total	45.8%	12.7%	11.9%	17.6%	12.0%	100.0%

Truck Flow with Origins at Ports and Destination at Counties

	Los Angeles	Orange	Riverside	San Bernardino	San Diego	Total
LAX	90.2%	6.1%	0.8%	1.9%	0.9%	100.0%
Port of Los Angeles	86.6%	4.1%	3.6%	4.7%	1.0%	100.0%

Truck Flow with Origins at Counties and Destination at Ports

	LAX	Port of Los Angeles
Los Angeles	91.4%	86.7%
Orange	5.3%	3.8%
Riverside	0.7%	2.7%
San Bernardino	1.8%	5.6%
San Diego	0.7%	1.1%
Total	100.0%	100.0%

SOURCE: STREETLIGHT (2015)

Truck Flows Within and Between Cities

Table 1-6B. 2015 Southern California Weekday Daily Truck Flows (Medium)

Origin \ Destination	Los Angeles	Orange	Riverside	San Bernardino	San Diego	Total
Los Angeles	46.7%	1.3%	0.3%	0.8%	0.1%	49.1%
Orange	1.2%	12.9%	0.2%	0.2%	0.1%	14.6%
Riverside	0.3%	0.2%	9.0%	0.9%	0.2%	10.6%
San Bernardino	0.9%	0.2%	1.0%	9.7%	0.0%	11.8%
San Diego	0.1%	0.1%	0.2%	0.0%	13.4%	13.8%
Total	49.1%	14.7%	10.7%	11.7%	13.8%	100.0%

Truck Flow with Origin at Ports and Destination at Counties

	Los Angeles	Orange	Riverside	San Bernardino	San Diego	Total
LAX	91.8%	6.2%	0.4%	1.2%	0.5%	100.0%
Port of Los Angeles	90.5%	3.4%	2.9%	2.1%	1.1%	100.0%

Truck Flow with Origin at Counties and Destination at Ports

	LAX	Port of Los Angeles
Los Angeles	92.8%	90.4%
Orange	5.4%	3.4%
Riverside	0.4%	2.1%
San Bernardino	1.0%	2.9%
San Diego	0.3%	1.3%
Total	100.0%	100.0%

SOURCE: STREETLIGHT (2015)

Truck Flows Within and Between Cities

Table 1-6C. 2015 Southern California Weekday Daily Truck Flows (Heavy)

Origin \ Destination	Los Angeles	Orange	Riverside	San Bernardino	San Diego	Total
Los Angeles	25.8%	1.5%	1.7%	4.7%	0.2%	33.9%
Orange	1.6%	2.7%	0.4%	0.7%	0.2%	5.6%
Riverside	1.7%	0.4%	9.3%	4.4%	0.4%	16.1%
San Bernardino	4.8%	0.8%	4.6%	28.1%	0.4%	38.7%
San Diego	0.2%	0.2%	0.5%	0.3%	4.6%	5.8%
Total	34.1%	5.6%	16.5%	38.1%	5.7%	100.0%

Truck Flow with Origins at Ports and Destination at Counties

	Los Angeles	Orange	Riverside	San Bernardino	San Diego	Total
LAX	68.7%	5.2%	7.3%	12.5%	6.4%	100.0%
Port of Los Angeles	78.7%	5.6%	5.0%	9.9%	0.8%	100.0%

Truck Flow with Origins at Counties and Destination at Ports

	LAX	Port of Los Angeles
Los Angeles	68.6%	78.8%
Orange	3.0%	4.8%
Riverside	6.7%	4.0%
San Bernardino	14.8%	11.5%
San Diego	6.9%	0.8%
Total	100.0%	100.0%

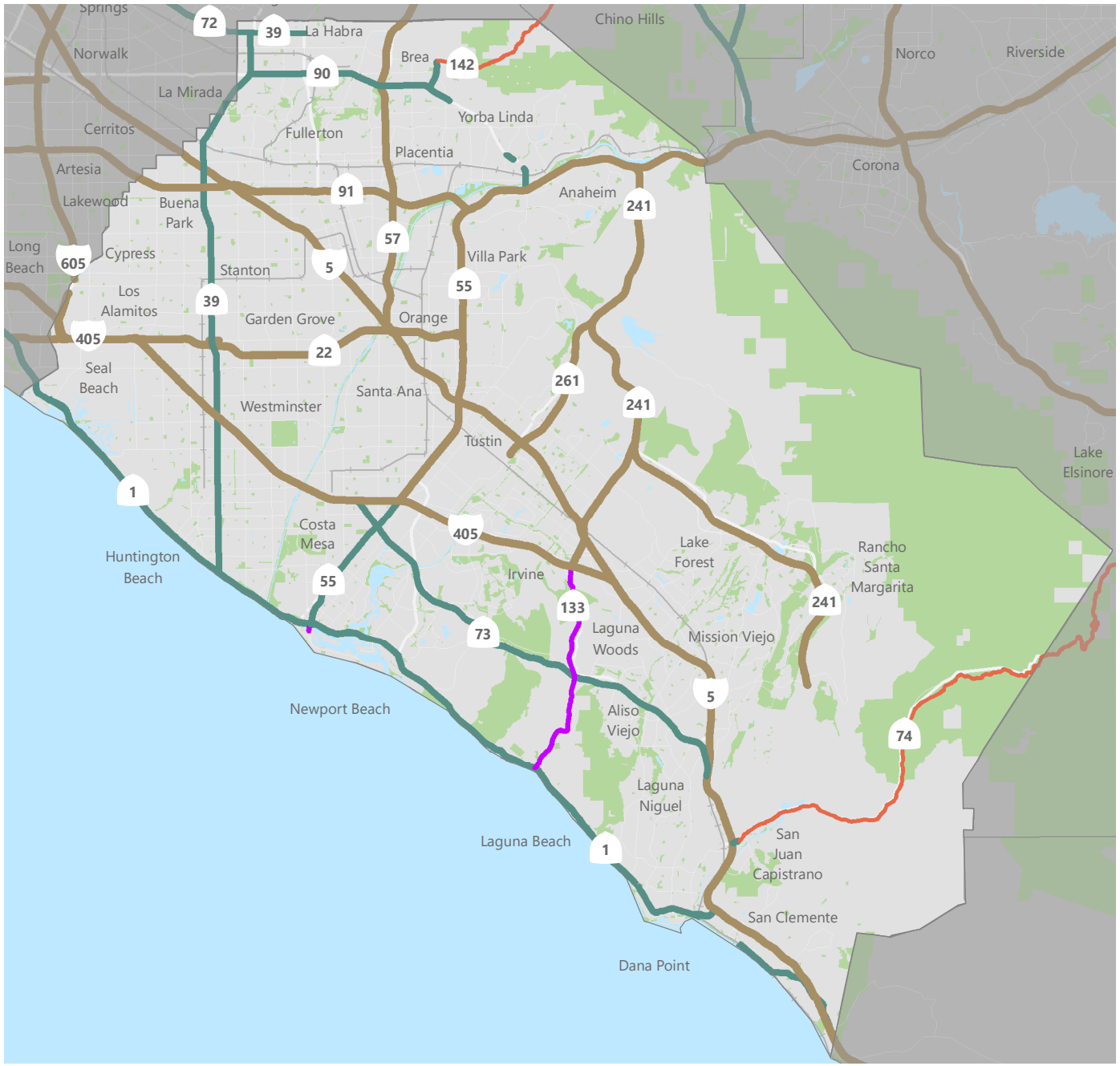
SOURCE: STREETLIGHT (2015)

Truck routes within Orange County are represented by the Surface Transportation Assistance Act (STAA) National Network and Terminal Access, the California Legal Network, and the California Legal Advisory Route (**Figure 1-7**). These facilities and the corresponding 2014 Caltrans truck volumes are shown in **Appendix A.** The figures also incorporate 2012 truck count data from SCAG. These data were collected along "screenlines" at mid-block locations.

Local Truck Routes

Several cities within OC maintain a map or description of designated truck routes within their city. These are not always kept up to date by cities, but those that were obtainable are shown in **Appendix D**. These routes are meant to identify the "through" and/or preferred routes in a City. By state law, a truck may use the most expeditious route to reach their destination, provided it isn't precluded by width or weight limits.

Figure 1-7. Freight Facilities



Truck Origins/Destinations

The origin-destination information in the following sections is derived from GPS and cell phone data processed by a vendor (Streetlight) who has direct access to the raw data. Fehr & Peers purchased this data on behalf of OCTA, reviewed it for reasonableness, and organized it for this report.

This data represents a large sample size (10,000s) but it is a sample; therefore, the values expressed below are in percentage form, rather than absolute values.

The average weekday truck flows within Orange County by city are shown in **Appendix B**. To help digest this data, **Table 1-7** and **Figure 1-8** show the flows grouped by north, central, and south Orange County. The flows are relatively balanced, with the northern area being a slightly higher truck generator (Anaheim is the highest generating city).

Table 1-7. 2015 Daily Truck Flows by Region of Orange County

North Cities	Central Cities	South Cities
Anaheim	Costa Mesa	Aliso Viejo
Brea	Fountain Valley	Dana Point
Buena Park	Huntington Beach	Irvine
Cypress	Orange	Laguna Beach
Fullerton	Santa Ana	Laguna Hills
Garden Grove	Tustin	Laguna Niguel
La Habra	Villa Park	Laguna Woods
La Palma		Lake Forest
Los Alamitos		Mission Viejo
Placentia		Newport Beach
Seal Beach		Rancho Santa Margarita
Stanton		San Clemente
Westminster		San Juan Capistrano
Yorba Linda		

Origin	Destination: North	Central	South	Total
North	33%	6%	2%	41%
Central	6%	19%	5%	30%
South	2%	5%	23%	30%
Total	41%	30%	30%	*100%

VALUES DO NOT ADD TO 100% DUE TO ROUNDING
SOURCE: STREETLIGHT (2015)

Figure 1-8. Daily Truck Flows by Region of Orange County

North Orange County

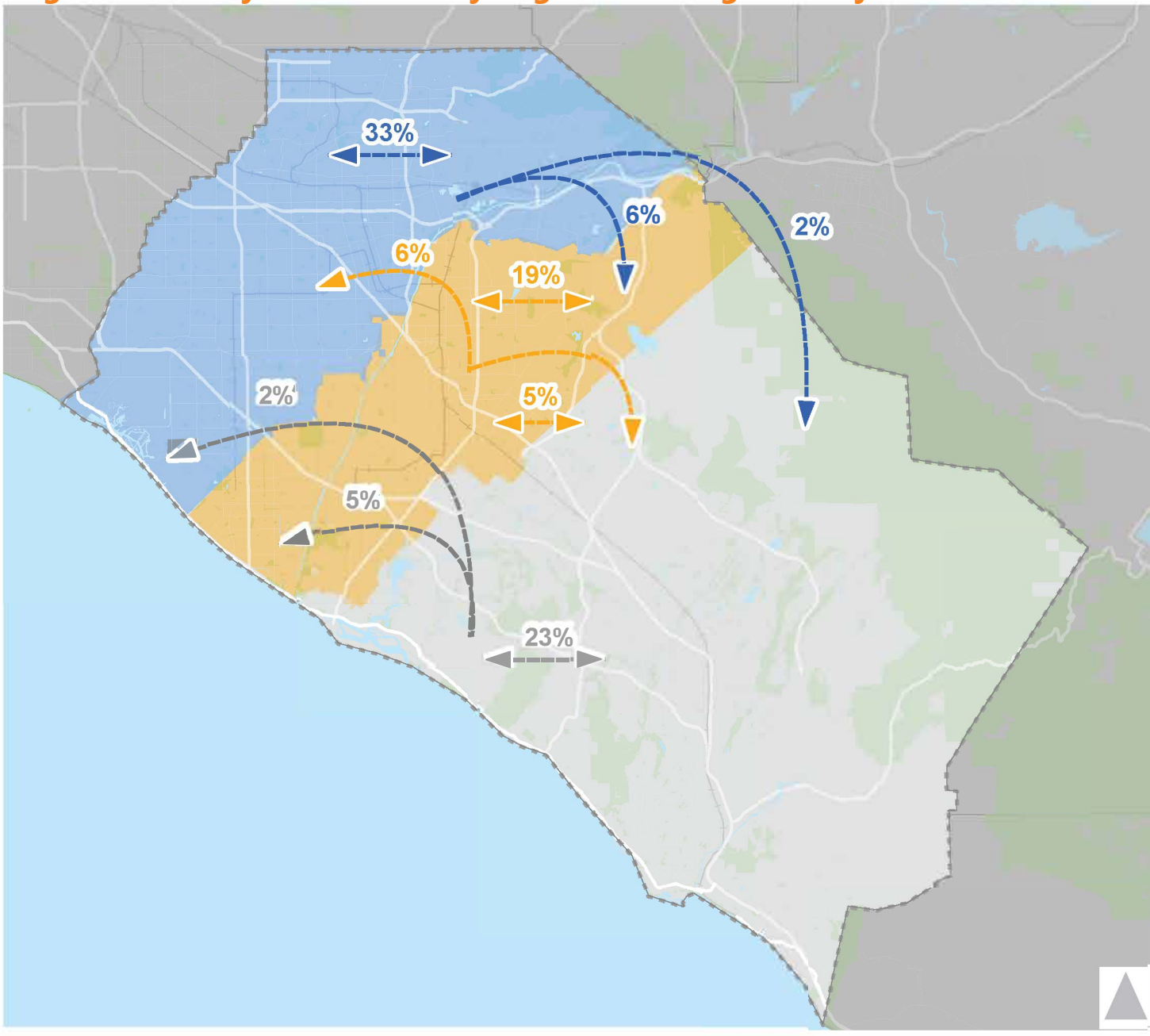
Anaheim
Brea
Buena Park
Cypress
Fullerton
Garden Grove
La Habra
La Palma
Los Alamitos
Placentia
Seal Beach
Stanton
Westminster
Yorba Linda

Central Orange County

Costa Mesa
Fountain Valley
Huntington Beach
Orange
Santa Ana
Tustin
Villa Park

South Orange County

Aliso Viejo
Dana Point
Irvine
Laguna Beach
Laguna Hills
Laguna Niguel
Laguna Woods
Lake Forest
Mission Viejo
Newport Beach
Rancho Santa Margarita
San Clemente
San Juan Capistrano



SOURCE: STREETLIGHT (2015)

Truck travel was measured[11] at nine representative highway segments to better understand flows along major truck routes. The segments were initially selected due to the availability of data from another recent study, and additional data was collected (mostly in Northern Orange County) to represent a geographical balance. All data collected and described in the following table represents average weekday, daily truck traffic for 2015. *Note – the values do not add to 100%, as some trips have at least one end outside of the region*.

The range of trips that stay within Orange County varies from a low of 21% on State Route 91 (west of State College Blvd) to a high of 74% on Ortega Highway (east of Interstate 5).

Truck flows to/from San Diego County are relatively low for these facilities, with Interstate 5 carrying the highest percentage at 8%.

Not surprisingly, those facilities in the northern part of Orange County have more travel that relates to Los Angeles County. For example, approximately 50% of truck flows on State Route 39 (south of SR 90) are coming to/from LA County.

Travel to/from the Inland Empire is comparatively high, with approximately half of the truck trips on State Route 91 going between Orange County and the Inland Empire.

By contrast, the amount of trucks on State Route 91 that stay within Orange County is low, at 21%.

The detailed information for each facility can be found in **Appendix C**.

[11] GPS and cell phone data via Streetlight (vendor). Sample size of more than a thousand data records in 2015.

Figure 1-9. Origin-Destination Truck Volume on Selected Highway Segments

	Within Orange County	Orange County to Los Angeles County	Orange County to Riverside\San Bernardino Counties	Orange County to San Diego County	Los Angeles County to San Diego County
State Route 22 West of Harbor Blvd.	50%	23%	20%		
State Route 39 South of State Route 90	35%	50%	5%		
State Route 74 West of Interstate 5	74%	4%	15%		
State Route 90 West of South Brea Blvd.	40%	19%	33%	4%	
State Route 91 West of State College Blvd.	21%	20%	48%		
Interstate 5 South of Jamboree Rd.	52%	15%	9%	8%	14%
Interstate 405 South of Jamboree Rd.	56%	18%		6%	18%
State Route 55 South of Lincoln Ave.	46%	5%	42%		
State Route 57 South of Lincoln Ave.	47%	21%	24%		

Truck Safety

For this study, collision data for freeways and major state highways in Orange County was assembled for the period of January 1, 2010 through December 31, 2014 (the most currently available) from the Transportation Injury Mapping System (TIMS), a project of the University of California, Berkeley that processes statewide collision records. The data, as entered by the police officer responding to an incident, includes: crash severity, number of injuries and fatalities, involvement of certain classes of mobility including bicyclists, pedestrians, freight trucks and others. The category of traffic violation is included for each record and other attributes include: the type of crash (of which rear-end and hit object are the most common), weather and pavement conditions, and whether a traffic signal was present and functioning.

Approximately 4% of collisions in Orange County involved trucks. Although truck-involved collisions occur on every state highway in Orange County, they are most prevalent and evenly distributed across the major freeways, and to a lesser degree along major arterial highways such as Beach Boulevard. Truck-involved collisions are relatively few on the rural highways and the tolled highways. **Figure 1-10** shows locations of all collisions in Orange County.

Spatial patterns were searched to find locations that were worse than average in terms of absolute numbers, severity, involvement of trucks, or prevalence of a certain crash type. Due to the high density of collisions and overwhelming proportion of minor incidents and rear-end crash types, finding significant clusters or patterns proved challenging. Collision numbers and types correlate closely with expected conditions; heavily congested and high-volume freeways tend to have very high numbers of collisions and the worst clusters are located near dense urban areas and intersections of two or more freeways. This is especially true near the cities of Orange and Santa Ana. No significant clusters of highly-severe collisions were found that would suggest any especially problematic location.

A kernel density analysis was conducted on all collisions to estimate collision "hot spots" in which many crashes happen in close proximity compared to the average distance between crash points across the region (**Figure 1-11**). Each crash point is analyzed in relation to an imaginary grid of ¼ mile-spaced cells. Cells with greater numbers of collisions in close proximity to each other are assigned higher values in the analysis. The analysis is purely calculated on the proximity and quantity of collisions; no other weighting factors were used. From this output, ten corridors were selected where the cell values were highest along several contiguous cells, representing areas where collision density is highest in one or more given quarter-mile stretches of highway compared to all other quarter mile analysis cells countywide. This resulted in the definition of 10 segments with the highest density of collisions.

Many of the top ten corridors are located around freeway interchanges, and suggest areas where traffic may become heavily congested or where long back-ups occur on ramps, leading to rear-end crashes. As seen in **Figure 1-12**, the selected segment lengths vary widely based on the continuity of closely-clustered incidents, from as short as .7 miles on CA-57 near the intersection with CA-91, to as long as 4 miles on CA-22 between the city of Garden Grove and the intersection with I-5 and CA-57.

Figure 1-10. All Highway and All Truck Collisions

Highway Collisions

Collision On Highways

	All Hwy Collisions	Truck Hwy Collisions	Truck % of Total
1	39	1	2.56%
5	5,430	278	5.12%
22	1,676	62	3.70%
39	231	6	2.60%
55	1,706	43	2.52%
57	1,826	123	6.74%
73	333	8	2.40%
74	14	1	7.14%
90	42	3	7.14%
91	3,072	207	6.74%
133	113	1	0.88%
241	11	0	0.00%
405	2,998	126	4.20%
605	161	4	2.48%

48% of all truck collisions in Orange County occurred on a highway.

SOURCE: TRANSPORTATION INJURY MAPPING SYSTEMS (TIMS); ORIGINAL DATA FROM CALIFORNIA STATEWIDE INTEGRATED TRAFFIC RECORDS SYSTEM (SWITRS) 2010-2014

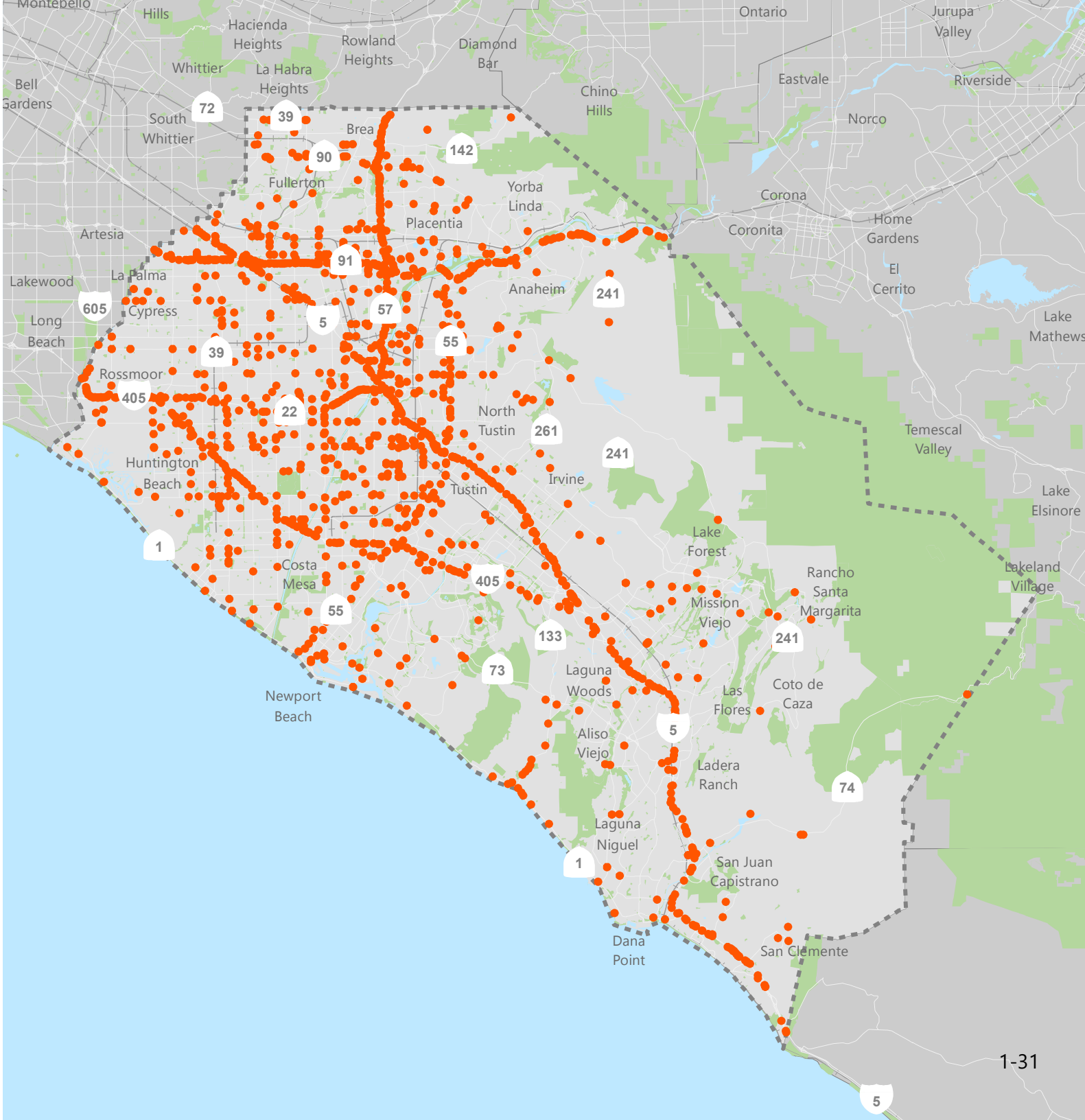


Figure 1-11. Highway Collision Clusters

Truck Network

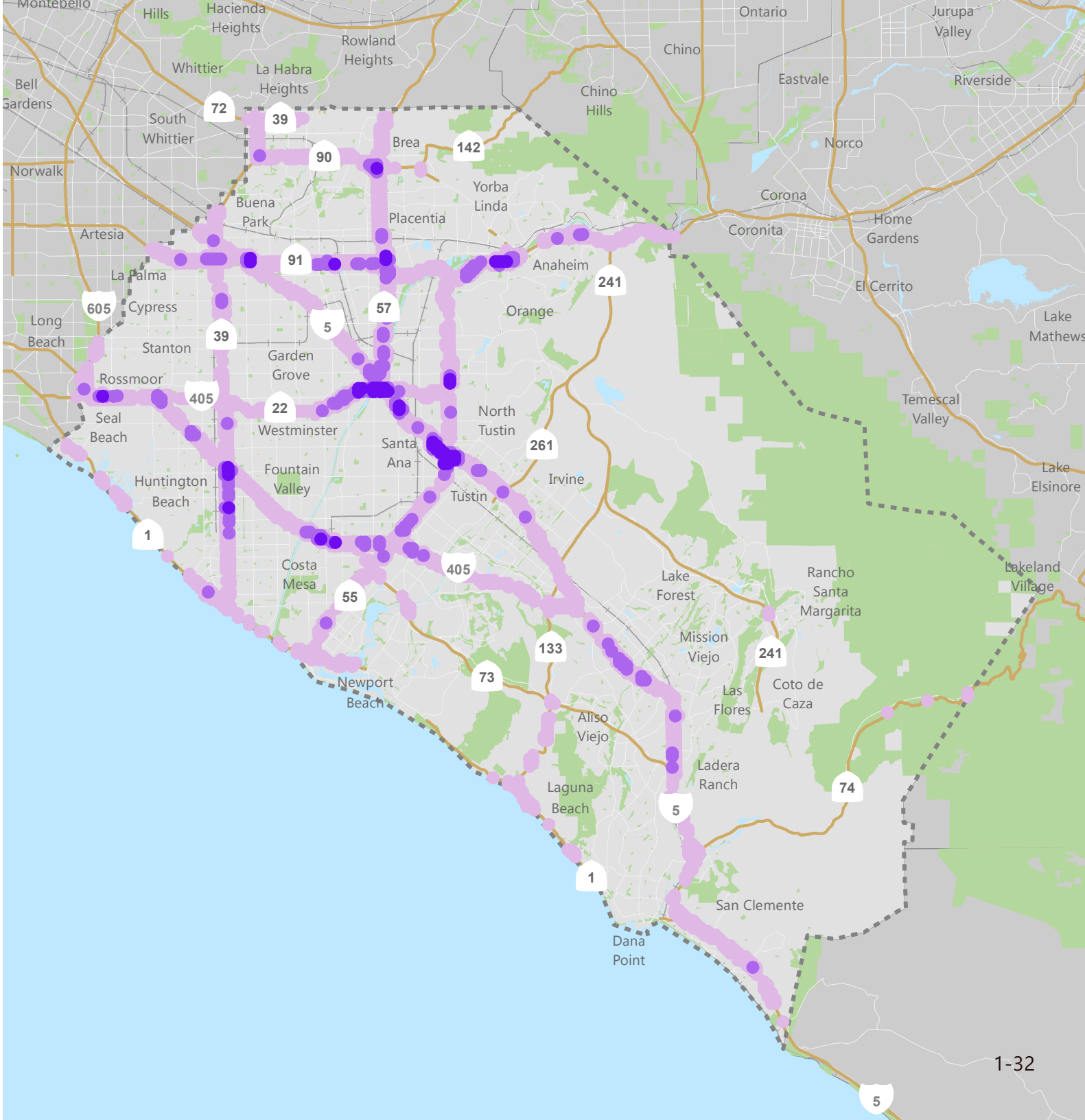
Dense Clusters

Low

Medium

High

Only highest clusters of collisions are shown



SOURCE: TRANSPORTATION INJURY MAPPING SYSTEMS (TIMS); ORIGINAL DATA FROM CALIFORNIA STATEWIDE INTEGRATED TRAFFIC RECORDS SYSTEM (SWITRS) 2010-2014

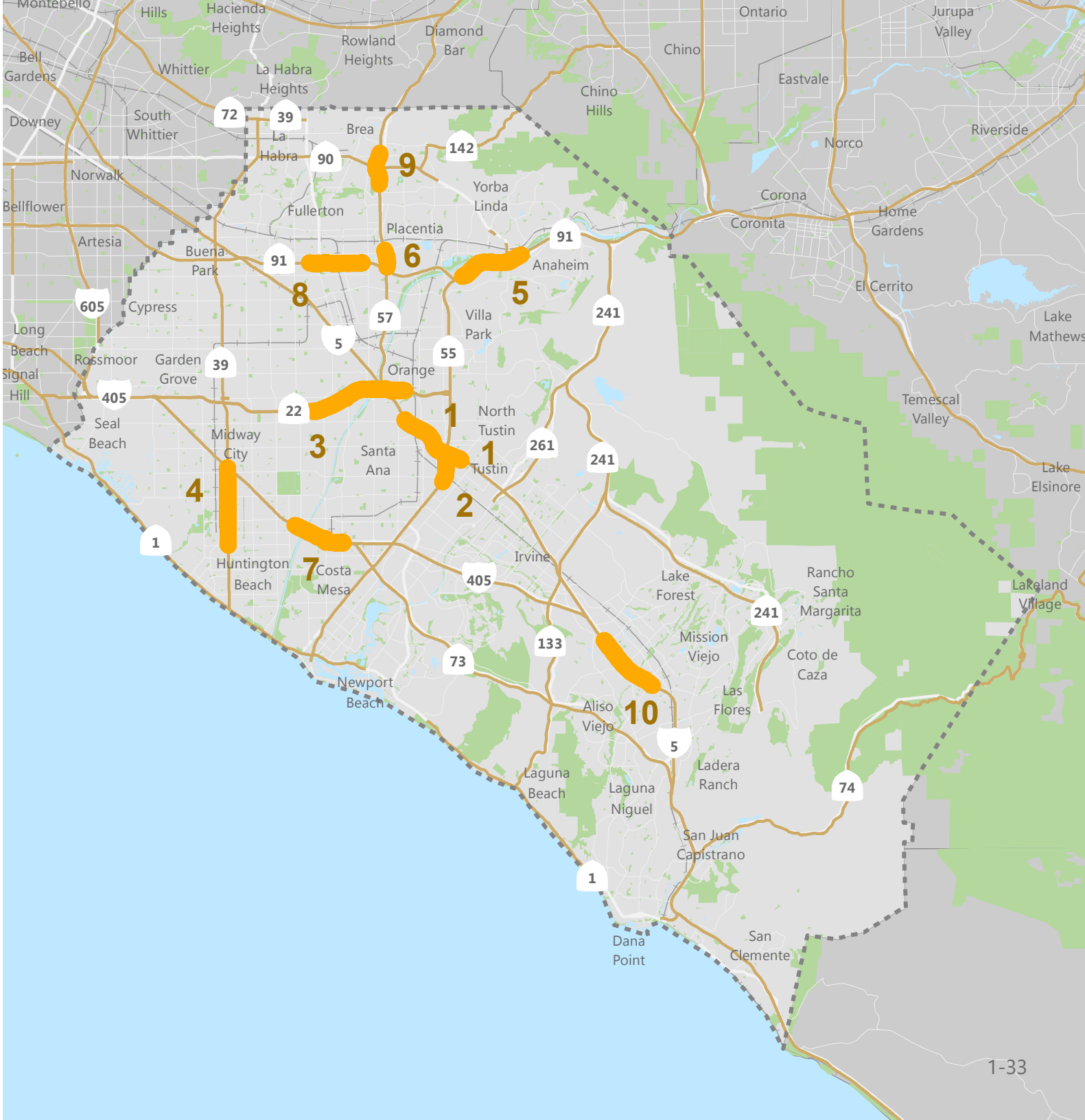
Figure 1-12. Selected Locations of Highway Collision Clusters

Truck Network

Top 10 Collision Locations

		All Collisions	Truck Collisions	Truck % of Total
1	Santa Ana	839	39	4.65%
2	Santa Ana	245	5	2.04%
3	Orange/Santa Ana	921	37	4.02%
4	Huntingon Beach	713	5	0.70%
5	Anaheim	597	25	4.19%
6	Anaheim	180	17	9.44%
7	Costa Mesa	421	16	3.80%
8	Anaheim	464	36	7.76%
9	Brea/Fullerton	229	26	11.35%
10	Laguna Hills/Mission Viejo	531	18	3.39%

SOURCE: TRANSPORTATION INJURY MAPPING SYSTEMS (TIMS); ORIGINAL DATA FROM CALIFORNIA STATEWIDE INTE 4



Only one arterial was selected in these ten segments, CA-39 (Beach Boulevard) between I-5 and Garfield Avenue in Huntington Beach. This location is a good example of the difference in safety conditions on surface streets compared to freeway segments. Less than 1% of the incidents in this segment involved trucks, while the average for other facilities was 5.6% and the highest value was 11.4% on a segment of CA-57.

Truck-Related Emissions

For this study, emissions were estimated using the EMFAC tool within the OCTAM TransCAD. The tool uses EMFAC 2014, assuming default fleet composition while customized by the VMT estimated from OCTAM TransCAD 2010.

As shown in **Figure 1-13**, the light and medium-duty vehicles dominate the emissions; however, impact of the emission from heavy-duty trucks is not negligible.

