TRANSPORTATION SYSTEM

GOODS MOVEMENT

SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS

2016 2040 RTPSCS

APPENDIX

ADOPTED | APRIL 2016

2016 2040 RTPSCS

APPENDIX

TRANSPORTATION SYSTEM | GOODS MOVEMENT

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GOODS MOVEMENT

SYSTEM VISION

Our region's transportation network for moving goods, referred to as our "goods movement" system, relies on a complex infrastructure that supports multiple modes of transportation. This system includes deep-water marine ports, international border crossings, Class I rail lines, interstate highways, state routes and local connector roads, air cargo facilities, intermodal facilities and distribution and warehousing centers.

With rising consumer demand for multiple shopping options, faster order replenishment and inexpensive or free two-way shipping costs, holistic supply chain strategies supported by a reliable transportation network are critical. Supply chain strategies are becoming increasingly complex and imposing greater demands on our transportation system. Collaborative planning is critical in this emerging environment and to this end, the Southern California Association of Governments (SCAG) continues to support the vision for the region's goods movement system established in coordination with our public and private sector industry partners.

> SCAG supports a world-class, coordinated Southern California goods movement system that accommodates growth in the throughput of freight to the region and nation in ways that support the region's economic vitality, attainment of clean air standards and the quality of life for our communities.

This vision continues to promote the improvement of the goods movement system in order to:

- Maintain the long-term economic competitiveness of the region
- Promote local and regional job creation and retention
- Increase freight and passenger mobility
- Improve the safety of goods movement activities
- Mitigate environmental impacts of goods movement operations

In support of this vision, the 2016 RTP/SCS describes a goods movement system with regional initiatives and projects totaling about $71 billion through 2040. This Plan includes key initiatives identified in past RTPs, namely a comprehensive system of zero- and near zero-emission freight corridors, alleviation of major bottlenecks, a rail corridor improvement package and an environmental strategy to address emissions through both near-term initiatives and a long-term action plan for technology advancement.

This Goods Movement Appendix provides an overview of our regional goods movement system, describing key components and how they work together to support commerce and our economy. The following section describes critical markets served, and how these markets depend on our transportation infrastructure. The final section identifies regional strategies and initiatives, including an action plan to support the development and commercialization of technologies necessary for a zero and near-zero emissions goods movement system.

THE REGIONAL GOODS MOVEMENT SYSTEM

The goods movement system in the SCAG region is comprised interconnected infrastructure components designed to serve commercial activities spurred by regional, national and global demand. This goods movement system provides the backbone for the flow of goods between businesses and consumers. Numerous demand factors (e.g., types of products, destinations, urgency, costs, etc.) create unique markets that must be accommodated by varying types of goods movement activities. Markets in the SCAG region range from origins like local manufacturing companies and the San Pedro Bay Ports to business and customers across the U.S. These markets depend on an extensive regional transportation network that provides the mobility and speed necessary to support economic growth. These mobility needs, coupled with air quality, environmental and community challenges posed by regional goods movement activities, serve as the rationale for developing a comprehensive plan to enhance the regional freight system.

COMPONENTS OF THE REGIONAL GOODS MOVEMENT SYSTEM

EXHIBIT 1 depicts the region's multimodal goods movement system, which is comprised of the following major elements:

- **Seaports (Ports of Los Angeles, Long Beach and Hueneme):** Serving as the largest container port complex in the U.S., the Ports of Los Angeles and Long Beach (together called the San Pedro Bay Ports) handled about 117 million metric tons of imports and exports in 2014 – for a total value of goods at about $395.7 billion.[1] The Port of Hueneme, in Ventura County, specializes in the import and export of automobiles and produce, and serves as the primary support facility for the offshore oil industry. In 2014, two-way trade activities through the Port of Hueneme were valued at nearly $9.2 billion and generated $1.1 billion in economic activities in the immediate region.[2]

- **Land Ports:** The international border crossings in Imperial County are busy commercial land ports; they were responsible for more than $8 billion in imports and $6 billion in exports in 2014. This cross-border commerce was driven by the maquiladora trade, as well as the movement of agricultural products.
- **Air Cargo Facilities:** 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 $96 billion[3], in 2014.
- **Class I Railroads:** Critical to the growth of the region's economy, the Burlington Northern Santa Fe Railway (BNSF) and Union Pacific (UP) carry international and domestic cargo to and from distant parts of the country. The BNSF mainline operates on the Transcontinental Line (Cajon and San Bernardino Subdivisions). The UP operates on the Coast Line, Saugus Line through Santa Clarita, Alhambra and LA Subdivisions, and Yuma Subdivision to El Paso. Both railroads operate on the Alameda Corridor that connects directly to the San Pedro Bay Ports. The San Pedro Bay Ports also provide several on-dock rail terminals along with the six major intermodal terminals operated by the BNSF and UP. The SCAG region also has Class III railroads (Pacific Harbor Line, Los Angeles Junction Railway and the Ventura County Railway) that provide short-haul services.
- **Warehouse and Distribution Centers:** In 2014, the region had close to 1.2 billion square feet of facility space for warehousing, distribution, cold storage and truck terminals.[4] Nearly 750 million square feet of this space, or 4,900 buildings, were facilities that are larger than 50,000 square feet. An estimated ten percent of the occupied warehouse space served port-related uses, while the remaining 90 percent supported domestic shippers.[5] Many of these warehouses are clustered along key goods movement corridors (**EXHIBIT 1**). Port-related warehousing is concentrated in the Gateway Cities subregion, while national and regional distribution facilities tend to be located in the Inland Empire.
- **Interstate, Highways and Local Roads:** Our region has about 70,000 lane miles of roadways.[6] Sections of I-710, I-605, SR-60 and SR-91, which carry the highest volumes of truck traffic in the region, averaged more than 25,000 trucks per day in 2013. Other major components of the regional highway network also serve significant numbers of trucks. These include I-5, I-10, I-15 and I-210. More than 20,000 trucks per day travel on some sections. These roads carry a mix of cargo loads, including local, domestic and international. The arterial roadway system also plays a critical role in goods movement, providing first and last-mile connections to regional ports, manufacturing facilities, intermodal terminals, warehousing and distribution centers and retail outlets.
- **Primary Highway Freight System:** With the recent passage of the Fixing America's Surface Transportation (FAST) Act, the Primary Highway Freight System (PHFS) is designated, using a 41,000 mile highway network. Within the SCAG region, about 1,477.33 miles of highways are designated as a part of the PHFS, with Los Angeles and San Bernardino Counties accounting for about 60 percent of the total coverage. **TABLE 1** shows the breakdown of the miles by county within the SCAG region.

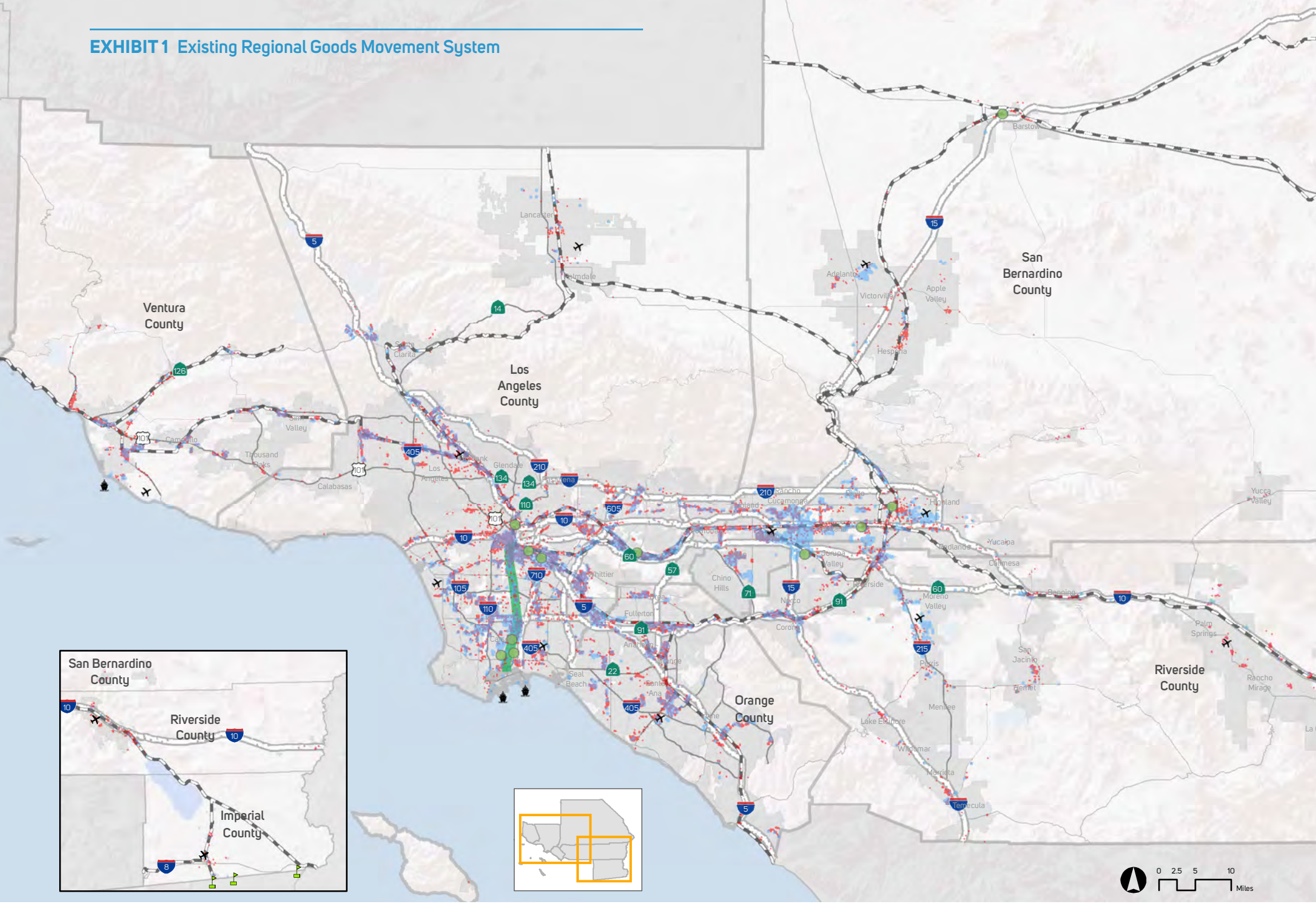
EXHIBIT 2 shows the location of both the PHFS coverage within the SCAG region.

TABLE 1 Primary Highway Freight System-Southern California Summary

County	Total Miles of Primary Freight Network	% Share
Imperial	77.74	5.3%
Los Angeles	460.81	31.2%
Orange	126.21	8.5%
Riverside	312.72	21.2%
San Bernardino	446.88	30.2%
Ventura	52.97	3.6%
Total	1,477.33	100.0%

Source: U.S. Department of Transportation
Note: Does not include "Other Interstate" portions not on the PHFS, Critical Rural Freight Corridors (CRFCs), nor Critical Urban Freight Corridors (CUFCs).

EXHIBIT 1 Existing Regional Goods Movement System



Ports
Ports of Entry
Major Airports
Intermodal Facilities

Routes
Major Freight Highway Corridors
Main Line Rail Network
Alameda Corridor

Warehouses
>= 50,000 sq ft
< 50,000 sq ft

(Source: SCAG, CoStar Realty Information Inc.)

EXHIBIT 2 Primary Highway Freight System

Primary Highway Freight System

Source: U.S. Department of Transportation *Note: Does not include "Other Interstate" portions not on the PHFS, Critical Rural Freight Corridors (CRFCs), nor Critical Urban Freight Corridors (CUFCs).*

THE SUPPLY CHAIN SYSTEM AND SOUTHERN CALIFORNIA

Supply chains generally refer to end-to-end processes, starting from product demand forecasting and production planning, material sourcing, manufacturing and product delivery to intermediate nodes such as distribution centers and warehouses to consumption nodes such as stores. While supply chains encompass end-to-end processes, logistics involves the management of inventory, whether goods are in transit or stored in warehouses. The simplest definition of logistics is the flow of funds, goods and information between source and consumer. If logistics doesn't flow, then the supply chain does not function.[7]

Businesses are continuously evaluating their supply chain strategies. Generally, functional products with steady demand, long product life and low profit margins (e.g., daily items such as toilet paper, canned foods, general purpose nails and screws) require efficient supply chains to minimize inventory and transportation cost. Innovative products with high demand uncertainties, high inventory cost, high seasonality and high profit margins (e.g., latest model of digital printers, high fashion items, seasonal furniture) require responsive supply chains to ensure that the products are available at the right time and in the right quantities. Further, businesses factor in supply chain trade-offs (i.e., making choices to accept less of one thing in order to receive more of something else).

There are several prominent forces that have facilitated the rapid globalization of supply chains in the last couple of decades. These include national GDP growth rates of foreign countries, the availability of skilled labor in different parts of the world, advanced technology, trade policies, and political and economic factors. The force of rapid globalization and information technology have raised the importance of international gateways as consumers demand faster order fulfillment and companies promise to deliver through their sophisticated global supply chains. Southern California is a key global trade gateway as many trade routes are connected through SCAG's regional transportation system to the rest of the nation and the world.

GOODS MOVEMENT-DEPENDENT INDUSTRIES

All industries depend on reliable and efficient transportation services to meet their business objectives. Understanding the impacts and linkages between improvements in the transportation system and supply chains for key goods movement-dependent businesses is critical for making decisions to support the regional economy. Goods movement-dependent industries are defined as industries that operate frequent inbound and outbound freight vehicle trips and costs associated with goods movement have sizable impact on their business expenses. Key industries include construction, manufacturing, wholesale trade, retail trade, and transportation and warehousing.

As a premier global trade gateway to the U.S., Southern California boasts high concentrations of goods movement-dependent industries, with each industry contributing considerably to the overall regional GDP and employment (**TABLE 2**). In 2014, the SCAG region's goods movement-dependent industries collectively generated close to three million jobs, which is 33 percent of the region's total number of jobs. These industries also contributed $291 billion, or 35 percent of the regional GDP in the same year. Among all goods movement-dependent industries, retail trade generated the highest number of jobs at 985,000, or 11 percent of the regional total, followed by manufacturing at 702,000 jobs or eight percent of the regional total. In terms of GDP, manufacturing contributed the most at $107 billion, or 13 percent, of the regional total, followed by the wholesale trade at $58 billion, or seven percent of the regional total.

TABLE 2 Regional Employment and GDP Contribution of Key Goods Movement-Dependent Industries (2014)

Key Industries	Jobs (in Thousands)	% Share of Total	GDP (in Billions)	% Share of Total
Construction	437	5%	$29	3%
Manufacturing	702	8%	$107	13%
Wholesale Trade	461	5%	$58	7%
Retail Trade	985	11%	$54	7%
Transportation and Warehousing	332	4%	$23	3%
Other Goods Producing	82	1%	$21	3%
All Goods Movement Dependent Industries	2,999	33%	$291	35%
All Sectors	9,069		$820	

Source: Regional Economic Models, Inc. TranSight SCAG, CA, US v3.6.5
Note: Numbers may not sum to total due to rounding.

MANUFACTURING SECTOR IN THE SCAG REGION

While the overall national trend in the number of manufacturing establishments has been declining, the SCAG region remains the second largest manufacturing center in the nation, after the state of California (**FIGURE 1**).[8]

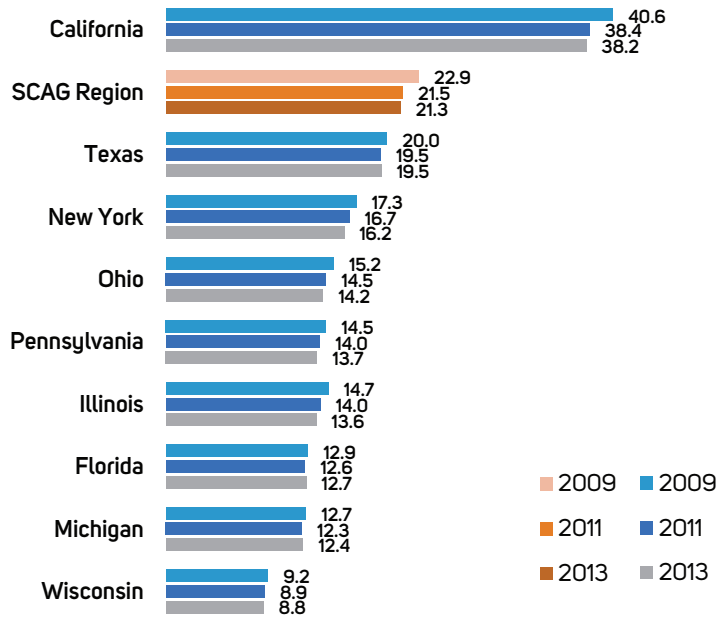
The top five manufacturing sectors in the SCAG region in terms of the number of establishments include fabricated metal product manufacturing, apparel manufacturing, food manufacturing[9] and printing and related support activities.[10] In 2013, the manufacturing sector generated over $34 billion in payroll. Contributing 13 percent to the regional GDP and generating eight percent of the region's employment, manufacturing still plays an important role in the SCAG region's economy.