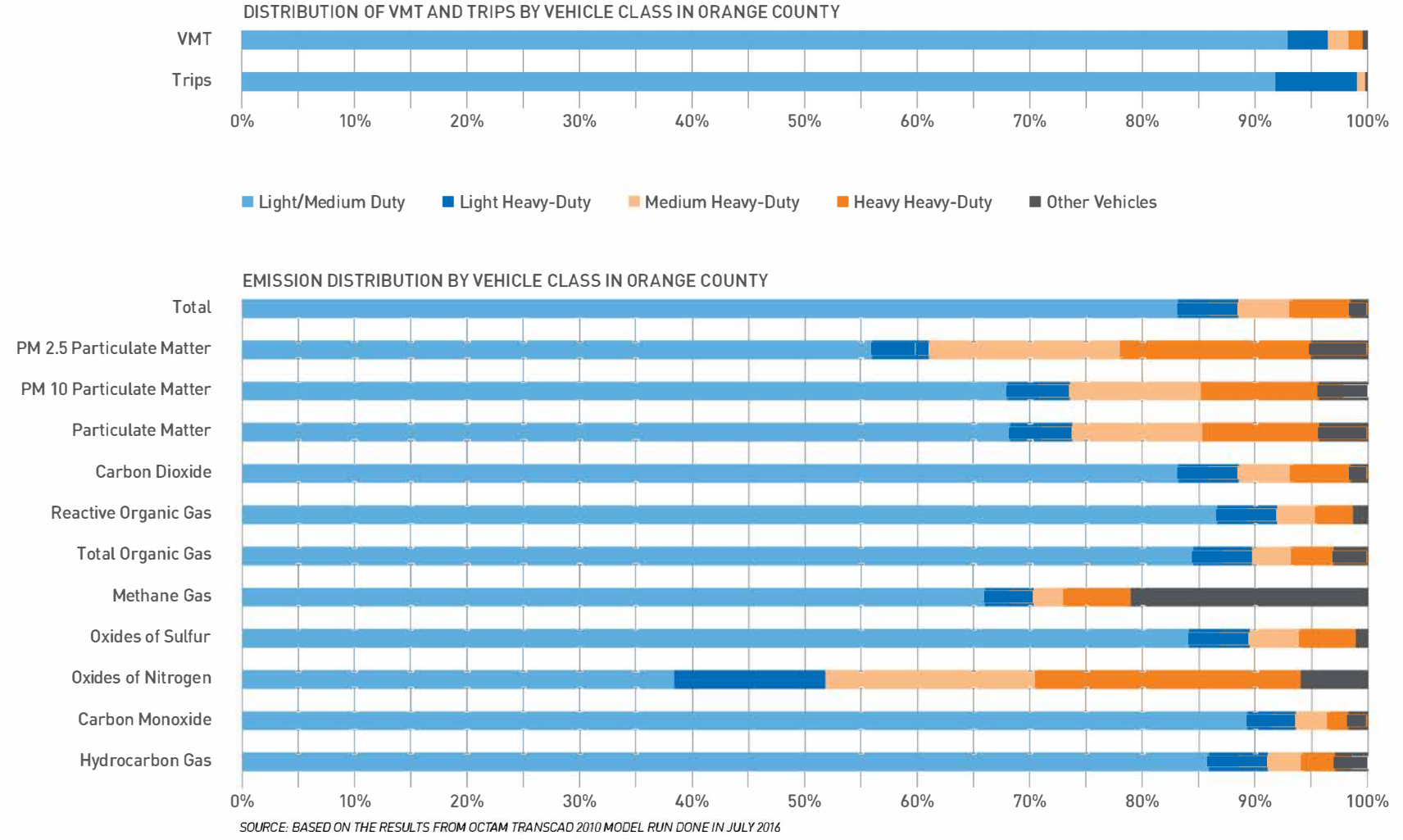
Heavy-duty trucks accounts for 15% of the overall emissions among all the vehicles, while for only 7% of total VMT and 8% of total vehicle trips. However, heavy-duty trucks emit 56% of all the Oxides of Nitrogen (NOx), much higher than all the other vehicle classes. This is important, as NOx is a key precursor to ozone and particulate matter (PM 2.5), both of which have National Ambient Air Quality Standards that the South Coast Air Basin does not currently meet.

Truck Parking

A lack of adequate truck parking was identified as a problem throughout California in a 2014 survey conducted as a requirement of the "Moving Ahead for Progress in the 21st Century" Act (MAP-21). This survey is known as "Jason's Law" in reference to a driver who was killed while parked on the side of a road. In addition to state departments of transportation, the USDOT surveyed safety officials, trucker drivers, truck stop operators, and other trucking industry stakeholders. This survey found that nearly half of surveyed state departments of transportation reported truckers have been forced to park on highway ramps and shoulders instead of designated parking areas, which tend to be much safer for the driver and other motorists. California, with 53.7 parking spaces per 100,000 miles of truck vehicle-miles-of-travel (VMT), ranked the second worst state, and no truck parking was identified in Orange County. The nearest facilities are the Port of Long Beach (privately owned and operated) and near Camp Pendleton (Caltrans' "Aliso Creek" rest area). A recent internet search turned up no new private truck rest areas.

According to the survey, in California 36% of truck drivers and 42% of logistics professionals reported regularly having difficulty finding safe – and legal – parking during rest periods, and that number jumped to about 50% at night. The majority of respondents reported truck parking shortages at all times of the day on every day of the week.

Figure 1-13. Vehicle Miles Traveled, Trips, and Emissions by Vehicle Class



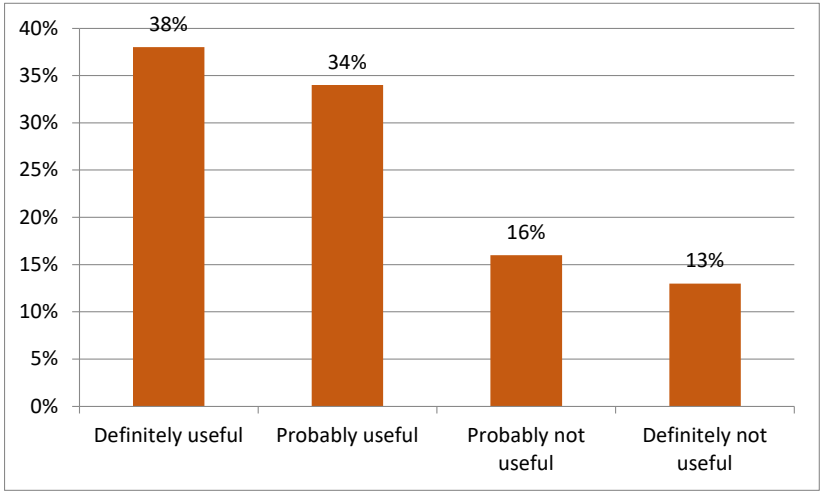
SOURCE: BASED ON THE RESULTS FROM OCTAM TRANSCAD 2010 MODEL RUN DONE IN JULY 2016

A major hurdle in addressing the shortage is the fact that there is no single government or private entity responsible for truck parking facilities. The study analysis included ideas to address the issue such as: increased data collection on supply and demand, congestion, and safety with regard to truck parking, and a call for the creation of a national coalition to further examine and tackle the shortage. However, no significant steps have been taken as of writing of this report. The matter is further complicated, however, by reports from truck-stop operators about difficulties in expanding truck parking. Truck-stop operators reported running afoul of environmental and zoning laws, as well as protests from local communities that would prefer trucks stop elsewhere. Truck stop operators reported that California is one of the most difficult regions in terms of acquiring permits to open new parking or to expand the existing facilities.

The law requires truck drivers to take 30-minute rests after eight hours of driving and for longer periods after 11 hours. The laws were intended to increase safety on the road by limiting the amount of time a driver could go continuously without stopping, but the truck parking shortage has proven an unexpected negative consequence. Discussions with CHP officers revealed that they are reluctant to ask truck drivers stopped along the freeway to continue to a formal parking stop if it would result in them exceeding the HOS duration rules.

A 2010 survey was conducted by UC Berkeley at 11 truck stops along I-5 in the Central Valley to explore trucker parking habits and their reaction to a hypothetical system that would permit them to look up parking availability online and make parking reservations. The survey explored parking behavior and parking preferences, and probed their willingness to pay for services. Approximately 100 completed surveys were collected, and 45% of the respondents indicated it was difficult to find overnight parking. **Figure 1-14** shows their response, which was favorable, to an on-line system showing parking availability. Given the proliferation of smart phones since the time of the survey (7 years ago); it would seem that such a service would even more valued today.

Figure 1-14. Would the Ability to Use the Internet to Look up Availability of Parking Space at Truck Stops Be Useful to You?



As part of this research, UC Berkeley Transportation Sustainability Research Center (TSRC) and the California Department of Transportation (Caltrans) led the development of an American Truck Parking™ web site. The intent was to help truckers locate parking spaces, with a simple, easy-to-use interface designed for quick access to parking information. The site shows truck parking locations, including: private truck stops, logistics terminals, public rest areas, and truck fueling locations for both conventional diesel and alternative fuels.

There are a limited number of commuter park-and-ride facilities near freeways in Orange County. In their present configuration, none of the public park-and-ride lots are suitable for truck parking. Adapting portions of underutilized lots could be an opportunity to create safe truck parking in the county. According to Caltrans District 12, there were 17 park-and-ride lots in Orange County as of May 2017, 12 operated by Caltrans and 5 by OCTA. Many of these lots are used by agreement and shared with another business or sometimes church that may be underutilized during weekdays; these locations are unsuitable for use by trucks.

Economic Setting

The 2016 Economic Forecast, an annual report created by California State University Fullerton (CSUF), provides industry employment projections through 2017 for Orange County, Southern California, and the nation.

As seen in **Table 1-8**, more than half of the industry categories can be characterized as having a significant goods movement relationship. Many of the largest employment categories either generate goods movement or are dependent upon goods movement.

The revenue in the US "e-Commerce" market equates to $314 billion in 2016 and it is expected to show a compound annual growth rate of 8% between 2016 and 2020, according to Statista Digital Market Outlook.

The 2016 CSUF report includes the following statements that describe the importance of freight in Orange County:

A multitude of geographic and economic competitive advantages present in Orange County have created a unique market landscape which has led to the emergence of four important industries that cross traditional industry clusters. These cross-cutting industries include International Trade, Information Technology, Creativity, and Green Technology. The evolution of these industries has turned them into industry drivers, helping to boost employment in the County's traditional employment sectors, while providing a clear assessment of the major

trends, opportunities, and shortfalls currently impacting Orange County.

International Trade is a strong industry driver in Orange County as a result of the region's proximity to the ports located in Los Angeles and Long Beach, proximity to international and domestic airports including LAX and John Wayne Airport, well-connected freeways and road systems, rail lines providing national linkages, and an increasingly well-educated, multi-cultural workforce."

Table 1-8. Orange County Employment by Industry

	2007	2014	2017 Estimated	Estimated Annual Growth 2014-2017	Intensive Goods Movement Aspect?
Natural Resources	600	700	700	-	Yes
Construction	103,100	82,000	100,400	6,130	Yes
Manufacturing	180,400	158,800	168,600	3,260	Yes
Durable Goods	126,200	116,600	122,800	2,060	Yes
Nondurable Goods	54,200	42,200	45,800	1,200	Yes
Wholesale Trade	86,900	81,700	86,600	1,630	Yes
Retail Trade	161,200	148,700	156,900	2,730	Yes
Transportation & Utilities	28,900	26,600	29,500	960	Yes
Information	31,200	24,200	25,300	360	No
Financial Activities	127,700	114,100	117,200	1,030	No
Professional & Business Services	269,100	275,800	303,900	9,360	No
Educational & Health Services	142,700	190,300	206,700	5,460	No
Leisure & Hospitality	172,900	193,500	207,000	4,500	Unclear
Other Services	47,400	47,700	52,700	1,660	Unclear
Government	159,400	151,900	155,300	1,130	No
Total Nonfarm	1,515,800	1,495,900	1,610,800	38,300	

DATA SOURCE: CALIFORNIA STATE UNIVERSITY FULLERTON ECONOMIC FORECAST 2016

Emerging Trends

The landscape of goods movement is changing (rapidly in some aspects) due to socio-economic shifts, consumer shifts, and technology. This section provides an overview of these changes, while Appendix E provides more detail.

Consumer Trends and Emerging Land Use Utilization

The advent of e-commerce has changed business as usual for the retail industry, prompted most notably by Amazon. E-commerce continues to transform consumer behavior resulting in significant changes to retail supply chains – everything from storefront and warehouse location decisions to modes of delivery. Brick-and-mortar contenders continue to try different approaches to better compete with major online vendors. Online shopping's major disruptor for storefront retailers has been the impact on impulse shopping. Online shopping means that consumers can price check otherwise impulse items on their smart phones in the store and wait as little as a few hours for it to arrive on their doorstep at a lower price. This is why retailers have cut back on new store openings in favor of shifting that investment toward online operations.

Nationally, the impact of increasing internet sales has spurned discussions in Congress about how to address sales tax. The guiding federal principle is based on the 1992 Supreme Court decision, Quill Corp. v. North Dakota, which addressed the obligations of mail order businesses to collect sales tax on out-of-state sales. This decision now extends to internet sales. The decision obligates companies with a "Physical Presence" in a state to collect sales tax. In addition to this rule, California's legislature enacted additional rules in 2012 that apply to large internet sellers that do not have a physical presence in California (aka, the Amazon law).[12] This California law protects the State from loss of sales tax revenues generated by the largest online retailers, but it does not fully address the loss in sales tax revenue caused by out-of-state sales. According to a 2012 estimate prepared by the University of Tennessee, internet sales generate $11 billion in sales tax revenue losses annually.[13]

Amazon poses a potentially more significant challenge for Orange County and other similar counties with large retail spaces and less developable industrial warehouse space. Amazon has recently constructed four (4) fulfillment centers in San Bernardino County and two (2) in Riverside County to respond to consumer demands for one- and two-day delivery. Goods shipped from out-of-state by a company that has

[12] California Revenue and Taxation Tax Code Section 6203(c)(5)

[13] Bruce, Donald, William F. Fox, William B. Stokely, LeAnn Luna. *State and Local Government Sales Tax Revenue Losses from Electronic Commerce*. University of Tennessee. April 13, 2009. Page 4.

"physical presence" in California generate sales tax at the delivery address. By contrast, goods shipped from a fulfillment center in California generate sales tax for the jurisdiction where the fulfillment center is located.

3D Printing/Additive Manufacturing

3D printing, often dubbed the Third Industrial Revolution[14], is anticipated to cause significant disruptions in both manufacturing and supply chains, including re-shoring manufacturing jobs back to the U.S., comingling of manufacturing, storing and fulfilling orders under one roof, and encouraging local production and customization opportunities for everything from the latest tennis shoes to automobile parts – and all with zero waste.

3D printing is scalable and has the ability to support the production of very small items, such as nuts and bolts, to very large scale items like houses. The process can occur in small spaces and could lead to redevelopment of underutilized and antiquated industrial uses in older parts of the County. The process is also beginning to be used in the biotech industry, which could further increase the movement of products in and out of Orange County. One of the leading bioprinting firms, Organovo, is located in San Diego, California, and Orange County has a strong biotech presence.

Emerging Freight Delivery Trends

How cleanly and efficiently goods move to market is exemplified by UPS, who continues to lead the industry in its commitment to reducing its carbon footprint worldwide through a number of initiatives – most notably, its large fleet of alternative-fueled vehicles. Through this effort, UPS has used current routes and drivers to test promising new alternative fuel technologies ranging from LNG Class 8 heavy-duty trucks to electric bicycles. The challenge is creating a critical mass that results in lower equipment and infrastructure prices. It's a fine balance between equipment and infrastructure, as operators need available fueling stations, but fueling stations require demand to survive. For these reasons, UPS is making substantial financial and operational investments in LNG vehicles and infrastructure in the United States. Bigger LNG fleets enable manufacturers to achieve economies-of-scale. They also make it economically viable for companies to build fueling and maintenance stations.

On the other end of the delivery spectrum – the issue of speed to market continues to drive changes. A few years ago, the deployment of USPS trucks on Sundays to deliver Amazon packages made the front page. Now, it's the norm. As companies continue to investigate and test better and faster

[14] Rifkin, Jeremy, *The Third Industrial Revolution*, September 27, 2011.

means for moving goods to consumers, the commercial operation of drones may become a reality.

Tied closely to both clean and fast movement of goods to market are other less understood and more challenging types of technology propositions that fall into a category commonly referred to as "zero-emission cargo mover systems". These technology applications envision the cargo movement of large amounts shifting from trucks and trains to zero-emission systems, such as General Atomics' Electrodynamics Cargo Conveyor (ECCO), American Maglev's Environmental Mitigation and Mobility Initiative Logistics Solution, and Texas A & M University's Freight Shuttle System[15]; and more recently, Elon Musk's Hyperloop One.

Inland Ports and Inland Cargo Depots

The Ports of Long Beach and Los Angeles have looked at many different strategies to improve port efficiency, such as shifting more cargo from truck to rail. One strategy that is receiving renewed attention is the use of short-haul intermodal trains to move marine containers to "inland ports" located near the hub of regional distribution centers and warehouses in the Inland Empire.

Technology Advancements and Innovations

As manufacturers continue to make advancements in fuel efficiency and emissions reductions for heavy-duty trucks, other technology developers continue to focus on after-market solutions for the trucking industry. Truck platooning is a promising option, which offers not only significant fuel efficiency improvement opportunities, but it should also improve safety.

Truck Only Toll (TOT) Lanes

The separation of heavy vehicles and passenger vehicles decreases the risk of collisions. Not only do accidents frequently result in injuries, and potentially fatalities, but they also create congestion. Approximately 12 percent of passenger vehicle fatalities come from collisions with trucks, which could be reduced if some or all trucks are diverted to a truck-only toll lane. The passenger vehicle experience would improve, as well, without the lower speeds and discomfort due to trucks sharing a lane with autos.

There are no truck-only toll lanes in California, however, The Toll Roads in Orange County charge based on the number of axels. For example, SR 73 rates for 2-axle vehicles tops out at $7.61, whereas the rate for 5-axle trucks is $30.44.

[15] The Tioga Group, Inc., CDM Smith, Richard G. Little. *National Cooperative Freight Research Report (NCFRP) 34: Evaluating Alternatives for Landslide Transport of Ocean Containers*. National Academies of Science, Transportation Research Board. Washington, D.C. 2015.

Furthermore, truck-only toll lanes are one of the recommended alternatives for the I-710 Corridor between the San Pedro Bay Ports and I-5 in Los Angeles County.

CHAPTER 2. STRATEGIES

This chapter presents freight-related strategies for OCTA's consideration, with the intent of facilitating freight activities within Orange County and the corresponding economic and consumer benefits. The issues are presented in the order that reflects the author's opinion as to the relative importance and the degree of OCTA's influence on the topic. For example, truck emissions are very important, but most of the influence rests at the state and federal level.

Issue #1: First/Last Mile Connectors

Orange County does not have an established network of first/last-mile connectors for trucks. This is important in designating appropriate geometric standards, pavement treatments, and funding priorities.

A first- or last-mile connector is a route that provides direct, efficient, and safe access for trucks from major highways to freight centers – areas with high concentrations of truck-based industrial and commercial land uses. These roads provide immediate links between major freight generators such as manufacturers, processing and distribution centers, which are often located along arterial roads that may not be part of the national highway freight network.

The connectors identified below in Orange County were selected based on our analysis of concentrated truck activity with relation to freight-generating land use, an assessment of neighboring land use incompatibility (such as residential and schools), locally-designated truck routes, traffic and truck volumes (where that information was available), and analysis of the shortest and most direct path to freeways. These locations are shown in **Table 2-1 and Figure 2-1**.

Potential Actions:

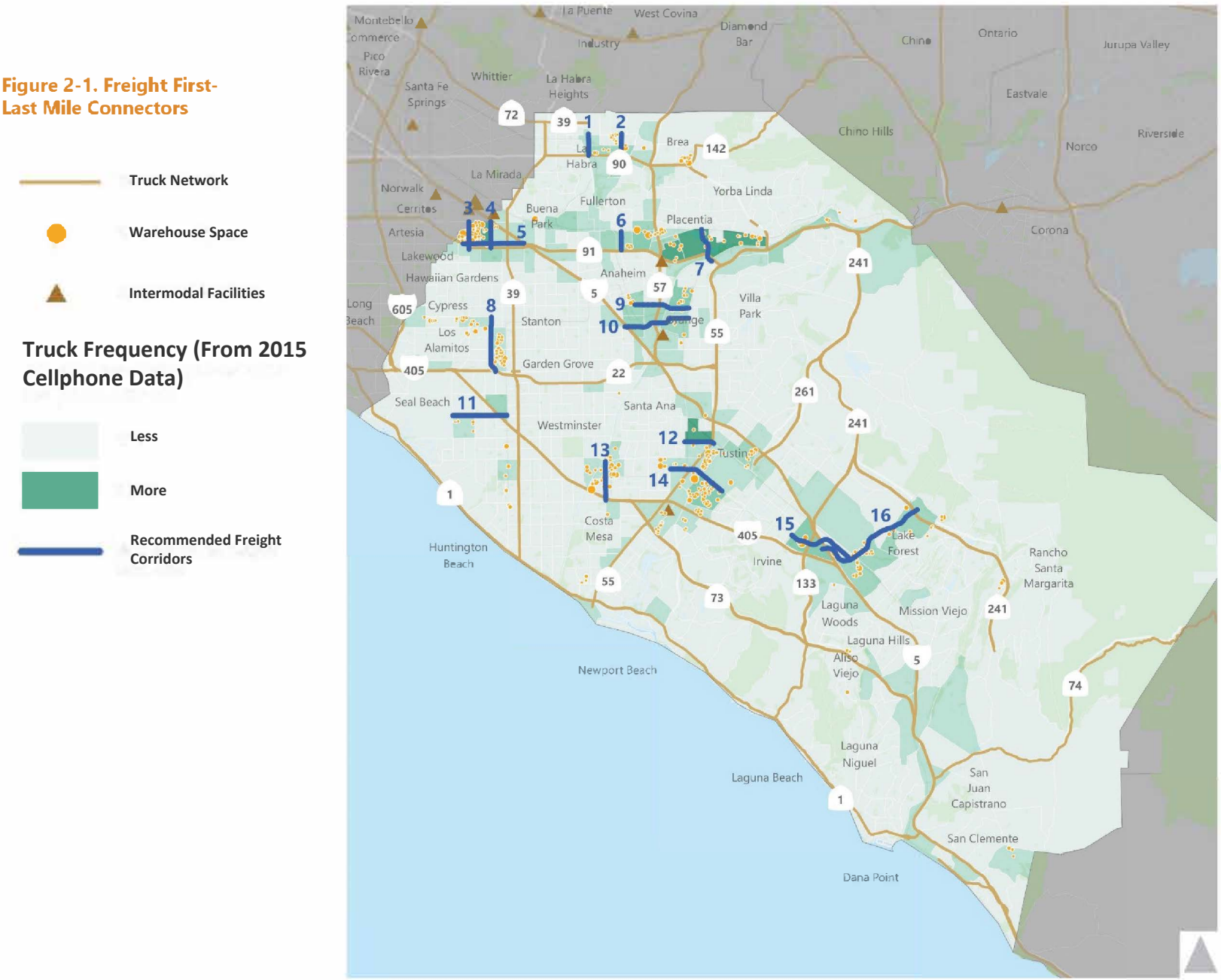
- Incorporate a first/last mile truck route designation for the above routes (or a sub-set) within OCTA's LRTP and/or MPAH.
- Identify standards for this first/last mile truck routes with respect to: pavement section, lane widths, corner radii, safety signage, etc.
- Favor these facilities for funding opportunities and/or create a new category within the LRTP, with the idea of looking for freight-designated FAST money.

Table 2-1. First/Last-Mile Connectors

	Street	From	To	Length (miles)	AADT	Truck Volume (if available)	Truck Route?
1	Harbor Blvd	Superior Ave	Imperial Blvd	0.75	30,200-33,300		No
2	Berry St	Central Ave	Imperial Blvd	1	9,095-13,543		Yes
3	Valley View St	Artesia Blvd	CA-91	1.15	19,500-33,900	5,699	Yes
4	Knott Ave	I-5	CA-91	1.29	14,900-30,600		Yes
5	Orangethorpe Ave	CA-91	Magnolia Ave	3.3	12,700-35,000	3,344	Yes
6	Raymond Ave	Valencia Dr	CA-91	0.9	17,700-28,500		Yes
7	Tustin Ave	Orangethorpe Ave	CA-91	1.3	26,900-65,398		Yes
8	Knott Ave	Katella Ave	Garden Grove Blvd	2.1	27,299-36,393		Yes
9	Ball Rd / Taft Ave	Anaheim Blvd	Glassell St	3	18,000-53,000	5,391	Yes
10	Katella Ave	I-5	Glassell St	3.1	26,900-39,700		Yes
11	Bolsa Ave	Bolsa Chica Rd	Chestnut St	2.24	15,000-27,000	2,924	Yes
12	Edinger Ave	Standard Ave	Del Amo Ave	1.5	31,026-39,097		Yes
13	Harbor Blvd	Warner Ave	I-405	1.7	43,164-61,688	3,204	Yes
14	Dyer Rd / Barranca Pkwy	Main St	Jamboree Rd	2.73	27,566-43,261		Yes
15	Barranca Pkwy	Sand Canyon Ave	Alton Pkwy	3.2	11,381-23,207	900	No
16	Alton Pkwy	I-5	CA-241	5.3	17,484-45,588		Yes

Source: Fehr & Peers; AADT: Caltrans (2014); Truck volumes: SCAG (2012)

Figure 2-1. Freight First-Last Mile Connectors



Issue #2: Congestion

Congestion in Orange County affects shipping costs, delivery times, and shipping reliability. This congestion also contributes to increased collision rates, particularly in areas with a high percentage of trucks and conditions that involve weaving, merging, or abrupt speed changes.

The SCAG 2016 Regional Transportation Plan / Sustainable Communities Strategy identifies 8 projects in Orange County that are scheduled for study, construction, or completion by 2040. The only project specifically addressing trucking capacity is the addition of a northbound truck climbing lane on CA-57 from Lambert Avenue to the LA county line. Other projects may not directly address goods movement capacity, but general roadway improvements that decrease delay and improve overall safety are beneficial for trucks as well.

The projects in **Table 2-2** are sorted from the 2016 RTP/SCS based on the number of truck-involved collisions per mile. A lane addition on I-5 between 55 and 57 is identified by SCAG, but excluded from **Table 2-2** since it is intended as an HOV lane addition and, therefore, would not compete well for freight-related funding. Consideration was also made of the Caltrans District 12 Mobility Performance Report 2012, which identified AM and PM peak period congestion and bottlenecks, and the 2015 Orange County Congestion Management Program. The projects are also shown in **Figure 2-2**.

The toll road system in Orange County represents an opportunity for trucks to avoid some of the more congested locations on the traditional freeways. However, the two longest facilities (SR-73 and SR-241) have significant grades that may be a deterrent to truck usage. The maximum sustained grade on SR-73 near El Toro Road and SR-241 just south of SR-91 is 6%. Additionally, the toll costs are significant for 5+ axle trucks. The fee to traverse the entire stretch of SR-73 from I-405 to I-5 is over $30. Similarly, using SR-241 from SR-91 to Oso Parkway is approximately $33.

Potential Actions:

- In determining the priorities for implementing major roadway improvements, OCTA could consider the operational and safety benefits for trucks. This can be reflected in the RTP.
- Work with TCA to promote the use of the toll roads for trucks. This could take many forms: applying for federal grant money to subsidize truck usage, advising truck drivers on which routes are appropriate for the specifications of their truck, or modifying the toll structure to promote off-peak truck usage to reduce VMT.

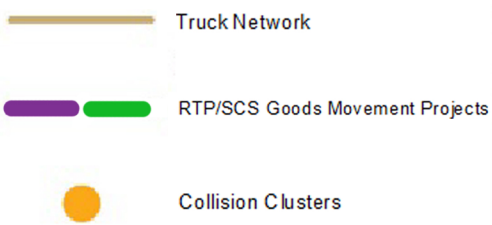
- Consider locations with clusters of truck-related collisions (**Figure 1-12**) in future freeway or arterial needs assessments.

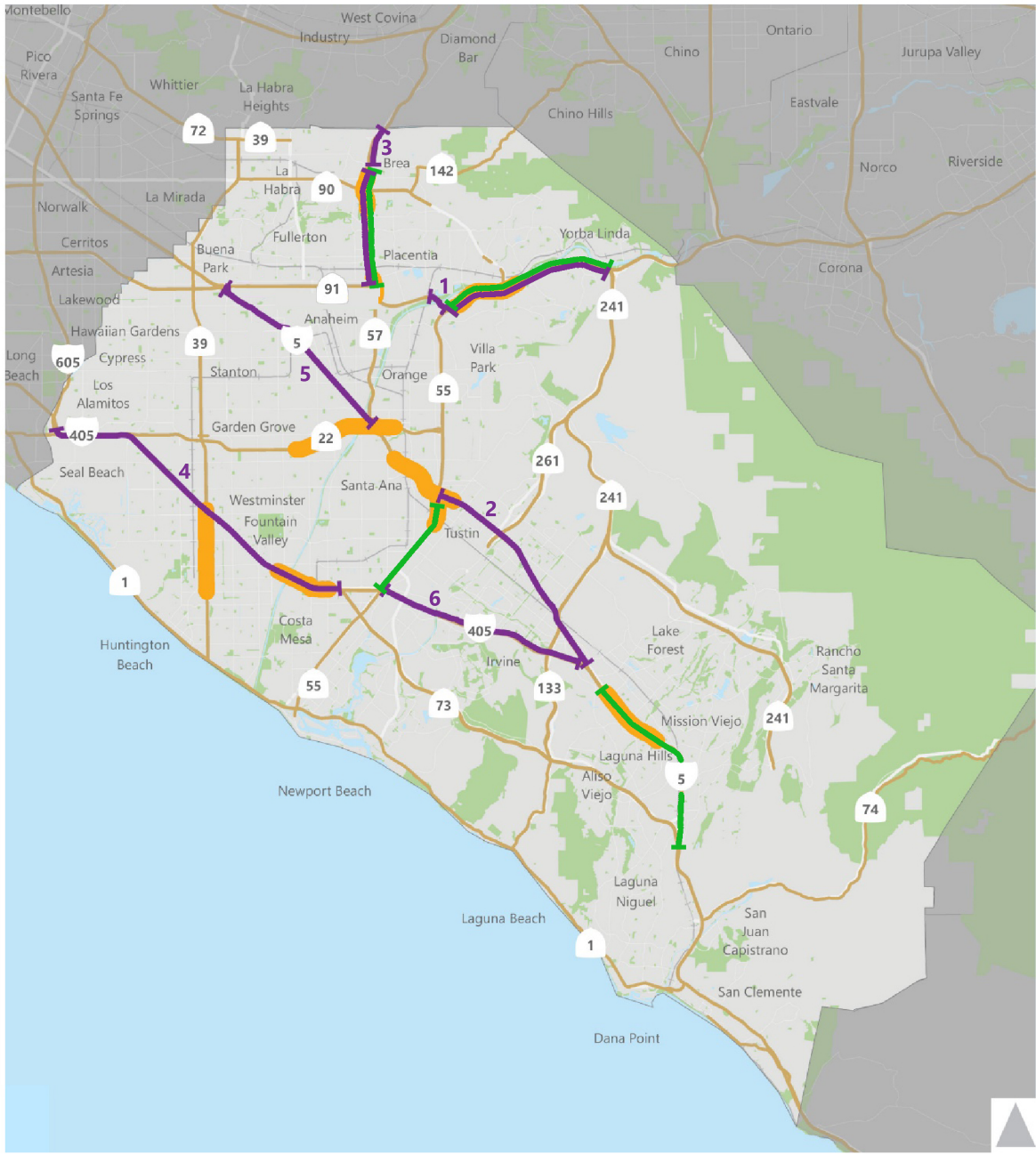
Table 2-2. Orange County Goods Movement Projects from 2016 SCAG RTP

	Project Description	Route	Two-way AADT	Truck % of AADT	Collisions Per Mile	Truck-Involved Collisions Per Mile	Notes
1	Connect WB 91 aux lane through interchanges between 5 and 57	91	512,700	6.8 - 9.2%	141	12	Includes Collision Hotspot #8: Completed May 2016
2	Extend and reconstruct aux lane on WB 91 between 55 and Tustin	91	553,300	4.5 - 6.5%	72	8	
3	Add lane each direction on I-5 from 55 to 405	5	443,300	3.4 - 5.5%	122	7	Overlaps Collision Hotspot #1
4	SR-57 Add Truck Climbing Lane	57	29,646	6.1 - 6.1%	81	7	
5	Add lane each direction on I-405 from 73 to 605	405	531,200	3.0 - 3.5%	132	6	Includes Collision Hotspot #7
6	Add lane each direction on I-5 between 57 and 91	5	505,700	5.5 - 9.6%	102	4	Overlaps Collision Hotspot #1
7	Add lane each direction on I-405 from 55 to I-5 plus aux lanes	405	463,000	3.5 - 5.6%	90	3	

Source: Fehr & Peers; AADT: Caltrans (2014); Truck volumes: SCAG (2012); Collisions: TIMS/SWITRS (2010-2014)

Figure 2-2. Collision Clusters and 2016 RTP/SCS Orange County GM Projects





Issue #3: Funding is Limited

Public funding for freight-related facilities is very limited. The first dedicated federal source was established in late 2015, and there are no state or local sources.

The federal FAST Act (Dec 2015) has provisions for freight-related funding for the National Primary Freight Network. Although portions of I-5 and SR-91 in Orange County are designated as part of this system, the current estimate is that California will receive a little over $100 million annually, which will only support a handful of projects statewide.

In 2014, Congressman Alan Lowenthal introduced legislation to establish a freight infrastructure trust fund via a nationwide 1% fee on the waybill for goods moved more than 50 miles by ground transportation. As currently proposed, the fee would be allocated via two programs: 1) a formula-based distribution to states based upon existing freight infrastructure, and 2) a competitive grant program that includes a dedicated 5% for electrification projects. While this legislation appears to have lost momentum, additional avenues should be explored.

SCAG is intending to complete its study of freight activities across the US border with Mexico in late 2016. According to SCAG staff, this study will not be identifying specific infrastructure-related improvements; however, it will likely provide information to support the case for specific improvements that could be useful in a grant application.

Potential Actions:

- Work with other urban agencies in CA and throughout the US to explore and promote changes to the method of sales tax, with potential for order location as determining criteria. One possibility is developing a county-wide fee program specific to freight. This could be used for: parking, TSEs, air-quality mitigation, and/or maintenance of first/last mile truck routes.
- Support legislative efforts to raise freight-related funding, such as the Lowenthal waybill tax, and position potential projects to compete for this money.
- Review the results of the SCAG study of freight movement across the Mexico border for potential use in funding applications.

Issue #4: Truck Parking

Orange County lacks any general-use truck parking facilities. Consequently, there is more incentive for truck drivers to park in inappropriate locations (such as neighborhoods or freeway ramps).

Parking Availability

The project team investigated options for truck parking (either private or public) along I-5, I-405, and SR 91, as these represent the highest truck volume corridors in Orange County. We looked for under-utilized parcels of land near an interchange, including park-and-ride lots. The site with the most promise is the Fullerton park-and-ride:

The Fullerton park-and-ride, at the intersection of CA-91 and I-5, is operated by OCTA and has a capacity of 800 spaces. Based on a review of available satellite and Google StreetView imagery back to 2009, on any given day the western quarter of the lot tends to be underutilized or empty, with available capacity in the eastern quarters. The western quarter is furthest from the transit boarding islands, which would reduce pedestrian conflicts if trucks parked in this area. We estimate that reconfiguring the western parking lot could provide pull-through parking for 12-16 full size tractor-trailers. All trucks would arrive (regardless of their original direction on the freeway) via Magnolia Ave, turning left onto Orangethorpe Ave, and turning left into the entrance of the parking lot at Auto Center Drive. Although signalized, the left turn is unprotected across a three-lane, 45mph road. A protected left turn phase should be considered for safety. Departing trucks heading to CA-91 or I-5 southbound would retrace the same route. Trucks departing to I-5 northbound can access the ramp directly from the lot exit. There are some amenities within walking distance, including convenience stores and fast food.

A possibly significant hurdle for meeting the needs for truck parking and rest facilities in Orange County is the zoning, permitting and environmental concerns related to truck stops. Truck stops may be difficult projects to approve due to emissions from the truck trips generated and from trucks idling during their rest period to keep in-cab systems running. However, on-site electrical hook-ups could resolve this concern, as discussed below.

Parking Electrification

The National Renewable Energy Laboratory (NREL) collects the data used in the Truck Stop Electrification (TSE) Site Locator. This tool was developed as a collaborative effort between the Federal Highway Administration (FHWA) and the U.S. Department of Energy. It displays public truck stop locations that have idle reduction facilities for heavy-duty trucks. Despite the strong sustainability movement in California, there are only seven electrified sites identified in the state and none in Orange County.

Many EPA SmartWay carrier partners do use Truck Stop Electrification (TSE) where it fits with their travel patterns, and more seem to be establishing private TSE in their yards and allowing visiting truckers to use it. Trucking associations can

encourage fleet owners to pay drivers to use designated parking areas. OCTA can also help DOE and EPA to promote it.

Potential Actions:

- Pursue conversion of the western portion of the Fullerton park-and-ride to truck parking, as a pilot project for such an arrangement.
- Once established, be sure that any truck parking in OC is shown on apps that have been created for truckers to indicate available parking.
- Ensure that any planned truck parking in Orange County is included in the OC and SCAG long-range planning documents, such that any related emissions are budgeted within those plans.
- Investigate arrangements with private sector partners in the development of truck parking investments.
- Consider ways to incentivize land use decisions to facilitate the path for the private sector to create truck parking. One example would be an amendment to local zoning codes to allow truck parking in industrial zones.
- Surplus public properties can be converted to truck stops (e.g., converting a former weigh station to truck parking spaces). If the property has adequate pavement, this is fairly easy. If not, the cost is higher.
- Funding provided by FAST could be used to construct truck parking facilities. The National Highway Freight Program (NHFP) created under FAST, allocates $1.2 billion annually by formula to states to undertake freight planning, performance measures, operational improvements and construction activities. While the program is highway focused, it allows states to allocate up to 10 percent of the program funds to truck parking, rail, intermodal and port projects.
- Shippers/receivers often demand that drivers leave the facility immediately after delivery. OCTA could encourage prominent OC freight-related companies to develop procedures or agreements to allow drivers use their parking facilities for short breaks.
- Promote that companies with TSEs in private yards allow the use by visiting truckers (for a fee) and look to reduce any local opposition or regulations that might discourage such activities.
- Encourage the use of TSE as an air-quality mitigation measure in future SCSs and RTPs. This would likely be concurrent with creating publically available parking areas.
- Look for funding sources to incentivize electrification at truck stops (to eliminate engine idling and corresponding pollutants). Possible sources are the California Air Resources Board and the South Coast Air Quality Management District.

Issue #5: Truck Emissions

Emissions from heavy-duty trucks contribute 15% of the mobile pollutants generated within OC, while they represent only 7% of the vehicle-miles-travelled (Source: EMFAC2014)

Emissions-related regulations for trucks are handled at the federal and state level, therefore OCTA does not have a direct role. OCTA also does not have a direct role in the technology enhancements that reduce emissions per ton-mile. However, OCTA can take actions that encourage or facilitate emission-reductions.

In June 2016, the South Coast Air Quality Management District (SCAQMD) was part of a coalition of state and regional air quality organizations that petitioned the federal government for more stringent (10x more than current) standards for emissions from heavy-duty trucks. The California Air Resources Board (CARB) plans to adopt similar ulta-low NOx standards for truck engines sold in California, but they estimate not meeting the 2031 standard for ozone without similar requirements on interstate trucking operations.

CNG, LNG, and hydrogen fueling stations are available in OC at private fueling facilities (associated with a specific business) but not at public fueling stations.

Potential Actions:

- Encourage that CNG, LNG, and/or hydrogen fueling facilities be developed at public fueling stations in Orange County.
- Support CARB's pending near-zero emissions standards for heavy-duty trucks and SCAQMD's efforts to encourage the federal government to adopt similar standards.

Issue #6: Evolving Technology

Freight technology is evolving with respect to production (3D printing), storage/shipping, and delivery. These changes represent an opportunity for leadership within Orange County.

The process of creating a variety of products, locally, using 3D printing is an attractive option to more centralized production and storage. However, this process necessitates that raw materials be available and stored in proximity. It also requires that final products be stored until shipped. While the space requirements are not as great as with traditional production and warehouse facilities, there is still space needed. Additionally, the appropriate zoning for 3D printing facilities is not clear. For example, could such facilities be placed with

more traditional office areas, rather than heavy industrial zones.

The vehicle technology for freight is evolving quickly, with great progress in the areas of driverless vehicles and/or platooning. Aerial deliveries via drones are also emerging as a viable option. Magnetic Levitation has great promise but is yet to be proven as practical. Orange County is fortunate to have many innovative companies and institutions that could be leaders in testing and refining such technologies. Auto companies such as Hundai, Kia, and Ford have a significant presence in Orange County, along with research facilities at UC Irvine and controlled roadways via the Toll Roads.

Potential Actions:

- Collaborate with local agencies to identify ways to recruit/promote 3D printing and other "light" manufacturing via guidelines, zoning, and promotions.
- Encourage and/or facilitate partnerships between public and private entities to test, enhance, refine, and promote alternative freight technologies.

Issue #7: Limited Data

Freight travel data is limited in general, and particularly in Orange County. This creates a challenge in having a clear picture of the benefits and needs.

Weigh-In-Motion (WIM) data is a continuous classified data collection source, and therefore represents a good source to track truck movement patterns. **Figure 2-3** shows that there are 4 pairs (both directions) of existing WIM stations in OC and one is planned for SR-55. None are planned for either SR-57 or SR-91. Although Caltrans controls these stations, OCTA may be able to partner with, or influence, Caltrans.

Potential Actions:

- Collaborate with Caltrans District 12 to expand the network of WIM stations, ensure they are operating, and use the data (with each RTP update) to evaluate trends.

Figure 2-3. Existing and Future WIM Sites

Existing and Future WIM Sites

Site #	DIST	CO	RTE	PM	LOCATION
15	12	ORA	5	25.8	IRVINE (SB)
16	12	ORA	5	25.8	IRVINE (NB)
0	12	ORA	55	16.1	KATELLA NB
0	12	ORA	55	16.1	KATELLA SB
61	12	ORA	91	R11.9	PERALTA (EB)
62	12	ORA	91	R11.9	PERALTA (WB)
103	12	ORA	57	21	ORANGE (SB)
104	12	ORA	57	21	ORANGE (NB)
111	12	ORA	405	18.6	SAIGON SB
112	12	ORA	405	18.6	SAIGON NB

Issue #8: Changing Delivery Methods

Home deliveries are increasing tremendously due to on-line shopping, and the method of deliveries is becoming more ad-hoc. These factors could lead to safety or nuisance concerns in neighborhoods.

Some delivery companies are now supporting the use "shared" deliveries. Namely, individuals can sign-up to deliver packages in their neighborhoods. Therefore, more deliveries are being made by persons who may not be as known or "trackable" by the company. This could lead to security concerns.

As a consequence of congestion and more same-day deliveries, the hours of delivery to homes has expanded to nights and weekends. This could create a nuisance concern in some neighborhoods.

Potential Actions:

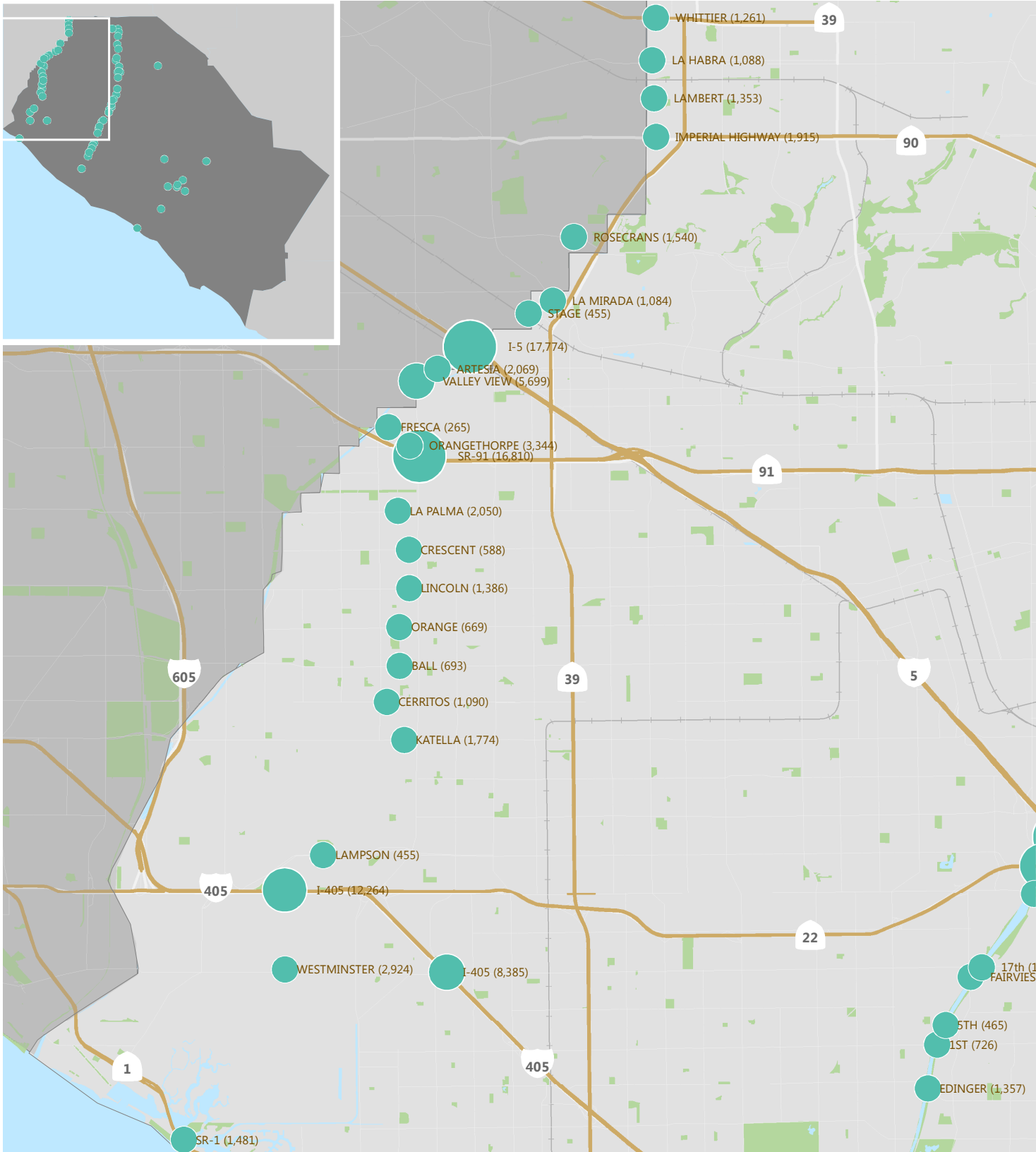
- Monitor the above concerns via conversations with OCTA member agencies

APPENDIX A

ORANGE COUNTY TRUCK COUNTS

APPENDIX A1

Daily Two-Way Truck Volumes (Northwest Orange County)



NOTE: COUNTS ARE SHOWN AT THE MID-BLOCK LOCATION WHERE THE DATA WERE COLLECTED.

SOURCE: CALTRANS (2014); SCAG (2012)

APPENDIX A2

Daily Two-Way Truck Volumes (North Orange County)

< 5,000

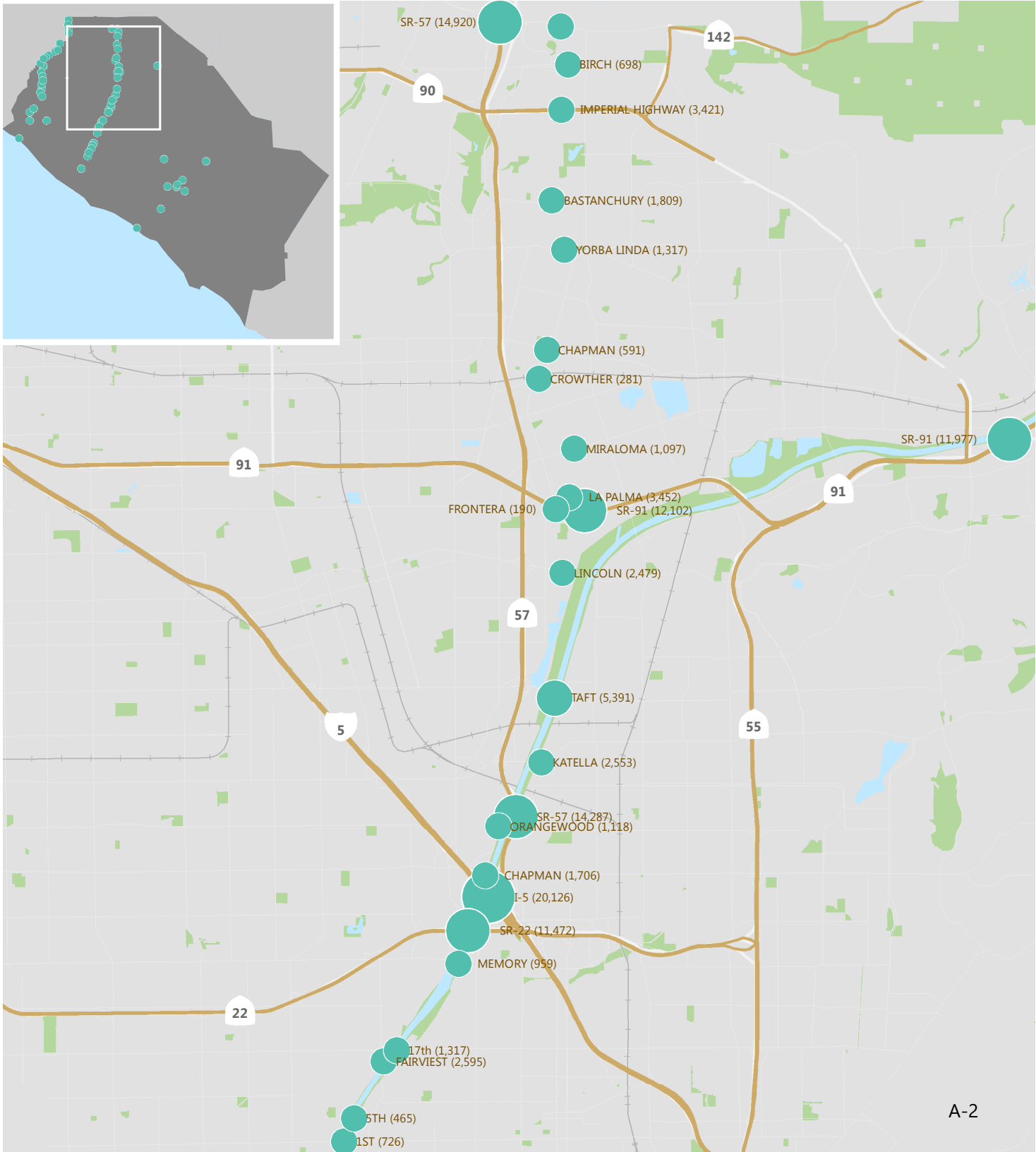
5,000 - 10,000

10,000 - 15,000

15,000 - 20,000

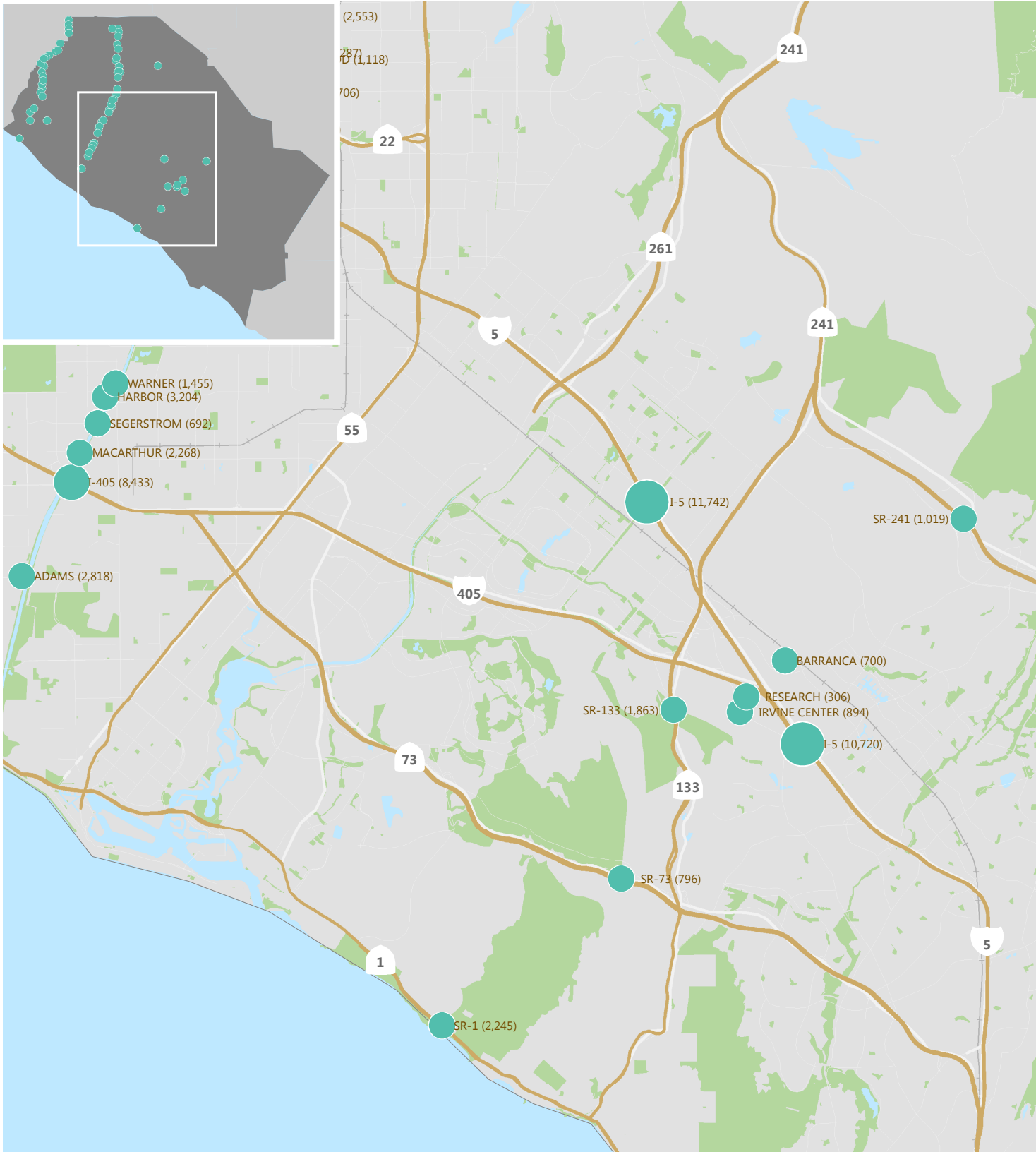
NOTE: COUNTS ARE SHOWN AT THE MID-BLOCK LOCATION WHERE THE DATA WERE COLLECTED.

SOURCE: CALTRANS (2014); SCAG (2012)



APPENDIX A3

Daily Two-Way Truck Volumes (Central Orange County)



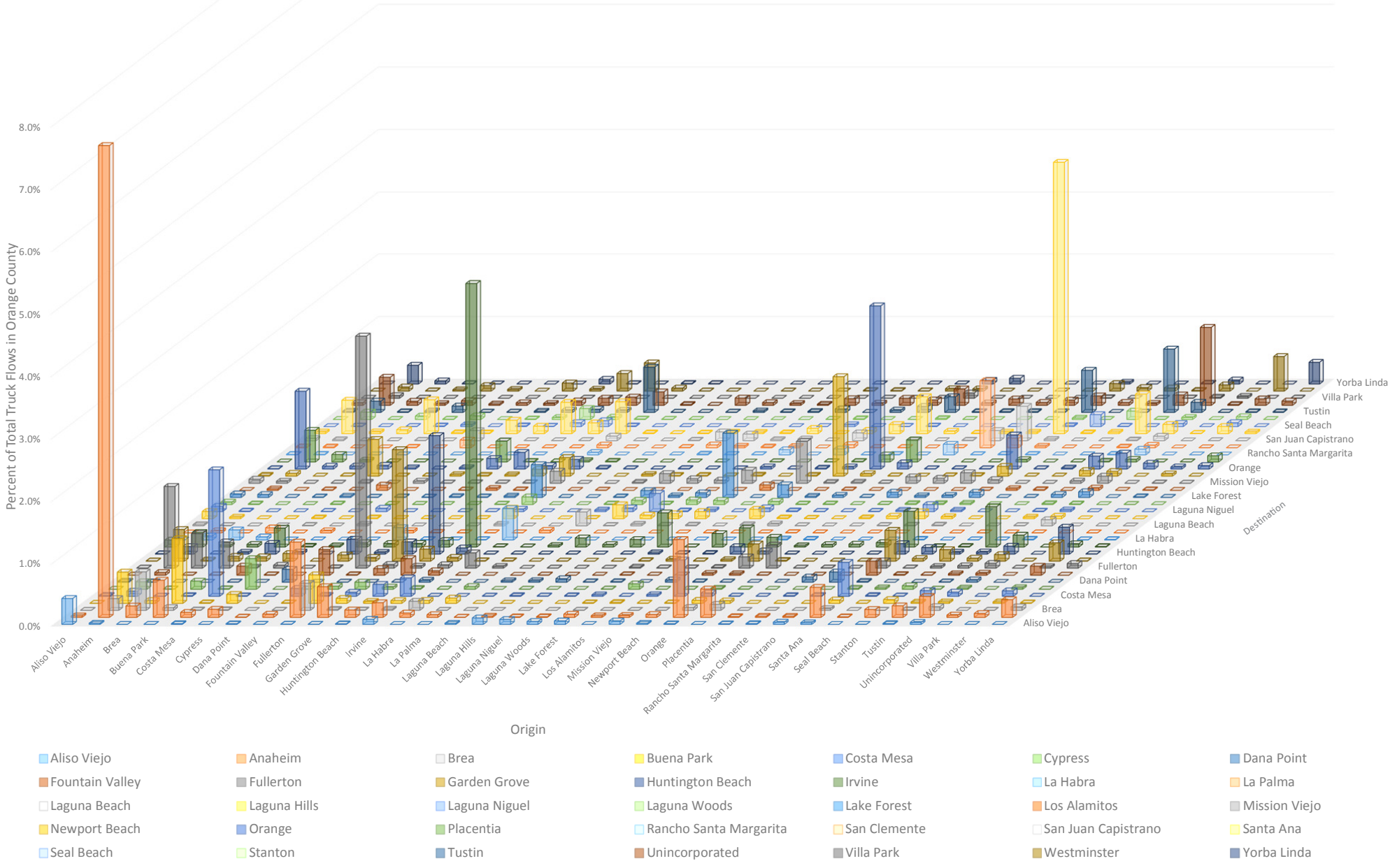
SOURCE: CALTRANS (2014); SCAG (2012)

APPENDIX B

ORANGE COUNTY CITY-TO-CITY DAILY TRUCK FLOWS

APPENDIX B1

2015 Daily Truck Flows by City



SOURCE: STREETLIGHT (2015)

APPENDIX B1 (CONTINUED)

Destination

Origin	Aliso Viejo	Anaheim	Brea	Buena Park	Costa Mesa	Cypress	Dana Point	Fountain Valley	Fullerton	Garden Grove	Huntington Beach	Irvine	La Habra	La Palma	Laguna Beach	Laguna Hills	Laguna Niguel	Laguna Woods	Lake Forest	Los Alamitos	Mission Viejo	Newport Beach	Orange	Placentia	Rancho Sta Margarita	San Clemente	San Juan Capistrano	Santa Ana	Seal Beach	Stanton	Tustin	Unincorporated	Villa Park	Westminster	Yorba Linda	Total
Aliso Viejo	0.4%	–	–	–	–	–	–	–	–	–	–	0.1%	–	–	–	0.1%	0.1%	–	0.1%	–	0.1%	–	–	–	–	–	–	–	–	–	–	–	–	–	1.2%
Anaheim	–	7.6%	0.2%	0.5%	0.1%	0.1%	–	–	1.3%	0.5%	0.1%	0.2%	0.1%	–	–	–	–	–	–	–	–	–	1.2%	0.5%	–	–	–	0.5%	–	0.1%	0.2%	0.4%	–	0.1%	0.3%	14.5%
Brea	–	0.2%	0.6%	–	–	–	–	–	0.6%	–	–	–	0.2%	–	–	–	–	–	–	–	–	–	–	0.1%	–	–	–	–	–	–	–	0.1%	–	–	0.1%	2.0%
Buena Park	–	0.6%	–	1.0%	–	0.1%	–	–	0.4%	0.1%	–	–	–	0.1%	–	–	–	–	–	–	–	–	–	–	–	–	–	0.1%	–	0.1%	–	–	–	–	–	2.9%
Costa Mesa	–	0.1%	–	–	2.0%	–	–	0.1%	–	0.1%	0.2%	0.3%	–	–	–	–	–	–	–	–	–	0.6%	0.1%	–	–	–	–	0.5%	–	–	0.1%	0.1%	–	0.1%	–	4.5%
Cypress	–	0.1%	–	0.1%	–	0.5%	–	–	–	0.1%	–	–	–	–	–	–	–	–	–	0.1%	–	–	–	–	–	–	–	–	–	0.1%	–	–	–	–	–	1.3%
Dana Point	–	–	–	–	–	–	0.2%	–	–	–	–	–	–	–	–	–	0.1%	–	–	–	–	–	–	–	–	0.1%	0.2%	–	–	–	–	–	–	–	–	0.8%
Fountain Valley	–	0.1%	–	–	0.1%	–	–	0.4%	–	0.1%	0.2%	0.1%	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.2%	–	–	–	–	–	0.1%	–	1.5%
Fullerton	–	1.2%	0.4%	0.5%	–	0.1%	–	–	3.7%	0.1%	–	0.1%	0.2%	–	–	–	–	–	–	–	–	–	0.2%	0.3%	–	–	–	0.1%	–	–	–	0.1%	–	–	0.1%	7.2%
Garden Grove	–	0.5%	–	0.1%	0.1%	0.1%	–	0.1%	0.1%	1.8%	0.2%	0.1%	–	–	–	–	–	–	–	–	–	–	0.3%	–	–	–	–	0.5%	0.1%	0.2%	0.1%	0.1%	–	0.3%	–	4.6%
Huntington Beach	–	0.1%	–	–	0.2%	–	–	0.3%	–	0.2%	1.9%	0.1%	–	–	–	–	–	–	–	–	–	0.1%	0.1%	–	–	–	–	0.2%	0.1%	–	–	0.1%	–	0.5%	–	4.1%
Irvine	0.1%	0.2%	–	–	0.3%	–	–	0.1%	0.1%	0.1%	0.1%	4.2%	–	–	–	0.2%	–	0.1%	0.5%	–	0.2%	0.3%	0.2%	–	–	–	0.1%	0.5%	–	–	0.7%	0.2%	–	–	–	8.5%
La Habra	–	0.1%	0.1%	–	–	–	–	–	0.2%	–	–	–	0.5%	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.1%
La Palma	–	–	–	0.1%	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.3%
Laguna Beach	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.2%	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.1%	–	–	–	0.6%
Laguna Hills	0.1%	–	–	–	–	–	–	–	–	–	–	0.1%	–	–	–	0.2%	0.1%	0.1%	0.1%	–	0.2%	–	–	–	–	–	0.1%	–	–	–	–	–	–	–	–	–	1.3%
Laguna Niguel	0.1%	–	–	–	–	–	0.1%	–	–	–	–	–	–	–	–	0.1%	0.3%	–	–	–	0.1%	–	–	–	–	–	0.1%	–	–	–	–	–	–	–	–	–	0.9%
Laguna Woods	–	–	–	–	–	–	–	–	–	–	–	0.1%	–	–	–	0.1%	–	0.1%	0.1%	–	0.1%	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.6%
Lake Forest	0.1%	0.1%	–	–	–	–	–	–	–	–	–	0.5%	–	–	–	0.1%	–	0.1%	1.0%	–	0.2%	–	–	–	0.1%	–	–	0.1%	–	–	0.1%	0.1%	–	–	–	2.7%
Los Alamitos	–	–	–	–	–	0.1%	–	–	–	–	–	–	–	–	–	–	–	–	–	0.1%	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.4%
Mission Viejo	0.1%	–	–	–	–	–	–	–	–	–	–	0.2%	–	–	–	0.2%	0.1%	0.1%	0.2%	–	0.7%	–	–	–	0.1%	0.1%	0.1%	0.1%	–	–	–	0.1%	–	–	–	–	2.1%
Newport Beach	–	–	–	–	0.6%	–	–	–	–	–	0.1%	0.3%	–	–	–	–	–	–	–	–	–	1.6%	–	–	–	–	–	0.1%	–	–	0.1%	0.1%	–	–	–	3.3%
Orange	–	1.3%	–	–	0.1%	–	–	–	0.2%	0.3%	0.1%	0.2%	–	–	–	–	–	–	–	–	–	–	2.6%	0.1%	–	–	–	0.6%	–	–	0.3%	0.3%	0.1%	–	0.1%	6.3%
Placentia	–	0.5%	0.1%	–	–	–	–	–	0.4%	–	–	–	–	–	–	–	–	–	–	–	–	–	0.1%	0.4%	–	–	–	–	–	–	–	–	–	–	0.1%	1.7%
Rancho Sta Margarita	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.1%	–	0.1%	–	–	–	0.2%	–	–	–	–	–	–	0.1%	–	–	–	0.6%
San Clemente	–	–	–	–	–	–	0.1%	–	–	–	–	–	–	–	–	–	–	–	–	–	0.1%	–	–	–	–	1.1%	0.2%	–	–	–	–	–	–	–	–	1.7%
San Juan Capistrano	–	–	–	–	–	–	0.2%	–	–	–	–	0.1%	–	–	–	0.1%	0.1%	–	–	–	0.2%	–	–	–	–	0.2%	0.6%	–	–	–	–	0.1%	–	–	–	–	1.6%
Santa Ana	–	0.5%	–	0.1%	0.5%	–	–	0.2%	0.1%	0.5%	0.2%	0.6%	–	–	–	–	–	–	0.1%	–	0.1%	0.2%	0.5%	–	–	–	–	4.3%	–	–	0.7%	0.2%	–	0.1%	–	9.2%
Seal Beach	–	–	–	–	–	–	–	–	–	–	0.1%	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.2%	–	–	–	–	0.1%	–	0.6%
Stanton	–	0.1%	–	0.1%	–	0.1%	–	–	–	0.2%	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.1%	–	–	–	0.1%	–	0.8%
Tustin	–	0.2%	–	–	0.1%	–	–	–	–	–	–	0.6%	–	–	–	–	–	–	–	–	–	0.1%	0.2%	–	–	–	–	0.6%	–	–	1.0%	0.2%	–	–	–	3.5%
Unincorporated	–	0.3%	0.1%	–	0.1%	–	–	–	0.1%	0.1%	0.1%	0.2%	–	–	0.1%	–	–	–	0.1%	–	0.1%	0.1%	0.3%	–	0.1%	–	0.1%	0.1%	0.1%	–	0.2%	1.2%	–	0.1%	0.1%	4.0%
Villa Park	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.1%	–	–	–	–	–	–	–	–	–	–	–	–	0.2%
Westminster	–	0.1%	–	–	0.1%	–	–	0.1%	–	0.3%	0.4%	0.1%	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.1%	0.1%	–	–	0.1%	–	0.6%	–	2.2%
Yorba Linda	–	0.3%	0.1%	–	–	–	–	–	0.1%	–	–	–	–	–	–	–	–	–	–	–	–	–	0.1%	0.1%	–	–	–	–	–	–	–	0.1%	–	–	0.3%	1.1%
Total	1.1%	14.3%	1.8%	2.8%	4.4%	1.3%	0.8%	1.6%	7.5%	4.6%	4.0%	8.5%	1.1%	0.3%	0.6%	1.3%	0.9%	0.6%	2.6%	0.4%	2.2%	3.3%	6.2%	1.8%	0.6%	1.7%	1.6%	9.1%	0.6%	0.8%	3.7%	4.2%	0.2%	2.2%	1.1%	100%