The regional manufacturing sector relies heavily on truck transportation, followed by rail transportation. In 2014, the manufacturing sector spent over $2.25 billion on truck transportation, a 68 percent share of total direct transportation expenditures (**TABLE 3**). This is evident as many of the manufacturing facilities in the SCAG region are strategically located near major transportation corridors (**EXHIBIT 3**). This is a highly specialized and segmented industry, where a number of manufacturers individually handle various stages of production before products become finished goods. As a result, semi-finished goods are moved between plants via trucks, especially if the plants are located within or near the SCAG region. As discussed in the next section, the SCAG region's manufacturing industries have complementary relationships with a number of manufacturers in Mexico, including maquiladoras along the Baja California border. The distance between the SCAG region and Mexico makes truck transportation the most desirable mode of transportation.

MANUFACTURING, NEAR-SHORING AND RE-SHORING

Manufacturing is expected to remain critical to the regional economy for the foreseeable future. This is largely due to the synergy created by increasing manufacturing activities in Mexico, especially in Baja California. Since 2007, Mexico has invested nearly $40 billion on transportation infrastructure to significantly improve the quality and increase the capacity of its multi-modal transportation system. The country generates approximately three times more engineering graduates each year as compared to the U.S. Mexico's strategic decision to shift its manufacturing sector make-up two decades ago has resulted in a major shift from commodity manufacturing to high-tech manufacturing. As a result, Mexico's industry cluster today includes manufacturing of vehicles, automotive parts, aerospace components, white goods (washers, dryers, refrigerators, etc.), electronics (cell phones and other small electronic devices), medical devices and pharmaceuticals.[11]

FIGURE 1 Total Number of Manufacturing Establishments (in Thousands)



Source: U.S. Census County Business Patterns

TABLE 3 Expenditures on Transportation by Manufacturing Industries (2014) (Direct inputs)

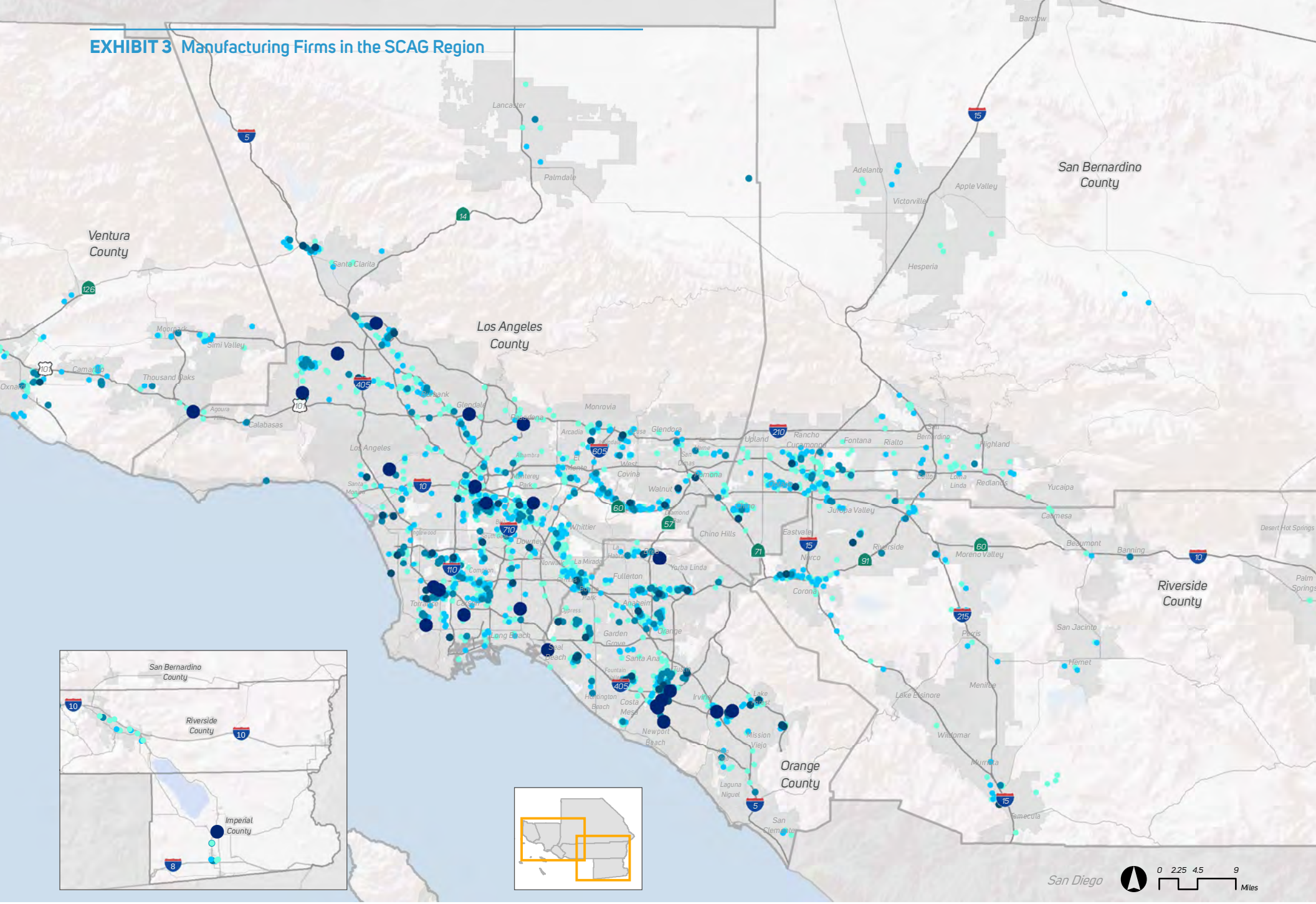
Transportation Mode	Spending on Different Transportation Modes	
	Millions of Dollars	Percent of Total
Air transportation	$211	6%
Rail transportation	$424	13%
Water transportation	$125	4%
Truck transportation	$2,252	68%
Warehousing and storage	$166	5%
Other*	$113	3%
Total	$3,291	100%

** Other includes "Transit and ground passenger transportation", "Pipeline Transportation", "Other transportation and support activities" and "Household production of transportation services"*

Source: REMI TranSight for SCAG v3.7.6 and the Transportation Satellite Accounts Commodity-by-Industry Direct Requirements (2012)

Note: Numbers may not sum to total due to rounding.

EXHIBIT 3 Manufacturing Firms in the SCAG Region



Manufacturing Firms by Total Employment

- <=50
- 51 - 100
- 101 - 250
- 251 - 500
- 501 - 1,000
- 1,001 - 3,000

Source: InfoGroup 2011

Many of the goods manufactured at plants in the SCAG region and Mexico are semi-finished goods that receive further modifications and refinements before being transported to warehouses and distribution centers. Similarities in manufacturing commodities are observed in the types of manufacturing establishments that exist in the SCAG region and Mexico. These include transportation equipment, computer and electronic products, electrical equipment, appliances, and components and machinery.[12] The similarities in commodities indicate that complementary manufacturing processes take place with Mexico. Often, semi-finished products are moved across the border several times, each time getting closer to finished products, before being shipped to final destinations in the U.S. for consumption. This synthesized manufacturing system is expected to continue as more businesses observe the benefits of near-shoring.

While outsourcing and off-shoring of manufacturing still dominate the current industry practice, some multi-national corporations such as General Electric and Caterpillar are re-shoring jobs to the U.S. The types of products that lend themselves to re-shoring, however, are relatively limited. These include electrical equipment, appliances, transportation equipment, computers and electronics, plastics and rubber products, fabricated metal products and machinery. Top decision drivers for companies to re-shore include [13]:

- Reduce time-to-market (73.7 percent);
- Reduce cost (63.9 percent);
- Improve product quality (62.2 percent);
- Gain more control (56.8 percent);
- Reduce hidden supply chain management costs (51.4 percent); and
- Protect intellectual property (48.5 percent).

RETAIL SUPPLY CHAINS

Retail trade includes a wide variety of subsectors including motor vehicles, furniture, electronics and appliances, building materials, health and personal care products, clothing, sporting goods and books. The retail industry supported nearly $30 billion in wages and salaries in 2014.[14] In general, retail industries are heavily dependent on international trade to receive materials and products, usually through containerized cargo imported through the San Pedro Bay Ports. This industry is also heavily reliant on Southern California's freight transportation systems to ensure products are available at stores as well as for the delivery of goods via online shopping.

Similar to the manufacturing sector, the direct transportation expenditures by the SCAG region's retail industry exhibit the industry's heavy reliance on truck transportation. Compared to the manufacturing sector, however, the retail industry spends significantly more on transportation services. In 2014, the regional GDP was almost $107 billion for manufacturing and $54 billion for retail (**TABLE 2**). While total direct transportation expenditure for manufacturing sector was $3.3 billion (three percent of the SCAG region manufacturing GDP), the retail sector's direct expenditure was $5.6 billion (ten percent of the SCAG region retail GDP) (**TABLE 3 & 4**). This indicates that a reliable transportation system is critical to the SCAG region's retail industry.

KEY FUNCTIONS AND MARKETS

The freight transportation system in the SCAG region serves a wide range of user markets with unique performance needs that dictate the components of the system that they will use. The following provides a summary of international, domestic and local trade markets and associated transportation system needs.

INTERNATIONAL TRADE

The SCAG region is the largest international trade gateway in the U.S. with trade moving through the San Pedro Bay Ports, international land border crossings with Mexico and regional airports. This international trade is supported by an extensive transportation system that includes a highly developed network of roadways and railways, air cargo facilities, intermodal facilities and an abundance of regional distribution and warehousing clusters. While the SCAG region has made great strides in building infrastructure and planning for the future, continued investment is needed to support commerce and economic growth.

TABLE 4 Transportation Expenditures by Retail Industry (2014) (Direct inputs)

Transportation Mode	Transportation Spending	
	In Millions	Percent of Total
Air transportation	$65.1	1%
Rail transportation	$7.8	0%
Water transportation	$2.8	0%
Truck transportation	$3,290.8	59%
Warehousing and storage	$1,524.0	27%
Other*	$709.2	13%
Total	$5,599.6	100%

** Other includes "Transit and ground passenger transportation", "Pipeline Transportation", "Other transportation and support activities" and "Household production of transportation services"*

Source: REMI TranSight for SCAG v3.7.6 and the Transportation Satellite Accounts Commodity-by-Industry Direct Requirements (2012)

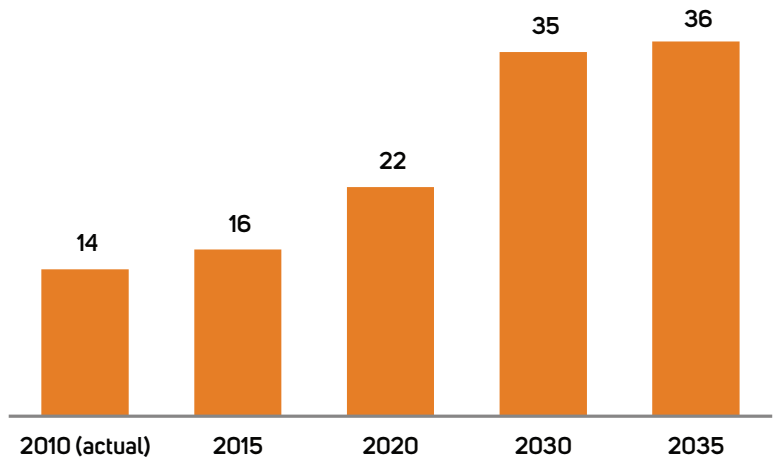
SAN PEDRO BAY PORTS

Containerized trade between the U.S. and Asia constitutes the majority of international cargo transiting the SCAG region, with over 32.5 percent of all containers in the U.S. moving through the San Pedro Bay Ports.[15] Despite some modest shifts recently in container volumes to other U.S., Canadian and Mexican ports, total container volume for the San Pedro Bay Ports is still expected to grow to 36 million by 2035, a 225 percent increase over the next two decades (**FIGURE 2**).

Imports, which constitute most of the containers that move through the San Pedro Bay Ports, may be categorized as local or discretionary. Local containerized traffic is that which is ultimately consumed in a geographical area local to the San Pedro Bay Ports (Southern California, Southern Nevada, Arizona and New Mexico and southern portions of Utah and Colorado). Discretionary containerized traffic is that which terminates outside this region. Recent analysis indicates that local traffic carrying containerized imports accounts for approximately 22-29 percent of San Pedro Bay Ports' total import-related traffic. The other 71-78 percent is assumed to be discretionary traffic, routed through the San Pedro Bay Ports for economic reasons.[16]

Beyond local or discretionary (outside of the region), imports can be further categorized as Direct, Transloaded, or Rail. When containers arrive at the San Pedro Bay Ports, the way they move is largely determined by final consumption points, inventory needs and transportation costs (see **FIGURE 3**).

FIGURE 2 San Pedro Bay Ports Container Volume Trend and Projections (Millions of TEUs)



Source: Port of Long Beach and Port of Los Angeles, based on thier Feb. 2015 forecats:

Transloading is broadly defined as activities that involve the deconsolidation of the contents of marine containers, which are usually 40-foot equivalent units (FEUs) and reloading of their contents into 53-foot domestic trailers that can be transported by trucks. Transloading allows for the movement of increased amounts of goods while utilizing less equipment, resulting in significant cost savings through economies of scale and other transportation-related savings. Transloading sometimes provides value-added services as well. Existing infrastructure, equipment and trade flows in the SCAG region provide a substantial competitive advantage and serve as a major economic incentive for importers to move freight requiring transloading through Southern California.

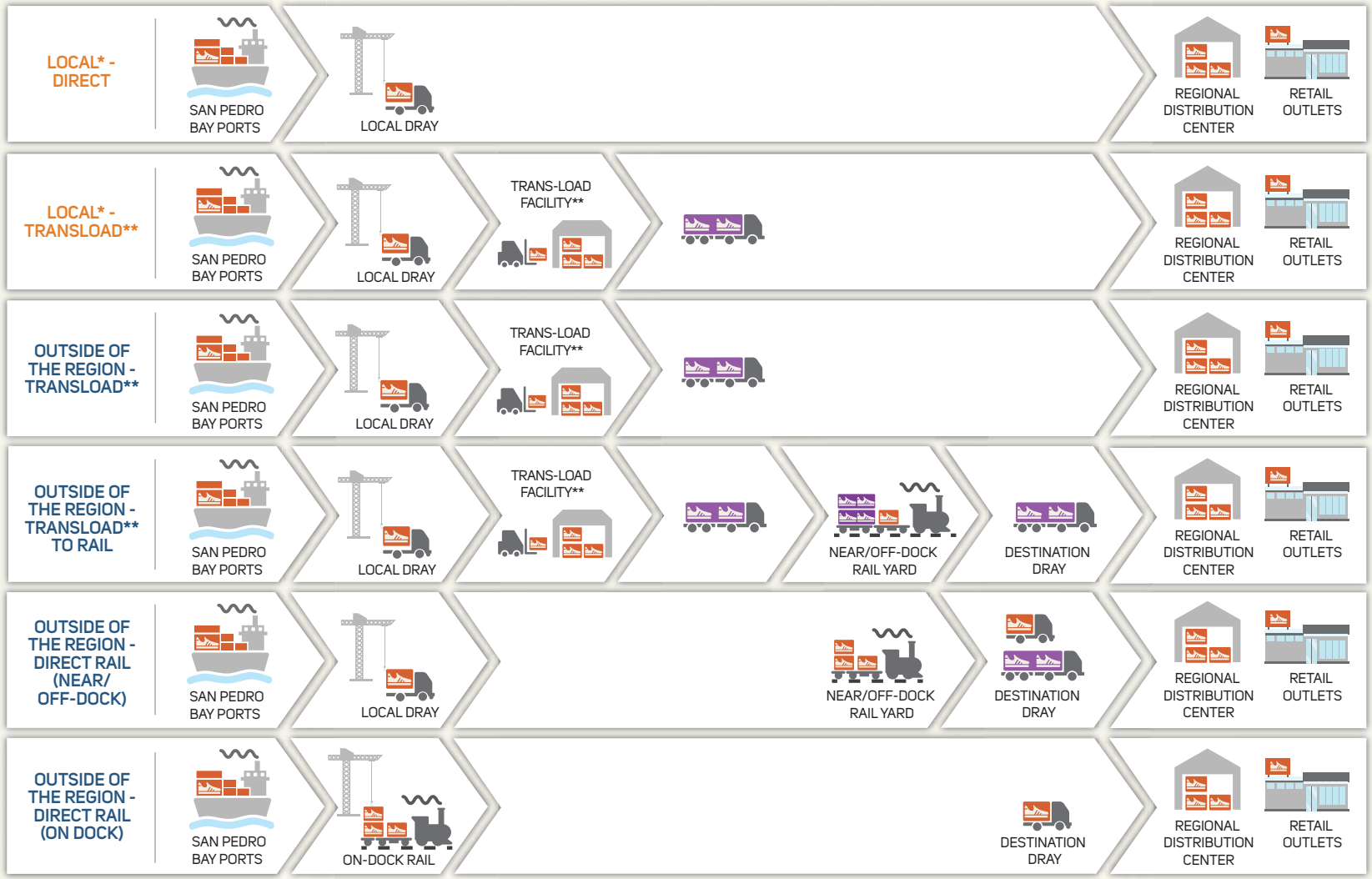
INTERNATIONAL BORDER CROSSINGS

International border crossings between the U.S. and Mexico are critical components of the freight transportation system in Southern California. Mexico remains the third-largest trading partner of the U.S. behind Canada and China, with a $534.5 billion trade volume in 2014, accounting for 13.5 percent of total U.S. foreign trade. It is also the largest market for exports of goods made in California, accounting for approximately $25.4 billion (or 12.4 percent) of California's overall exports in 2014. Most of the merchandise flows in the California-Baja California region are made by truck, supporting manufacturing and maquiladora industries that lie on the Mexican side of the international border.