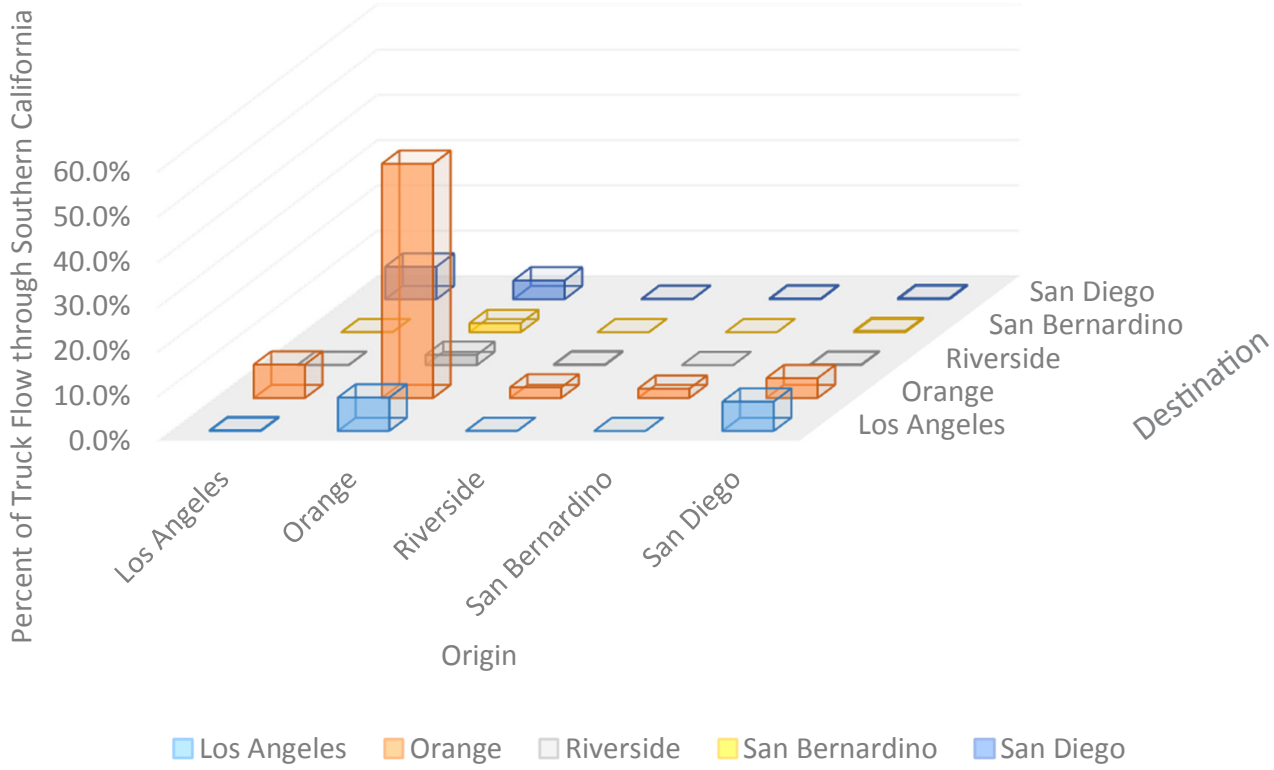
SOURCE: STREETLIGHT (2015)

APPENDIX C

ORIGIN/DESTINATION OF TRUCK TRIPS ON KEY ORANGE COUNTY ROAD SEGMENTS

APPENDIX C1

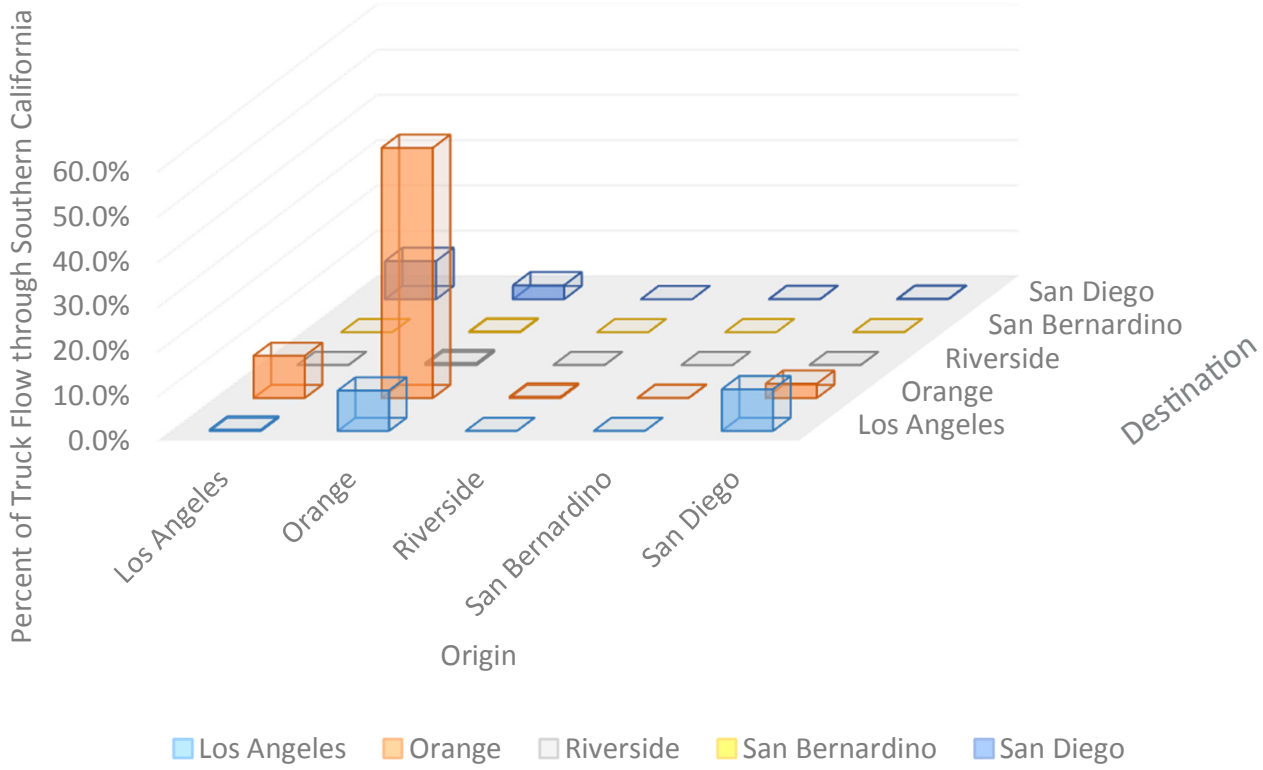
County to County Flows via I-5 s/o Jamboree Road



		Destination				
		Los Angeles	Orange	Riverside	San Bernardino	San Diego
Origin	Los Angeles	0.2%	7.5%	0.1%	0.0%	7.2%
	Orange	7.5%	52.1%	2.3%	2.0%	4.1%
	Riverside	0.0%	2.4%	0.2%	0.0%	0.1%
	San Bernardino	0.0%	2.1%	0.0%	0.0%	0.2%
	San Diego	6.6%	4.5%	0.2%	0.3%	0.3%

APPENDIX C2

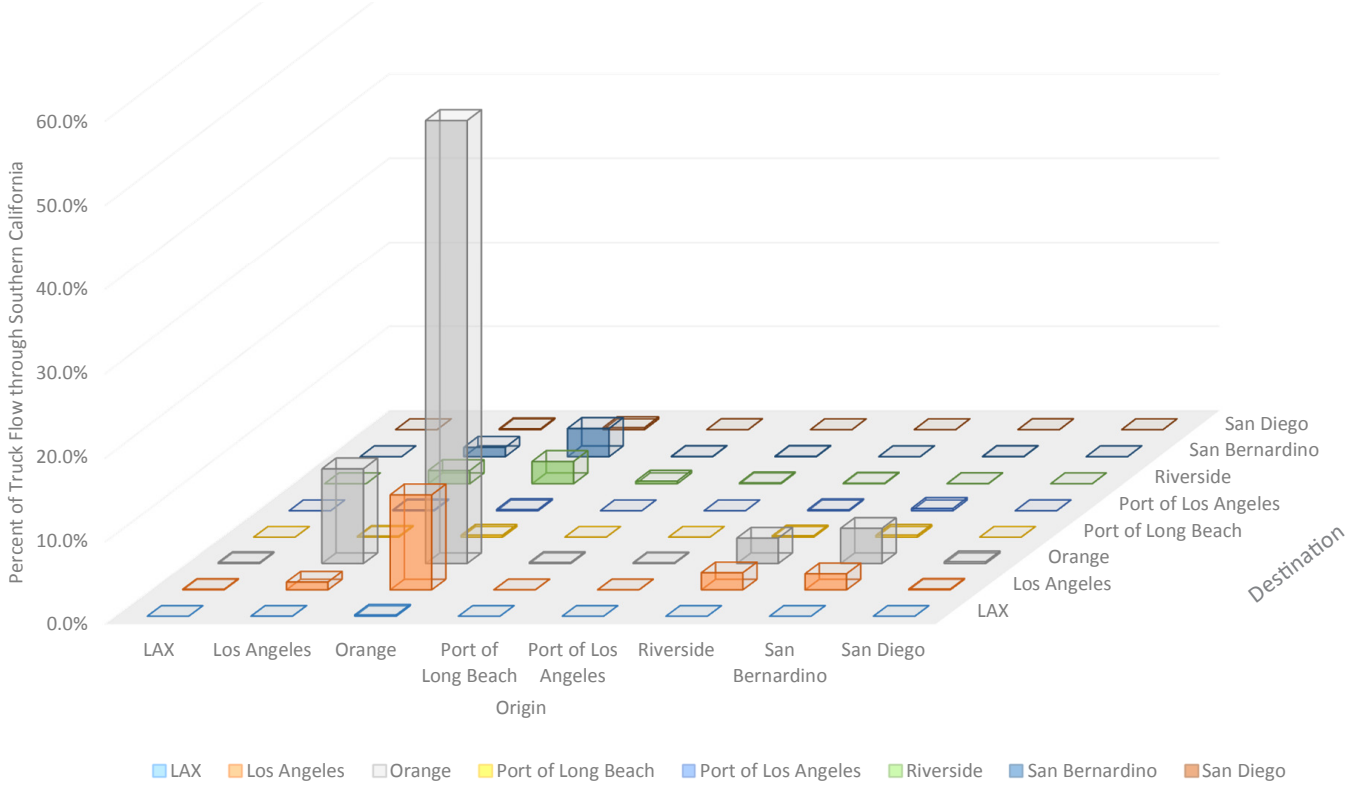
County to County Flows via I-405 s/o Jamboree Road



		Destination				
		Los Angeles	Orange	Riverside	San Bernardino	San Diego
Origin	Los Angeles	0.3%	9.5%	0.1%	0.0%	8.4%
	Orange	9.1%	55.6%	0.5%	0.2%	3.1%
	Riverside	0.0%	0.3%	0.0%	0.0%	0.0%
	San Bernardino	0.0%	0.1%	0.0%	0.0%	0.1%
	San Diego	9.4%	3.2%	0.0%	0.0%	0.1%

APPENDIX C3

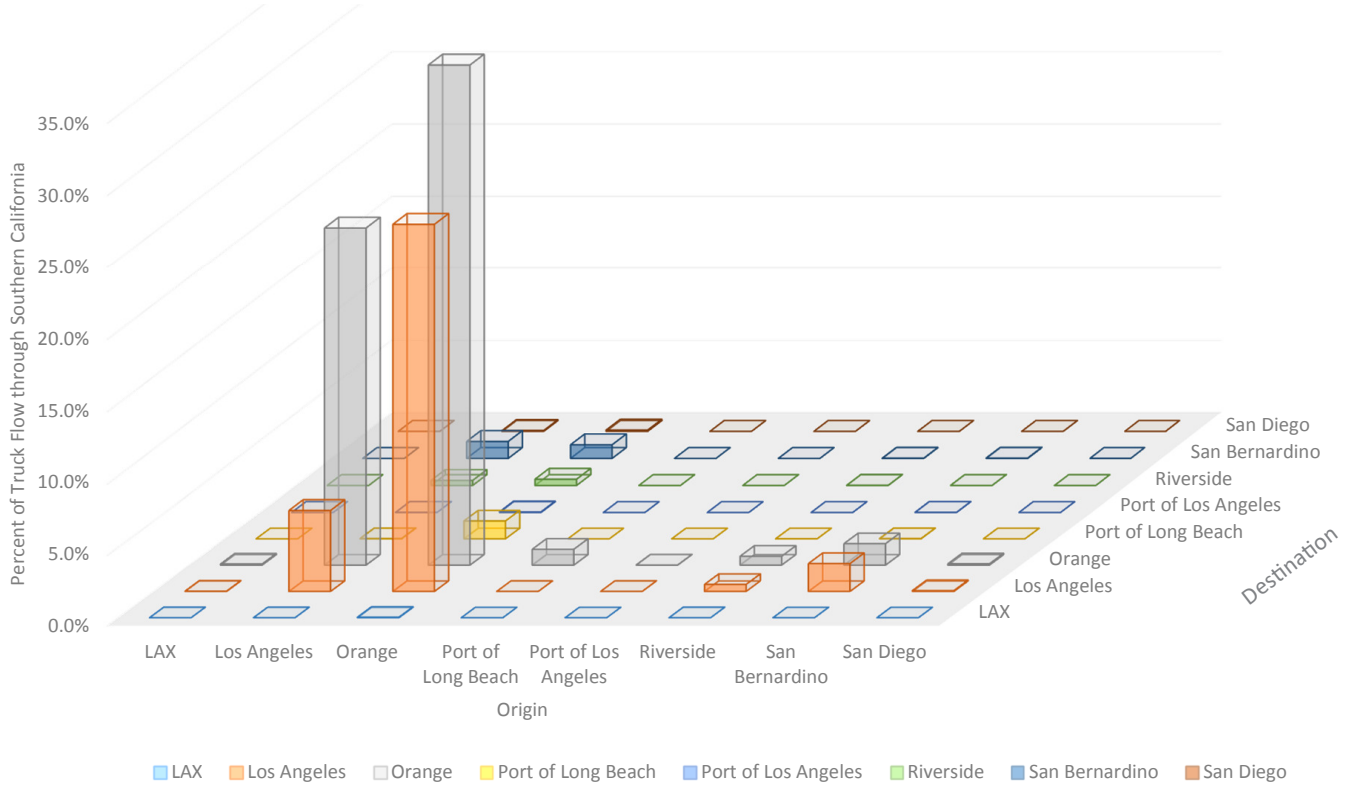
County to County Flows via SR-22 w/o Harbor Boulevard



		Destination							
		LAX	Los Angeles	Orange	Port of Long Beach	Port of Los Angeles	Riverside	San Bernardino	San Diego
Origin	LAX	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	Los Angeles	0.0%	1.0%	11.4%	0.1%	0.1%	1.6%	1.1%	0.1%
	Orange	0.2%	11.5%	52.7%	0.2%	0.2%	2.6%	3.3%	0.2%
	Port of Long Beach	0.0%	0.0%	0.1%	0.0%	0.0%	0.3%	0.0%	0.0%
	Port of Los Angeles	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.1%	0.0%
	Riverside	0.0%	2.1%	3.1%	0.2%	0.1%	0.1%	0.0%	0.0%
	San Bernardino	0.0%	2.0%	4.3%	0.2%	0.3%	0.0%	0.0%	0.0%
	San Diego	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%

APPENDIX C4

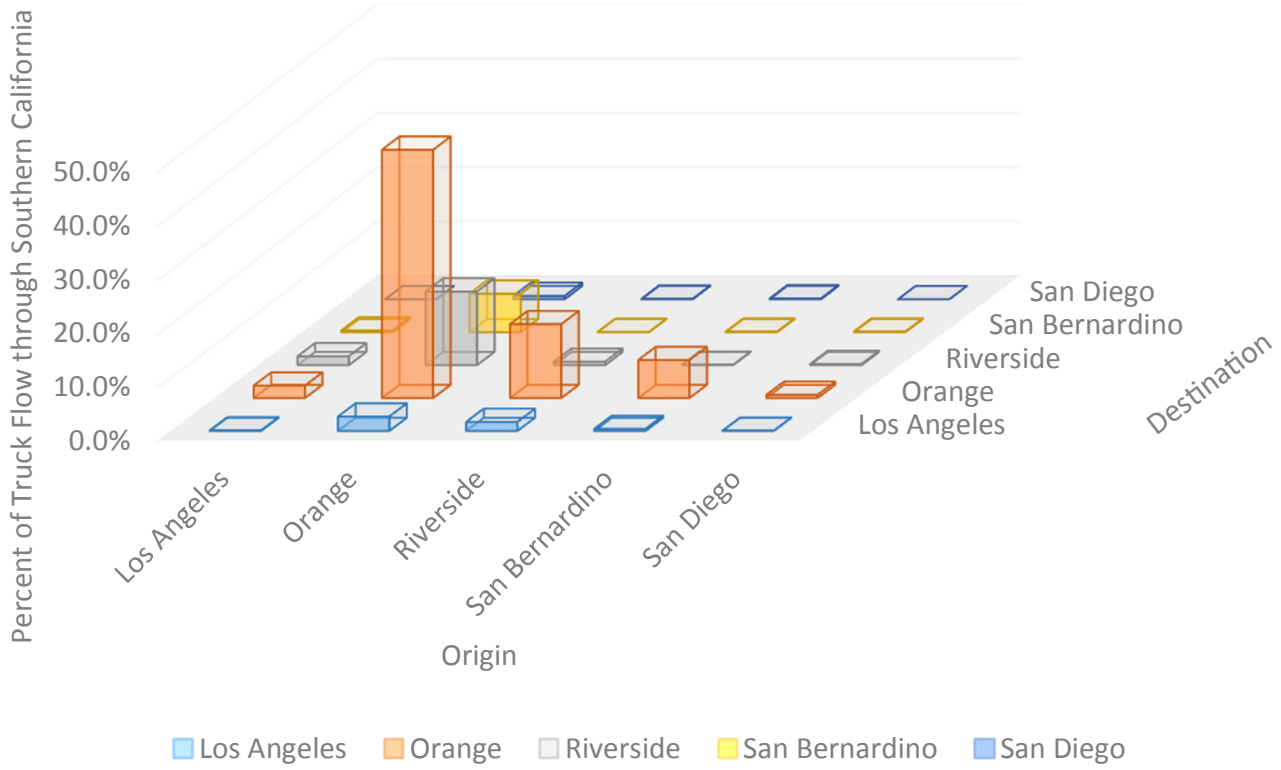
County to County Flows via SR-39 s/o State Route 90



		Destination							
		LAX	Los Angeles	Orange	Port of Long Beach	Port of Los Angeles	Riverside	San Bernardino	San Diego
Origin	LAX	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	Los Angeles	0.0%	5.7%	23.4%	0.0%	0.0%	0.3%	1.2%	0.1%
	Orange	0.0%	25.6%	34.7%	1.3%	0.0%	0.4%	0.9%	0.1%
	Port of Long Beach	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	Port of Los Angeles	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Riverside	0.0%	0.5%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%
	San Bernardino	0.0%	2.0%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%
	San Diego	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%

APPENDIX C5

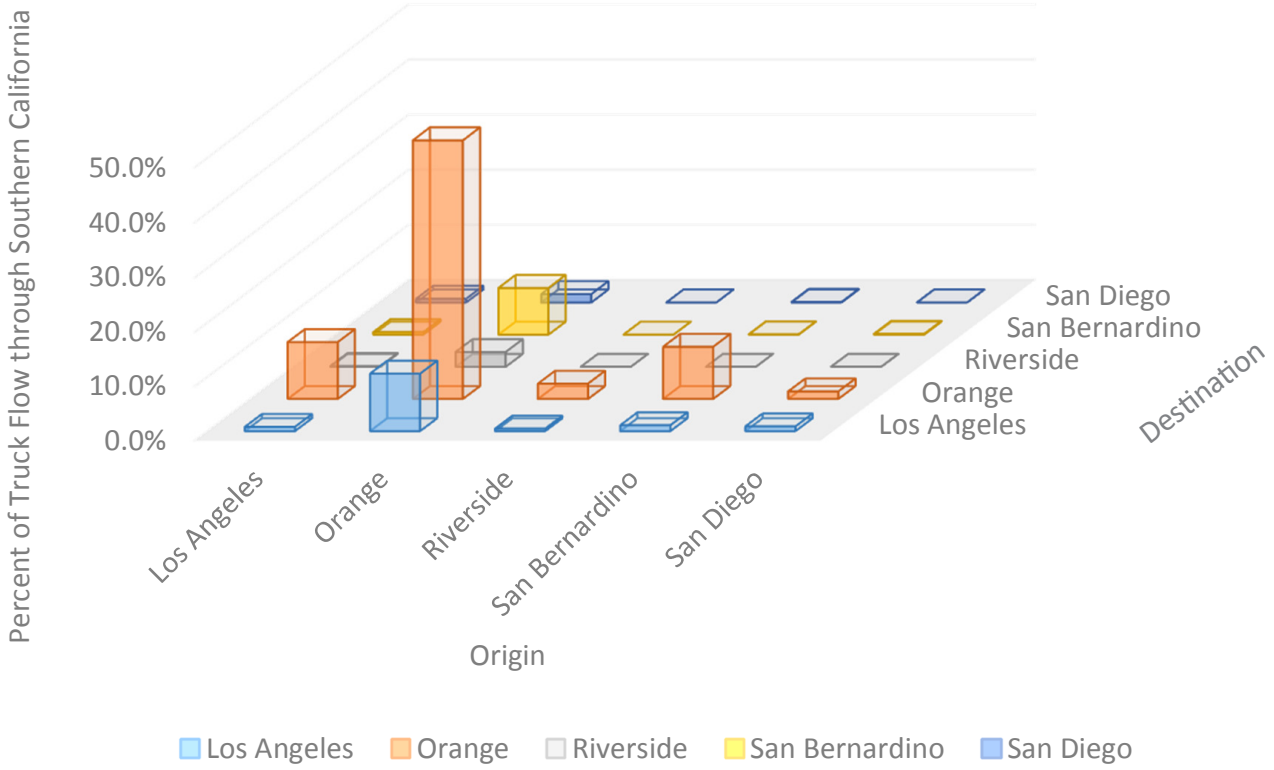
County to County Flows via SR 55 s/o Lincoln Avenue



		Destination				
		Los Angeles	Orange	Riverside	San Bernardino	San Diego
Origin	Los Angeles	0.1%	2.3%	1.7%	0.3%	0.0%
	Orange	2.7%	46.0%	13.7%	7.2%	0.6%
	Riverside	1.7%	13.8%	0.6%	0.1%	0.1%
	San Bernardino	0.4%	7.1%	0.1%	0.1%	0.2%
	San Diego	0.1%	0.6%	0.2%	0.2%	0.0%

APPENDIX C6

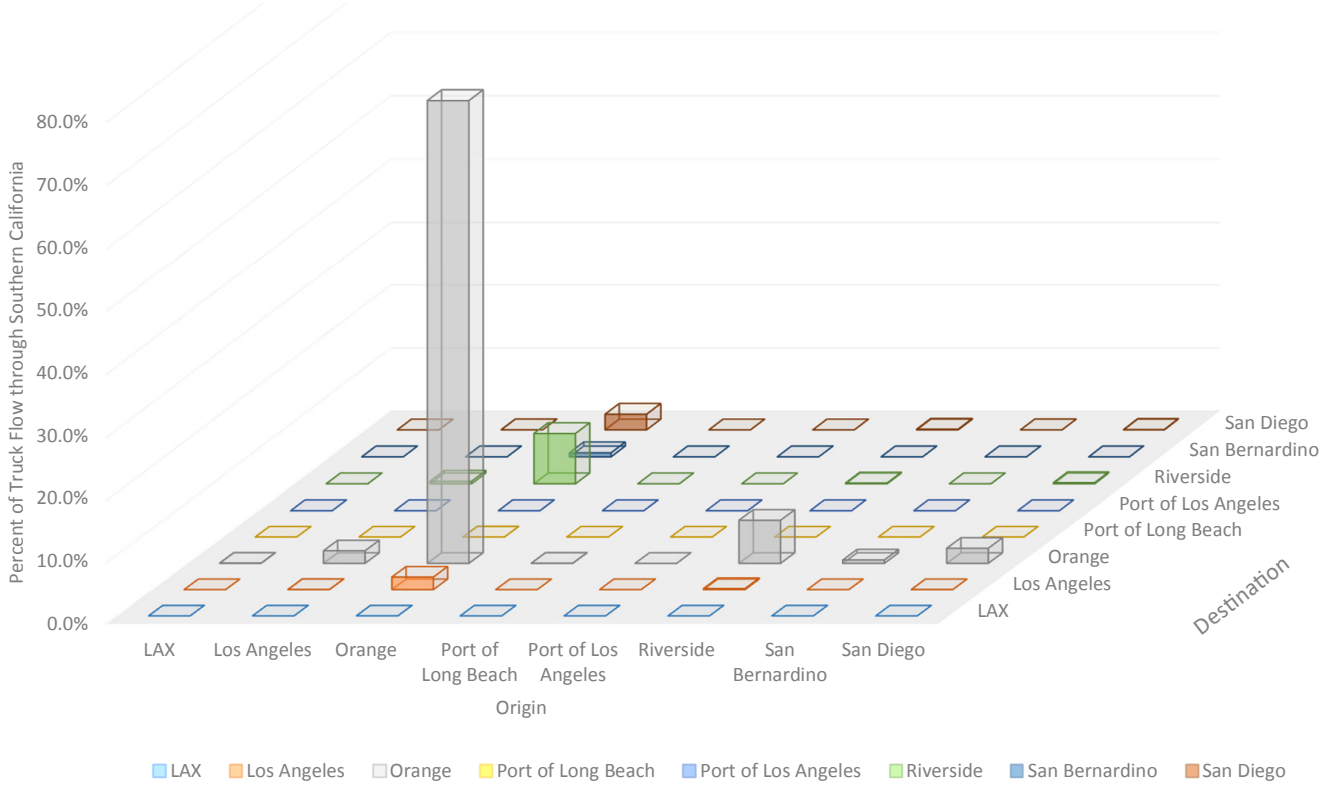
County to County Flows via SR 57 s/o Lincoln Avenue



		Destination				
		Los Angeles	Orange	Riverside	San Bernardino	San Diego
Origin	Los Angeles	0.8%	10.5%	0.2%	0.5%	0.7%
	Orange	10.6%	47.2%	2.7%	8.6%	1.5%
	Riverside	0.5%	2.8%	0.0%	0.0%	0.0%
	San Bernardino	1.1%	9.6%	0.0%	0.1%	0.1%
	San Diego	0.9%	1.4%	0.0%	0.2%	0.0%

APPENDIX C7

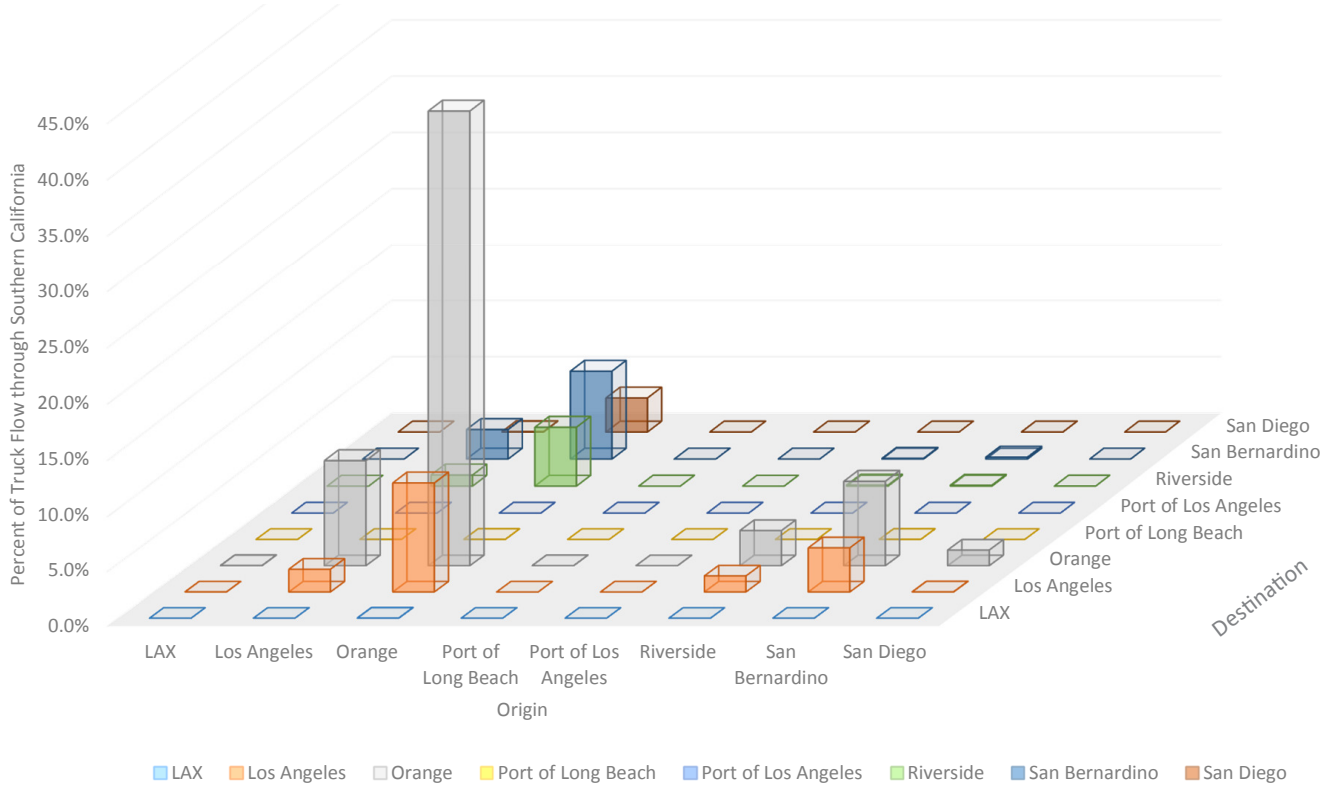
County to County Flows via SR-74 w/o I-5



		Destination							
		LAX	Los Angeles	Orange	Port of Long Beach	Port of Los Angeles	Riverside	San Bernardino	San Diego
Origin	LAX	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Los Angeles	0.0%	0.0%	2.0%	0.0%	0.0%	0.4%	0.0%	0.0%
	Orange	0.0%	2.0%	73.6%	0.0%	0.0%	8.0%	0.6%	2.5%
	Port of Long Beach	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Port of Los Angeles	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Riverside	0.0%	0.2%	7.0%	0.0%	0.0%	0.1%	0.0%	0.1%
	San Bernardino	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%
	San Diego	0.0%	0.0%	2.4%	0.0%	0.0%	0.2%	0.0%	0.1%

APPENDIX C8

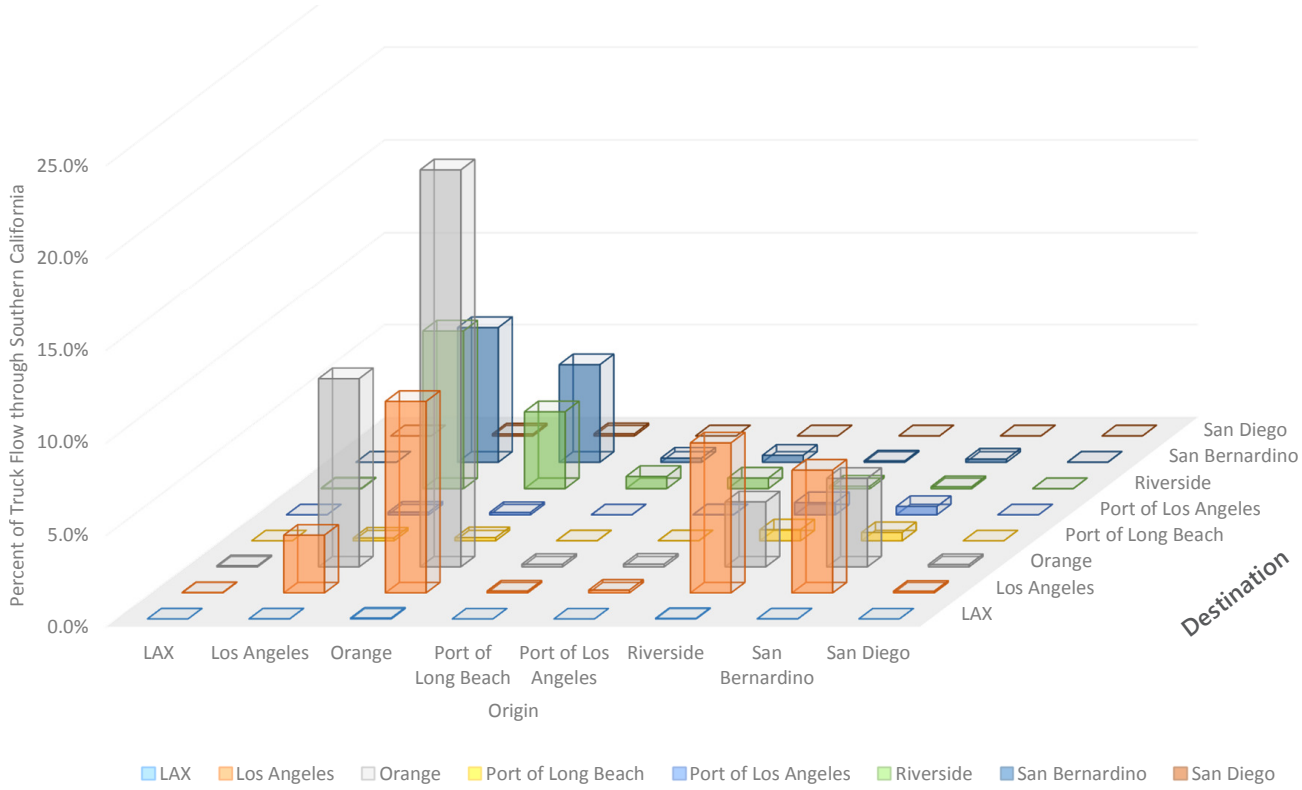
County to County Flows via SR-90 w/o South Brea Boulevard



		Destination							
		LAX	Los Angeles	Orange	Port of Long Beach	Port of Los Angeles	Riverside	San Bernardino	San Diego
Origin	LAX	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Los Angeles	0.0%	2.1%	9.5%	0.0%	0.0%	1.0%	2.6%	0.0%
	Orange	0.0%	9.9%	40.6%	0.0%	0.0%	5.2%	7.8%	3.0%
	Port of Long Beach	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Port of Los Angeles	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Riverside	0.0%	1.5%	3.2%	0.0%	0.0%	0.1%	0.1%	0.0%
	San Bernardino	0.0%	4.0%	7.6%	0.0%	0.0%	0.1%	0.2%	0.0%
	San Diego	0.0%	0.0%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%

APPENDIX C9

County to County Flows via SR-91 w/o State College Boulevard



		Destination							
		LAX	Los Angeles	Orange	Port of Long Beach	Port of Los Angeles	Riverside	San Bernardino	San Diego
Origin	LAX	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	Los Angeles	0.0%	3.2%	10.2%	0.2%	0.1%	8.5%	7.3%	0.1%
	Orange	0.1%	10.4%	21.5%	0.2%	0.1%	4.1%	5.3%	0.1%
	Port of Long Beach	0.0%	0.1%	0.1%	0.0%	0.0%	0.7%	0.2%	0.0%
	Port of Los Angeles	0.0%	0.2%	0.1%	0.0%	0.0%	0.6%	0.4%	0.0%
	Riverside	0.0%	8.2%	3.5%	0.6%	0.7%	0.1%	0.1%	0.0%
	San Bernardino	0.0%	6.7%	4.8%	0.5%	0.5%	0.1%	0.2%	0.0%
	San Diego	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%

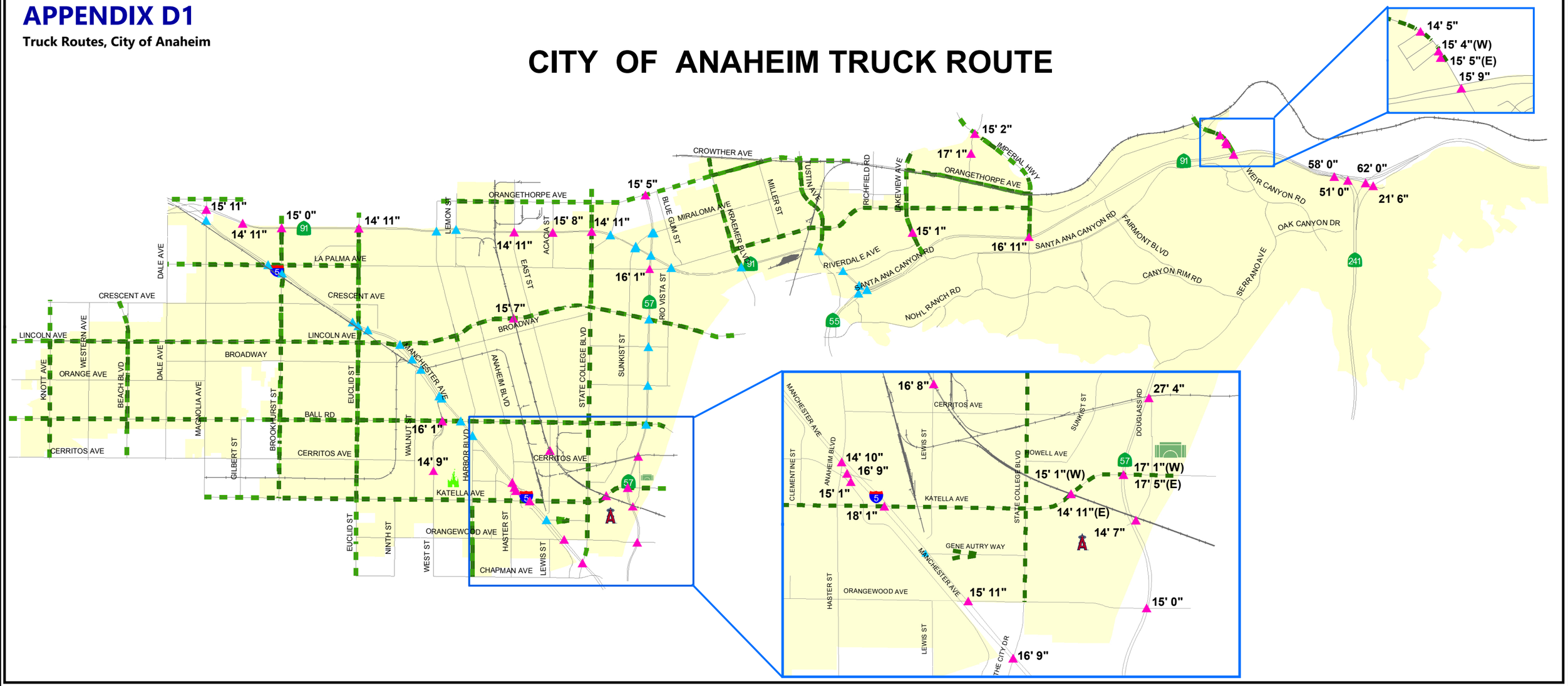
APPENDIX D

DESIGNATED TRUCK ROUTE MAPS AND DESCRIPTIONS BY CITY

APPENDIX D1

Truck Routes, City of Anaheim

CITY OF ANAHEIM TRUCK ROUTE



UPDATED OCTOBER 2007

BALL ROAD - WEST CITY LIMITS TO EAST CITY LIMITS
BEACH BOULEVARD - NORTH CITY LIMITS TO SOUTH CITY LIMITS (CALTRANS)
BROOKHURST STREET - NORTH CITY LIMITS TO SOUTH CITY LIMITS
EUCLID STREET - NORTH CITY LIMITS TO SOUTH CITY LIMITS
HARBOR BOULEVARD - KATELLA AVENUE TO SOUTH CITY LIMITS
IMPERIAL HIGHWAY - NORTH CITY LIMITS TO SR-91 RIVERSIDE FREEWAY (CALTRANS)
KATELLA AVENUE - WEST CITY LIMITS TO EAST CITY LIMITS
KNOTT STREET - NORTH CITY LIMITS TO SOUTH CITY LIMITS
KRAEMER BOULEVARD - NORTH CITY LIMITS TO SR-91 RIVERSIDE FREEWAY
LA PALMA AVENUE - WEST CITY LIMITS TO EUCLID STREET
- KRAEMER BOULEVARD TO SR-90 IMPERIAL HIGHWAY
LAKEVIEW AVENUE - NORTH CITY LIMITS TO SR-91 RIVERSIDE FREEWAY
LINCOLN AVENUE - WEST CITY LIMITS TO EAST CITY LIMITS
ORANGETHORPE AVENUE - WEST CITY LIMITS TO EAST CITY LIMITS
STATE COLLEGE BOULEVARD - NORTH CITY LIMITS TO SOUTH CITY LIMITS
TUSTIN AVENUE - NORTH CITY LIMITS TO SR-91 RIVERSIDE FREEWAY

UPDATED OCTOBER 2011

KATELLA BRIDGE E/O STATE COLLEGE
MIRALOMA FROM LA PALMA TO BLUE GUM

UPDATED OCTOBER 2013

KATELLA UNDERCROSSING AT SR-57

LEGEND

- TRUCK ROUTE
- UNDERPASS BRIDGE
- FREEWAY OVERPASS BRIDGE

0 1 Miles

NOTE:

TRUCK HEIGHT

ALL TRUCK LOADS TO BE
MIN. 3" BELOW THE
POSTED BRIDGE HEIGHTS.

MAX. FOR ANNUALS
14' 00" HIGH
15' 00" WIDE
110' 00" LONG

REV: SEPT. 27 - 2013
FILE: TRUCK_ROUTE11X17.MXD

APPENDIX D2

Truck Routes, City of Brea

BREA Municipal Code re Truck Routes

§ 10.40.050 WEIGHTS AND ROUTES DESIGNATED.

A. No vehicle exceeding a maximum gross weight of six thousand (6,000) pounds shall be used on any street within the city except a vehicle subject to the provisions of Cal. Pub. Util. Code, §§ 1031 to 1036, inclusive, any vehicle otherwise exempted by any provision or provisions of state law, any vehicle complying with § 10.40.020 of this code and except as provided in paragraphs B. and C. of this section.

B. The following truck routes are established for use by vehicles exceeding a maximum gross weight of six thousand (6,000) pounds during all hours of the day:

Central Avenue, West City Limit to Berry Street
Lambert Road, West City Limit to Berry Street
Imperial Highway, West City Limit to East City Limit
Carbon Canyon Road, Valencia Avenue to East City Limit
Puente Street, Central Avenue to Imperial Highway
Berry Street, Central Avenue to Imperial Highway
Brea Boulevard, North City Limit to South City Limit
State College Boulevard, Birch Street to South City Limit
Kraemer Boulevard, Imperial Highway to South City Limit
Valencia Avenue, Lambert Road/Carbon Canyon Road to Imperial Highway
Route 57 Freeway, North City Limit to South City Limit
Birch Street, Voyager Avenue to Valencia Avenue
Enterprise Street, Ranger Avenue to Surveyor Avenue
Voyager Avenue, Birch Street to Enterprise Street
Surveyor Street, Enterprise Street to Nasa Street
Nasa Street, Westerly Terminus to Valencia Avenue

C. In addition to the truck routes established in paragraph B., the following truck route is established for use by vehicles exceeding a maximum gross weight of six thousand (6,000) pounds from 6:00 a.m. to 8:00 p.m. during any day:

Central Avenue, Berry Street to Brea Boulevard
State College Boulevard, Brea Boulevard to Birch Street
Lambert Road, Berry Street to Route 57 Freeway
Valencia Avenue, Northerly Terminus to Lambert Road/Carbon Canyon Road

APPENDIX D3

Truck Routes, City of Buena Park

Buena Park Municipal Code – Truck Routes

10.36.010 Truck routes.

A. Whenever any resolution of the city designates and describes any street or portion thereof as a street the use of which is permitted by any vehicle exceeding a maximum gross weight limit of three tons, the city traffic engineer is authorized to designate such street or streets by appropriate signs as “truck routes” for the movement of vehicles exceeding a maximum gross weight limit of three tons.

B. When any such truck route or routes are established and designated by appropriate signs, the operator of any vehicle exceeding a maximum gross weight limit of three tons shall drive on such route or routes only; except, that nothing in this section shall prohibit the operator of any vehicle exceeding a maximum gross weight of three tons coming from a truck route having ingress and egress by direct route to and from restricted streets when necessary to make pickups of deliveries of goods, wares and merchandise, or when necessary to deliver materials to be used in the actual and bona fide repair, alteration, remodeling or construction of any building or structure upon such restricted streets for which a building permit has previously been obtained.

C. The provisions of this section shall not apply to:

1. Passenger buses under the jurisdiction of the Public Utilities Commission; or

2. Any vehicle owned or operated by a public utility while necessarily in use for purposes of construction, installation or repair of any public utility.

D. Those streets and portions of streets designated hereafter are declared to be truck routes for the movement of vehicles exceeding a maximum gross weight of three tons:

1. Artesia Boulevard, from west city limits to Beach Boulevard and from Dale Street to east city limits;

2. Ball Road, from west city limits to east city limits;

3. Beach Boulevard, from south city limits to north city limits;

4. Commonwealth Avenue, from Manchester Boulevard to east city limits;

5. Dale Street, from Commonwealth Avenue to Artesia Boulevard;

6. Firestone Boulevard, from Artesia Boulevard to west city limits at Knott Avenue;

7. Knott Avenue, from south city limits to north city limits, two thousand one hundred fifty feet north of Firestone Boulevard;

8. La Palma Avenue, from west city limits to east city limits;

9. Lincoln Avenue, from west city limits to east city limits;

10. Magnolia Avenue, from south city limits to north city limits;

11. Malvern Avenue, from Beach Boulevard to east city limits;

12. Manchester Boulevard, from Artesia Boulevard to Orangethorpe Avenue;

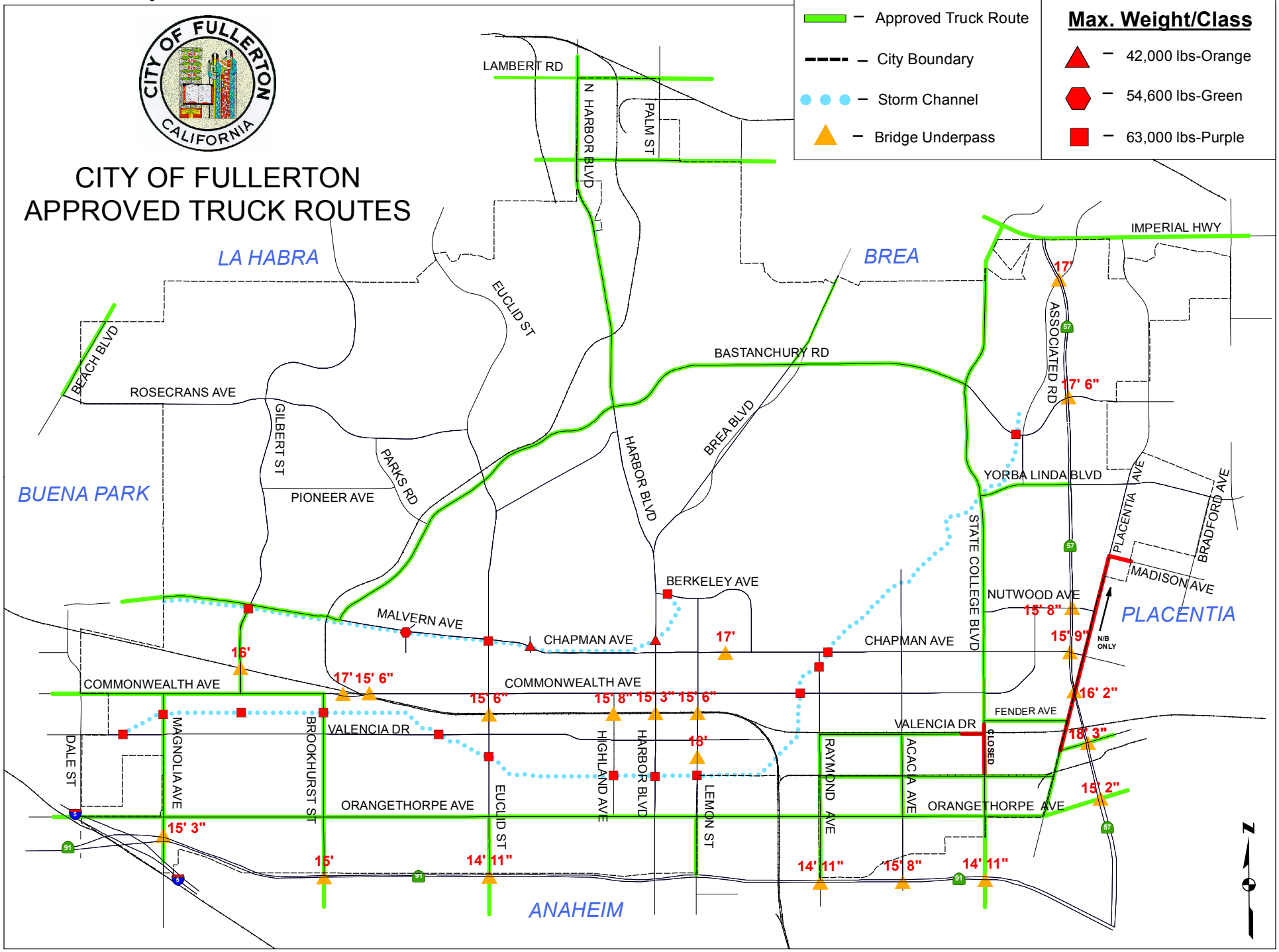
13. Orangethorpe Avenue, from west city limits to east city limits;

14. Stanton Avenue, from Orangethorpe Avenue to Manchester Boulevard;

15. Valley View Street, from south city limits to north city limits. (Ord. 1203, 1987: prior code § 17-94)

APPENDIX D4

Truck Routes, City of Fullerton



APPENDIX D5

Truck Routes, City of Garden Grove

Garden Grove

10.40.030 Truck Routes and Large Truck Routes Established

It is determined that certain streets or portions of streets will be designated for the use of any commercial vehicle exceeding a maximum gross weight of 6,000 pounds and with a maximum length from the kingpin to the rearmost axle of not to exceed 38 feet. These streets shall be signed as "truck routes" by the City Traffic Engineer and are described as follows:

No.	Name of Street	Portion Affected
005	Acacia Avenue	Knott Street east to Monarch Street
070	Beach Blvd.	Garden Grove Blvd. south to Trask Ave.
076	Belgrave Avenue	Knott Street east to Industry Street
105.1	Bolsa Avenue	All portions within city
116	Brookhurst Street	Katella Avenue south to Hazard Avenue
138	Cannery Street	Garden Grove Blvd. south to Magnolia St.
155	Century Blvd.	Garden Grove Blvd. southeast to Euclid St.
159	Chapman Avenue	Valley View Street to Lewis Street
243	Edison Way	Belgrave Avenue to Lampson Avenue
269	Euclid Street	Katella Avenue south to Hazard Avenue
275.5	Fairview Street	Garden Grove Blvd. south to Westminster Ave.
318	Garden Grove Blvd.	City limits west of Beach Blvd. east to Siemon Street
354	Harbor Blvd.	Chapman Avenue south to Westminster Ave.
360	Haster Street	City limits north of Chapman Avenue south to Garden Grove Blvd.
363	Hazard Avenue	All portions within the City
398.5	Industry Street	Chapman Avenue south to Lampson Avenue
442	Katella Avenue	Dale Street east to Euclid Street
456	Knott Street	City limits north of Orangewood Avenue south to Garden Grove Blvd.
466	Lampson Avenue	Knott Street east to east of Western Ave.
495	Lewis Street	Chapman Avenue south to Garden Grove Blvd.
531	Magnolia Street	Katella Avenue south to Westminster Ave.
588.5	Monarch Street	Chapman Avenue south to Acacia Ave.

No.	Name of Street	Portion Affected
607	Nelson Street	Stanford Avenue south to Garden Grove Blvd.
610	Newhope Street	Garden Grove Blvd. south to Westminster Avenue
618	Nutwood Street	Stanford Avenue south to Garden Grove Blvd.
648	Pala Drive	Acacia Avenue north to terminus
817	Stanford Avenue	Nutwood Street east to Nelson Street
866	Trask Avenue	Beach Blvd. east to Fairview Street
890	Valley View	City limits north of Chapman Street Avenue south to Garden Grove Freeway
933	Western Avenue	City limits north of Orangewood Avenue south to Garden Grove Blvd.
935	Westminster Ave.	Newland Street east to Fairview Street.

It is also determined that certain streets or portions of streets are designated for the use of any commercial vehicle exceeding 38 feet in length from the kingpin to the rearmost axle; these streets shall be signed as "large **truck** routes" by the City Traffic Engineer and are described as follows:

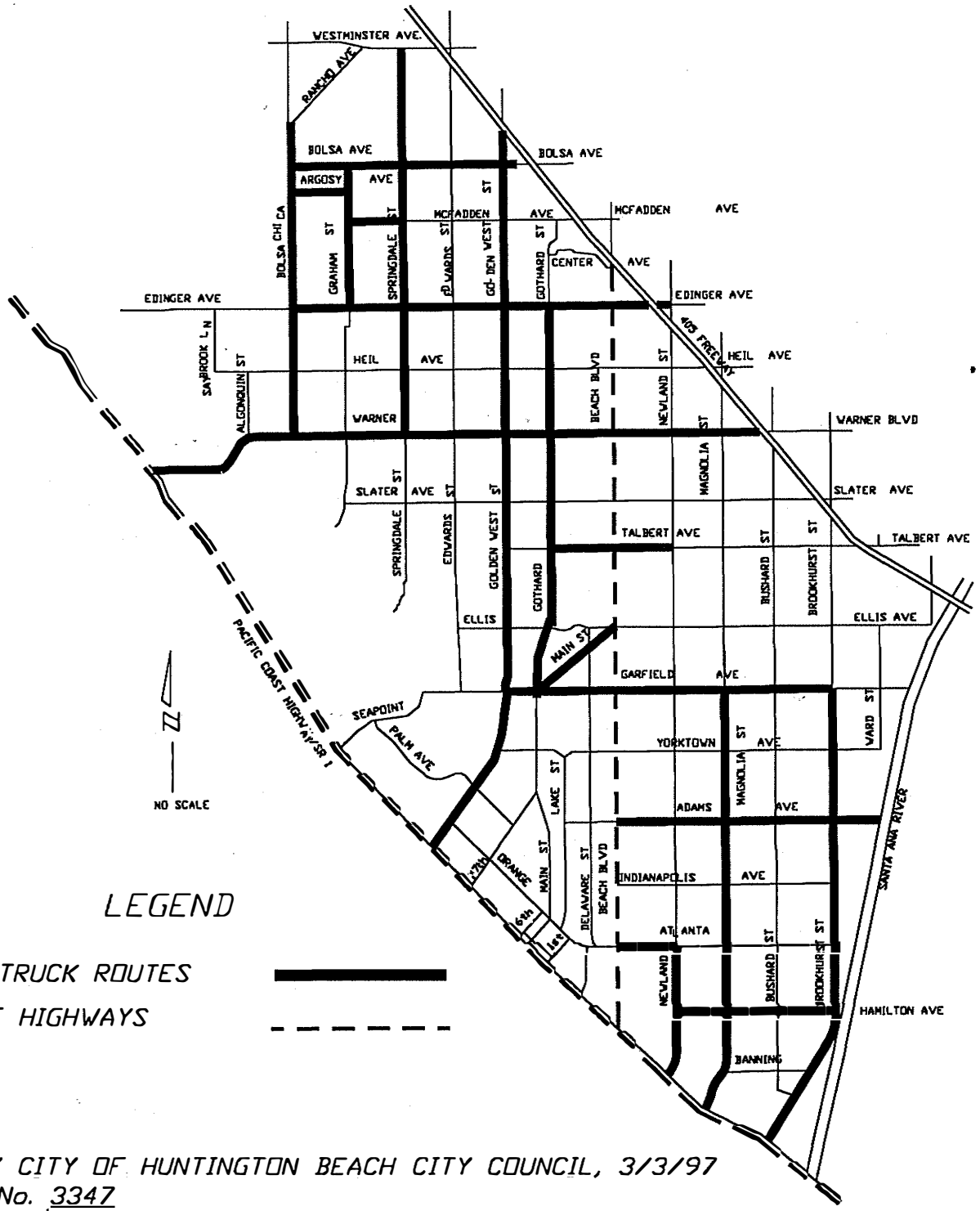
No.	Name of Street	Portion Affected
070	Beach Blvd.	Garden Grove Blvd. south to Trask Ave.
116	Brookhurst Street	Katella Avenue south to Hazard Avenue
159	Chapman Avenue	Valley View Street east to Beach Blvd.
269	Euclid Street	Garden Grove Blvd. south to Hazard Ave.
318	Garden Grove Blvd.	Knott Street east to Beach Blvd.
354	Harbor Blvd.	Garden Grove Blvd. south to Westminster Avenue
442	Katella Avenue	Dale Street east to Euclid Street

456	Knott Street	City limits north of Orangewood Avenue south to Garden Grove Blvd.
890	Valley View Street	City limits north of Chapman Avenue south to Garden Grove Freeway
933	Western Avenue	City limits north of Orangewood Avenue south to Garden Grove Blvd.
935	Western Avenue	Newland Street east to Fairview Street

(2804 § 1, 2011; 2447 § 1, 1998; 1253 § 5, 1972)

APPENDIX D6

Truck Routes, City of Huntington Beach



ADOPTED BY CITY OF HUNTINGTON BEACH CITY COUNCIL, 3/3/97
ORDINANCE No. 3347
ADOPTED BY CITY OF HUNTINGTON BEACH TRANSPORTATION COMMISSION, 12/21/94
REFERENCE: CALIFORNIA VEHICLE CODE, DIVISION 15, SECTION 35700

FILE NAME: G:\ACAD\TRAFFIC\MAPS\TRUCKENV.DWG

CITY OF HUNTINGTON BEACH * PUBLIC WORKS * TRAFFIC ENGINEERING

TRUCK ROUTE MAP

APPENDIX D7

Truck Routes, City of Irvine

- **Sec. 6-3-565. - Truck routes designated.**

The following streets or portions of streets are designated as truck routes within the City of Irvine:

	Name of Street	Portion Designated
A.	Bake Parkway	Rockfield Boulevard to the eastern City limit
B.	Barranca Parkway	Red Hill Avenue to Jamboree Road
C.	Irvine Boulevard	Culver Drive to the eastern City limit
D.	Jamboree	All portions within City limits
E.	Laguna Canyon Road	Alton Parkway to State Route 133
F.	Laguna Freeway	All SR-133 designated portions
G.	MacArthur Boulevard	Western City limit to Campus Drive; Jamboree Road to SR-73
H.	Red Hill Avenue	Barranca Parkway to the San Diego Freeway (I-405)
I.	Rockfield Boulevard	Bake Parkway to the eastern City limit
J.	Sand Canyon Avenue	San Diego Freeway (I-405) to Portola Parkway
K.	San Diego Freeway	
L.	Santa Ana Freeway	
M.	Main Street	Jamboree Road to western City limit
N.	Campus Drive	Jamboree Road to MacArthur Boulevard
O.	Alton Parkway	Sand Canyon Avenue to Irvine Boulevard

P.	San Joaquin Hills Transportation Corridor (SR-73)	

(Code 1976, § VI.F-651; Ord. No. 262, § 3, 5-13-80; Ord. No. 92-9, § 1, 7-14-92)

- **Sec. 6-3-566. - Reserved.**
- **Sec. 6-3-567. - Restricted use of certain streets.**

A.

Vehicles in excess of 14,000 pounds gross weight. It shall be unlawful, when authorized signs are in place giving notice thereof, to drive, propel, or cause to be driven or propelled, any vehicle exceeding a maximum gross weight of 14,000 pounds on any of the following streets:

	Name of Street	Portion Designated
1.	Campus Drive	Jamboree Road to University Drive
2.	Culver Drive	Santa Ana Freeway (I-5) to Portola Parkway
3.	Jeffrey Road	Irvine Center Drive to Santa Ana Freeway (I-5)
4.	Jeronimo Road	Goodyear to the eastern City limit
5.	Toledo Way	Goodyear to the eastern City limit
6.	Trabuco Road	400 feet east of the northbound Santa Ana Freeway off-ramp near Culver Drive to Jeffery
7.	Walnut Avenue	Harvard Avenue to Culver Drive
8.	Harvard Avenue	Walnut Avenue to Irvine Center Drive (applies to portion within City limits)

B.

Vehicles in excess of 6,000 pounds gross weight. It shall be unlawful, when authorized signs are in place giving notice thereof, to drive, propel, or cause to be driven or propelled, any vehicle exceeding a maximum gross weight of 6,000 pounds on any of the following streets:

	Name of Street	Portion Designated

1.	Bonita Canyon Road	Newport Coast Drive to Culver
2.	Culver Drive	Michelson Drive to Bonita Canyon Road/Shady Canyon Drive
3.	University Drive	Ridgeline Drive to Harvard Avenue
4.	Shady Canyon Drive	Culver to Sunnyhill

C.