Increased trade across the border has been bolstered by the existence of multiple free trade zones (FTZs). As a result of the associated tax savings and lower wages in Mexico, FTZs have been used by U.S. companies to export raw materials into Mexican manufacturing firms (maquiladoras), where goods are processed or assembled and then exported back in their finished state to the U.S.[17] The ability to transfer goods from one FTZ to another within Mexican territory without losing any of the fiscal incentives (tax savings) is slowly creating a logistics and manufacturing network of FTZs that is expected to boost Mexican foreign trade with the U.S.

As more businesses try to capitalize on the benefits of sourcing and manufacturing in Mexico, substantial impacts are expected on the transportation systems that service the border region and provide network connections to the trade nodes that have strong relationships with the border region i.e., the Inland Empire and the San Pedro Bay Ports. In order to assess the mobility of commerce at the Imperial County-Mexicali border and to develop freight planning strategies that address long term trade and transportation infrastructure needs in this border region, SCAG is analyzing the patterns and the efficiency of goods that move across the border. Although analysis is still underway, some key findings include the following: (i) projected cross-border goods movement volumes in future years suggest that roadway congestion levels will increase, partly due to cross-border activities; (ii) transportation infrastructure in the greater Los Angeles area (intermodal rail, ports, roadway

FIGURE 3 Import Container Flow by Mode, Handling Process, and Destination



* Geographical areas included in Local Market are Southern California, Southern Nevada, Arizona, New Mexico, and southern portions of Utah and Colorado for which the San Pedro Bay Ports serve as the closest container ports with the lowest land-side transportation costs.
** Transloading is broadly defined as activities that involve the deconsolidation of the contents of marine containers, which are usually forty-foot equivalent units (FEUs), and reloading of their contents into 53-foot domestic trailers. Transloading allows for the movement of increased amounts of goods while utilizing less equipment, resulting in transportation cost savings through economies of scale. Transloading sometimes provides value-added services as well.

LEGEND

MARINE (40 Feet in Length)

DOMESTIC (53 Feet in Length)

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network, air cargo facilities) and distribution facilities in the Inland Empire will continue to be critical in supporting the growth of manufacturing activities in Tijuana; (iii) the magnitude of the near-shoring trend and associated impacts on overall cross-border activities is yet to be determined; (iv) delays associated with land port of entry, especially for northbound finished goods, continue to be major concerns for companies on both sides of the border; and, (v) research & development, value engineering in certain manufacturing sectors like medical devices and components is providing additional opportunities for growth.

INTERNATIONAL AIR CARGO

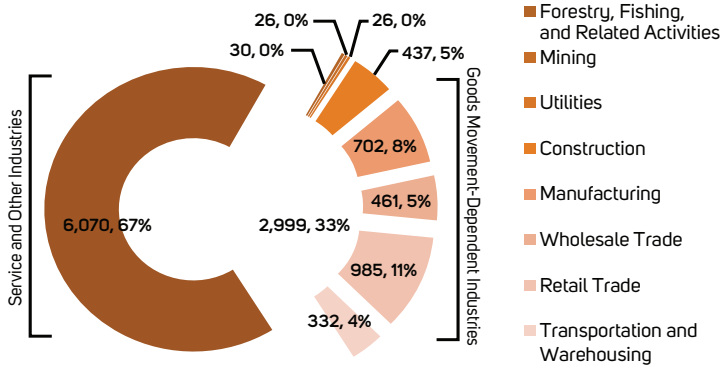
Los Angeles International Airport (LAX) handled over 897,000 metric tons of cargo in 2014, making it the seventh-busiest cargo airport in the United States and the 14th busiest in the world. Most often used for time-sensitive and higher-value goods, international air cargo plays a significant role in the regional economy, representing $96 billion in trade. Over 82 percent of the international air cargo at LAX is handled by scheduled passenger airlines or their cargo divisions that operate freighter aircraft. According to SCAG's recent air cargo forecast, air cargo activity has been declining over the past decade, with most of this decline confined to domestic air cargo. International air cargo, representing nearly 60 percent of tonnage handled, peaked in 2007, declined during the recession between 2007 through 2009 and is slowly recovering to pre-recession levels. As the regional economy continues its recovery from the recession, international air cargo at LAX is expected to grow by 1.9 percent annually within the next twenty years, totaling 3.0 million metric tons by 2040. Preparing for this growth will be a major challenge for LAX over the coming decades as the existing urban footprint may limit the ability to address warehousing and office requirements, aeronautical infrastructure needs, auto parking demands and other landside operational issues.

DOMESTIC AND LOCAL GOODS MOVEMENT

While the region is a major gateway for international containers, local and domestic freight is dominant. An overwhelming majority of goods movement activity in the SCAG region is generated by local businesses moving goods to local customers and serving national domestic trade systems. These local goods movement-dependent industries rely on transportation as a key part of their business model and generally utilize a more geographically dispersed transportation network than the international container market. About 85 percent of truck trips are associated with intra-regional goods movement. Domestic manufacturers, wholesalers and retailers also use the rail system and the air cargo system, though to a much more limited extent than international shippers.

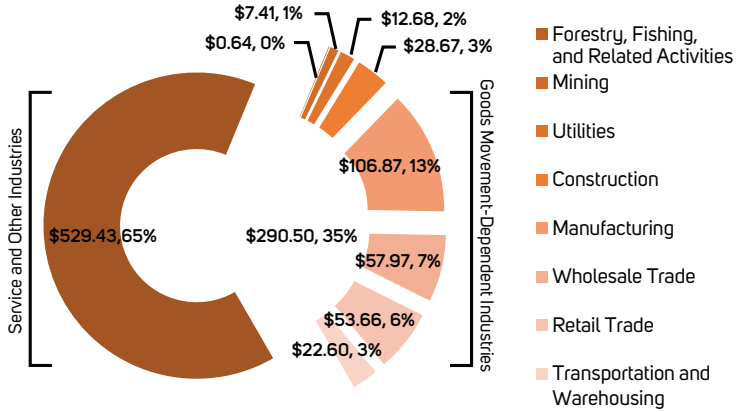
The regional transportation system provides the infrastructure to allow these businesses to ship and receive the materials necessary to perform daily operations. Examples include shipments of raw material to support manufacturing processes and the delivery of refined or finished products to market. Major goods movement-dependent industries include those related to the manufacturing, wholesale trade, construction, transportation and warehousing, and mining sectors.

FIGURE 4 2014 Employment Contribution of Goods Movement-Dependent Industries (in Thousands)



Source: REMI TranSight SCAG, CA, USv3.6.5.

FIGURE 5 2014 Economic Contribution of Goods Movement-Dependent Industries (in Billions)



Source: REMI TranSight SCAG, CA, USv3.6.5.

In 2014, local goods movement-dependent industries employed over 2.9 million people throughout the region (**FIGURE 4**) and contributed $291 billion to the regional GDP. (**FIGURE 5**). As shown in **FIGURE 6** these industries are projected to grow steadily through 2040.

Regional GDP is a broad indicator of the level and strength of economic activity in a region. In the long term, the region's GDP is projected to grow steadily through 2040 at a rate slightly faster than the U.S. economy as a whole. The region's total GDP was $820 billion in 2014 and is projected to top $1.45 trillion in 2040, growing at an average rate of 2.3 percent between these years. In comparison, the U.S. economy (U.S. GDP) is expected to grow at 2.4 percent annually during the same period.[18]

Mirroring national trends, this GDP growth is anticipated to be accompanied by an increasing transition toward a higher value-added manufacturing and service economy. The predicted highest-growth industry sectors from 2014 to 2040 include the manufacturing, wholesale trade and construction sectors—all of which are highly dependent on the regional freight transportation system. All three of these sectors will more than double in size over the next two decades and will contribute a combined $545 billion to regional GDP by 2040.

FIGURE 6 2014-2040 Average Real Annual Growth Rates by Major Goods Movement-Dependent Sectors

Source: REMI TranSight SCAG, CA, USv3.6.5.

TECHNOLOGY AND CONSUMER BEHAVIOR IMPACTING GOODS MOVEMENT

In 2014, the retail industry provided nearly $30 billion in wages and salaries for the region.[19] This industry includes a wide variety of subsectors including motor vehicles, furniture, electronics and appliances, building materials, health and personal care products, clothing, sporting goods, and books. In general, retail industries are heavily dependent on international trade to receive materials and products, usually through containerized cargo imported through the San Pedro Bay Ports.

One of the most notable changes in the retail industry is the strong growth in e-commerce. E-commerce sales for U.S. retailers were $261 billion in 2013, an increase of 13.6 percent from 2012, while total sales increased by 3.8 percent at $4.5 trillion in 2013. Within the e-commerce sales merchandise category, clothing and clothing accessories had the largest sales at $40 billion, followed by electronics and appliances at nearly $23 billion. E-commerce provides consumers with a broad range of shopping options as they compare product prices instantaneously from their mobile devices and decide how the purchased products will be acquired (e.g., home delivery or store pick-up), known as omni-channel retailing (**TABLE 5**). Omni-channel retailing offers shoppers multiple purchasing and receiving options. Simultaneously, e-commerce has generated a considerable force of change in terms of how traditional distribution centers and retail outlets are operating to meet customer demands.

Distribution centers in the past delivered bulk size goods to their customers or single vendors. Because e-commerce orders tend to be smaller in size than the traditional distribution center orders (i.e., a single item order as compared to a bulk-case order), many retailers and distribution center/warehouse operators are upgrading their facilities, or developing new facilities to meet surging e-commerce orders.

TABLE 5 Omni-Channel Retailing Options

Shopping Mode	Fulfillment Options	Return Options
• In store • Online or catalog • Via phone or other mobile device	• Pick up in store • Online or catalog • Ship from warehouse/distribution center • Direct shipping from manufacturer	• In store • Online • Via phone or other mobile device

Source: Industrial Warehousing in the SCAG Region Study, Task 3 Trend Report, SCAG, 2015

Further, consumers are increasingly demanding quicker fulfillment of their orders and same-day delivery options. To meet the same-day delivery promise, distribution or fulfillment center proximity to population centers becomes critical. This is exemplified by large-scale e-commerce fulfillment center developments in the periphery of urban population centers. At the same time, small to medium size buildings that are narrow, but with ample loading doors and docks in urban cores, have also been attractive as they provide even quicker access to dense population centers than those in the outskirts. Additionally, retailers are increasingly using products available at their stores to fulfill e-commerce orders. This has increased their reliance on parcel delivery services such as UPS, FedEx and the U.S. Postal Service, making parcel hubs, delivery centers, as well as local streets and highways in urban environments critical to e-commerce.[20,21,22]

GOODS MOVEMENT TRENDS AND DRIVERS

A number of key trends and drivers are expected to impact our region's goods movement system. Some of these are highlighted below:

- **Population and Employment Growth:** The regional population and rate of employment in our region are key indicators of economic health, and both are projected to grow rapidly over the next two decades. By 2040, the region's population is expected to grow by about 21 percent and employment is expected to grow by about 32 percent. This growth is expected to fuel consumer demand for products and in turn, the goods movement services that provide them. This increased demand will drive stronger growth in freight traffic on already constrained highways and rail lines.
- **Unemployment rates:** The rates have declined in more recent years for the region. The latest data reflects a 6.6 percent unemployment rate for the region—a decline from 7.5 percent a year ago.[23] The Inland Empire, in particular, is experiencing steady job growth with a 6.9 percent unemployment rate—2.1 percentage points lower than it was one year ago. Employment growth in the Inland Empire is being led by the Transportation, Warehousing and Utilities sectors.[24]
- **Continued Growth in International Trade:** The San Pedro Bay Ports anticipate cargo volumes to grow to 36 million containers by 2035[25]—despite increasing competition with other North American ports, the expansion of the Panama Canal and more recent delays at the port terminals due to labor contract negotiations. Port of Hueneme in Ventura County is also positioned to grow as a preferred port for specialized cargo such as automobiles, break bulk fruit and military cargo. This growth will place further demands on marine terminal facilities, highway connections, and rail intermodal terminals. If port-related rail traffic and commuter demands are to be met, main line rail capacity improvements also will be required. Meanwhile, mitigating the impacts of increased train traffic in communities will continue to be a challenge.
- **Logistics Epicenter:** Southern California continues to be the nation's epicenter for distribution and logistics activity despite challenges that were observed in recent years, including increasing land prices, labor cost and transportation cost for moving goods through Southern California. The geographical proximity to the nation's largest container ports and accessibility to the rest of the country via the region's extensive transportation network make Southern California an ideal location for many logistics activities. With continued growth in international trade and regional and national population, Southern California is poised to continue serving as a global trade node.
- **Air Quality Issues:** Much of our region does not meet federal air quality standards for ozone and fine particulate matter ($PM_{2.5}$). Ships, trucks, trains and other goods movement equipment are among the largest contributors to regional air pollution. Criteria pollutants such as NO_x and $PM_{2.5}$ can have significant public health impacts. Freight transportation is also a major producer of greenhouse gas emissions. Emissions generated by the movement of goods are being reduced through efforts such as the San Pedro Bay Ports Celan Air Action Plan, as well as regulations such as the statewide Heavy Duty Truck and Bus Rule. But these reductions are unlikely to be sufficient to meet regional air quality goals.
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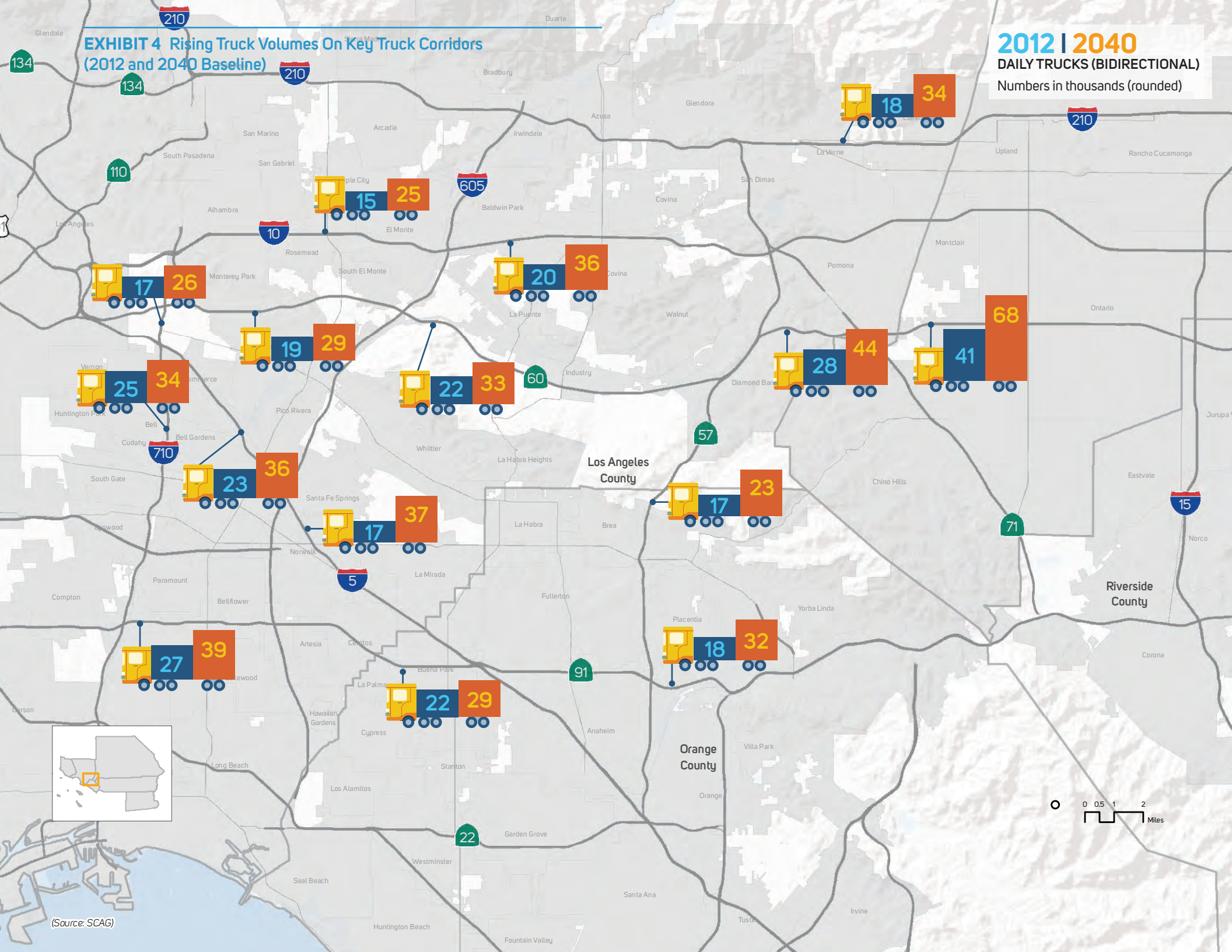
HIGHWAY STRATEGIES

Our strategies will now be described, however, for information on individual regional goods movement projects, refer to Regional Goods Movement Project List (**TABLE 19**) at the end of this appendix.