Exemptions. The provisions of this section shall not apply to any of the following:

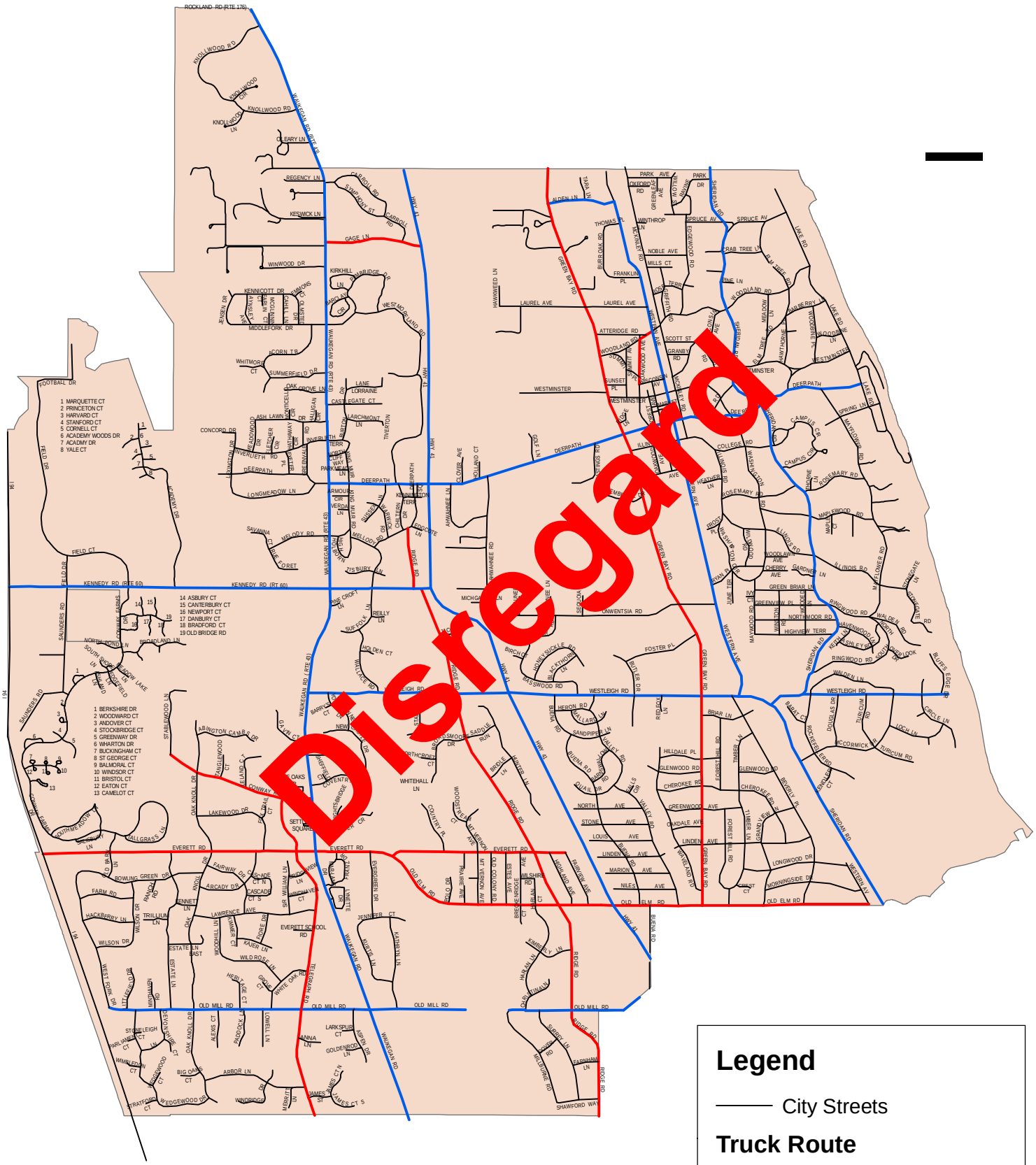
1. Emergency vehicles;
2. Passenger buses under the jurisdiction of the Public Utilities Commission;
3. Any vehicle owned by a public utility while necessarily in use in the construction, installation, or repair of any public utility; or
4. Any vehicle delivering street construction materials for street construction or repairs.

(Code 1976, § VI.F-652; Ord. No. 27, § 64.013, 4-17-72; Ord. No. 262, § 1, 5-13-80; Ord. No. 92-9, § 1, 7-14-92; Ord. No. 98-16, § 1, 11-10-98)

APPENDIX D8

Truck Routes,
City of Lake Forest

City of Lake Forest Truck Routes



APPENDIX D9

Truck Routes, City of Orange

- **10.66.020 - Restricted Use of Streets by Trucks and Other Vehicles.**

Upon recommendation of the Traffic Commission and the City Traffic Engineer, the City Council may, by ordinance, designate, establish and maintain fixed truck routes within the City. The City Council hereby establishes the following streets as fixed truck routes to be effective when posted:

ANAHEIM BOULEVARD	Chapman Avenue to North City Limits.
BATAVIA STREET	Chapman Avenue to Lincoln Avenue.
CHAPMAN AVENUE	West City Limits to East City Limits, except as otherwise limited in Section 10.66.030B.
COLLINS AVENUE	Eckhoff Street to Glassell Street.
CITY DRIVE, THE	South City Limits to North City Limits.
GARDEN GROVE BOULEVARD	West City Limits to East City Limits.
GLASSELL STREET	Collins Avenue to North City Limits.
KATELLA AVENUE	West City Limits to East City Limits.
LA VETA AVENUE	Main Street to the eastbound ramp connections of the Garden Grove (S.R. 22) Freeway.
LINCOLN AVENUE	West City Limits to Santiago Boulevard.
MAIN STREET	South City Limits to Chapman Avenue.
	Collins Avenue to Taft Avenue.
MEATS AVENUE	Glassell Street to Orange-Olive Road.
ORANGE-OLIVE ROAD	Glassell Street to Lincoln Avenue.
ORANGEWOOD AVENUE	West City Limits to Eckhoff Street.
SANTIAGO BOULEVARD	Northbound off-ramp (Santiago Boulevard/Nohl Ranch Road) of the Costa Mesa (S.R. 55) Freeway to the northbound on-ramp of the Costa Mesa (S.R. 55) Freeway.
SANTIAGO CANYON ROAD	West City Limits to Chapman Avenue.
STATE COLLEGE BOULEVARD	Chapman Avenue to North City Limits.
TAFT AVENUE	West City Limits to Glassell Street.
TOWN & COUNTRY ROAD	Main Street to the eastbound on-ramp of the Garden Grove (S.R. 22) Freeway.
TUSTIN STREET	South City Limits to North City Limits.

(Ord. 21-99; 38-82; 19-82)

- **10.66.030 - Prohibited Routes.**

A.

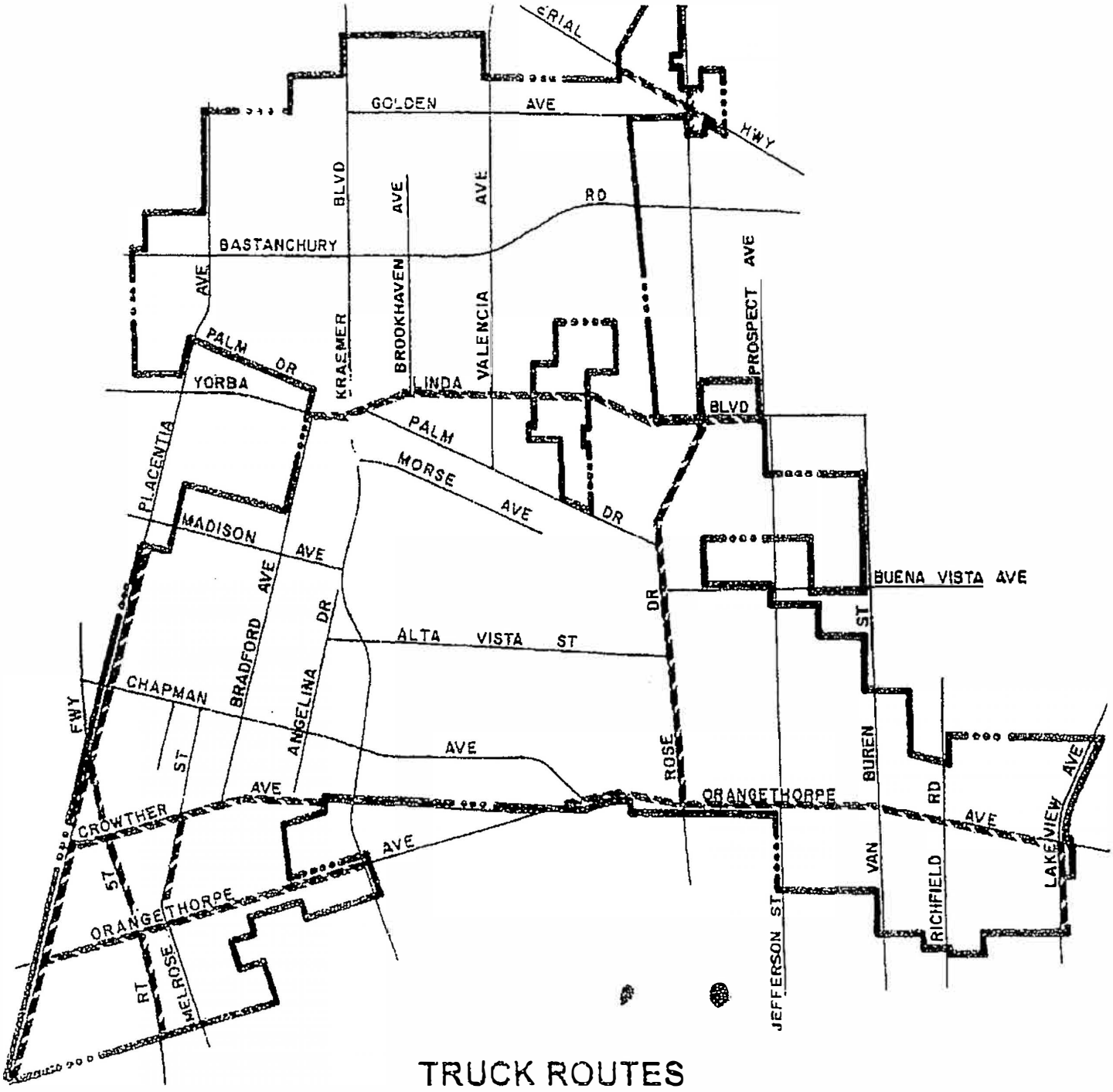
Subject to the provisions, exceptions and limitations of Section 35703 of the Vehicle Code, no person shall operate any vehicle, which has a gross weight of six thousand (6,000) pounds or more, upon any street not designated as a truck route.

B.

Subject to the provisions, exceptions and limitations of Section 35703 of the Vehicle Code, no person shall operate any vehicle, which has a gross weight of twenty-six thousand (26,000) pounds or more, upon Chapman Avenue, between Tustin Street and Batavia Street.

(Ords. 21-99; 38-82; 31-82; 19-82: Prior Code 10.52.020)

The permittee shall check overhead utilities (such as AT&T, S.C. Edison and Time Warner, etc.) for adequate vertical clearance prior to move of any wideload through the City of Placentia Permittee shall notify City immediately upon discovery of any overhead utility line or other overhead obstruction that does not meet vertical clearance requirements and shall not use said route for transport of wideload.



TRUCK ROUTES
CITY OF PLACENTIA

LEGEND

TRUCK ROUTE

ADOPTED 2 - 85
REVISED 10 – 85
REVISED 5 – 08

APPENDIX D10

Truck Routes, City of Placentia

APPENDIX D11

Truck Routes, City of Santa Ana

- **Sec. 36-170. - Designated; placing signs.**

The city council designates certain streets or portions thereof as streets, the use of which is permitted by any vehicle exceeding a maximum gross weight of three (3) tons; these streets shall be known as truck routes, and are described as follows:

(1)
Seventeenth Street-Westminister Avenue, all portions within the city.

(2)
Fourth Street, all portions within the city from Grand Avenue, easterly.

(3)
First Street, all portions within the city.

(4)
Edinger Avenue, all portions in the city.

(5)
Warner Avenue, all portions in the city.

(6)
MacArthur Boulevard, all portions in the city.

(7)
Segerstrom Avenue-Dyer Road, all portions in the city.

(8)
Bristol Street, all portions in the city.

(9)
Main Street, all portions in the city.

(10)
Standard Avenue, between Warner Avenue and First Street.

(11)
Grand Avenue, all portions in the city.

(12)
Harbor Boulevard, all portions in the city.

(13)
Euclid Street, all portions in the city.

(14)
Fairview Street, all portions in the city.

(15)
Tustin Avenue, all portions in the city.

(16)
Memory Lane, all portions in the city from Bristol, westerly.

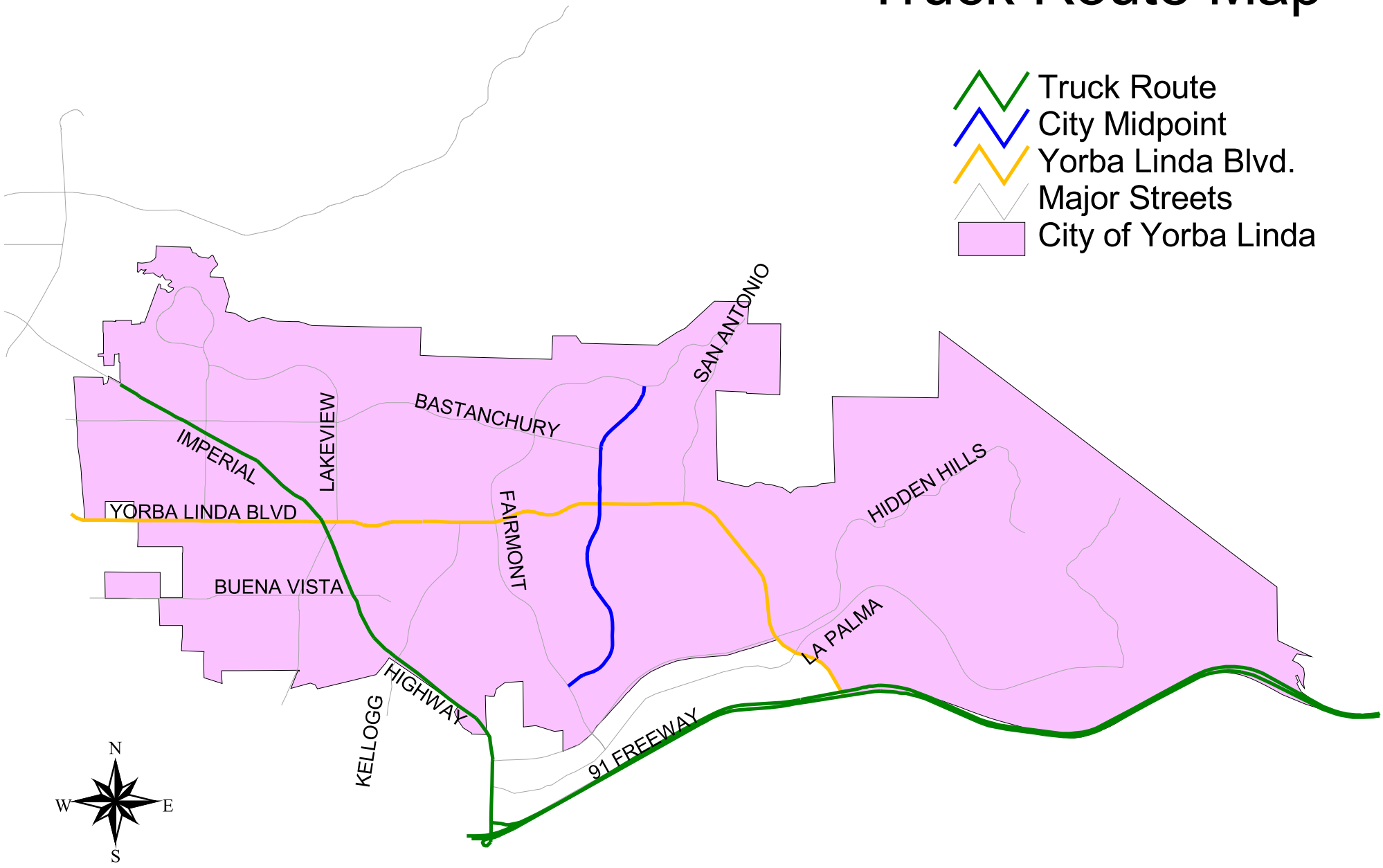
The director of public works is authorized to designate the above streets by appropriate signs as truck routes for the movement of vehicles exceeding a maximum gross weight limit of three (3) tons, where, in his opinion, such designation is required.

(Code 1952, § 3270; Ord. No. NS-560, § 1, 1-15-62; Ord. No. NS-1699, § 1, 10-24-83)

APPENDIX D12

Truck Routes, City of Yorba Linda

City of Yorba Linda Truck Route Map



January 28, 2007

APPENDIX E

EMERGING TRENDS AND GOODS MOVEMENT IMPLICATIONS FOR ORANGE COUNTY

APPENDIX E: EMERGING TRENDS AND GOODS MOVEMENT IMPLICATIONS FOR ORANGE COUNTY

This appendix presents emerging societal, economic, and technology trends and how they are likely to affect future goods movement in Orange County.

Population and Employment Forecasts

The Economic Analysis Branch at the California Department of Transportation (Caltrans) provides long-term socio-economic forecasts. The forecasts for Orange County and comparisons to California and the U.S. are summarized in **Table E-1**. These forecasts do not take into account economic development policies for Orange County. Population growth rates are expected to be similar at all levels of geography. Per capita income growth rate for Orange County is expected to be similar to that for California as a whole.

The Economic Analysis Branch of Caltrans expects that manufacturing employment will increase over the long-term, although the U.S. Bureau of Labor Statistics' national forecasts indicate that a decline is expected in the short-term. Employment growth rates in trade for Orange County are expected to be nearly the same as that for California and the U.S. as a whole. Employment growth rates in transportation, warehousing and utilities for Orange County are expected to be much lower than that for California as a whole, but similar to that for the U.S. as a whole. Industrial output growth rate and taxable retail sales growth rate for Orange County are expected to be similar to that of California as a whole.

Based on **these**, per capita income seems to correlate closely with future taxable retail sales. Also, industrial output is anticipated to grow at a similar rate. High growth in industrial output and retail sales are indicative of a high growth in goods movement originating from and moving within Orange County.

Table E-1. Comparisons of Socio-Economic Forecasts, Orange County versus California versus U.S.

	Annualized Growth Rate		
Factor	**Orange County**	**California**	**U.S.**
Population	0.7 percent (2016-2040)	0.8 percent (2016-2040)	0.7 percent (2016-2040)
Households	0.5 percent (2016-2040)	0.9 percent (2016-2040)	N/A
Per Capita Income	3.4 percent (2016-2040)	3.5 percent (2016-2040)	N/A
Total Employment	0.8 percent (2016-2040)	0.9 percent (2016-2040)	0.6 percent (2014-2024)
Manufacturing Employment	0.3 percent (2016-2040)	0.3 percent (2016-2040)	-0.7 percent (2014-2024)
Trade Employment	0.3 percent (2016-2040)	0.4 percent (2016-2040)	0.5 percent (2014-2024)
Transportation, Warehousing and Utilities Employment	0.3 percent (2016-2040)	1.8 percent (2016-2040)	0.2 percent (2014-2024)
Industrial Output	3.3 percent (2016-2040)	3.5 percent (2016-2040)	N/A
Taxable Retail Sales	3.6 percent (2016-2040)	3.4 percent (2016-2040)	N/A

Source: California Department of Transportation's (Caltrans) Economic Analysis Branch, 2015 Forecast; U.S. Census Bureau's 2014 National Population Projections; U.S. Bureau of Labor Statistics, Employment Projections, 2014-2024.

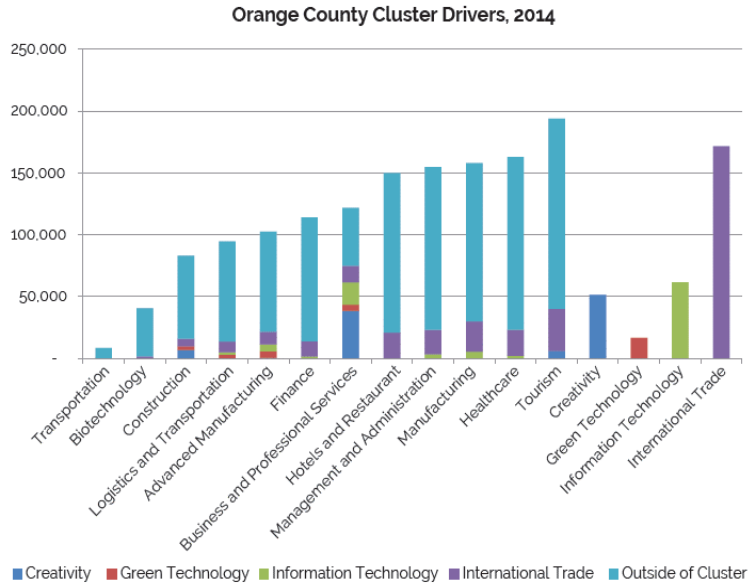
Note: N/A = Not Available

Economic Development Policies in Orange County

As shown in **Figure E-1**, Orange County Business Council (OCBC) and Orange County Workforce Investment Board (OCWIB) have identified international trade, information technology, green technology and creativity as drivers behind various industry clusters in Orange County[1]. Among these international trade and green technology are goods movement related cluster drivers. They affect goods movement related sectors of manufacturing, advanced manufacturing and logistics and transportation.

International trade growth is expected in Orange County through growth in exports. OCBC and OCWIB expect computer and electronic products and transportation equipment to continue being the most dominant export sectors.[1]

Figure E-1. Orange County Cluster Drivers



Source: OCBC Analysis of California Employment Development Department Data, OTIS Report, Next10, and Los Angeles Economic Development Corporation

Advanced manufacturing is associated with the use of high-tech software, materials and robotics and processes and a range of web-based services in manufacturing would increase export opportunities. New export opportunities may arise as biotechnology converges with advanced manufacturing through advances in synthetic biology and genetic engineering[2]. Similar opportunities may also arise in additive manufacturing (e.g., 3D

[1] Orange County Business Council and Orange County Workforce Investment Board, 2015-2016 Orange County Workforce Indicators Report, Available at: http://ocwib.org/civicax/filebank/blobdload.aspx?BlobID=51401 (last accessed on August 29, 2016)

[2] Deloitte Presentation made on January 15, 2014, Making an impact – driving productivity and advanced manufacturing growth opportunities in Hamilton. Available at: http://www.investinhamilton.ca/wp-content/uploads/2014/06/HamiltonAdvMfg-PPT.pdf (last accessed on August 29, 2016)

Printing) and nanotechnology[3]. As advanced manufacturing in the U.S. matures, it will likely restructure supply chains and generate high-skilled and well-paying job opportunities in the U.S. This applies also to an economically competitive Orange County. Instead of importing manufactured parts, raw materials would be imported at a lower shipping cost, and the parts would be manufactured in Orange County using local labor and advanced but lower cost technology, and distributed to secondary manufacturing or assembling plants worldwide, thus increasing export revenue and value added to Orange County's economy.

For green technology, in 2013, five regions in California were selected for a Regional Industry Clusters of Opportunity (RICO) grant program under the California Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act of 2007 (Assembly Bill (AB) 118). Orange and Los Angeles Counties were selected for focusing on hydrogen vehicle infrastructure, waste-to-energy and energy storage sectors[4].

Orange County is currently promoting deployment of hydrogen infrastructure, by increasing hydrogen stations, conducting outreach and education activities, and supporting pilot programs for fleet/residential use[5]. Orange County is also an important partner of the California's proposed Hydrogen Highway which could link Southern and Northern California[6].

OCBC and OCWIB also note that Orange County would face a skill gap for businesses in the future, specifically in advanced manufacturing, health care and information technology, which are also key drivers of future economic development and workforce development success. Among these, advanced manufacturing is a goods movement related cluster. OCBC and OCWIB also found that a significant percentage of population are still not on educational pathways into these well-paying jobs that require greater educational attainment.[7]

Therefore, the economic development in Orange County is focused on increasing exports, developing green vehicle technology, reducing the skill gaps and providing workforce

[3] Deloitte Presentation made on January 15, 2014, Making an impact – driving productivity and advanced manufacturing growth opportunities in Hamilton. Available at: http://www.investinhamilton.ca/wp-content/uploads/2014/06/HamiltonAdvMfg-PPT.pdf (last accessed on August 29, 2016)

[4] A Regional Industry Clusters of Opportunity (RICO) – Summary Report. Available at: http://www.coecon.com/assets/rico_summary_2014.pdf (last accessed on August 29, 2016)

[5] Pacific Gateway Symposium, Workforce Opportunities in Alternative Fuels, July 29, 2014. Available at: http://www.pacific-gateway.org/power%20point/rico%20symposium%20presentation%20final.pdf (last accessed on August 29, 2016)

[6] Orange County Business Council and Orange County Workforce Investment Board, 2015-2016 Orange County Workforce Indicators Report, Available at: http://ocwib.org/civicax/filebank/blobdload.aspx?BlobID=51401 (last accessed on August 29, 2016)

[7] Orange County Business Council and Orange County Workforce Investment Board, 2015-2016 Orange County Workforce Indicators Report, Available at: http://ocwib.org/civicax/filebank/blobdload.aspx?BlobID=51401 (last accessed on August 29, 2016)

training and pathways. Overall, these economic development policies would result in an increase in goods movement while also reducing emissions, increasing export revenue and increasing employment opportunities.

Consumer Trends

The trends with consumers and their buying behavior in Orange County are similar to those in the rest of the U.S. They have goods movement implications as follows:

Millennials, who are between the ages of 16 years and 34 years, are a growing share of Orange County's population as in the rest of the nation. The millennials have faced higher student loan debt than generations before them, and since the 2008-2009 global recession, they have been faced with an inability to find jobs that meet costs of living. The housing issue is also affecting low-income residents. This results in their willingness to migrate to low rent areas and access to high-wage occupations, public transportation, and proximity to convenience stores. There are very few locations in Orange County that have such characteristics, so some young millennials and low-income residents have been migrating out of the County.

A Boston Consulting Group (BCG) study[8] found that there are differences in buying behavior and attitudes between millennials and the older populations of gen-exers and baby boomers. These differences are well-correlated with their use of social media and internet when buying products or rating purchased products. According to the study, a majority of millennials (about 29 percent) are "cautious consumers, globally aware, charitable, and information hungry", who make extensive use of social media to rate services but do not contribute content to internet. Another 22 percent of millennials are parents who are "wealthy, family-oriented, work out, confident, and digitally savvy" who are highly social and make extensive use of internet for daily routine. Another 13 percent of millennials are "successful, wired, free-spirited, confident, and at ease", who own the most gadgets (smartphones, tablets, etc.) and somewhat contribute to user-generated content such as uploading videos, images and blog entries to internet. Another 10 percent of millennials are "impressionable, cause driven, healthy, green and positive" who make significant contribution to user-generated content such as uploading videos, images and blog entries to internet that are cause related. Non-millennials and more conservative millennials (the remaining 26% of millennials) are low-end users of social media and

[8] The Boston Consulting Group (BCG), The Millennial Consumer – Debunking Stereotypes, April 2012. Available at: https://www.bcg.com/documents/file103894.pdf (last accessed on August 29, 2016)

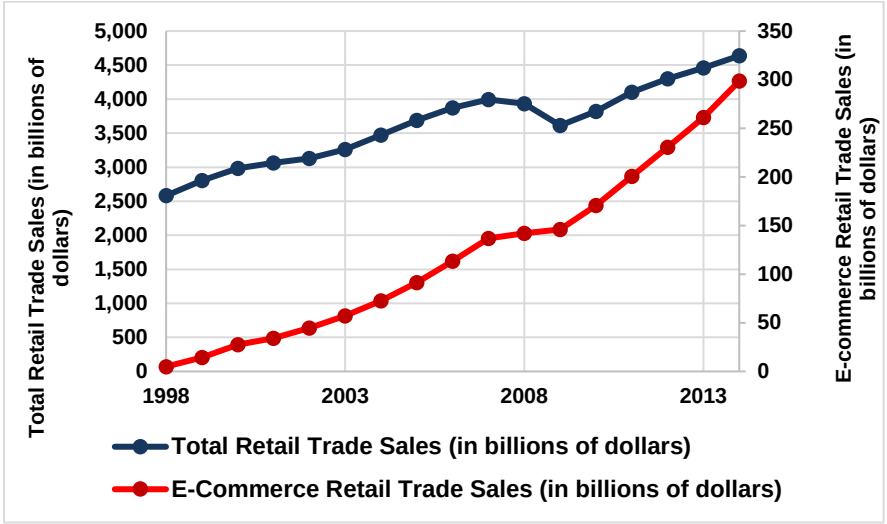
internet and would fall under the category of traditional consumers.

Due to access and higher use of social media and internet and their attitudes towards shopping, progressive (non-conservative) millennials tend to shop online (use e-commerce) more than the traditional consumers. Companies that better understand the buying behavior and attitudes of millennials are able to adapt their supply chains to meet their needs. This has often required them to provide services such as last-mile delivery from fulfillment centers, order online and pick up at brick and mortar retail stores, and an "omnichannel"[9] customer experience.

Historical national retail trade sales data shows e-commerce as a small share of total retail trade but a steadily growing market segment (see **Figure E-2**). Even during the 2008-2010 global recession, when retail trade other than e-commerce slowed, e-commerce showed mild growth.

Note: E-commerce sales are sales of goods and services where the buyer places an order, or the price and terms of the sale are negotiated, over an Internet, mobile device (M-commerce), extranet, Electronic Data Interchange (EDI) network, electronic mail, or other comparable online system.

Figure E-2. Historical National Total and E-Commerce Retail Trade Sales, 1998-2014



Source: U.S. Census Bureau's 2014 Annual Retail Trade Survey.

A recent BCG survey[10] found that online shopping (e-commerce) is expected to slow considerably over the next three years

[9] Based on https://www.informatica.com/services-and-training/glossary-of-terms/omnichannel-retailing-definition.html#fbid=4kVdiS2hJ5R: Omnichannel retailing describes a retailer's efforts to provide a consistent, coordinated customer experience across all possible customer channels, using consistent, universal data. The channels may include in-store (brick and mortar) and internet based systems – mobiles, tablet, desktop, etc.

[10] The Boston Consulting Group surveyed 3,374 U.S. consumers, ages 15 to 85, in late May and early June 2016. Respondents answered a battery of questions about their

among all age groups, including millennials because consumers said that they would not increase their online spending[11]. According to BCG Senior Partner Michael J. Silverstein:

"E-commerce has provided incredible value, enhanced competition and forced land-based retailers to improve their game."

"E-commerce is a channel, like any form of distribution: growth does not continue at a rapid, double-digit rate forever. Most consumer categories have been available online for several years. The 'newness' is gone, and we're looking at mature levels of penetration in many categories."

"E-commerce winners will have to earn new dollars and new spending by providing new value. That means me-too players will suffer – and leaders will need to provide more user-friendly websites, lower prices and offers tailored to individual customers."

Port, Airport and Border Crossing Cargo Forecasts

According to a recent news release by the Port of Long Beach[12]:

"Combined cargo volumes through the San Pedro Bay ports are likely to grow at an average 3.9 percent annual rate and exceed 41.1 million twenty-foot equivalent units (TEUs) by 2040, according to a new long-term economic forecast prepared for the ports of Long Beach and Los Angeles. The two ports had a combined volume of 15.3 million TEUs in 2015."

"The document examines various scenarios and shows demand in 2040 could fluctuate between

spending habits and intentions. The sample, half male and half female, included consumers with incomes from $25,000 to $500,000.

[11] Market Wired, News Room Article dated June 10, 2016. Americans' Move to Online Shopping Is Plateauing: Vast Majority of Consumers Say They Won't Significantly Increase E-Commerce Spending in Coming Years, According to Boston Consulting Group Survey. Source: The Boston Consulting Group. Available at: http://www.marketwired.com/press-release/americans-move-online-shopping-is-plateauing-vast-majority-consumers-say-they-wont-significantly-2133290.htm (last accessed on August 29, 2016)

[12] Port of Long Beach New Release dated February 19, 2016. San Pedro Bay Cargo Volume Projected to Top 41 million TEUs by 2040. Available at: http://www.polb.com/news/displaynews.asp?NewsID=1527&TargetID=42 (last accessed on August 29, 2016)

30.9 million and 54.5 million TEUs, depending on economic assumptions."

The annualized growth rate under the baseline forecast of 41.1 million TEUs is about 4.0 percent per year, higher than even the industrial output and retail sales. Currently, 35 percent of the cargo is inland point intermodal (IPI). This is cargo that remains in the sea container and moves out of the region directly from the ports on rail. This share is not anticipated to change, which means that 65 percent of the cargo remains in the region. If growth in cargo occurs, the demand for storage, warehousing, and distribution facilities will also continue to grow in the SCAG region.

According to Caltrans' 2013 California Air Cargo Groundside Needs Study, the cargo tonnage at airports in and near Orange County is expected to grow as shown in **Table E-2**. In the table, some of the cargo shown is belly cargo, which would be moved on ground by airline passengers by personal auto or taxi; while other cargo shown is air freight cargo, which would be moved on ground by trucks.

Table E-2. Air Cargo Tonnage Forecasts by Airport in and near Orange County, 2011 and 2040

Airport	Total Cargo Tonnage, 2011	Total Cargo Tonnage, 2040	Annualized Growth Rate, 2011-2040
Los Angeles Airport (LAX)	1,688,000	3,016,000	2.0 percent
Ontario Airport (ONT)	382,000	972,000	3.3 percent
Long Beach Airport (LGB)	26,000	20,000	-0.9 percent
John Wayne Airport (SNA)	14,000	22,000	1.6 percent

Source: Caltrans' 2013 California Air Cargo Groundside Needs Study.

According to Caltrans' Office of System and Freight Planning[13]:

"In 2010, over one million trucks transported goods valued at over $53 billion through California's POEs. The highway system carries 98 percent of freight flows, and the system is strained at key bottlenecks (e.g., POEs)."

[13] Caltrans District 11 International Border Area, Freight Planning Fact Sheet dated February 15, 2012. Available at: http://www.dot.ca.gov/hq/tpp/offices/ogm/internation_border_docs/D-11_Border_FactSheet_021512.pdf (last accessed on August 29, 2016)

"The forecast for San Diego County border crossings in 2050 is over 3.4 million incoming trucks and 39 million tons of goods, valued at $309 billion (an average annual growth of 5.3 percent in value, between 2007 and 2050)."

Assuming about 10 tons per TEU, both cargo through the airports and border crossings are small in comparison to the cargo through the ports. Roughly, in existing and future conditions, the cargo through airports is/will be 1 percent, and the cargo through border crossings is/will be 10 percent.

Although a majority of the growth in imports would continue to be stored in warehouses in the Gateway Cities region (southeast edge of Los Angeles County and bordering with Orange County) and the Inland Empire, a small share of the growth in imports could be stored in Orange County, which could come from expansion of distribution facilities in Anaheim, Buena Park, Brea, Foothill Ranch, Fullerton, and Irvine. The growth in population and per capita income in Orange County would mainly drive the movement of imported goods from the warehouses to retail stores.

As explained earlier, economic development policies are focused on increasing exports from Orange County, these would contribute to growth in exports through the ports, airports and border crossings. The presence of a manufacturer's in-house storage facility sometimes reduces the need for third party warehouse facilities for exported goods. However, a significant portion of manufacturers strategically outsource logistics (storage, transportation activity and value added services) to focus on their core competence.

Emerging Land Use Utilization Trends

The advent of e-commerce has changed business as usual for the retail industry, prompted most notably by Amazon. Started in 1994, the online business focused mainly on the sale of books, but Amazon has since changed the way that the world shops. E-commerce continues to transform consumer behavior resulting in significant changes to retail supply chains – everything from storefront and warehouse location decisions to modes of delivery.

Macy's began using its department stores as online fulfillment centers by converting more than half of its 840 physical stores to respond to online orders, which has allowed it to keep the majority of its inventory of popular items on store shelves and in front of customers, rather than stocking them in faraway warehouses. As Macy's continues to improve its internet presence, it simultaneously has been closing more and building less storefronts, including its store at the Irvine Spectrum. **Table E-3** indicates that this trend applies to all major retailers.

Table E-3. Macy's Store Closings and Opening Announcements, 2015-2017

	2015 Openings	2015 Closings	2016 Openings	2016 Closings	2017 Openings	2017 Closings
Macy's / Bloomingdales	3	15	5	36	0	100

Online shopping's major disruptor for storefront retailers has been the impact on impulse shopping. Online shopping means that consumers can price check otherwise impulse items on their smart phones in the store and wait as little as a day for it to arrive on their doorstep at a lower price. This is why retailers, such as Home Depot, have cut back on new store openings in favor of shifting that investment toward online operations. Meanwhile, major retailers such as: Sears, The Gap, JC Penney, and others have closed hundreds of stores over the past couple of years, K-Mart is bordering full closure, and Sports Authority announced that it is going out of business. Such closings could accelerate as leases for big retailers typically last between 10 and 25 years, meaning many were negotiated before e-commerce really took off. Only 44 million square feet of retail space opened in the 54 largest U.S. markets last year, down 87 percent from 325 million in 2006, according to CoStar Group, Inc., a real-estate research firm.[14] There will continue to be more of this as the growth and demand for easy and convenient shopping and merchandise returns continue.

One of the biggest unknowns for cities and counties is the true impact of e-commerce on sales tax revenue, land use, and infrastructure. These fast-moving, large magnitude changes in the relationship between consumers and providers will impact local sales tax revenues. traffic patterns, and occupancy of retail centers. Some initial research indicates that e-commerce will actually reduce overall vehicle trips[15], eliminate local sales staff jobs, and increase high-tech and warehouse jobs, but the impact on an agency's sales and property tax revenues is not yet well-documented.

In 2014 at the NAIOP Commercial Real Estate Development Association's first E-CON (e-commerce conference), keynote speaker Jim Tomkins discussed consumer demands for delivery speed and described it as follows:

[14] Banjo, Shelly and Drew Fitzgerald, Wall Street Journal, *Stores Confront New World of Reduced Shopper Traffic E-Commerce Not Only Siphons Off Sales, but Changes Shopping Habits*, January 16, 2014, http://online.wsj.com/news/articles/SB10001424052702304419104579325100372435802

[15] Cao, Xinyu (Jason), Frank Douma, Fay Cleveland, and Zhiyi Xu, The Interactions between E-Shopping and Store Shopping: A Case Study of the Twin Cities Final Report, Humphrey Institute of Public Affairs, University of Minnesota, August 2010, The Intelligent Transportation Systems InstituteCenter for Transportation Studies http://conservancy.umn.edu/bitstream/11299/101340/1/CTS%2010-12.pdf

…it depends on many factors, including location, customer age and gender and, most importantly, product type. "Fast," for grocery deliveries, he noted, means same day; for luxury items, it means next day; for electronics, two days; for small kitchen appliances, three days; for larger appliances, four days; and for garden items, seven days. Customer expectations continue to increase, he added, noting that "fast for 2014 is next day to two days; fast for 2015 will be same day to next day."

What does all of this mean for commercial real estate? Faster-than-two-day delivery for many products will require e-commerce retailers to set up more (but smaller) fulfillment centers in more urban areas, meaning that multistory facilities (like those Prologis and others already operate in Japan) may begin to make sense because of higher land costs.

Nationally, the impact of increasing internet sales has spurned discussions in Congress about how to address sales tax. The guiding federal principle is based on the 1992 Supreme Court decision, Quill Corp. v. North Dakota, which addressed the obligations of mail order businesses to collect sales tax on out-of-state sales. This decision now extends to internet sales. The decision obligates companies with a "Physical Presence" in a state to collect sales tax. Physical Presence is generally described as a firm that has:

1. A warehouse in the state,
2. A store in the state,
3. An office in the state, or
4. A sales representative in the state.

In addition to this rule, California's legislature enacted additional rules in 2012 that apply to large internet sellers that do not have a physical presence in California (aka, the Amazon law)[16] (see **Table E-4**). The law enables sales tax collection from retailers that meet the following criteria:

1. Retailer has an agreement with a person(s) with a physical presence in California to pay for customer

[16] California Revenue and Taxation Tax Code Section 6203(c)(5)

referrals obtained via a link on the California seller's website (click-through arrangement)

2. The out-of-state retailer's total cumulative sales to purchasers in California exceeds $10,000 during the preceding twelve months, and

3. The out-of-state retailer also has total cumulative sales to purchasers in California exceeding $1,000,000.[17]

[17] Steingold, David M., NOLO, *California Internet Sales Tax Law*, http://www.nolo.com/legal-encyclopedia/california-internet-sales-tax.html April 14, 2016.

Table E-4. California Guidelines for Allocation of Local Sales & Use Tax

Place of Sale	Location of Goods at the Time of Sales	How Customer Receives Goods	Allocation of Taxes*
Online	California Fulfillment Center	Shipped to California Customer	Local tax is allocated to the jurisdiction in which the fulfillment center is located.
Online	Out of State Fulfillment Center	Shipped to California Customer	Local tax is allocated to the countywide pool based on point of delivery.
Online	Out of State Fulfillment Center	Picked up In-Store (Click & Collect)	Local tax is allocated to the countywide pool based on point of delivery.
Online	California Fulfillment Center Owned and Operated by a Third Party Vendor	"Drop-shipped" ** to California Customer	Local tax is allocated to the countywide pool based on point of delivery.
Online	In-Store (Goods withdrawn from store inventory)	Shipped to California Customer	Local tax is allocated to the jurisdiction in which the store is located.
Online	In-Store (Goods withdrawn from store inventory)	Pick-up In-Store (Click & Collect)	Local tax is allocated to the jurisdiction in which the store is located.
In-Store	In-Store (Goods withdrawn from store inventory)	Over the Counter	Local tax is allocated to the jurisdiction in which the store is located.

*District tax for online purchases is allocated based on the point of delivery.

**Drop-shipping" by a third party vendor is becoming a common tool for online retailers. Here, the manufacturer or wholesaler maintains the inventory and ships the goods directly to the customer for the retailer who takes the order. If the retailer collects the tax when the order is taken, the tax is allocated via the county pools. If the drop-shipper collects the tax as part of the service, the tax goes to the jurisdiction where the stock of goods is held.

Source: HdL Companies, Local Government Guide to Sales, Use and Transactions Taxes, February 2016
https://www.hdlccompanies.com/modules/showdocument.aspx?documentid=136

California law protects the State from loss of sales tax revenues generated by the largest online retailers, but it does not fully address the loss in sales tax revenue caused by out-of-state sales. According to a 2012 estimate prepared by the University of Tennessee, internet sales result in $11 billion in annual sales tax revenue losses (nationally).[18] Since 2012, several states have enacted legislation to collect sales tax from internet sales, including four more states in 2016 followed suit, due in part to the substantial and continuing growth in internet sales (up from 4.2 to 8.1 percent of total retail sales from 2010 to 2016), as well as Congress' inaction to address the sales tax issue at the federal level. To date, the Supreme Court has refused to hear the challenges to state internet sales tax laws. In 2013, the U.S. Senate acted on the Marketplace Fairness Act, but the House of Representatives failed to pass anything similar. Currently, three internet sales tax bills are being considered, including a 2015 Marketplace Fairness Act, the Remote Transaction Parity Act (RTPA), and the Online Sales Simplification Act. The first two would generate sales tax for the delivery location, whereas the last one would generate sales tax revenue at the point of origination. A fourth bill, No Regulation without Representation Act of 2016 would require an exact interpretation of Quill Corp. v. North Dakota.

Amazon poses a potentially more significant challenge for Orange County and other similar counties with large retail spaces and less developable industrial warehouse space. Amazon has recently constructed four (4) fulfillment centers in San Bernardino County and two (2) in Riverside County to respond to consumer demands for one- and two-day delivery. Goods shipped from out-of-state by a company that has "physical presence" in California generate sales tax at the delivery address, whereas goods shipped from a fulfillment center in California generate sales tax for the jurisdiction where the fulfillment center is located. Amazon currently accounts for 24 percent of all internet-based sales in the U.S. For Orange County, because Amazon has fulfillment centers within the State, Orange County delivery addresses do not generate sales tax revenue, but rather the physical locations of the fulfillment centers generate the sales tax revenue.

3D Printing/Additive Manufacturing

3D printing is a subset of Additive Manufacturing, which refers to technologies that fabricate products by building up thin layers of material from three-dimensional, computer-aided designs. 3D printing uses machines to "print" successive layers

[18] Beitsch, Rebecca, Stateline, *In Online Sales Tax Battle, States Pin Hopes on Courts*, http://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2016/05/26/in-online-sales-tax-battle-states-pin-hopes-on-courts, May 26, 2016.

of materials to create a full-range of products. 3D printing, often dubbed the Third Industrial Revolution[19], is anticipated to cause significant disruptions in both manufacturing and supply chains, including re-shoring manufacturing jobs back to the U.S., comingling of manufacturing, storing and fulfilling orders under one roof, and encouraging local production and customization opportunities for everything from the latest tennis shoes to automobile parts – and all with zero waste.

3D printing could drive down the volume of finished goods shipments. In turn, the nature and destination of raw materials shipments might change dramatically. Businesses will have to figure out which products (or parts of products) can be printed and, accordingly, what manufacturing, assembly and shipment options need to be reinvented…Logistics services providers might offer customers 3D printing services at centralized warehouse locations connected to their shipping facilities. So instead of shipping a product from Cleveland to Seattle, a manufacturer might sell the rights to the digital model to a logistics company, which then prints the product in Seattle and delivers it to the customer.[20]

3D printing can lead to more sustainable manufacturing – both economically and environmentally. The ability to print on-demand as orders are received could eliminate shipping costs of unsold goods, discarding unsold goods, and eliminating waste in the manufacturing process itself, which in turn would reduce the amount of energy consumed for both producing and transporting unwanted merchandise.

3D printing is scalable and has the ability to support the production of very small items, such as nuts and bolts, to very large scale items like houses. The process can occur in small spaces and could lead to redevelopment of underutilized and antiquated industrial uses in older parts of the County.

3D printing is also beginning to be used in the biotech industry, which could further increase the movement of products in and out of Orange County. One of the leading bioprinting firms, Organovo, is located in San Diego, California. Bioprinting research is yielding success in "printing" organ tissue for

[19] Rifkin, Jeremy, *The Third Industrial Revolution*, September 27, 2011.

[20] Accenture, Disruptive Potential of 3D Printing.

patches, cartilage for ear and nose replacements, and other biological components such as blood vessels.

Emerging Freight Delivery Trends

Over the past few decades, transportation emissions impacts have continued to decline. The federal CAFÉ rules have sparked innovative designs and the exploration of alternative fuels, including natural gas, bio-fuels, hydrogen, dual energy (hybrid gas/electric), and electricity. Clean truck and locomotive technologies continue to be explored; however, two key drivers impact the use of alternative fuels for moving goods: 1) equipment and fuel costs, and 2) range and weight.

The new federal CAFÉ standards continue to drive fuel efficiency and emissions reductions for heavy duty trucks. Furthermore, in California, the Air Resources Board and South Coast Air Quality Management District continue to introduce more stringent air quality regulations that are driving technological advances in near-zero and zero emissions trucks, including electric and hydrogen fueled trucks. These new technologies are much costlier than the new clean diesel technologies – three to five times as expensive to purchase. In addition, the operating hours per day for electric are far less due to the length of time to recharge the vehicles. For hydrogen, fueling infrastructure has been an issue. The cost of installing hydrogen fueling infrastructure is twice as expensive as liquefied natural gas infrastructure. In addition to these cost obstacles, fueling cost savings are limited as shown in **Table E-5**.

Table E-5: National Average, July 1 - 15, 2016

Biofuel (B20)	$2.54/gallon
Biofuel (B99-B100)	$3.03/gallon
Electricity	$0.12/kWh
Ethanol (E85)	$1.99/gallon
CNG	$2.05/GGE*
LNG	$2.41/GGE
Propane	$2.76/gallon
Gasoline	$2.26/gallon
Diesel	$2.46/gallon

*GGE = gallons of gasoline equivalent

Source: Alternative Fuel Price Report, July 2016 and US Energy Information Administration

UPS Rolling Laboratory

UPS continues to lead the industry in its commitment to reducing its carbon footprint worldwide through a number of initiatives – most notably, its fleet of alternative-fueled vehicles. Through this effort, UPS has used current routes and drivers to test promising new alternative fuel technologies ranging from LNG Class 8 heavy-duty trucks to electric bicycles. The testing offers opportunities to commercialize promising technologies and respond to unique regulatory requirements for emissions reductions in different parts of the world. UPS understands that different pieces of its supply chain require different sizes of

vehicles, and its rolling laboratory allows it to test different fueling technologies by type of vehicle, required operating range, and regulatory environment.

Liquefied natural gas (LNG) is one of the most promising alternatives to conventional diesel fuel for Class 8 trucks, especially in the United States. LNG-configured heavy-duty tractors combine strong pulling power and long range, so they compete operationally with comparable diesel-powered tractors while offering a lower emission profile. The cost of operation can be lower as well, because LNG is growing in availability from sources within the United States.

The challenge is creating a critical mass that results in lower equipment and infrastructure prices. It's a fine balance between equipment and infrastructure as operators need available fueling stations, while fueling stations require demand to survive. For these reasons, UPS is making substantial financial and operational investments in LNG vehicles and infrastructure in the United States. Bigger LNG fleets enable manufacturers to achieve economies of scale. They also make it economically viable for companies to build fueling and maintenance stations. As LNG-fueled commercial transportation becomes more widely affordable, it will help the country lower its greenhouse gas emissions. UPS already plays an important role in the nation's longest LNG corridor, known as the Interstate Clean Transportation Corridor (ICTC). This corridor stretches from the West Coast to the Rocky Mountains and into the Southwest. In 2015, UPS added over 1,750 new alternative fuel and advanced technology vehicles, including 800 natural gas Class 8 trucks.

Increasing the miles driven with these vehicles provides incremental increases in emissions efficiency. Just as importantly, it increases the amount of information flowing in from their "rolling laboratory" of non-conventional vehicles. UPS is rapidly expanding its use of liquefied natural gas and propane as vehicle fuels because of the positive results they showed as part of its rolling laboratory. In 2013, UPS was operating 3,142 and logged 55 million miles in those vehicles during the year. The following summarizes UPS' alternative fueled fleet as of 2013:

- 1,000 LNG Tractors
- 13 LNG fueling facilities
- 1,000 propane package cars
- Total of 3,150 alternative fuel and advanced technology low-emissions vehicles, including:
    - All-electrics,
    - Electric hybrids,
    - Hydraulic hybrids,
    - Propane,
    - Compressed natural gas (CNG),

- Liquefied natural gas (LNG), and
- Biomethane.

UPS believes that the economic and environmental aspects of sustainability act together. To that end, they developed a set of criteria for vehicle type selection that it uses to identify, adopt and deploy alternative technology vehicles. The technology must meet the following criteria in order to be considered:

- It's safe
- It must have a reliable fueling infrastructure
- Supply of vehicles and parts is predictable
- Measurable improvement in emissions, fuel savings and/or environmental benefit
- Economically viable in terms of initial purchase price, maintenance costs and reliability and adapt to our fleet use characteristics

Using these selection criteria, UPS has developed a rolling laboratory for alternative fuels development. The rolling laboratory tests prototypes on the road. The company works with manufacturers, the EPA and other government agencies to pilot projects before new vehicles are ready for commercial deployment. In 2016, UPS reached its goal to log 1 billion miles with alternative fuel fleet more than a year ahead of schedule.

Independent Delivery Drivers: AmazonFlex, UberRUSH, Lyft, and Postmates

Amazon has been partnering with different delivery and courier services for the past several years to reduce the delivery time on Amazon orders with limited success. Due in part to several complaints about missed delivery times, missing orders, and overall dissatisfaction with courier service used by Amazon, the company made the decision to alter last-mile, same-day delivery operations. Recently, Amazon began contracting with its own drivers through a program called AmazonFlex[21], which will be contracting with independent owner-operators of light vehicles (similar to Uber and Lyft) to make reliable, same-day delivery possible.

At the same time, Wal-Mart contracted with both Uber (UberRUSH) and Lyft to provide delivery capabilities to compete with Amazon. Unlike the Uber and Lyft passenger services, they do not currently operate within the same market areas. Wal-Mart is using Uber in Phoenix and Lyft in Denver.[22]

[21] Demmitt, Jacob. GeekWire, *Amazon has big plans for Uber-like 'Flex' package delivery service, job postings reveal*, http://www.geekwire.com/2015/amazon-plans-to-expand-uber-style-crowdsourced-delivery-network-to-millions-of-drivers/, December 16, 2015.

[22] Masunaga, Samantha. Uber and Lyft team up to deliver for Wal-Mart, June 3, 2016.

For smaller, local businesses, Postmates.com acts in a similar capacity. Independent owner-operators of passenger cars respond to online orders for goods ranging from groceries to home improvement products and deliver the items within an hour. Postmates allow non-Amazon retailers to better compete with the faster and more convenient delivery options that are being demanded by consumers.[23]

Drone Delivery

In addition to cleaner fuels for trucks, other alternative delivery vehicles are also being tested by large and small delivery companies. For example, UPS, FedEx, and DHL have been testing small, electric delivery vehicles. Amazon, who is seriously testing drones, has submitted an official request to the FAA to utilize drones. Even bicycle delivery services, like Postmates.com and local restaurants/sandwich shops are emerging, although the market for these types of technologies and services is limited.

These new options provide cleaner, more sustainable delivery options. As mentioned by Amazon in its letter to the FAA, 80 percent of the packages that they ship weigh less than five pounds. While drones and bicycle delivery will continue to develop, the efficiencies gained through new routing technology points to the smaller, electric delivery vehicles appear to have the most utility of these emerging technologies in the short term.[24]

The San Bernardino International Airport recently joined forces with Tesla Foundation Group to begin testing drone technology

[23] Kelleher, Kevin. Time, *How Postmates Survived and Thirved Despite the Naysayers*, http://time.com/4401591/postmates-on-demand-delivery/ , July 11, 2016.

[24] Misener, Paul. Amazon, Vice President of Global Public Policy, Letter to FAA, http://www.regulations.gov/document?D=FAA-2014-0474-0014 December 7, 2014.

at the major cargo airport. The first FAA-approved drone delivery of a package without a human to manually steer it occurred in Nevada in 2016. A startup company named Flirtey conducted the delivery.[25] Such a delivery system operating commercially requires rules and operating regulations to ensure safety. The FAA established a working group in 2015 to investigate these issues. In addition, NASA and FAA conducted an extensive field test to develop a system to manage low-flying drone traffic in April 2016, which included a 3-hour test of 24 drones monitored by NASA engineers remotely. At one point, 22 of the drones flew simultaneously without incident. As Amazon continues to test and operate their drones abroad, and the FAA and NASA continue to develop mechanisms for ensuring safe movement of drones for commercial delivery, the reality of delivery drones is something that local agencies may someday need to consider.

Zero-Emission Cargo Mover Systems

In recent years the San Pedro Bay (SPB) Ports of Long Beach and Los Angeles have investigated a number of ways to reduce emissions from cargo moving systems. In 2009, the ports commissioned a study of zero-emission conveyance systems. The Ports officially issued a "Request for Concepts and Solutions," (RFCS) on June 3, 2009, outlining the goals and requirements of the project, known as the zero-emission container mover system (ZECMS). The primary focus of this study was to explore new technology to move containers between docks and the Intermodal Container Transfer Facility (Union Pacific Intermodal Rail Yard), potentially eliminating thousands of short-haul diesel truck trips each day and reducing air pollution. Proposed technologies included electric guideways, zero-emission trucks, or electrified rail, all of which use electricity to power the movement of cargo, rather than diesel-fueled trucks. The project management team for the Request for Concepts and Solutions included representatives from both ports and the Alameda Corridor Transportation Authority (ACTA). The team also enlisted a panel of outside, independent experts, including the USC Keston Institute for Public Finance and Infrastructure Policy, to help evaluate concepts for the ZECMS.[26]

The study received proposals from a variety of firms, as shown in **Table E-6**. Included were various magnetic levitation (maglev) and linear induction motor approaches. A more recent technology called Hyperloop is discussed in the next section.

[25] Fortune, *This Drone Startup Just Achieved a Milestone In Doorstep Delivery*, http://fortune.com/2016/03/25/flirtey-drone-legal-delivery-urban/ March 25, 2016.

[26] http://www.polb.com/environment/transplan/zecms/default.asp.

Table E-6. POLB/POLA ZECMS Technology Readiness Assessment

POLB/POLA Zero Emissions Container Mover System Evaluation Technologies

Technology (Proponent)	Summary	Status of Technology
AirHelo (International, Inc.)	Airship	Concept only
Automated Shuttle Car System (Automated Terminal Systems, Inc.)	Fully electronic cars; power is delivered to the cars via a contact shoe and a third rail	Concept only
CargoRail/Caro Tram (MegaRail Transportation System)	Automated or manual transport of trucks and containers in a train consist on an elevated guideway; electric motor driver wheels	Concept only
Container Port Skid (Tubular Rail)	Terminal-to-rail loading only; no line-haul application	Concept only
Container Express Corridor (Cit-Car)	Use conventional rail trackage; would require conventional locomotive to move electric power driven railcar to automated guideway; no design for railcar motor power source	Concept only
Electric Cargo Conveyor System (General Atomics) *(RFCS respondent)*	Magnetic levitation system (different than the technology submitted in RFCS)	Test track/system built with small container type railcar
Environmental Mitigation and Mobility Initiative Logistics Solution (American Maglev) *(RFCS respondent)*	Magnetic levitation system	Test track built with passenger car type railcar
Freightrapid (Transrapid International-USA)	Magnetic levitation system using synchronous longstator linear motors	Operating passenger system in Shanghai, China
Rail Motor & SPM Maglev (Launchpoint Technologies)	Electric propulsion of locomotives and magnetic levitation using linear; a motor is installed in the track, would require no mechanical connection to the vehicles	In conceptual design phase
LIM-Rail/MagRail (Innovative Transportation Systems Corporation	Electric propulsion of locomotives and magnetic levitation using linear; a motor is installed in the track, would require no mechanical connection to the vehicles	In conceptual design phase
Southern California Guideway (Southern California Guideway/Whelan & Associates)	Linear Induction Motor	Concept only
SAFE Freight Shuttle (Freight Shuttle Development Corporation) *(RFCS respondent)*	Linear induction motor in an automated, grade-separated, elevated guideway system	In conceptual design phase
Air Rail (Skytech)	Linear induction motor with electric transport above and below rails; overhead grid would move containers down monorail-like tracks	Concept only

A National Academies Press publication, National Cooperative Highway Research Program No. 34: Evaluating Alternatives for Landside Transport of Ocean Containers (NCHRP 34)[27]" followed up on the San Pedro Bay Ports report, and added some additional analysis on similar concepts being proposed on the East Coast. In this report, the authors noted the alternative container transport systems offered a similar ambitious goal to:

"Move much more cargo with far less pollution, more securely, with better cargo tracking, at a higher throughput per [marine terminal] acre, with less traffic congestion, using less energy and energy generated from renewable sources without driving up the price."

Per the conclusions stated in NCHRP 34:

"The proposed evaluation method [finds that] systems are too costly, too narrow in their application, too inflexible, and insufficiently scalable to be cost-effective solutions to the emissions, congestion, and capacity problems facing the [SPB] Ports and the region. Moreover, the very long and uncertain lead time for their development and implementation would leave pressing problems unaddressed for an unacceptably long time and entail considerable risk. The proposed method also identified advanced truck drayage concepts as more feasible in the near term. The results are driven by a few inherent characteristics of advanced fixed-guideway technologies and the container transport needs of the Southern California ports:

- *Automated small-vehicle fixed-guideway technologies are inherently unsuited to moving large volumes of marine containers in complex or multi-destination networks. These technologies excel at handling passengers in relatively short, simple loops or systems.*

[27] Smith, Dan and Richard Little, National Cooperative Highway Research Program (NCHRP) Report No. 34: *Evaluating Alternatives for Landside Transport of Ocean Containers",* National Academies Press, 2015

- *Advanced fixed-guideway systems are inherently capital-intensive, especially where they must be elevated and retrofit to legacy facilities.*
- *Advanced fixed-guideway systems are inherently inflexible and non-scalable compared to truck drayage systems.*

The opportunity window for advanced fixed-guideway systems may be closing. Foreseeable developments at LA/LB, particularly expansion of UP's ICTF [Union Pacific Railroad's Intermodal Container Transfer Facility], development of BNSF's SCIG [BNSF Railway's Southern California International Gateway intermodal railyard], and additional on-dock rail capacity, would drastically reduce the volume of traffic and potential advantages of advanced fixed-guideway technologies."

For Orange County, a fixed guideway system for moving freight inland would likely have no impact on freight moves between the ports and Orange County unless such a system was scaled to serve an inland port, similar to the short haul rail concepts. Orange County is an unlikely destination for an inland port so the impact of such a system would be limited to changes in traffic patterns with a shift from LA County to San Bernardino and Riverside Counties.

Hyperloop

Elon Musk released a whitepaper at the end of 2013, in which he describes a new transportation system he calls a Hyperloop. In his whitepaper Musk describes it as follows:

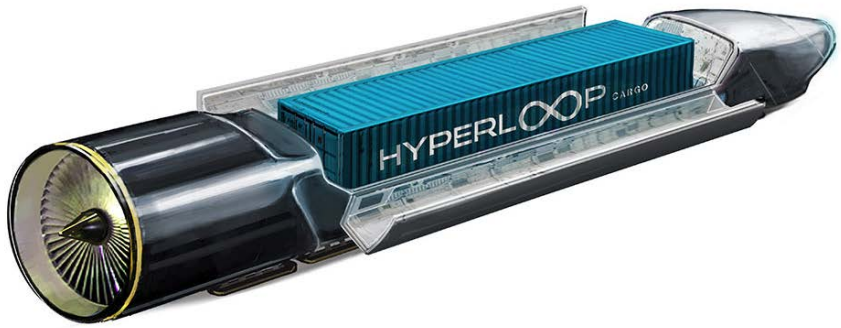
Existing conventional modes of transportation of people consists of four unique types: rail, road, water, and air. These modes of transport tend to be either relatively slow (i.e., road and water), expensive (i.e., air), or a combination of relatively slow and expensive (i.e., rail). Hyperloop is a new mode of transport that seeks to change this paradigm by being both fast and inexpensive for people and goods. Hyperloop is also unique in that it is an open design concept, similar to Linux….

…Short of figuring out real teleportation, which would of course be awesome (someone please do this), the only option for superfast travel is to build a tube over or under the ground that contains a special environment…. Hyperloop consists of a low pressure tube with capsules that are transported at both low and high speeds throughout the length of the tube. The capsules are supported on a cushion of air, featuring pressurized air and aerodynamic lift. The capsules are accelerated via a

magnetic linear accelerator affixed at various stations on the low pressure tube with rotors contained in each capsule. Passengers may enter and exit Hyperloop at stations located either at the ends of the tube, or branches along the tube length.

An artist's rendering of how the Hyperloop could be used for shipping cargo containers is shown in **2**. Russia is considering its own version of the Hyperloop for connecting the farthest reaches of the country. Russian rail operator RZD is planning a high-speed rail system for transporting freight between the north and south as well as the east and west of the country.

The first stage of the proposed project would see Moscow connected with ports in St Petersburg serving the Baltic Sea. Speaking to RBC, Anatoly Zaitsev, head of St Petersburg Railway Innovation Development Centre, said the proposed project would cost between $12 and $13bn.[28]



Source: http://www.logisticsmatter.com/wp-content/uploads/2015/02/hyperloop-pod.jpg.

Inland Ports and Inland Cargo Depots

Inland Ports and Short-Haul Rail

Over the years, the Ports of Long Beach and Los Angeles have looked at many different strategies to improve port efficiency including reducing truck traffic through marine terminal gates. One strategy that is receiving renewed attention is the use of short-haul intermodal trains to move marine containers to "inland ports" located near the hub of regional distribution centers and warehouses in the Inland Empire.

[28] http://www.ibtimes.co.uk/russia-700mph-hyperloop-technology-cross-country-freight-transport-works-1562912.

Potential benefits of rail-served inland ports are:

- Reduced congestion at marine terminal gates,
- Lower operating cost (potentially),
- Greater schedule reliability (potentially),
- Reduced congestion on local freeways,
- Reduced net emissions,
- Reduced container dwell time and consequent congestion within marine terminals,
- Increased job opportunities in the Inland Empire, and
- 24/7 operations at inland port.

Challenges to address include:

- Time and cost of double-handling containers,
- Convenience of truck haulage,
- Securing capacity on railroad mainlines for shorthaul trains,
- Securing on-dock capacity for shorthaul trains, and
- Attracting customers.

To attract customers, an inland port must address what segment(s) of the market would be served. There has to be a compelling business model that will overcome the disadvantages listed above. The Transload and Local market segments are the most likely to take advantage of a well-located shorthaul rail served inland port, and this includes Orange County imports and exports. Rather than exports and imports to Orange County requiring trips to/from the ports, an inland port in the Inland Empire could result in a shift of truck traffic, as well as more opportunities for off-peak delivery of goods.

Short-Haul Rail Study, Port of Long Beach (2016)

The Port of Long Beach recently commissioned a study to research the potential of inland ports. The lead consultant for the study is Larry Mallon, President & CEO at Strategic Mobility 21, Inc. and CEO of Level Six Logistics. The report is still in draft form, but some preliminary findings that have been shared publicly indicate that a short-haul rail operation could now be economically viable because rail costs may have fallen below trucking costs for relatively short distances in recent years due to escalating drayage costs stemming from port and freeway congestion, and some drayage companies and drivers exiting the market. Furthermore, in the past the railroads have been opposed to short-haul rail, but recent discussions have been more promising due presumably to market shifts within the rail industry resulting in railroads examining new markets.

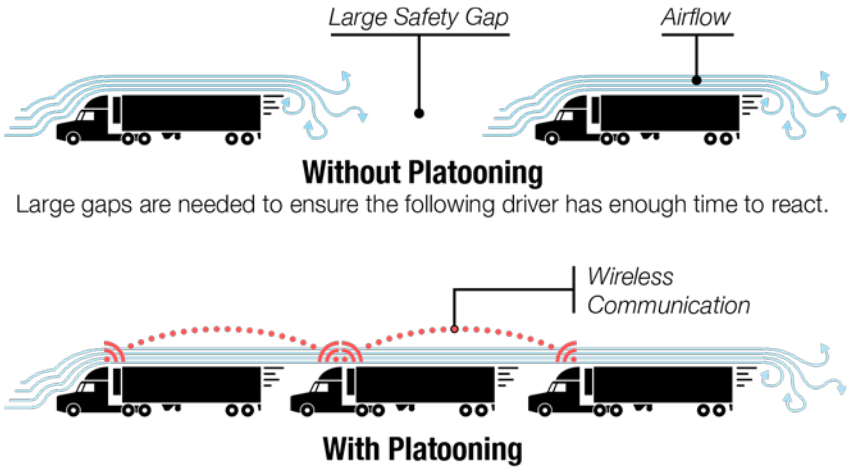
The current short-haul rail study is investigating locations with proximity to distribution centers and warehouses, such as the "golden triangle" (the area bounded by the I-215 and I-15 and Highway 60) and other areas in or east of the Inland Empire.