EXISTING AND PROJECTED HIGHWAY CONDITIONS

With continued growth in freight demands, regional truck-related activities will increase over the 2016 RTP/SCS time horizon. SCAG's Heavy Duty Truck (HDT) model is the primary analysis tool to evaluate the impacts of truck traffic and highway goods movement strategies on the regional transportation network. Major sources of truck traffic are grouped into the following categories in SCAG's HDT model:

EXHIBIT 4 Rising Truck Volumes On Key Truck Corridors (2012 and 2040 Baseline)



(Source: SCAG)

- **Internal Truck Trips:** These are truck trips that have both an origin and a destination within the SCAG region and are generated by local industries, construction sites, domestic warehouses, truck terminals and residences.
- **External Truck Trips:** These are interregional truck trips that reflect trade between the SCAG region and the rest of the U.S.
- **Port Truck Trips:** These are truck trips with an origin or destination at the San Pedro Bay Ports.
- **Secondary Port Truck Trips:** These are truck trips with an initial origin or destination at the San Pedro Bay Ports that are moved a second time after the first trip to or from the San Pedro Bay Ports. Transloading trips are in this category.
- **Intermodal (IMX) Truck Trips:** These are domestic intermodal truck trips that have origins or destinations at regional intermodal rail terminals. These truck trips do not include those that have either an origin or destination at the San Pedro Bay Ports.

TABLE 6 shows the number of regional truck trips in 2012 by category and county.

In 2012, the San Pedro Bay Ports were responsible for approximately 55,000 direct daily regional truck trips. As shown in **TABLE 6**, this constitutes only five percent of regional truck trips. That number is expected to grow to approximately 87,000 daily regional truck trips, an increase of nearly 58 percent, by 2040.

All key regional highway corridors used to move goods are expected to see an increase in overall truck volumes by 2040 (**EXHIBIT 4** reflects 2040 baseline conditions). **EXHIBIT 5** and **EXHIBIT 6** illustrate existing truck speeds on the regional highway network during the AM and PM Peak periods, respectively. **EXHIBIT 7** illustrates the expected speeds on the regional highway network during the PM Peak period in 2040 if no action is taken.

HIGHWAY TRUCK COLLISIONS

Truck-involved collisions are of critical concern as the region's highways carry high volumes of trucks daily. Between 2010 and 2012, truck-involved collisions on the region's highway network totaled 5,013, predominately along heavily truck traveled corridors in Los Angeles County and the Inland Empire.

EXHIBIT 8 shows truck involved crashes on the major highways in the region on a per-mile basis. Some of the key locations with the highest truck involved crashes are located along the following highways within our region:

- I-5 between SR-60 and I-10
- SR-60 east of SR-57 to Euclid Ave
- I-710 North of I-5
- I-710 between I-105 and SR-91
- I-10 between SR-57 and I-215

TABLE 6 Daily Regional Truck Trips by Category by County

	Imperial	Los Angeles	Orange	Riverside	San Bernardino	Ventura	Total	Percent
Internal	10,002	550,207	174,631	89,910	112,434	45,781	982,965	84.8%
External *	2,061	47,992	8,046	4,231	7,601	2,347	72,278	6.2%
Port	14	50,585	1,460	659	1,897	104	54,719	4.7%
Intermodal (IMX)	6	5,430	284	197	1,610	44	7,571	0.7%
Secondary	2	5,986	307	128	1,206	20	7,648	0.7%
Total	12,085	660,200	184,728	95,124	124,748	48,295	1,125,181	
Percent	1.0%	56.9%	15.9%	8.2%	10.8%	4.2%		

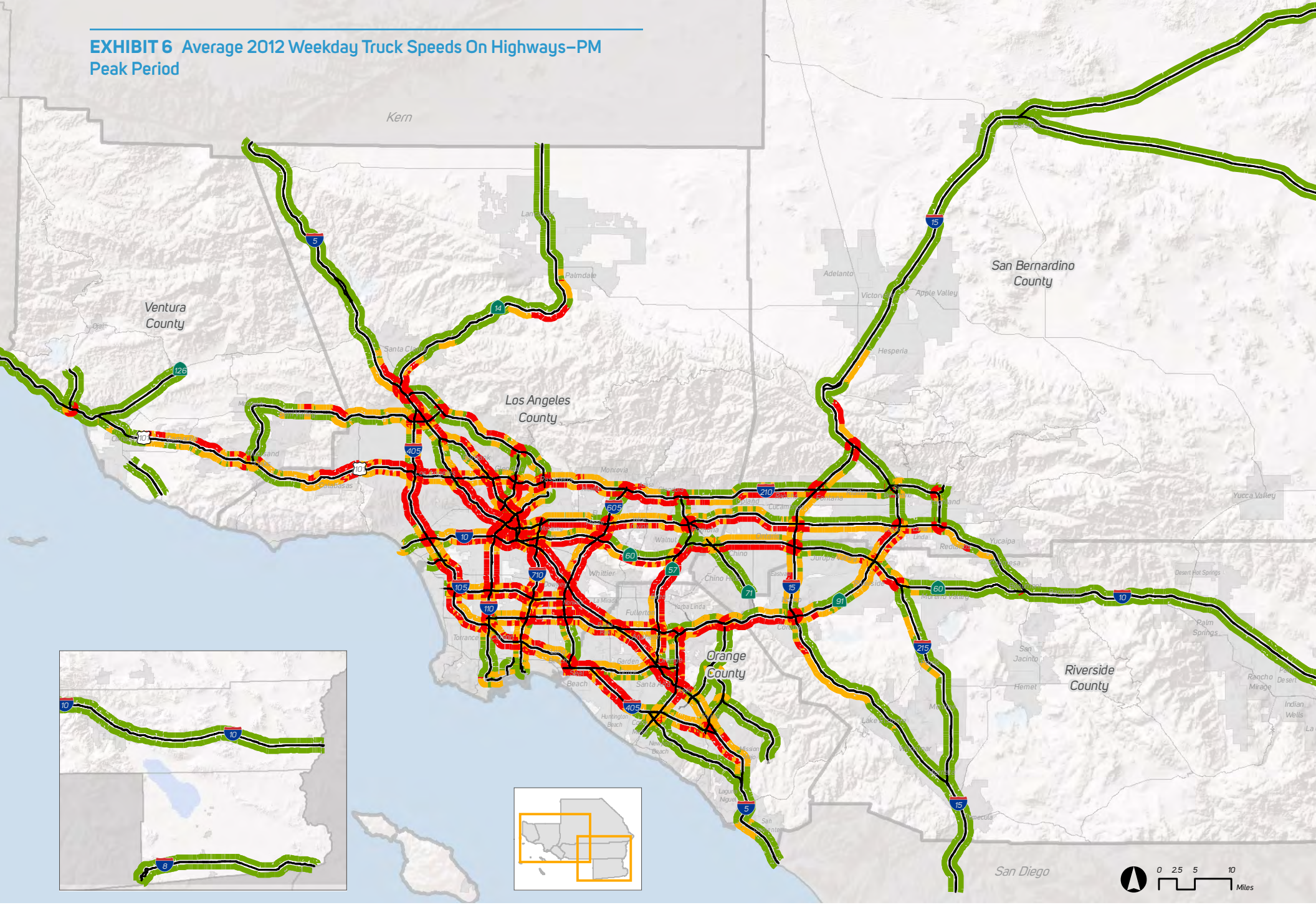
** Does not include the trips between external to external SCAG zones (about 10,000 trips)*
Source: SCAG

EXHIBIT 5 Average 2012 Weekday Truck Speeds On Highways–AM Peak Period

AM Peak Speed (mph) 2012 — Less than 35 — 36 to 50 — Greater than 50

Source: SCAG

EXHIBIT 6 Average 2012 Weekday Truck Speeds On Highways–PM Peak Period



PM Peak Speed (mph) 2012 — Less than 35 — 36 to 50 — Greater than 50

Source: SCAG

EXHIBIT 7 Baseline 2040 Weekday Truck Speeds on Highways–PM Peak Period

PM Peak Speed (mph) 2040 — Less than 35 — 36 to 50 — Greater than 50

Source: SCAG

EXHIBIT 8 Truck Involved Crashes on Major Highways

Avg Truck Involved Crashes per mile <= 3 | 4 to 7 | 8 to 12 | 13 to 15 | > 15

Source: Califorina Statewide Integrated Traffic Records System (SWITRS), Safe Transportation Research & Education Center at University of California, Berkeley (2010, 2011, & 2012)

REGIONAL CLEAN FREIGHT CORRIDOR SYSTEM

The 2016 RTP/SCS continues to envision a system of truck-only lanes extending from the San Pedro Bay Ports to downtown Los Angeles along I-710, connecting to the SR-60 corridor and finally reaching I-15 in San Bernardino County. Such a system would address the growing truck traffic and safety issues on core highways through the region and serve key goods movement industries. Truck-only lanes add capacity in congested corridors, improve truck operations and safety by separating trucks and autos and provide a platform for the introduction and adoption of zero- and near zero-emission technologies. Ongoing evaluation of a regional freight corridor system is underway, including recent work on an environmental impact report (expected to be recirculated in Winter 2016) for the I-710 segment. Additionally, as a part of the 2016 RTP/SCS, SCAG continues to refine the east-west corridor component of the system along the SR-60 corridor. Current efforts have focused on working to identify an initial operating segment. Additional study is underway to evaluate the East-West Freight Corridor (EWFC) project concept.

EAST-WEST FREIGHT CORRIDOR

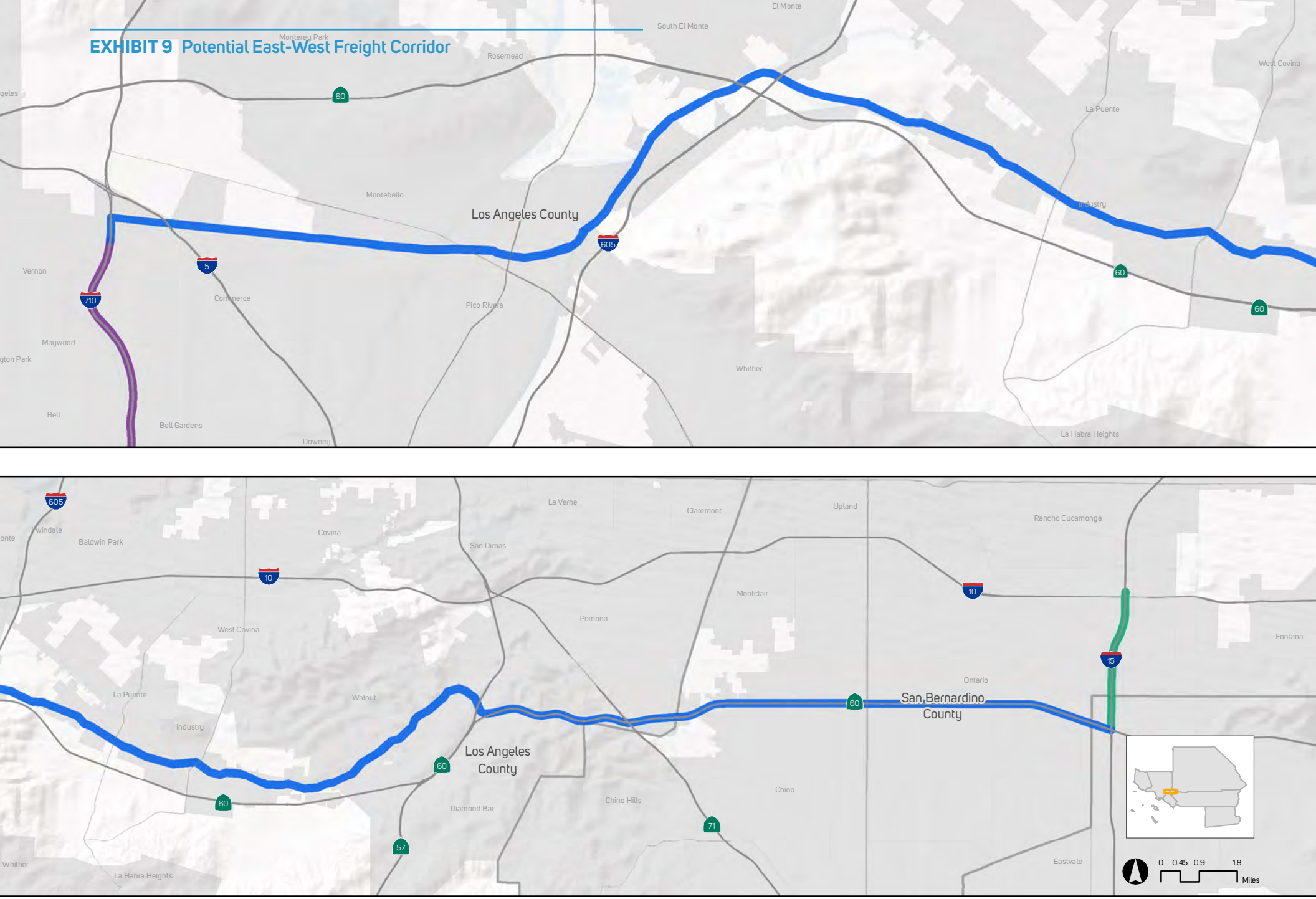
The 2016 RTP/SCS continues to identify a corridor concept along the SR-60 (**EXHIBIT 9**). While numerous EWFC options were examined, the Plan identifies a corridor concept to be explored further. Utilizing a right-of-way of approximately 100 feet, the bi-directional corridor would be restricted to truck traffic and have limited ingress/egress points. The EWFC would be a catalyst for the use of zero- and near zero-emission truck technologies, improving air quality for communities near the corridor and throughout the region.

BENEFITS OF THE EAST-WEST FREIGHT CORRIDOR

Continuing to move freight efficiently is critical to retain Southern California's trade competitiveness. The EWFC offers the opportunity to address many goods movement challenges, including congestion, air quality and safety concerns. The EWFC will support mobility for key industries, serve goods movement markets in an efficient manner, promote the region's environmental goals and contribute to alleviating the region's congestion. Analysis completed as part of the SCAG Comprehensive Regional Goods Movement Plan and Implementation Strategy indicates that major benefits of the potential East-West Freight Corridor include:

- **Mitigation of Future Truck Traffic:** Truck traffic is projected to grow significantly on all existing key east-west freeway segments. These dramatic increases in truck traffic on east-west corridors will cause increased congestion and longer delays to both trucks and general traffic on existing routes. The construction of the EWFC would increase capacity to accommodate the projected growth in truck activity. The corridor's traffic mitigation impacts would be significant, especially considering that some segments of the EWFC are forecast to carry between 58,000 and 78,000 trucks per day in 2040.
- **Reduction in Regional Delay:** The EWFC is projected to result in substantial delay reduction for both trucks and autos. Within the identified project influence area, all traffic is expected to experience a reduction of approximately 4.3 percent, with heavy-duty trucks seeing a nearly ten percent decrease. This reduced delay would provide demonstrable travel time savings as well as reduce emissions from idling vehicles on congested roadways.
- **Impact on Parallel Routes:** The EWFC is projected to draw significant volumes of truck traffic away from parallel routes, easing congestion and creating capacity for other vehicles on general purpose lanes. Estimates indicate that the EWFC could reduce daily traffic on portions of SR-60 (between 42-82 percent), I-10 (up to 33 percent), SR-91 (up to 19 percent), I-210 (up to 17 percent) and major regional arterials (up to 21 percent).
- **Mobility Benefits for Critical Markets:** The EWFC would offer considerable benefits to regional businesses and industries served by the numerous clusters of warehousing and manufacturing facilities near the route. Portions of the recommended potential route lie within a five-mile radius of 52 percent of the region's warehousing square footage and 27 percent of regional manufacturing employment.
- **Reduction of Truck-Involved Accidents:** The East-West Freight Corridor offers the potential to reduce truck-involved crashes as a result of the separation between trucks and other vehicles. Safety analysis revealed that several existing east-west corridors have high rates of truck-involved crashes, including segments of SR-60, SR-91 and I-10. The EWFC designed specifically for use by heavy duty trucks has the potential to improve safety and decrease the number of accidents for trucks and autos on parallel routes.
- **Preservation of Jobs and Income:** Increasing congestion is making Southern California a less attractive place to do business, threatening jobs and the positive economic impacts of the goods movement sector. An EWFC delivers a transportation system with greater capacity and less congestion in support of industries that depend on efficient freight movement throughout the SCAG region.
- **Reduction of Harmful Emissions:** The EWFC provides an opportunity to reduce harmful pollutants through the use of zero and near-zero emission technologies for freight transportation, although the technology to be used will be determined as the market evolves.

EXHIBIT 9 Potential East-West Freight Corridor



I-15 Freight Corridor Potential East West Freight Corridor Alignment I-710 Freight Corridor

(Note: Actual alignment is being evaluated)

Source: SCAG

TRUCK BOTTLENECK RELIEF STRATEGY

As driver wages and fuel costs represent over 50 percent of total motor carrier costs, truck congestion has major impacts on the bottom line of the trucking industry. In a 2013 analysis conducted by the American Transportation Research Institute (ATRI), the Los Angeles metropolitan area was identified as leading the nation in costs to the trucking industry caused by traffic congestion, with nearly $1.1 billion in added operational costs to truckers.[26] Further, the SCAG region had five of the top 100 truck bottlenecks in the U.S. in 2014 and 2015 as identified by ATRI. The 2015 ranking for the SCAG region is as follows:

- #9 SR-60 at SR-57 in Los Angeles County
- #18 I-710 at I-105 in Los Angeles County
- #36 I-10 at I-15 in San Bernardino County
- #43 I-15 at SR-91 in Riverside County
- #61 I-110 at I-105 in Los Angeles County.[27]

In 2013, SCAG's Comprehensive Regional Goods Movement Plan identified the top-priority truck bottlenecks through a process that included both a quantitative analysis of congestion in the region along with stakeholder outreach and input from other sources such as Caltrans' Corridor System Management Plans (CSMPs). This analysis resulted in a list of the top 50 regional priority bottlenecks (**TABLE 7**). Top priority bottlenecks include those that had the highest truck-related annual delay according to the quantitative bottleneck assessment as well as others identified by key stakeholders and CSMPs.

For the 2016 RTP/SCS, these bottlenecks were updated using a two-step approach. The first step was to update the congestion levels for the previously identified bottlenecks to verify if any major changes had occurred between 2008 and the 2012 base year for the 2016 RTP/SCS. The second step used readily available data to identify potential emerging truck bottlenecks that may have developed since the last analysis. The existing bottleneck "refresh" was performed by estimating the percent change in truck delay on a corridor between 2009 and 2012. To facilitate this analysis using the Caltrans Performance Measurement System (PeMS), a corridor was defined as a directional freeway at the county level (e.g., I-5 northbound in Orange County). The percent change was calculated by taking PeMS corridor delays for 2008 and 2012, adjusting those total delays to represent truck congestion by using Caltrans estimated truck volumes and calculating the percent change in corridor delay for the two years.

Using this approach, all truck bottlenecks on a corridor will have the same percent change applied to them. Potential emerging bottlenecks were identified by utilizing the PeMS "Top Bottlenecks" feature to measure queue lengths, time periods and estimated delays for recurring regional bottlenecks. These delays were adjusted by using Caltrans truck volumes since PeMS estimates total delay, but not truck delay. This recent analysis also identifies potential new truck bottleneck locations as shown in **TABLE 7** and **EXHIBIT 10**.

These priority truck bottleneck locations, combined, contribute over 1 million hours of truck delay annually to SCAG regional roadways during congested time periods. Addressing these bottlenecks would contribute to reduction in delay as well as emissions "hot spots."

One of the most congested truck bottleneck locations in the SCAG region is at the intersection of the SR-57 and SR-60 freeways in Los Angeles County. In 2014, the City of Industry, along with the Los Angeles County Metropolitan Transportation Authority (LACMTA), was awarded a TIGER Grant to construct the 57/60 Confluence Freight Corridor Project. This $37.3 million project will improve both directions of travel to/from the Grand Avenue interchange by constructing an eastbound on- and off-ramp bypass, add an eastbound mainline lane, re-align all on- and off-ramps, replace the Grand Avenue Overcrossing and reconstruct the Grand Avenue & Golden Springs Drive intersection. The multi-phase effort is expected to reduce congestion, eliminate the hazards associated with a high accident rate at that location, and will facilitate more efficient freight movement.

There are a number of major highway projects that were recently completed or are currently under construction as shown in **TABLE 8**. These projects are expected to provide significant improvements at or near the identified truck bottleneck locations. SCAG is currently developing a supplemental truck bottleneck report, and with access to the latest real time data, bottleneck issues are anticipated to be monitored on a continuous basis.

Some of the truck bottleneck locations also have a higher number of truck related crashes in the region with a crash rate of more than eight on a per mile basis. These locations are listed below:

- **I-5:** At I-210, between SR-2 and I-710, South of I-605, between SR-22 and SR-55;
- **I-605:** Between I-105 and I-10;
- **I-15:** Between I-10 and SR-60;
- **I-210:** East of SR-134;
- **I-10:** East of I-605 and east of I-15;
- **SR-60:** Between I-10 and east of I-710, between I-605 and SR-57;
- **SR-91:** West of SR-57.

TABLE 7 Priority Truck Bottlenecks in the SCAG Region

Identification Methodology	Route	Direction	Absolute Postmile/Limits	County
SCAG Analysis*	605	SB	13.8	Los Angeles
	5	NB	117.8	Los Angeles
	405	NB	46.5	Los Angeles
	101	SB	4.1	Los Angeles
	5	NB	124.9	Los Angeles
	605	NB	17.5	Los Angeles
	60	EB	18.3	Los Angeles
	110	NB	16.1	Los Angeles
	10	EB	25.6	Los Angeles
	91	WB	3.9	Los Angeles
	60	EB	21.6	Los Angeles
	110	SB	17.8	Los Angeles
	60	EB	19.3	Los Angeles
	10	WB	32.0	Los Angeles
	405	NB	50.8	Los Angeles
	60	EB	5.1	Los Angeles
	60	EB	8.2	Los Angeles
	91	WB	42.7	Los Angeles
	101	NB	132.4	Los Angeles
	5	SB	128.5	Los Angeles
	5	NB	101.5	Orange
	605	NB	19.2	Los Angeles
	5	SB	132.3	Los Angeles
	210	WB	31.0	Los Angeles
	60	WB	13.0	Los Angeles

Note: Not listed in the order of priority.
*Sources: *Comprehensive Regional Goods Movement Plan and Implementation Strategy. ** 2016-2040 Regional Transportation Plan/ Sustainable Communities Strategy (RTP/SCS).*

TABLE 7 Priority Truck Bottlenecks in the SCAG Region Continued

Identification Methodology	Route	Direction	Absolute Postmile/Limits	County
SCAG Analysis*	91	WB	40.9	Riverside
	5	NB	160.8	Los Angeles
	10	WB	30.1	Los Angeles
	10	EB	6.6	Los Angeles
	105	WB	12.9	Los Angeles
	5	NB	119.2	Los Angeles
	60	WB	16.4	Los Angeles
	710	SB	17.5	Los Angeles
	91	WB	23.6	Orange
Corridor System Management Plan (CSMP)*	5	SB	144.3	Los Angeles
	10	EB	70.5	San Bernardino
	57	SB	12.3	Orange
	91	WB	46.9	Riverside
	210	WB	28.8	Los Angeles
Stakeholder Identified*	215	NB/SB	NA	San Bernardino
	10	EB	57.5	San Bernardino
	101	NB	53.2	Ventura
	101	NB	42.1	Ventura
	57	NB	24.4	Los Angeles
	710	NB	0.5	Los Angeles
	98	EB/WB	Dogwood Rd to SR111	Imperial
	Forrestor Rd	NB/SB	SR-78/86 to CA-98	Imperial
	8	EB/WB	Imperial Ave	Imperial
Potential New Bottlenecks Identified SCAG Analysis**	5	NB	137.7	Los Angeles
	57	NB	15.2	Los Angeles

Note: Not listed in the order of priority.
*Sources:*Comprehensive Regional Goods Movement Plan and Implementation Strategy. ** 2016-2040 Regional Transportation Plan/ Sustainable Communities Strategy (RTP/SCS).*

TABLE 7 Priority Truck Bottlenecks in the SCAG Region Continued

Identification Methodology	Route	Direction	Absolute Postmile/Limits	County
Potential New Bottlenecks Identified SCAG Analysis**	60	EB	23.5	Los Angeles
	105	EB	11.9	Los Angeles
	210	EB	33.4	Los Angeles
	605	NB	11.4	Los Angeles
	5	NB	104.6	Orange
	5	NB	108.7	Orange
	91	EB	42.9	Riverside
	91	EB	46.6	Riverside
	15	SB	107.7	San Bernardino
	101	SB	45.7	Ventura

Note: Not listed in the order of priority.
*Sources:*Comprehensive Regional Goods Movement Plan and Implementation Strategy. ** 2016-2040 Regional Transportation Plan/ Sustainable Communities Strategy (RTP/SCS).*

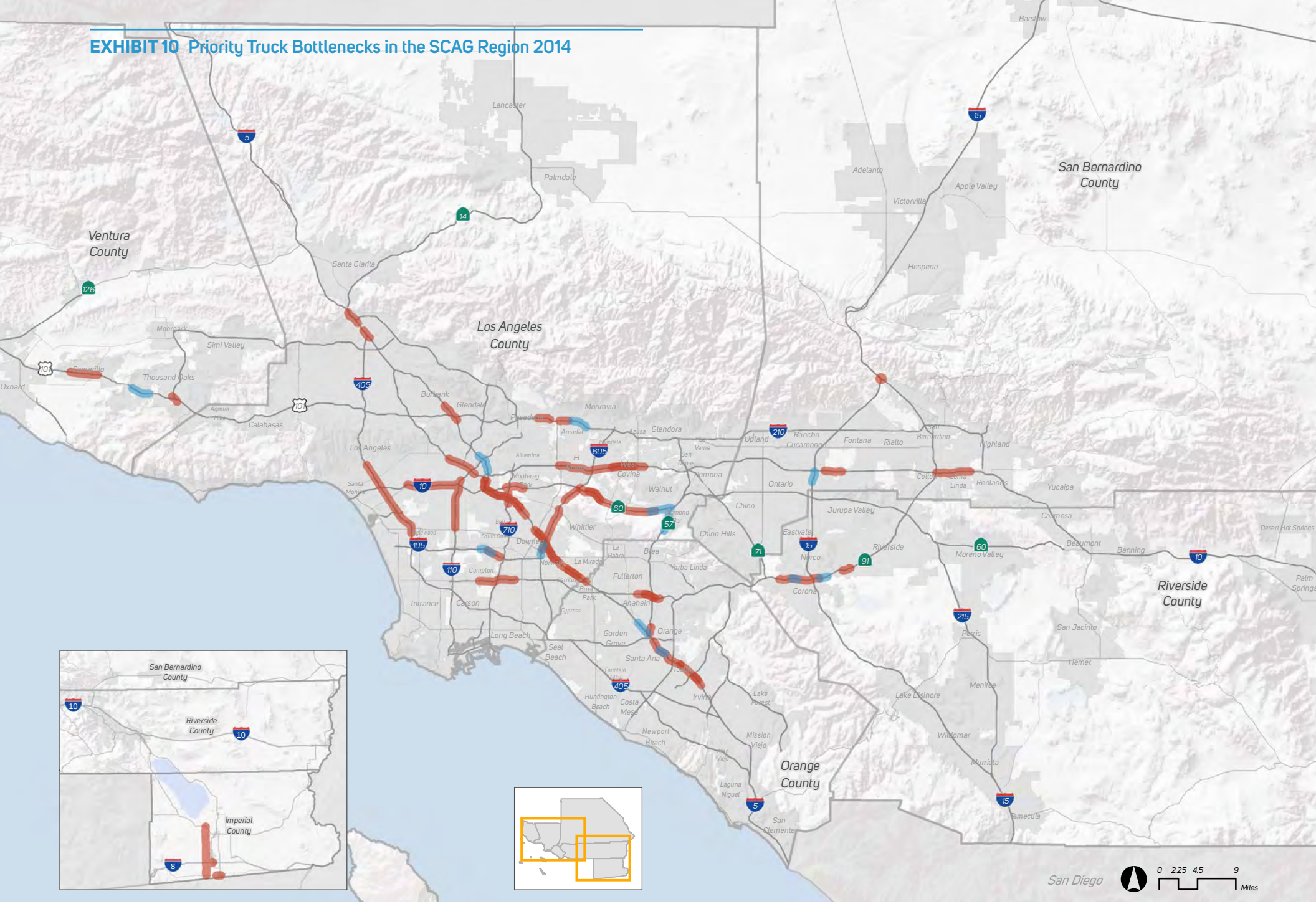
TABLE 8 Major Highway Projects within SCAG Region at Bottleneck Locations

Major Highway Projects	Status
I-5/SR-14 Direct HOV Connector	Completed
I-405 Sepulveda Pass Project	Completed
I-5 South Los Angeles County Projects	Under Construction
I-10/I-605 Interchange Improvements	Under Construction
I-15/I-215 Interchange Improvements at Devore	Under Construction
SR-91 Fast Forward Project (Riverside County)	Under Construction
SR-91 Westbound General Purpose (Between SR-57 and I-5)	Under Construction
US 101/SR-23 Interchange Improvements Projects	Under Construction
I-710/Firestone Blvd/Atlantic Interchange SR-2 Terminus Project (3 phases)	Under Construction

Source: SCAG

The 2016 RTP/SCS allocates an estimated $5 billion toward goods movement bottleneck relief strategies. Some bottleneck relief concepts have been identified through the CSMP process, and others are currently programmed for implementation. Major capital-intensive goods movement infrastructure investments must be supplemented with a comprehensive strategy to mitigate the most pressing bottlenecks in the region. Examples of bottleneck relief strategies include ramp metering, extension of merging lanes, ramp and interchange improvements, capacity improvements and auxiliary lane additions. Although some bottleneck relief projects, such as auxiliary lanes, can be capital-intensive. Others like ramp metering are less complex and would therefore be relatively easier to implement.

EXHIBIT 10 Priority Truck Bottlenecks in the SCAG Region 2014



Source: SCAG

RAIL STRATEGIES

EXISTING AND PROJECTED RAIL CONDITIONS

Southern California is served by two Class I railroads:[28] Union Pacific Railroad (UP) and the Burlington Northern Santa Fe Railway (BNSF). Pacific Harbor Line, Inc. (PHL), a Class III railroad, provides rail transportation, maintenance and dispatching services within the San Pedro Bay Ports area. The Port of Hueneme is served by the Ventura County Railway (VCR), a Class III railroad, which connects to the UP Coast main line in Oxnard. Another Class III line, the Los Angeles Junction Railway (LAJ), provides industrial switching services in the Cities of Vernon, Maywood, Bell and Commerce. The LAJ provides connections to both UP and BNSF. **EXHIBIT 11** shows key segments of the rail system described in more detail below.

North of the Ports of Los Angeles and Long Beach, UP and BNSF trains operate on the Alameda Corridor, which was completed in 2002. All harbor-related trains of the UP and BNSF use the Alameda Corridor to access the rail mainlines that originate near downtown Los Angeles. East of downtown Los Angeles, freight trains operate on the BNSF San Bernardino Subdivision, the UP Los Angeles Subdivision, or the UP Alhambra Subdivision. North and west of Los Angeles, freight trains operate on the UP Coast line toward Santa Barbara, the Antelope Valley line from the San Fernando Valley to Palmdale, or the UP Mojave Subdivision from West Colton to Palmdale.

To transition from the Alameda Corridor to the Alhambra Subdivision, the UP utilizes trackage rights over Metrolink's East Bank Line, which runs parallel to the Los Angeles River on the east side of downtown Los Angeles. The UP Los Angeles Subdivision terminates at West Riverside Junction, where it joins the BNSF San Bernardino Subdivision. The BNSF San Bernardino Subdivision continues north of Colton Crossing and transitions to the BNSF Cajon Subdivision. The Cajon line continues north to Barstow and Daggett and then east toward Needles, CA and beyond. UP trains exercise trackage rights over the BNSF San Bernardino Subdivision from West Riverside Junction to San Bernardino and over the Cajon Subdivision from San Bernardino to Daggett, which is a short distance east of Barstow. UP trains continue north of Daggett on the UP Cima Subdivision to Las Vegas.