Technology Advancements and Innovations

Truck Platooning

A truck platoon is a series of trucks following each other on the road, with acceleration and braking controlled automatically (steering is typically still manual). When any truck's speed changes, the others behind it are instantly notified wirelessly, and those trucks respond immediately by braking or accelerating. This allows for much closer following distances, which reduces wind resistance and increases the number of trucks that can fit on the road at high speeds, thereby increasing roadway capacity (see **Figure E-3**). This also protects against rear-end crashes by automating brake reaction time.

Figure E-3. Truck Platooning Concept



The remainder of this section provides a short summary of pilot studies of this technology in different parts of the nation, including (when available):

- Identification of involved parties
- Description of the on-board technology
- Description of corridor and traffic conditions of test
- Summary of key findings and recommendations

Texas Truck Platooning Test Program

In concept development phase.

Participants: Testing performed by the Texas Transportation Institute (TTI)

Configuration: TBD

Corridor: TBD in Texas

Vehicles and Equipment: TBD – program includes multiple industry partners, including truck OEM's.

Objectives: Test Level 2 truck platooning – an extension of cooperative adaptive cruise control that uses automated lateral and longitudinal vehicle control, while maintaining a tight formation of vehicles with short following distances

Design: TBD – Concept of Operations currently under development

Results: TBD.

FHWA Partial Automation for Truck Platooning (California)

Test program in progress.

Participants: Testing performed by UC Berkeley PATH and Volvo

Configuration: Two and three-truck platoons, multiple configurations

Corridor: I-580 in California, between Dublin and Tracey

Vehicles and Equipment: Volvo trucks.

Objectives: Perform high speed testing, longitudinal maneuvers (platoon splitting, platoon joining), fuel economy analysis, fault detection consideration.

Design: Engine control included both torque control and brake system control.

Results: Testing planned for fall 2016.

FHWA Partial Automation for Truck Platooning (Alabama)

Test program in progress.

Participants: Testing performed by University of Auburn and Peloton

Configuration: Two-truck platoons

Corridor: TBD

Vehicles and Equipment: Peterbilt trucks with Meritor Wabco advanced brake system integration and Peloton prototype commercial-off-the-shelf two-truck platooning system

Objectives: Test how the system reacts to passenger car cut-ins or other highway anomalies; test how to find similarly equipped vehicles on the road for the platoon; test improved fuel economy, test the role of the lead driver; estimate return on this investment.

Design: Peloton prototype commercial-off-the-shelf two-truck platooning system technology, integrating vehicle-to-vehicle communications with adaptive cruise control

Results: Testing planned for 2016.

Nevada Truck Platooning Tests

Participants: Testing performed by UC Berkeley PATH

Configuration: Three-truck platoons, 6 meter spacing at 53 mph

Corridor: SR 722 in Nevada

Vehicles and Equipment: Freightliner trucks equipped with a Cummins C-Celect Engine ECU, a V2V communications system (Savari DSRC), a WABCO "Euro" E85, an accelerometer, a gyroscope, a PC104 control computer, Lidar sensors, and Radar sensors.

Objectives: Perform high speed testing, longitudinal maneuvers (platoon splitting, platoon joining), fuel economy analysis, fault detection consideration.

Design: Engine control included both torque control and brake system control.

Results: Performance is sensitive to changes in roadway grade. Line-of-sight was necessary for reliable V2V communications, resulting in the middle truck's being offset laterally by 0.5 meters. First, second, and third truck achieved fuel savings of 4.54%, 11.91%, and 18.4% respectively.

Safe Road Train for the Environment (SARTRE), Aerodynamic Tests

Participants: Volvo Trucks, Volvo Cars and SP (Sweden), Ricardo (UK), IKA (Germany), IDIADA, and Technalia (Spain).

Configuration: Platoons of two trucks, followed by three passenger cars. Spacing of as little as 5 meters.

Corridor: Fuel consumption was evaluated at the IDIADA high-speed test track in Spain.

Vehicles and Equipment: Platoon operation based on radar data and Wi-Fi communication between trucks. Side radar units monitor traffic, forward-facing radar maintains vehicle spacing, and a camera measures position in the lane. A Wi-Fi antenna is mounted above the cabin for wireless communication to other platoon vehicles. New technologies were intentionally not developed for this project, as it was intended to be a demonstration of truck platooning using currently available technology. Acceleration and braking was controlled using radar, adaptive cruise control, and automated emergency braking. Steering control was provided using Volvo's Dynamic Steering system. The Radar and camera equipment is standard production technology, and the Wi-Fi communications use the 802.11p standard.

Objectives: Test aerodynamic effects of platooning and resultant fuel savings.

Design: Control system included steering, acceleration, and braking. Aerodynamic testing was performed at night to minimize fluctuations in temperature and wind.

Results: At a spacing of 5 meters, fuel savings were 8% for the lead truck and 13% for the following truck. At a spacing of 25 meters, fuel savings were 1.5% for the lead truck and 7.5% for the following truck.

Safe Road Train for the Environment (SARTRE), CACC and ACC Tests

Participants: Isuzu, HINO, FUSO, UD Trucks

Configuration: Four-truck platoons. In one test headways are 1 second and speed is deliberately reduced from 80 kph (start) to 50 kph (finish).

Corridor: Unspecified.

Vehicles and Equipment: Four different trucks by four different manufacturers (Isuzu CYL, HINO FW1EXBL, FUSO FS55VVZ, UD Trucks QGK-CD), each approximately 12 meters and 10 tons. Vehicles included V2V communications antennas on the roof of the cabin, a GPS antenna on the top of the cabin, an acceleration sensor, yaw rate sensor, wheel sensor, Laser Radar (IBEO), 76G Millie wave radar, a GPS unit, Rapid Pro unit, Micro Auto Box unit, and HMI screen/indicator lamps.

Objectives: Demonstrate feasibility of truck CACC technology and operation.

Design: In ACC mode, truck control is handled using V2V distance sensors only. In CACC mode, truck control is handled using V2V distance sensors and wireless communication.

Results: At 20-meter spacing, fuel savings were 8% on average. At 10 meters, fuel savings were 14% on average. At 5 meters, fuel savings were 16% on average.

Safe Road Train for the Environment (SARTRE), V2V Communications Tests

Participants: SARTRE participants.

Configuration: Platoons of two trucks followed by three passenger cars, at a spacing of 13 meters. Testing was performed at 50, 70, and 85 kph (6 minutes at each speed).

Corridor: IDIADA test track in Spain

Vehicles and Equipment: Trucks had two separate radios and antennas for V2V communication. Passenger cars only had one.

Objectives: Investigate potential V2V issues in a platooning environment.

Design: Data is broadcast to all vehicles, not relayed from one to another. Data was encrypted and communicated using 802.11p. Data was sent and received from the SARTRE CAN bus. The experiment did not focus on minimizing data volume or transmission needs. For time synchronization, a GPS/NTP method was used.

Results: Side mirrors were tested as alternate mounting locations for antennas, but were ultimately not selected. Line-of-sight issues may have contributed to lost messages between vehicles in some configurations. Interruptions in V2V communications between vehicles were typically shorter than 100 ms.

Japanese Energy ITS Project

Participants: Ministry of Economy, Trade, and Industry; New Energy and Industrial Technology Development Organization.

Configuration: Four-truck platoons at 80 kph. In CACC mode, the spacing was 30 meters; in fully automated mode, the spacing was 4 meters. Additional demonstrations were performed with three- and four-truck platoons at 30, 10, and 4.7 meter spacings.

Corridor: Tomei Expressway around Tokyo. 100 km segment. Traffic composed of 69% light vehicles and 31% heavy vehicles. Additional demonstrations performed at AIST test track.

Vehicles and Equipment: Image processing, radar (front bumper mounted), laser scanner (front bumper mounted), V2V communications (antennas installed at rear corners of trailer), and Lidar cameras on the sides of the vehicle. Human-Machine interface includes in-vehicle display and additional indicators on the back of the leading vehicle trailer.

Objectives: Demonstration of automated truck platoons and energy savings. Testing of obstacle avoidance and cut-in scenarios.

Design: Steering and speed control automated. Image processing is used for lane-keeping. Radar, laser, and V2V data are used for gap/longitudinal control.

Results: 13.7% fuel reduction for CACC mode, and 15.9% fuel reduction in fully automated mode. CO2 emissions were reduced by 2.1% at 10-meter gaps, and 4.8% at 4-meter gaps.

CHAUFFEUR Project

Participants: European Union, Daimler Chrysler, Renault Recherche, IVECO, Centro Ricerche Fiat, WABCO, Bosch, ZF Lenksysteme, Central Research Laboratories, TUV Rheinland, PTV, Clifford Chance & Punder, and CSST.

Configuration: Two-truck and three-truck platoons with 6-12-meter spacing.

Corridor: Not specified.

Vehicles and Equipment: DaimlerChrysler and IVECO trucks. Dedicated infrared image processing with two cameras, for measurement of tow bar angle and distance. 5.8 GHz V2V communication for platoon formation and coordination.

Objectives: Proof of concept for “electronic tow bar” operation of trucks.

Design: System controls lateral movement (lane keeping) and vehicle spacing, using a lane keeping system and cruise control. The infrared image processing uses a pattern of markers on the backside of the leading truck's trailer, arranged in an octagon.

Results: Up to 20% reduction in fuel consumption.

Regulatory and Policy Issues Relating to Truck Platooning

The current government/industry relationship and new truck technologies is favorable, in that the testing has been effective and safe. There currently is no formal process for implementing new technologies. The federal government is responsible for approving the technology while the state is accountable for the actual implementation of the new technology.

The certification of vehicles is the responsibility of the original equipment manufacturer, but industry organizations are the ones that provide the recommendations for certification standards and practices. However, Driver Assisted Truck Platooning (DATP) in Nevada has been classified as only Level 1 automation and therefore doesn't require special registration, with other states following suit.

Since there is partial automation in truck platooning, insurance and liability practices will become more complex. Currently, most accidents occur due to human error, but with Driver Assisted Truck Platooning the practice and standards may not be as clear anymore depending on the level of automation.[29]

Zero- and Near Zero-Emissions Technologies

Leading zero-emissions (ZE) and near-zero-emissions (NZE) truck technologies include: Dual-Mode Hybrid Electric Vehicles (HEVs), Plug-In Hybrid Electric Vehicles (PHEVs), Range-Extended Electric Vehicles (REEVs) with integrated engine, REEVs with integrated fuel cell, Battery Electric Vehicles (BEVs), and range extenders utilizing roadway power. The market readiness of each of these technologies has been evaluated according to NASA's technology readiness level (TRL), described in **Table E-7**.[30]

[29] Automated Driving and Platooning Issues and Opportunities, ATA Technology and Maintenance Council, 2015

[30] Technology Readiness Levels: A White Paper", John C. Mankins, Office of Space Access and Technology, NASA 1995.

Table E-7. NASA Technology Readiness Levels

Level	Definition
TRL 1	Basic principles observed and reported
TRL 2	Technology concept and/or application formulated
TRL 3	Analytical and experimental critical function and/or characteristic proof-of concept
TRL 4	Component and/or breadboard validation in laboratory environment
TRL 5	Component and/or breadboard validation in relevant environment
TRL 6	System/subsystem model or prototype demonstration in a relevant environment (ground or space)
TRL 7	System prototype demonstration in a space environment
TRL 8	Actual system completed and "flight qualified" through test and demonstration (ground or space)
TRL 9	Actual system "flight proven" through successful mission operations

Dual-Mode Hybrid Electric Vehicle

This is an advanced parallel hybrid with the internal combustion engine being the main source of power. It is a moderately mature technology, with little to no changes in operations as compared to a diesel-operated truck. However, the actual ZE range is limited, as it only functions in ZE mode at low speeds and/or is subject to certain load limits. These trucks achieve approximately 15% emissions savings compared to conventional diesel trucks. It is ranked with a 5 on the TRL scale.

Plug-In Hybrid Electric Vehicles

Unlike the HEVs, the PHEVs have batteries that are recharged through the electrical grid. This results in a larger battery, which also provides greater range in ZE mode. Despite this advantage over HEVs, PHEVs are based on a technology that is still in its relative infancy, is costlier, and generally more complex.

Range-Extended Electric Vehicles with integrated engine

These vehicles can use either electric power or diesel fuel, but the primary source of energy is the electric motor. The engine can run either on diesel or compressed natural gas (CNG) when the batteries are depleted. The determining factor for ZE range is battery size. Therefore, this truck type can be designed for specific ZE ranges as needed, subject to corresponding changes in cost. The technology has a TRL score of 7. These trucks achieve approximately 25% emissions savings compared to conventional diesel trucks.

Range-Extended Electric Vehicles with integrated fuel cells

This technology is analogous to the REEV with integrated engine, except that it relies on a fuel cell in place of an integrated engine when the vehicle battery is depleted. The fuel cells require hydrogen refueling stations for recharging, such

that these trucks are a practical solution only in areas where such refueling stations exist. The technology can be designed to fit within tight spaces and can be accommodated by a standard diesel truck, though this comes at a higher price point compared to other technologies. These vehicles also offer relatively long useful lifespans and small maintenance costs. This technology is already available on the market, and scores a 7 on the TRL scale. Because these vehicles are capable of operating in true zero-emissions mode, it is relatively easy to obtain regulatory certification for them.

Battery Electric Vehicles

The BEV an electric-only vehicle powered by its battery alone, meaning that longer ranges require larger, heavier, costlier batteries. The vehicle batteries can be recharged using dedicated recharging stations or overhead/in-pavement catenary power systems (if the vehicle is properly equipped to draw power from such a source). Recharging of the internal battery requires more time than refueling a REEV fuel cell or internal combustion engine. The actual truck technology has a TRL score of 7, while the fuel cell technology has a score of 6. Because these vehicles are capable of operating in true zero-emissions mode, it is relatively easy to obtain regulatory certification for them.

Range Extenders Utilizing Roadway Power

The technology requires roadway infrastructure to charge the electric trucks while on route using technologies that are already widely used for transit vehicles. This technology allows for smaller, cheaper on-board batteries and therefore lower vehicle costs as well. This cost savings per vehicle is offset by significantly greater costs for infrastructure supporting systems relative to other ZE/NZE technologies, however. This system scores a 5 on the TRL scale. Because these vehicles are capable of operating in true zero-emissions mode, it is relatively easy to obtain regulatory certification for them.

Truck Only Toll Lanes

The separation of heavy vehicles and passenger vehicles decreases accidents for a few reasons, including differential in travel speeds between trucks and autos and a lack of understanding of truck operating limitations. Many truck-involved crashes are attributed to the general driving population not understanding the blind spots encountered by truck drivers due to being seated much higher above the ground than automobile drivers. In addition, the general driving population does not understand the additional braking distance required for heavy duty trucks. Not only do accidents often result in injuries, and potentially fatalities, but they also create congestion. This separation would prevent some of this congestion. About 12 percent of passenger vehicle fatalities come from collisions with trucks and could be avoided if they were separated. The passenger vehicle experience would improve, as well, without the intimidations and lower speeds that accommodate the presence of trucks. In addition, truck

speed limits are frequently 10 MPH below the speed limit for autos, and trucks equal two to three autos, so the removal of trucks creates more mainline capacity by both increasing travel speeds and reducing vehicles. [31]

The trucking companies would benefit from the reduced accident rates of a truck only lane. Since there won't be many disturbances in the lane usually created by passenger vehicles, the trucks will need to brake, accelerate, and change lanes less creating smoother and more efficient travel. Just an addition of an extra lane will increase capacity, relieving the congestion and lowering the travel times. [32]

In addition to these benefits, truck only toll lanes may provide other benefits, such as an increase in size and weight, platooning/connected vehicle technology, and cost incentives for the use of near-zero and zero-emission technologies. Platooning reduces the distance between trucks with the aid of wireless communication technology in order to reduce wind resistance and increase capacity of a lane. [33] This technology has been shown to improve fuel efficiency by up to 15 percent, and also increase lane capacity by as much as 20 percent. Preliminary testing has also indicated that platooning would improve safety and smooth traffic operations due to connected/dynamic braking capabilities.

On the negative side of truck only toll lanes, costs and right-of-way requirements pose significant implementation challenges. For example, a proposed alternative for the I-710 Corridor Study includes a four-lane truck only facility between Ocean Boulevard near the Port of Long Beach and I-5. The most current concept includes tolling and incentives and/or requirements for near-zero and zero-emission trucks. The concept has been met with opposition from adjacent communities that are concerned about the visual and noise impacts of an elevated structure. The trucking community continues to be concerned about toll rates and the limited access to/from the facility. And the environmental community has been pushing for a zero-emission only concept that would be free to use, which poses significant funding concerns for LA Metro. This concept has been under consideration for 15 years and has yet to achieve environmental clearance or identify a funding strategy. Considering the limited truck activity in much of Orange County and limited right-of-way for freeway widening, a truck only toll lane concept is an unlikely strategy for OCTA to consider.

[31] https://www.fhwa.dot.gov/publications/publicroads/05sep/02.cfm

[32] https://www.fhwa.dot.gov/publications/publicroads/05sep/02.cfm

[33] http://fleetowner.com/driver-management-resource-center/platooning-closer-you-think-just-trucks

SUMMARY OF EMERGING TRENDS AND GOODS MOVEMENT IMPLICATIONS FOR ORANGE COUNTY

Several emerging trends were identified in this report as listed in the previous section of this document. **Table E-8** shows a summary of the goods movement implications resulting from the emerging trends. Each emerging trend is related to a stakeholder who is the source of the trend. Each goods movement implication is shown either as an opportunity or as a challenge. On a few occasions, the direction of change is unclear, so it could either be an opportunity or a challenge. The goods movement opportunities and challenges that result from the emerging trends are classified into categories of consumer, beneficial cargo owner (BCO), third party logistics company (3PL), capacity, operations, environment, or regulatory/policy.

Table E-8. Summary of Emerging Trends and Goods Movement Implications

		Goods Movement Implications (O = opportunity, C = challenge)						
Emerging Trend	**Related to**	**Public/Private - Consumer**	**Institutional - BCO**	**Institutional - 3PL**	**Public/Private - Capacity**	**Public/Private - Operations**	**Public - Environment**	**Public – Regulatory/ Policy**
Growth in population and per capita income	Consumer	(O) Improves standard of living and doing business by increasing consumption of higher cost and quality goods	(O) Promotes growth in retail trade sales of consumer goods	(O) Promotes growth in last mile delivery and other value added services of consumer goods	(C) Results in faster deterioration of transportation infrastructure; (C) Increases number and severity of highway and rail capacity bottlenecks	(C) Decreases average truck and train speeds; (C) Increases exposure to incidents (increases population density, vehicle miles traveled, auto-truck conflicts, etc.)	(O) Increases retail. Mfg, and logistics jobs, sales taxes and contribution to GDP; (C) Increases exposure to emission sources of all freight facilities (increases population density, trip generations at point sources, vehicle miles traveled, etc.); (C) Aging workforce population	(C) Increases land use conflicts; (C) Reduces affordability of residential, commercial and industrial space for development, purchase or rent, which may result in migration of younger and low-income workforce out of Orange County (C) May result in insufficient workforce for enforcement of law and regulations

		Goods Movement Implications						
Emerging Trend	**Related to**	**Public/Private - Consumer**	**Institutional - BCO**	**Institutional - 3PL**	**Public/Private - Capacity**	**Public/Private - Operations**	**Public - Environment**	**Public – Regulatory/ Policy**
Growth in imported goods	Beneficial Cargo Owner (BCO)	(O) Maintains cost-effectiveness (cost divided by quality) of goods consumed	(O) Promotes growth in retail trade sales of imported goods	(O) Promotes growth in last mile delivery and other value added services of imported goods, including transloading	(O) May result in development of inland logistics facilities (C) Constrained by maximum practical capacity of roadways, railways, ports, airports, border crossings, intermodal yards, and DCs and warehouses in and near Orange County, which may result in changes in goods movement pattern that increase average truck trip length	(O) Increases use of larger ships for economies of scale; (C) May increase empty truck movements due to increase in trade imbalance; (C) Increases access times to international trade related logistics facilities due to increase in average truck trip length, reduction in average drayage truck speeds and increased queuing at logistics facility	(O) Increases international trade jobs, duties and fees, taxes and contribution to GDP; (C) Increases exposure to emission sources of international trade related logistics facilities; (C) Aging truck driver population	(C) Constrained by industrial land availability; (C) Constrained by environment-al clearances on international trade related logistics facilities expansion pro-jects, air quality regulations of state and South Coast AQMD, air quality plans and programs of regional MPO (SCAG), Orange County and cities, ports and their drayage trucks, and MOUs between state and railroads; (C) Constrained by city and county ordinances (weight limits, hours of service limits, etc.)

		Goods Movement Implications						
Emerging Trend	**Related to**	**Public/Private - Consumer**	**Institutional - BCO**	**Institutional - 3PL**	**Public/Private - Capacity**	**Public/Private - Operations**	**Public - Environment**	**Public – Regulatory/ Policy**
Growth in manufacturing and export trade jobs	BCO	(O) Reduces cycle time between order placement and delivery of goods consumed	(O) Promotes growth in retail trade sales of manufactured goods and export revenue	(O) Promotes growth in value added services of manufactured goods (packaging, labeling, etc.)	(O) May result in development of new industry clusters or expansion of existing industry clusters; (C) Constrained by maximum practical capacity of roadways, railways, ports, airports, border crossings, intermodal yards, and DCs and warehouses in and near Orange County, which may result in changes in goods movement pattern that increase average truck trip length	(O) Increases use of larger ships for economies of scale; (C) May reduce empty truck movements due to decrease in trade imbalance; (C) Increases access times to international trade related logistics facilities due to increase in average truck trip length, reduction in average drayage truck speeds and increased queuing at logistics facility	(O) Increases international trade jobs, duties and fees, taxes and contribution to GDP; (C) Increases exposure to emission sources of international trade related logistics facilities; (C) Aging truck driver population	(C) Constrained by industrial land availability; (C) Constrained by environment-al clearances on international trade related logistics facilities expansion projects, air quality regulations of state and South Coast AQMD, air quality plans and programs of regional MPO (SCAG), Orange County and cities, ports and their drayage trucks, and MOUs between state and railroads; (C) Constrained by city and county ordinances (weight limits, hours of service limits, etc.)

		Goods Movement Implications						
Emerging Trend	**Related to**	**Public/Private - Consumer**	**Institutional - BCO**	**Institutional - 3PL**	**Public/Private - Capacity**	**Public/Private - Operations**	**Public - Environment**	**Public – Regulatory/ Policy**
Increased use of advanced manufacturing processes and services	BCO/3PL	(O) Increases quality of existing manufactured goods and introduces innovative manufactured products (O) Increases speed to market and customization options	(O) Reduces manufacturing costs by increasing production efficiency, reducing high-valued imported production inputs while increasing low-valued imported production inputs; (O) Increases average value and export revenue per manufactured good sold	(O) Increase in high-tech value addition services of manufactured goods (3D printing, product testing, etc.)	(O) May support development of new industry clusters or expansion of existing industry clusters	(O/C) Changes in capacity of international trade related logistics facilities are expected due to changes in types of imported production inputs	(O) Increases advanced manufacturing related jobs, taxes and contribution to GDP (O) Reduces waste from production; reduces trips by consolidating mfg., storage, and distribution under one roof, thus resulting in emissions reductions	(O) Wage increases (C) Gaps in educational attainment of workforce and skills required for advanced manufacturing jobs (C) Patenting of advanced manufacturing processes and services is needed (O) Potential for increase in sales tax revenue if paired with fulfillment center

		Goods Movement Implications						
Emerging Trend	**Related to**	**Public/Private - Consumer**	**Institutional - BCO**	**Institutional - 3PL**	**Public/Private - Capacity**	**Public/Private - Operations**	**Public - Environment**	**Public – Regulatory/ Policy**
Increased online shopping (e-commerce) and advancement of omnichannel retailing, warehouse inventory and fulfillment software solutions, and automation	Consumer	(O) Reduces cost per good consumed by increasing shopping choice and introducing more price competition; (O) Increases convenience in shopping and product can be customized	(C) To remain competitive, BCOs need to adapt supply chains to meet progressive millennial and modern business customer requirements (omnichannel retailing customer experience, "same day" fulfillment, etc.), which requires capital investment and operational and maintenance cost (O) Investments in automation and software solutions result in lower labor requirements	(C) To remain competitive, 3PLs need to adapt logistics to meet progressive millennial and modern business customer requirements ("same day" fulfillment, etc.), which requires capital investment and operational and maintenance cost (O) Investments in automation and software solutions result in lower labor requirements	(O/C) Operational changes may result in changes in Capacity (O) Automation allows more goods to be stored and processed within a smaller footprint	(O/C) Shift from in-store shopping to online shopping for home delivery or in-store pickup would shift trips from many auto to a truck under home delivery, and also may change trip purposes and times under in-store pickup (e.g., a home-shop-home trip on a weekend may be replaced by a tour type home-work-shop-home trip on a weekday); (C) May increase auto-truck conflicts within local community	(O) Increases e-commerce trade jobs, taxes and contribution to GDP; (O/C) Increases high-tech jobs but reduces blue-collar jobs (O/C) Increases exposure to emissions of home delivery trucks dispatched from store/warehouse while reducing exposure to emissions of many autos making a trip to store; new delivery techniques employing autos to make multiple deliveries within a single neighborhood may reduce overall trips	(C) Constrained by city and county ordinances (zoning regulations, truck restrictions), and often limited by community opposition to the development of major logistics facilities (C) Regulated by local sales tax measures (C) Gaps in educational attainment of workforce and skills required for advanced manufacturing jobs

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Improved last mile delivery systems and software solutions	Mostly 3PL	(O) Improves reliability and meets customer requirements ("same day" fulfillment, etc.)	(O) Promotes growth in retail trade sales of consumer goods; (C) When using in-house vehicle fleet for last mile delivery, requires capital investment for developing and equipping vehicles with software solution (O) Use of third party owner-operators	(O) Promotes growth in revenue from last mile delivery services of consumer goods (C) Requires capital investment for developing and equipping vehicles with software solution and managing in-house system (O) Improves delivery efficiency	(O/C) Depending on vehicle technology used, this may constrain or free up capacity on local streets	(O/C) Depending on vehicle technology used, this may increase or reduce auto-truck conflicts within local community	(O/C) Depending on vehicle technology used, this may increase or reduce exposure to emissions for local community (O) Use of third party owner-operators could result in less VMT and emissions	(O) Use of third party owner-operators could result in less VMT and associated roadway operation and maintenance costs

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Development of truck service facilities and software solutions	Private Developer, Private Operator	None	(O) When using in-house vehicle fleet, helps more effectively meet hours of service regulation, truck repair needs and ensure truck driver safety (C) When using in-house vehicle fleet, requires capital investment for installation of off-the-shelf software solutions on vehicles and at fleet center, and possibly a small operational and maintenance cost	(O) Provides better utilization and eases compliance with hours of service regulation, truck repair needs and ensure truck driver safety (C) Requires capital investment for installation of off-the-shelf software solutions on vehicles and at fleet center, and possibly a small operational and maintenance cost	(O) Increases number of facilities that can service trucks	(O) Increases convenience in locating truck service facilities en-route; (O) Ensures truck driver safety; (C) Increases auto-truck conflicts within local community	(O) Increase in jobs, taxes and contribution to GDP associated with development and maintenance of truck service facilities; (C) Increases exposure to emissions for local community	(C) Constrained by commercial land availability; (O) Compliance with Jason's Law; (C) Constrained by city and county ordinances (zoning and truck prohibitions) and community support for use (O) Reduce illegal truck parking and reduce truck VMT by providing real-time solutions

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Development of alternative fuel truck technology and support infrastructure	Private Developer, Private Operator, Public Regulator	(O) Infra-structure can support both public and private users thus increasing opportunities for the public to own and operate more fuel efficient vehicles	(O) Increases fuel efficiency and reduces operating costs (O) Assists companies in meeting sustainability goals and obtaining green business certification (SmartWay) (O) When using in-house vehicle fleet, reduces operating costs due to fuel savings; electric vehicles also reduce main-tenance costs (C) Cost of alternative fuel vehicles – typically 2-3 times as much as a standard diesel truck; cost of fueling infrastructure; cost of reliability issues	(O) Increases fuel efficiency and reduces operating costs (C) Increasingly becoming a requirement of BCOs per their sustainability goals (O) Provides SmartWay certification option (O) When using in-house vehicle fleet, reduces operating costs due to fuel savings; electric vehicles also reduce maintenance costs (C) Cost of alternative fuel vehicles – typically 2-3 times as much as a standard diesel truck; cost of fueling infrastructure; cost of reliability issues	(O) Increases number of retail facilities for alternate fuels that have truck access	(O) Increases convenience in locating truck service facilities en-route; (O) Ensures truck driver safety; (O/C) Improved public and private access to more alternative fueling locations increases options, but may also increase auto/truck conflicts	(O/C) Sales tax revenue could be impacted (O) Decreases exposure to emissions for operating region	(C) Constrained by commercial land availability; (C) Constrained by city and county ordinances (zoning and truck prohibitions), as well as community concerns about the storage and dispensing of certain alternative fuel types (C) Meeting federal, State and AQMD air quality standards

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Development of truck platooning technology	Private Vendor, Private Operator, Public Regulator	(O) Improves fuel efficiency and safety	(O) Reduces vehicle operating cost by reducing fuel consumption for platooned trucks due to reduced air friction of following trucks (C) When using in-house vehicle fleet, requires installation of truck platooning technology, and an operational and mainte-nance cost associated with the technology; (C) When using in-house vehicle fleet, unwilling-ness to platoon with competitor BCO could be a barrier	(O) Reduces vehicle operating cost by reducing fuel consumption for platooned trucks due to reduced air friction of following trucks; (C) Requires installation of truck platooning technology, and an operational and maintenance cost associated with the technology; (C) Unwillingness to platoon with competitor 3PL can be a barrier	(O) Increases highway capacity by reducing space occupied by trucks (C) Driver comfort (both platooned trucks and mixed-flow traffic) has yet to be determined	(O) Ensures truck driver safety by reducing fatigue and cargo safety during platooning; allows for simultaneous braking of the platooned trucks (C) Truck driver behavior during platooning and training requirements are still being tested; (C) Auto driver behavior and ability to perform standard driver maneuvers around platooned trucks are still being tested	(O) Decreases exposure to emissions for operating region	(C) Constrained by Federal Motor Carrier Safety Administration (FMCSA) regulations and the California Vehicle Code; (C) Governed by data communication, platooning, training and maintenance protocols (C) Insurance requirements

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Development of truck only toll (TOT) use infrastructure	Public Developer, Private Operator, Public Regulator	(O) Improves reliability of goods delivery	(O) Improves reliability of goods delivery and make region's BCOs more competitive than other region BCOs; (C) Toll amount may need to be paid either directly or as a surcharge fee to 3PL	(O) Improves reliability of goods delivery and make region's 3PLs more competitive than other region 3PLs; (C) Toll amount may need to be paid either directly or collected as a surcharge fee from BCO	(O) Enhances highway capacity by introducing new truck lanes (O) Improves safety by reducing potential auto and truck conflicts on mainline (O) Reduces mainline congestion	(O) Enhances auto and truck speeds due to additional lanes; (O) Ensures truck driver safety as the speeds on truck lanes are relatively more uniform than general purpose lane with auto and trucks; (O) Eliminates auto-truck conflicts on truck only use corridor	(O) Decreases emissions as auto and truck speeds improve (C) Increases emissions by providing additional capacity (O) Restricting TOT lanes to clean trucks would reduce emissions	(C) Substantial cost and ROW requirements; environmental approval process; (C) Requires creation of a toll authority

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Development of multimodal freight solutions	Private Developer, Private Operator, Public Regulator	(O) Maintains cost-effectiveness (cost divided by quality) of goods consumed	(O) Reduces transportation cost per for good sold by increasing mode choice and introducing more price competition	(C) To remain competitive, 3PLs need to adapt logistics to meet BCO requirements	(O) Enhances freight handling capacity by introducing mode choice; (C) Constrained by maximum practical capacity of modes	(O) Introduces redundancy in goods distribution and last mile delivery system; (O) May provide ability to avoid capacity bottlenecks and incident hotspots	(O) Increase in jobs, taxes and contribution to GDP associated with a capital investment in modes (e.g., rail spur, rail cars) and an operational and maintenance cost associated with the modal investment (O) Decreases emissions with use of more energy-efficient modes such as rail for longer haul;	(C) Constrained by industrial land availability; (C) Constrained by city and county ordinances (weight limits, hours of service limits, etc.); (C) Gaps in educational attainment of workforce and skills required for multimodal freight solutions;

Source: Cambridge Systematic