The UP Alhambra Subdivision and the BNSF San Bernardino Subdivision cross at Colton Crossing in San Bernardino County. East of Colton Crossing, the UP operates its transcontinental Sunset Corridor main line, also known as the UP Yuma Subdivision. The Yuma Subdivision passes through the Palm Springs area, Indio and continues to Arizona and beyond.

The UP Yuma Subdivision has two main tracks from Colton to Indio. East of Indio, double-tracking of more than 80 percent of the Sunset Corridor has been completed to date.

The BNSF San Bernardino Subdivision has at least two main tracks with segments of triple track between Hobart and Fullerton. On the Cajon Subdivision, the BNSF completed a third main track from San Bernardino to the summit of Cajon Pass.

While a majority of the UP Alhambra Subdivision is single track, since the 2012 RTP/SCS 5.8 miles between South Fontana and Reservoir has been double-tracked and three new run-through tracks at Montclair have been constructed. Combined, these projects addressed more than one-third of the entire project that is envisioned for the segment between South Fontana and Reservoir on the Alhambra subdivision. The UP Los Angeles Subdivision has two main tracks west of Pomona and a mixture of one and two tracks east of Pomona.

North from West Colton, the single-track UP Mojave Subdivision closely parallels the BNSF Cajon Subdivision as the two lines climb the south slope of Cajon Pass. There are connections at Keenbrook and Silverwood to enable UP trains to enter/exit the main tracks of the BNSF Cajon Subdivision. Beyond Silverwood to Palmdale, the UP Mojave Subdivision has very little train traffic. UP uses this line to reach points in Northern California and the Pacific Northwest.

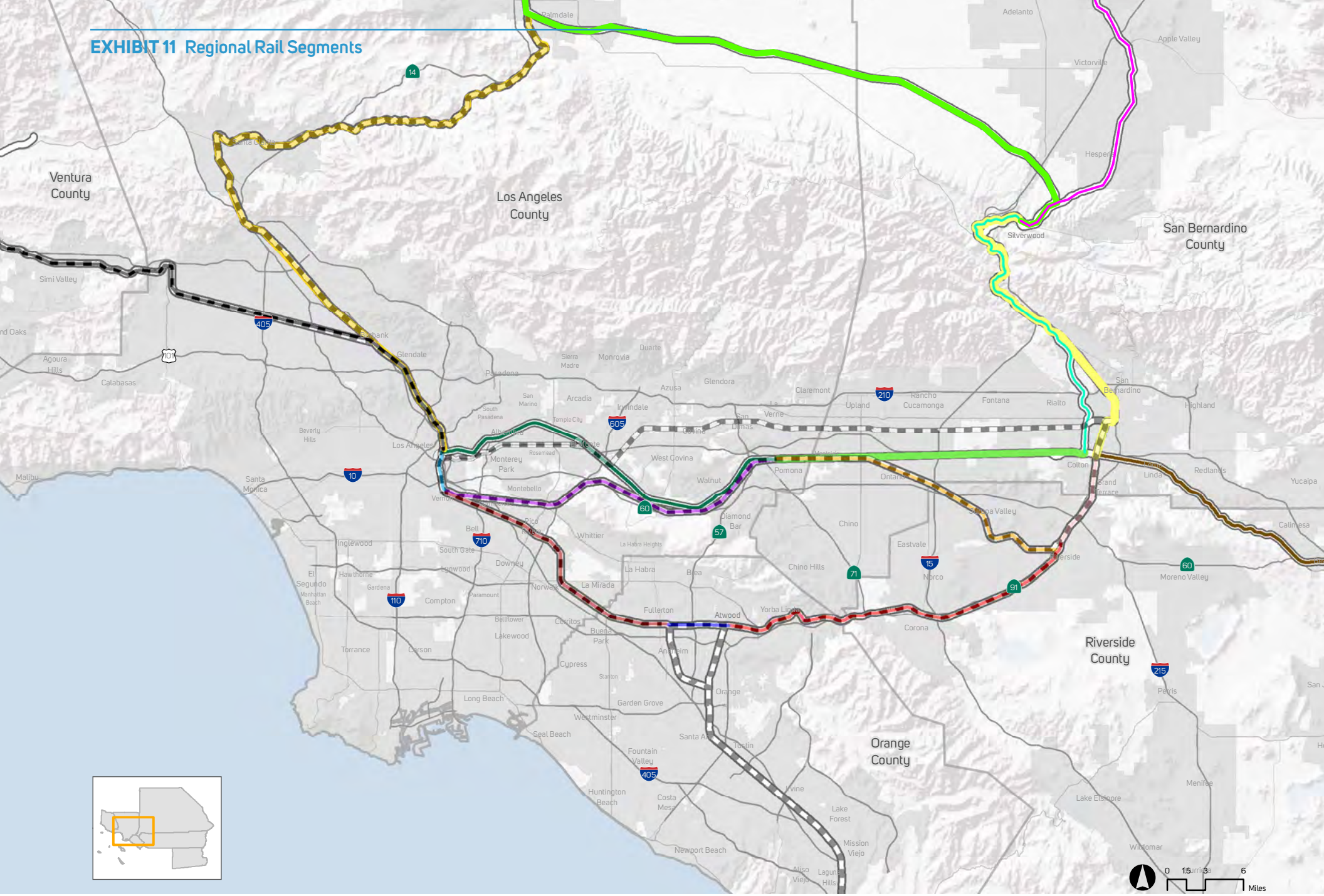
The BNSF operates intermodal terminals for containers and trailers at Hobart Yard (in the City of Commerce) and at San Bernardino. UP operates intermodal terminals at:

- East Los Angeles Yard at the west end of the UP Los Angeles Subdivision;
- Los Angeles Transportation Center (LATC) at the west end of the UP Alhambra Subdivision;
- City of Industry on the UP Alhambra Subdivision; and the
- Intermodal Container Transfer Facility (ICTF) near the south end of the Alameda Corridor.

In addition, both UP and BNSF operate trains hauling marine containers that originate or terminate at on-dock terminals within the Ports of Los Angeles and Long Beach.

UP also has a large carload freight classification yard at West Colton (at the east end of the Alhambra Subdivision). A large automobile unloading terminal is located at Mira Loma (mid-way between Pomona and West Riverside on the Los Angeles Subdivision).

EXHIBIT 11 Regional Rail Segments



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

- UP East Bank
- UP Coast Line
- UP Santa Clarita Line

- Main Line Rail
- Commuter Rail Network

Source: SCAG

CURRENT AND FUTURE VOLUMES AND POTENTIAL CAPACITY CONSTRAINTS

Significant growth in passenger and freight rail traffic is expected on most segments of the SCAG regional rail system by 2040. This anticipated growth is highlighted in **TABLE 9**, which shows 2012 and projected 2040 peak day train volumes on key segments. Freight train volumes include container trains, also called intermodal trains (marine and domestic) and non-intermodal trains (unit automobile trains, unit oil trains, unit bulk and carload trains). Passenger trains include Amtrak and Metrolink service. Increases in railroad traffic will require ongoing infrastructure investment to maintain current levels of service. 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.

REGIONAL RAIL STRATEGIES

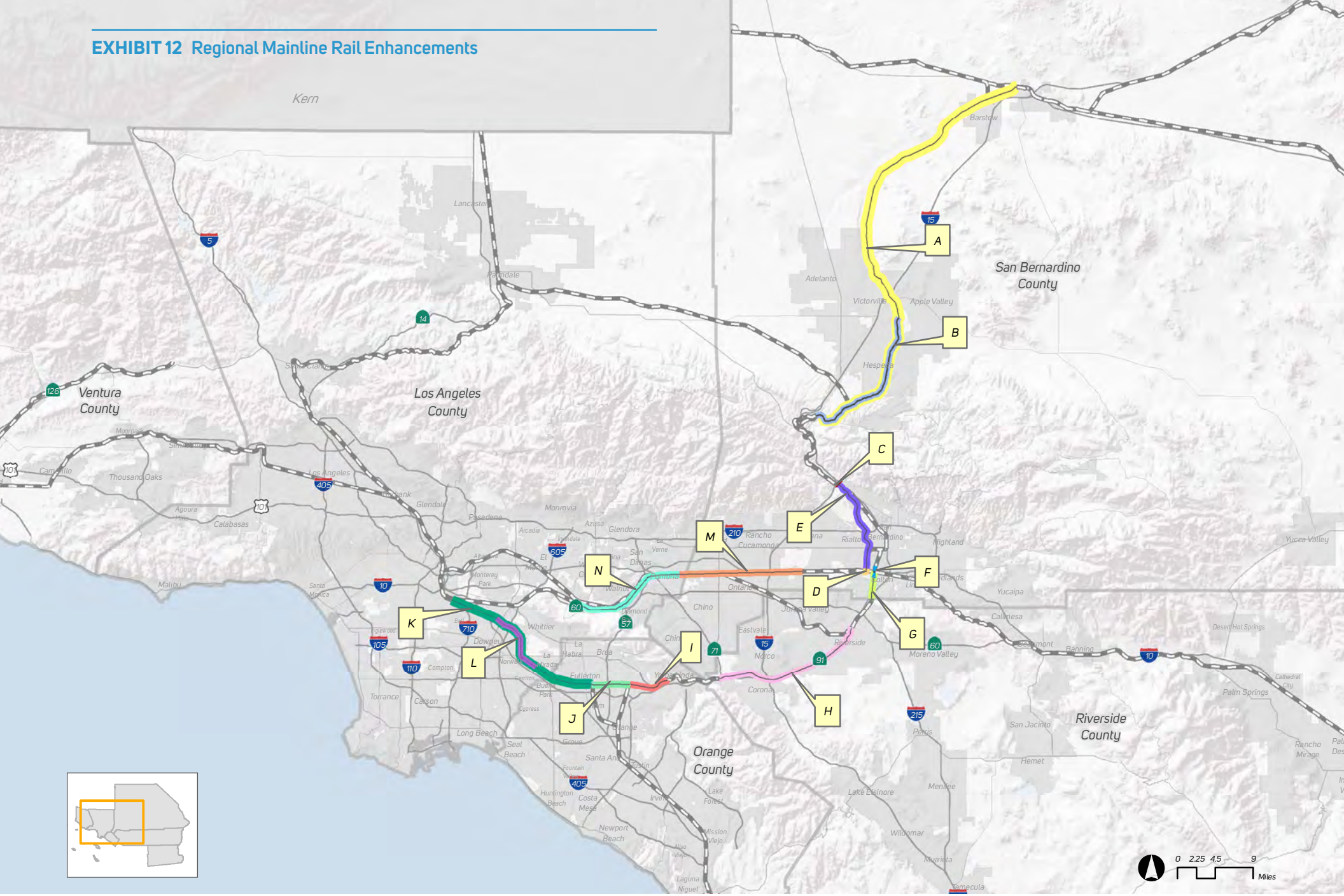
The proposed regional rail package has several components. These include mainline rail improvements (rail-to-rail grade separations, double or triple tracking, new signal systems, universal crossovers, new sidings, etc.) that would benefit both freight rail and passenger rail service depending on their location; rail yard improvements (upgrades to existing yards as well as construction of new yards); rail operation safety improvements such as Positive Train Control (PTC) that could greatly reduce the risk of rail collisions and increase capacity; grade separations; and emissions reduction strategies.

TABLE 9 Peak Day Train Volume (Metrolink Volumes in Parentheses)

Line Segments	Type	2012	2040
BNSF San Bernardino Sub Hobart-Fullerton	Passenger	49 (25)	110 (72)
	Freight	36	80
BNSF San Bernardino Sub Atwood-W. Riverside	Passenger	27 (25)	62 (60)
	Freight	40	91
BNSF San Bernardino Sub W. Riverside-Colton	Passenger	39 (37)	108 (106)
	Freight	60	139
BNSF Cajon San Bernardino-Silverwood + UPRR Mojave W. Colton-Silverwood	Passenger	2	2
	Freight	89	167
UPRR LA Sub East LA-Pomona + UP Alhambra Sub Yuma Jct. - Pomona	Passenger	54 (53)	98 (96)
	Freight	37	100
UP LA Sub Pomona-W. Riverside + UPRR Alhambra Sub Pomona-W. Colton	Passenger	13 (12)	48 (46)
	Freight	43	112
UPRR Yuma	Passenger	1	2
	Freight	40	95

Note: A "peak day" experiences the 90th percentile of the distribution of daily train movements. SCAG's freight rail volume forecast was originally developed by Dr. Robert Leachman, Leachman and Associates, LLC, and was recently updated using the Train Builder model by Cambridge Systematics. These numbers do not represent forecasts made by BNFS Railway or UP Railroad. Passenger volume totals include Amtrak and Metrolink. Passenger volumes reflect input provided by Metrolink, LOSSAN Rail Corridor Agency, Riverside County Transportation Commission, and San Bernardino Associated Governments.

EXHIBIT 12 Regional Mainline Rail Enhancements



A - Fourth Main Track from Silverwood to Frost
B - Third Main Track Martinez to Barstow
C - Devore Rd Crossovers
D - Flying Junction at Rancho
E - Second Main Track Devore to Rancho
F - Colton Crossing Grade Separation
G - Third Main Track MP 2.9 to Highgrove MP 6.1
H - Third Main Track West Riverside to Prado Dam
I - Third Main Track Esperanza to Atwood
J - Third Main Track Atwood to Fullerton
K - Fourth Main Track Fullerton to Hobart
L - Third Main Track Valley View to Serapis
M - Second Main Track South Fontana to Reservoir
N - Second Main Track Pomona to City of Industry
Main Line Rail Network

Source: SCAG

TABLE 10 Estimated Cost of Mainline Rail Improvements (in Nominal Dollars)

Mainline Rain Improvements	"Estimated Cost ($ YOE, Thousands)"
Rail package — mainline rail capacity expansion: Colton rail-to-rail grade separation–BNSF Cajon Subdivision (Complete not included in the total); Barstow to Keenbrook–BNSF San Bernardino Subdivision; Colton Crossing to Redondo Junction–UP Mojave Subdivision; Devore Road to West Colton (inc. Rancho Flying Junction)–UP Alhambra Subdivision; West Colton to City of Industry–UP Los Angeles Subdivision; UP Yuma Subdivision.	$3,092,400

MAINLINE ENHANCEMENTS

The most notable change since the 2012 RTP/SCS is the completion of the Colton rail-to-rail grade separation project in the City of Colton, San Bernardino County. Completed in August 2013, this project physically separated two Class I railroads that crossed perpendicularly. An elevated 1.4-mile-long overpass that lifts UP trains traveling east-west removed the chokepoint that existed where BNSF and UP mainlines crossed tracks in Colton. Physically separating this crossing has numerous economic benefits to the region as well as the nation as the majority of imported cargo through the San Pedro Bay Ports are moved by freight rail via this crossing. The project completion was widely celebrated by the surrounding community, San Bernardino Associated Governments, Caltrans and both UP and BNSF as the project was delivered eight months ahead of schedule with $109 million in project cost savings.[29]

Positive Train Control (PTC) is a radio or GPS-based system designed to automatically prevent train-to-train collisions, derailments caused by excessive speeds, unauthorized train movements in work zones, and the movement of trains through switches left in the wrong position. Congress mandated the installation of PTC through the Rail Safety Improvement Act of 2008 on lines where certain hazardous materials are carried and any line on which passenger or commuter rail services operate.[30,31]

While information on individual railroads implementation status is not available, recent documentation through the Federal Rail Administration reports that, nationally, 32 out of 38 railroads have completed installation of approximately 50 percent of the locomotives that require PTC equipment, deployed approximately 50 percent of wayside units, replaced approximately 505 signals that need replacement and completed most of the required mapping for PTC tracks. With projected volume increases on both freight and passenger rail, ensuring railroad safety is of paramount importance to the region's growth and quality of life.

The 2016 RTP/SCS assumes that no changes have been made to the Class I Railroads routing operations and includes mainline rail improvements that were estimated based on the Modified Status Quo routing along the UP Lines.[32]

Location of regional mainline rail enhancements are shown in **EXHIBIT 12** and estimated costs of the recommended mainline track improvements are shown in **TABLE 10**.

Improvements to the BNSF Cajon Subdivision include installing a third main track and a fourth main track on specific segments, exceptional earthmoving, crossovers and bridges across multiple culverts.

Improvements to the BNSF San Bernardino Subdivision include a third main track, as well as a fourth main track along the Hobart to Fullerton segment. Caltrans has provided $121.8 million for the triple tracking from Serapis (MP 151.1) to Valley View (MP 158.7).

TABLE 11 San Pedro Bay Ports Direct Intermodal Volumes as a Percentage of Total Port Container Throughput (2003–2014)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
% On-Dock	15.9%	18.1%	20.7%	24.1%	23.0%	23.7%	24.6%	23.5%	24.2%	25.0%	24.8%	26.9%
% Near-/Off-Dock	23.4%	21.2%	19.5%	18.7%	18.4%	18.5%	15.3%	11.7%	9.9%	11.2%	10.5%	9.7%
Total % Direct Intermodal	39.3%	39.3%	40.2%	42.8%	41.4%	42.2%	39.9%	35.2%	34.1%	36.2%	35.3%	36.6%
Total Throughput (POLA +POLB) Millions of TEUs	11.8	13.1	14.2	15.8	15.7	14.3	11.8	14.1	14	14.1	14.6	15.1

Source: Ports of Los Angeles and Long Beach

Improvements to the UP Mojave Subdivision include a second main track over a key segment and a "flying junction" at Rancho (West Colton).

Improvements to the UP Alhambra Subdivision include double tracking key segments and route connections in Pomona.

ON-DOCK/NEAR-DOCK RAIL CAPACITY ENHANCEMENTS

In 2014, approximately 36.6 percent of the San Pedro Bay Ports' containers were shipped by rail "intact" (direct intermodal), meaning the cargo was moved by rail in marine containers without being transloaded or deconsolidated first (TABLE 11). In addition to direct intermodal movement, containers can be transloaded into 53-foot domestic containers or trailers at deconsolidation facilities in the region. The larger containers are then trucked to off-dock rail yards for loading onto trains and transported out of the region. The 53-foot wheeled trailers are also typically transported out of the region. Containers that are neither shipped by rail intact (direct intermodal) nor transloaded are trucked directly to/from local warehouses or distribution facilities.

TABLE 11 shows the percentage of direct intermodal cargo handled at on-dock and near-dock rail yards. Containers moved using on-dock rail do not have to be trucked to/from more distant rail yards. In 2014, 26.9 percent of direct intermodal cargo was handled using on-dock rail. In that same year, 9.7 percent of containers were handled at off-dock yards (e.g., Hobart, East Los Angeles) or existing near-dock yards (i.e., ICTF). These containers must be trucked between port terminals and these yards.

TABLE 12 Estimated Cost of Port-Area Rail Improvement (Millions of Nominal Dollars)

Port Area Rail Improvements (Excluding SCIG and ICTF)	Estimated Costs
Port of Long Beach	
On-Dock Railyards	$186.20
Rail Infrastructure Outside Marine Terminals	$704.80
Subtotal Port of Long Beach	$891.00
Port of Los Angeles	
On-Dock Railyards	$806.02
Rail Infrastructure Outside Marine Terminals	$297.01
Subtotal Port of Los Angeles	$1,103.03
Total Port Area	$1,994.03

Source: Ports of Los Angeles and Long Beach

ON DOCK RAIL SUPPORT FACILITY AT PIER B STREET (PIER B ODRSF)

Pier B ODRSF is a $310 million project that will expand the existing Pier B Rail Yard. Creation of an expanded rail support facility at the Pier B Rail Yard site would provide comprehensive rail support that currently does not exist within the port complex. The Pier B ODRSF project will provide the following functions: (1) arrival or departure of an entire container train internal to the site, (2) sufficient yard track storage capacity to facilitate train assembly and disassembly and (3) ancillary yard functions, such as locomotive layover and refueling capability. Carrying containers by rail is the most efficient method for cargo destined to points well beyond the Southern California region. Utilizing rail has the added benefit of potentially reducing the number of truck trips on regional roadways and freeways, which would otherwise be needed to carry cargo containers to near-dock or off-dock yards. The expanded facility will ease congestion and reduce air pollution. An Environmental Impact Report (EIR) is currently being prepared for this project.

PORT AREA RAIL INFRASTRUCTURE IMPROVEMENTS

The Ports of Los Angeles and Long Beach have proposed neraly $2.0 billion in rail improvements within the harbor area (TABLE 12). These projects are designed to support increased on-dock rail service, to reduce railroad delay associated with train meets and passes and to reduce conflicts with highway traffic. By allowing more on-dock rail, truck traffic between the San Pedro Bay Ports and distant rail yards can be reduced. Use of on-dock rail eliminates truck vehicle miles of travel (VMT) and associated emissions by allowing trains to be loaded and unloaded inside marine terminals.

With continued investments in on-dock infrastructure as proposed, on-dock rail is estimated to account for the movement of approximately 35 percent of all port TEUs by 2035. This projected share is sizeable as on-dock rail will not be able to accommodate 100 percent of direct intermodal moves. It is limited by factors such as shipper/steamship line logistics (transloading, transportation costs, etc.), railroad operations (equipment availability, the need to generate destination-specific unit trains, train schedules and steamship line contracts/arrangements) and terminal operation and congestion.

The "On-Dock Railyards" category in TABLE 12 includes the following projects (see EXHIBIT 23 for project locations):

- Port of Long Beach

- Pier G South Working Yard Rehabilitation
- Pier G Metro Track Improvements
- Middle Harbor Terminal Rail Yard (Three Phases)

- Port of Los Angeles
  - **West Basin Container Terminal (WBCT) On-Dock Rail :** Addition of two new loading tracks
  - **YTI On-Dock Rail:** Addition of one new loading track
  - **Pier 400 Rail Expansion:** Phase 1
  - **Pier 300 Rail Expansion:** Addition of two new loading tracks
  - **Seaside Yard:** Dedicated on-dock rail yard for Berth 226-236 terminal (Evergreen)
  - Terminal Island Support Yard
  - **Berth 200 Railyard Expansion:** Additional Storage/working tracks
  - **Evergreen/TICTF:** Adding one new loading track
  - **Port of LA Container Movement Enhancement Program:** WBCT wharf improvements, YTI wharf improvements and Pier 300 wharf improvements
  - Pier 400 Second Lead Track.

The "Rail Infrastructure Outside Marine Terminals" category in **TABLE 12** includes the following projects (see Exhibit 23 for project locations):

- Port of Long Beach
  - Pier B Street Realignment
  - Pier F Support Yard (currently under construction)
  - Track Realignment at Ocean Boulevard (currently under operation)
  - Terminal Island Wye Track Realignment
  - Reconfiguration of Control Point (CP) Mole
  - Navy Mole Road Storage Yard
  - Pier B Rail Yard (Phase III–12th Street Alternative)
- Port of Los Angeles
  - Port Truck Traffic Reduction Program: West Basin Railyard
  - Port of Los Angeles Rail Efficiency Program (Alameda Corridor - West Basin Area Gap Closures)
- Port of Los Angeles and Port of Long Beach Joint Projects
  - New Cerritos Channel Rail Bridge[33]
  - Third Track at Thenard Junction.[34]

EXPANSION OF NEAR-DOCK RAIL

Additional lift capacity at near-dock yards is needed to accommodate projected demand and to reduce the number of truck trips to off-dock yards. Near-dock rail terminals provide rail accessibility to import and export cargo, using drayage trucks for the connection to and from port terminals. Expansion of near-dock rail will reduce truck VMT and emissions by eliminating the need to access more distant off-dock rail facilities.

Two near-dock rail projects are currently undergoing environmental review: BNSF's Southern California International Gateway (SCIG) and modernization of UP's Intermodal Container Transfer Facility (ICTF). Without the SCIG and ICTF expansion projects, it is estimated that the growth in direct intermodal container volumes would require that at least

TABLE 13 List of Recently Completed Grade Separation

County	Locations
Los Angeles	Valley View Ave
Los Angeles	S. Wilmington
Los Angeles	Baldwin Ave
Los Angeles	Del Amo Blvd
Los Angeles	Passons Blvd
Orange	Kraemer Blvd
Orange	Placentia Ave Undercrossing
Orange	Jeffery Rd
Riverside	Iowa Ave
Riverside	Streeter Ave
Riverside	Auto Center Drive
Riverside	Riverside Ave
Riverside	Avenue 52
San Bernardino	Hunts Ln
San Bernardino	Glen Helen Pkwy
San Bernardino	N. Milliken
San Bernardino	Ramona Ave at State Ave

Source: SCAG

1.5 million container lifts would have to be handled at different yards throughout the SCAG region. While the number of truck trips would not change significantly, vehicle miles traveled would be reduced due to the shorter distance from the Ports to the SCIG terminal (about 3 to four miles), compared to the distance to Hobart and East Los Angeles yards terminal (about 20 miles). The Alameda Corridor has sufficient capacity to handle the projected increase in railroad traffic from the ICTF and SCIG.

INTERMODAL TRANSFER CONTAINER FACILITY (ICTF)

The UP has proposed to invest $500 million in a modernization project that will increase the capacity at the ICTF, from the current maximum of 725,000 containers (1.4 million TEUs) to 1.5 million containers (2.8 million TEUs). The project will include the replacement of diesel cranes and yard hostlers with electric ones as well as the addition of six new railroad tracks totaling 50,000 ft. Clean technologies will be utilized to cut facility emissions by 74 percent. An EIR is currently being prepared for this project.

SOUTHERN CALIFORNIA INTERNATIONAL GATEWAY (SCIG)

SCIG is a $500 million project that will create a new near-dock facility for the BNSF adjacent to the San Pedro Bay Ports with direct access to the Alameda Corridor. BNSF forecasts that the new facility will take millions of truck-miles off regional freeways, easing congestion and reducing air pollution. The SCIG will include the use of electric and low-emission equipment and will have requirements that only lower emission trucks serve the facility. The Project was approved by Los Angeles City Council in May 2013.

RAIL GRADE SEPARATIONS

With increasing railroad and highway traffic, vehicle delays at grade crossings are expected to increase substantially by the year 2040. Allowing two intersecting axes of traffic to move concurrently, grade separations of at-grade crossings reduce traffic congestion and delays, as well as emissions from idling vehicles and address other critical rail crossing related concerns such as noise and safety.

TABLE 14 Estimated Cost of the Proposed Package of Rail Projects, by Major Category (Millions of Nominal Dollars)

Category	Estimated Costs
Mainline Rail Improvements	$3,092.40
Port Area Rail Improvements	$1,994.03
Near-Dock Railyard Improvements	$1,000.00
Rail-Highway Grade Separations	$4,870.20
Total	$10,956.63

Source: SCAG

Seventy-one grade crossings throughout the SCAG region were identified for inclusion in the financially constrained 2012 RTP/SCS. To date, seventeen grade separations were completed and opened to traffic as shown in **TABLE 13**.

Twenty-one grade separation projects are currently under construction and are anticipated to be complete and open to traffic in late 2015 to 2016. Further, additional grade separation projects have been identified for inclusion in the financially constrained 2016 RTP/SCS, for a total of forty-two grade separation projects (excluding complete and under construction projects). The forty-two grade separation locations are shown in **EXHIBIT 13.**

Financially Constrained and Strategic Plan (unfunded) grade separation projects are included at the end of this Technical Appendix (**TABLE 17 &18**), along with grade separation maps by county (**EXHIBITS 14, EXHIBIT 15, EXHIBIT 16, EXHIBIT 17, EXHIBIT 18 AND EXHIBIT 19**). The estimated costs of the grade separation projects in the financially constrained plan total approximately $4.8 billion.

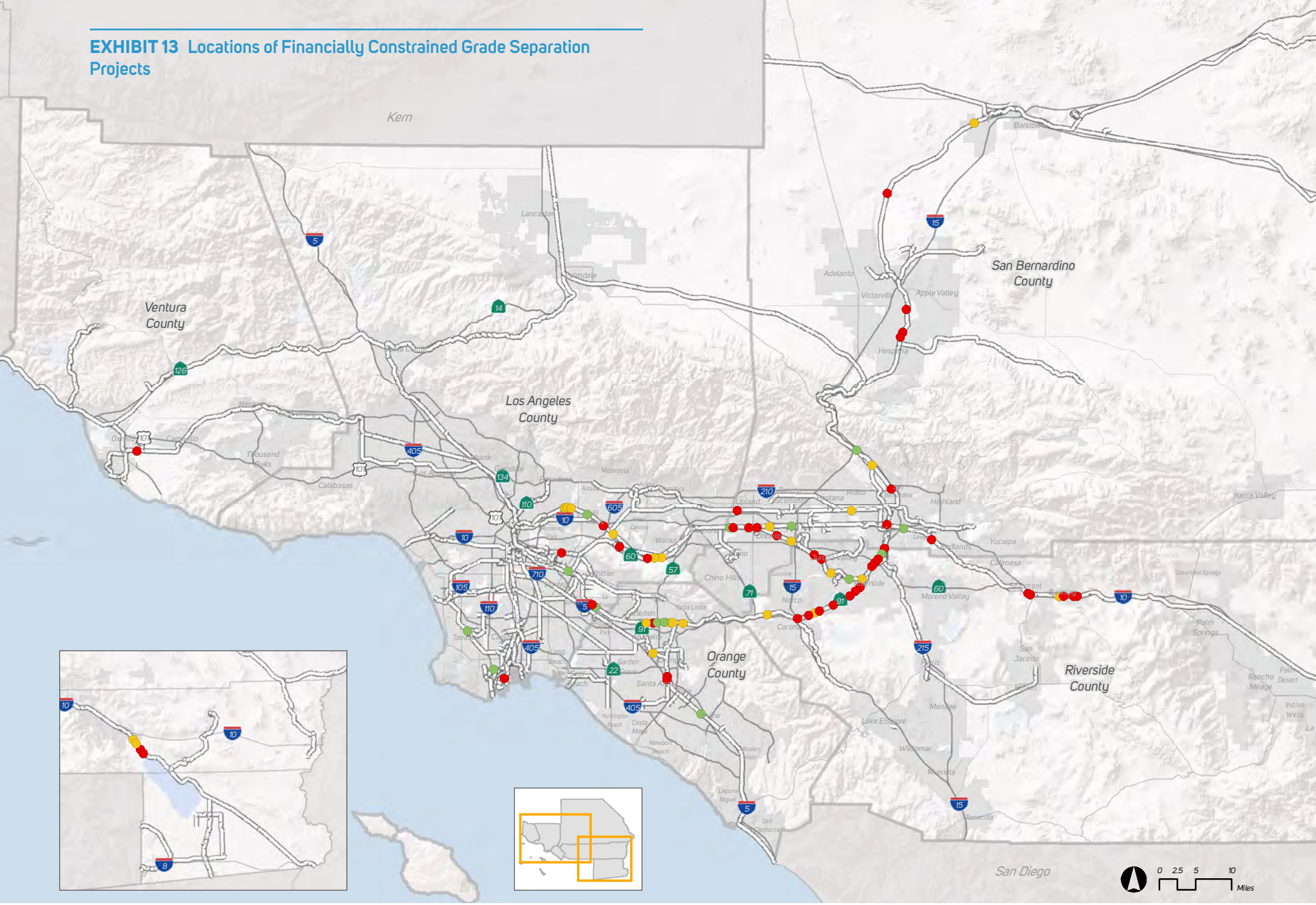
RAIL PACKAGE SUMMARY

As shown in **TABLE 15**, the combined rail package has been estimated to cost approximately $11 billion, including mainline rail improvements, port area rail improvements, near-dock railyard improvements and rail-highway grade separations.

FIGURE 7 Rendering of Gerald Desmond Bridge–Expected 2018

Source: Port of Long Beach

EXHIBIT 13 Locations of Financially Constrained Grade Separation Projects



Constrained Plan Status (as of November 2015): Complete (14) Planned (40) Under Construction (22) Regional Rail Lines

Source: SCAG

OTHER STRATEGIES

SAN PEDRO BAY PORTS ACCESS PROJECTS

Landside access to the San Pedro Bay Ports is provided by highway facilities, including I-110 and I-710 and the Vincent Thomas (SR-47), Commodore Schuyler Heim (SR-103) and the Gerald Desmond Bridges. The San Pedro Bay Ports have long worked with regional and state transportation planning organizations to identify and promote projects that will alleviate congestion to and from port areas and improve air quality in the region (**EXHIBIT 23**).

Some key projects to improve direct access to the San Pedro Bay Ports are already underway, including:

- **The Gerald Desmond Bridge replacement (FIGURE 7):** This bridge, which has been designated as a National Highway System Intermodal Connector Route and part of the Strategic Highway Network, carries nearly 15 percent of the nation's waterborne cargo and is a critical access route for the Port of Long Beach, the Port of Los Angeles, downtown Long Beach and surrounding communities. The new bridge will provide three travel lanes in each direction for improved traffic flow including the emergency lanes on both inner and outer shoulders. The bridge also includes a Class I bicycle facility and pedestrian path along the south side of the bridge, connecting Pico Avenue and Terminal Island. A 205-foot vertical clearance would accommodate some of the largest vessels in the world. The new bridge will be built with a cable-stayed design and will be high enough to accommodate the newest generation of the most efficient cargo ships. In addition, the new bridge will be wider and better able to accommodate existing and future traffic volumes. Currently, the bridge is under construction and is expected to generate about 3,000 jobs. It is expected to be completed between late 2017 and mid-2018.
- **The Pier B Street Freight Corridor Reconstruction Project:** This project is a crucial component to the success and full utilization of the Pier B On-Dock Rail Support Facility, a capital project that is intended to transport more containers by rail. The project involves realigning the roadway, which will facilitate future enhancement of the Pier B On-Dock Rail Support Facility, a critical link between the Port's container terminals and the Alameda Corridor. In addition to the realignment of Pier B Street and Pico Avenue, the project will also enhance the capacity of the roadway by adding additional lanes to the Pier B Street, which would accommodate projected future cargo demand. This "stand-alone" project will also provide safety enhancements for both motorists and pedestrians by increasing its capacity and constructing a new sidewalk on the south side (eastbound) of Pier B Street for pedestrian travel. Upon eventual completion of the Pier B On-Dock Rail Support Facility (which involves the removal of 9th street at-grade railroad crossing), the realigned Pier B Street & Pico Avenue will be designated as a National Highway System Intermodal Connector Route. An EIR is currently being prepared for this project.
- **The Schuyler Heim Bridge Replacement and SR-47 Expressway Project:** Includes replacement of the seismically deficient bridge and development of a truck expressway that will transport port truck traffic on an elevated structure from the new bridge 1.7 miles northwest to Alameda Street. This project is already in the design phase. This project will improve safety (by bypassing three signalized intersections and five rail at-grade crossings) and reduce congestion and delay at many of the Port of Los Angeles' terminals.
- **South Wilmington Grade Separation:** This project was completed in spring 2015 and eliminates the conflict between vehicular traffic and two existing at-grade railroad crossings. The project provides unimpeded grade-separated vehicular access to the South Wilmington area (including for emergency vehicles), eliminates truck queues on surrounding streets, reduces accidents and improves safety in the area.
- **C Street/I-110 Access Ramp Improvements:** This will consolidate two closely spaced intersections and improve connectivity to Figueroa Street and Harry Bridges Boulevard and access to several shipping terminals. This project is currently under construction and is scheduled to be completed in January 2017.
- **I-110/SR-47 Interchange & John S. Gibson Intersection/NB I-110 Ramp Access:** This project will provide an additional lane from the SR-47 connector to NB I-110 and extend the existing off-ramp at John S. Gibson Boulevard. It will eliminate weaving between the slow-moving, on-ramp traffic from San Pedro and the fast-moving bridge traffic from Long Beach to improve the connection between SR-47 and the I-110 Freeway. This project is currently under construction and is scheduled to be completed in June 2016.
- **SR 47 (Seaside Avenue)/Navy Way Interchange:** Construction of interchange at the intersection of SR-47/Navy Way to eliminate the existing traffic signal and movement conflicts. This project removes the last signal on SR 47 between the I-710and the I-110. SR 47 is an NHS Intermodal Connector Route.
- **SR 47/V. Thomas Bridge/Front St Interchange:** This project entails removal of the existing westbound (WB) SR 47/Vincent Thomas Bridge off-ramp (south of the Vincent Thomas Bridge) with Harbor Boulevard and construction of new WB SR 47/Vincent Thomas Bridge off-ramp (north of the Vincent Thomas Bridge) with Front Street. These improvements eliminate the existing non-standard ramp connection to the Harbor Boulevard off-ramp. Front Street is an NHS Intermodal Connector Route and the Vincent Thomas Bridge is a state-owned bridge that is on the U.S. DOT Primary Freight Network. This project also includes realigned eastbound and westbound SR 47 on-ramps.

- **Harbor Boulevard. & 7th Street Intersection:** The project includes a reconfigured intersection at the junction of Harbor Boulevard, Sampson Way and 7th Street. The project improves motorized/non-motorized mobility to/from regional highways (I-110 and SR-47) and the following major regional destinations: community of San Pedro, downtown San Pedro, Catalina Ferry/Freight facility, World Cruise Center, Battleship USS Iowa Museum, Ports O' Call (POC) Village, Alta Sea facility and Cabrillo Beach/Marina. The project entails the elimination of Sampson Way/6th Street intersection, incorporation of synchronized signals into the LADOT Advanced Traffic Control System, the widening of sidewalks from six to 12 feet, the building of textured concrete crosswalks, and Class II bike lanes.
- **Sampson Way to 22nd Street & Miner Street:** Sampson Way would be realigned and expanded to two lanes in each direction and would curve near the Municipal Fish Markets to meet 22nd Street in its westward alignment east of Miner Street. In the proposed project, Harbor Boulevard would remain in place at its current capacity with two lanes in each direction. Proposed enhancements would be consistent with design standards for the Community Redevelopment Agency (CRA) Pacific Corridor and the City of Los Angeles Planning Department Community Design Overlay.
- **Harbor Boulevard Improvements:** As part of the San Pedro Waterfront Development Project, Harbor Boulevard will be restriped and the median removed/reconstructed as needed to provide three northbound through and southbound through lanes between the reconstructed Sampson Way/Harbor Boulevard intersection and the Westbound SR 47 on-ramp/Front Street intersection. This will result in the removal of parking and the bike lane on the northbound side. The parking and five foot bike lane on the southbound side, south of O'Farrell Street, will be preserved. North of O'Farrell Street, the parking and the parking lane on the southbound side would need to be removed to accommodate the northbound dual left-turn lane. The innermost northbound through-lane at the Eastbound off-ramp intersection would become a forced left-turn lane at the SR 47 Westbound on-ramp. This improvement is projected to be needed by the year 2024.

PORT OF HUENEME ACCESS PROJECTS

In addition to the Ports of Los Angeles and Long Beach, the SCAG region is home to the Port of Hueneme in Ventura County. Although smaller, two-way trade activities through the Port of Hueneme were valued at nearly $9.2 billion and generated $1.1 billion in economic activities in the immediate region.[35] Unlike the San Pedro Bay Ports, the Port of Hueneme does not focus on containerized cargo. Instead, its primary imports and exports are refrigerated goods and produce, automobiles, bulk cargo and fuels.

On October 12, 2015, the Port of Hueneme Board of Harbor Commissioners formally adopted the 2020 Strategic Plan, which was developed through a comprehensive public outreach effort that included over 40 interviews with a diverse stakeholder base of port customers, local and regional agencies, Ventura County businesses and community stakeholders. The 2020 Strategic Plan highlights a number of key strategies including:

- Business Retention and Growth;
- New Business Opportunities;
- Waterside Investments;
- Project Funding and Fiscal Planning;
- Terminal Efficiency;
- Agency Coordination;
- Land Use and Logistical Efficiency; and
- Port Safety and Resiliency.

As part of the 2020 Strategic Plan, critical transportation project priorities along the Port Intermodal Corridor include:

- Grade Separation at Rice Avenue and East 5th Street;
- Port Hueneme Road Widening between Ventura Road and Rice Avenue; and
- Rice Avenue Paving (allowing for State Route designation).

In addition to the 2020 Strategic Plan, the following projects and strategies are among those anticipated to reduce truck congestion and other impacts:

- Rice Avenue UP Grade Separation;
- Rose Avenue UP Grade Separation;
- SR-118/Coast Line Grade Separation;
- Rice Avenue Reconstruction from Pacific Coast Highway (Route 1) to US Highway 101; and
- Maintain Port Hueneme Road/Hueneme Road and Rice Avenue as the primary truck access corridors to the Port of Hueneme and encourage trucks to use this route through additional signage.

The Port of Hueneme is also committed to protecting the environment and supporting a quality of life through numerous green initiatives. These include the use of clean energy at the Port, its Stormwater Improvement Plan, and shoreside power for vessels that will provide a 92 percent reduction in particulate matter, a 55 percent reduction in greenhouse gasses, and a 98 percent reduction in NO_x over the 30 year life of the project. For more information, go to http://www.portofhueneme.org/community/environment.

IMPERIAL COUNTY INTERNATIONAL PORTS OF ENTRY

International border crossings between the U.S. and Mexico in Imperial County are critical components of the freight transportation system in Southern California. Within Imperial County, the three ports of entry (POEs)–Calexico West-Mexicali I, Calexico East-Mexicali II and Andrade-Los Algodones–accounted for over $14 billion in international trade in 2014.

While most goods in Imperial County move by truck, the border areas also are served by the UP and Carrizo Gorge Railway (CGR). The Calexico East border crossing is the only international rail crossing in the SCAG region and provides the only rail connection from California into Central Mexico.

According to the Overall Economic Development Commission (OEDC), there are a number of challenges in Imperial County that could constrain future economic development. A lack of adequate transportation infrastructure, at the U.S. - Mexico border is a significant concern, but there are also operational issues that have to be addressed. Some of the most noticeable challenges include:

- The lack of direct freeway connections to railyards and intermodal facilities;
- The lack of dedicated truck lanes, passing lanes and truck bypass routes;
- High truck traffic through urban areas; and
- The impacts of empty trucks returning to Mexico after unloading their cargo in Calexico.

These statements are consistent with findings of recent SCAG goods movement border crossing studies, which found that costs of delays at the border are high. Other major findings were that:

- Border-crossing times in Imperial County's land port of entries (LPOEs) are among the highest along the U.S.-Mexico border;
- Southbound commercial border-crossing times are higher than commonly anticipated, occasionally attaining levels comparable to those of northbound commercial trips;
- Future volumes of goods crossing the border are anticipated to generate significant pressure on current LPOE infrastructure, potentially increasing commercial truck wait times at the border; and
- LPOE users are willing to pay to improve border-crossing times and reliability on northbound trips.

Key transportation strategies identified to improve the flow of goods in the area include:

- Improving interchanges and developing bypasses to appropriate regional roadways;
- Reconstruction of the I-8/Imperial Avenue interchange and Imperial Avenue Extension projects in the City of El Centro which expand to the Calexico East Port of Entry. The proposed projects would increase the number of commercial vehicle inspection lanes and booths from the existing three to six lanes and booths, while widening the bridge over the All-American Canal (Canal serves as U.S./Mexico Border);
- Construction of cold storage facilities in Imperial County to perform pre-inspections and allow streamlined crossing of trucks across the LPOEs; and
- Development at air cargo and intermodal capacity in the region.

HIGH DESERT CORRIDOR

The High Desert Corridor (HDC) project includes the construction of a new 63-mile east-west multi-purpose corridor between SR-18 and SR-14 in Los Angeles and San Bernardino counties. This multi-purpose corridor is composed of a range of alternatives including the possible incorporation of Transportation System Management/Travel Demand Management (TSM/TDM) strategies, expressway/tollway, high-speed rail, a bike route and green energy components. The exact elements that will be included as part of the project are dependent on the outcome of the final preferred alternative. The Draft EIR/EIS for the project was released in fall 2014, and the Final EIR/EIS is scheduled to be completed in spring 2016.

Caltrans and Los Angeles County Metropolitan Transportation Authority (LACMTA or Metro) are in the process of preparing the Draft EIR/EIS for the Northwest 138 Corridor project to analyze a range of alternatives along the 36-mile stretch of SR-138 between I-5 and SR-14. Proposed alternatives include a highway (six-lanes)/expressway (four-lanes), an expressway (six-lanes)/limited access conventional highway (four-lanes) and the TSM alternative to provide operational improvements to the existing SR-138 without adding capacity or access restrictions. Overall, the project will provide for improved connectivity and mobility between I-5 and SR-14.

TRUCK CLIMBING LANES

Additional highway projects that would facilitate goods movement activities in the region include truck climbing lanes. Examples of corridors identified as suitable for truck climbing lanes and currently programmed with funding and/or under construction include I-5, I-10, I-15, SR-57 and SR-60. Truck climbing lanes are additional lanes located outside mixed-flow lanes, which permit slower-moving trucks to operate at their own pace. This enables other vehicles to move at a faster pace, thereby reducing congestion. These lanes are typically placed where slow-moving trucks would cause an obstruction to other vehicles, such as hillsides or other areas with significant grade increases.

INTELLIGENT TRANSPORTATION SYSTEMS (ITS) AND FREIGHT

Under MAP-21, evidence of consideration of innovative technologies and operational strategies, including intelligent transportation systems (ITS), which improve the safety and efficiency of freight movement, is now required for project development. ITS technologies allow freight infrastructure to increase its efficiency and capacity by enabling the value and volume of freight and freight movement to increase while reducing demands on the system. ITS technologies are very flexible and can be applied to the vast transportation infrastructure of highways, streets, bridges, tunnels, railways, seaports and airports, as well as associated vehicles. ITS can also be applied to mobile freight handling equipment, such as cranes, forklifts and conveyor belts. Even the shipping containers used to transport goods can have ITS applications.

Both public agencies and the private sector have recognized the need for a coordinated, strategic approach to ITS deployment and have established direct links between ITS planning and other transportation and strategic planning efforts. It is expected that ITS and technology projects will be specifically identified and funded within every freight funding program and that nearly all freight projects will have an ITS or advanced technology component. Within the SCAG region, there are some key ITS projects that are currently ongoing and are summarized in the following paragraphs.

GATEWAY CITIES TECHNOLOGY PLAN FOR GOODS MOVEMENT

The Gateway Cities Technology Plan for Goods Movement represents the most significant fusion of ITS and freight operation technologies within the region. Through the integration of traditional highway, arterial and traveler information technologies with intermodal freight, port and truck technologies, this project evaluates the potential of providing an end-to-end information support system that can improve the efficiency of goods movement in Southern California. The plan identifies new and expanded technology applications for the Gateway Cities and also includes a concept of operations and business plan. It is being developed by the Gateway Cities Council of Governments and the LACMTA, with close involvement from the Ports of Long Beach and Los Angeles, Caltrans, the SCAG and other key stakeholders.

FREIGHT ADVANCED TRAVELER INFORMATION SYSTEM (FRATIS)

The United States Department of Transportation (US DOT), in conjunction with the Port of Los Angeles, a marine terminal and a drayage trucking company, is currently testing an advanced intermodal logistics information technology system designed to improve drayage and container handling. This system, termed the Freight Advanced Traveler Information System (FRATIS), is a demonstration project funded by the US DOT. The FRATIS project seeks to improve the efficiency of freight operations by using several levels of real-time information to guide adaptive and effective decision making.

The FRATIS project is focused on:

- Improving communications and sharing intermodal logistics information between the truck drayage industry and port terminals so that terminals are less congested during peak hours; and
- Improving traveler information available to intermodal truck drayage fleets so that they can more effectively plan around traffic and port congestion.

Together, these two areas of focus can result in significant improvements in intermodal efficiency, including reductions in truck trips, reductions in travel times and improved terminal gate and processing efficiency. Technologies that are being utilized during the demonstration test include advanced traveler information, port terminal truck-queue-time measurement, automated Estimated Time of Arrival (ETA) messaging to the terminals one day in advance of truck arrivals, direct messaging of trucks by terminals, and employment of an algorithm that will optimize truck deliveries and movements based on several key constraints (e.g., time of day, PIERPASS restrictions, terminal queue status, etc.).

The primary user interfaces for these technologies are a web application for drayage truck dispatchers, a mobile application for drayage truck drivers and messaging and alerts functionality for terminal operators. This demonstration project is currently in operational testing that began in December 2013. US DOT will be expanding the FRATIS project to more container terminals in the Ports of Los Angeles and Long Beach and involve more trucking companies as part of Phase 2.

I-710 AUTOMATED TRUCK RESEARCH

This project will implement a staged progression of commercial vehicle technologies in order to transition from current research-based, automated, commercial vehicle demonstration efforts to staged operational testing of a flow efficiency system of trucks along the planned I-710 truck lanes. The project will build upon the unique operational environment and potential partnerships of the Gateway Cities region to promote and enhance truck automated commercial vehicle research by bringing together the applications of automated commercial vehicle and automation technologies on one of the most heavily congested truck corridors in the country. The project will examine and test the specific design and operational concerns that impact the future development of I-710 and its approaches.

The Truck Platooning Demonstration Project is an intermediate step toward a long-term vision of trucks operating in closely coupled automated platoons on both long-haul and short-haul freight corridors. As part of the I-710 South Corridor project, one of the build alternatives considers dedicated truck lanes on a separate structure. Through the use of Vehicle-to-Vehicle (V2V) communication and suitable sensor technologies, the automated trucks will be able to follow each other in platoons at separations of just a few feet on a dedicated corridor. In addition, V2V and Cooperative Adaptive Cruise Control (CACC) will be

tested in mixed-flow traffic conditions on the highway system as a short-term solution, if dedicated truck lanes are not implemented in the near term.

Caltrans and Berkeley PATH received approximately $1.6 million to test Cooperative Adaptive Cruise Control (CACC) on heavy trucks, enabling them to electronically couple themselves so that they occupy less space and use less energy than if driven independently. The project was initiated in September 2014.

ADVANCED TRANSPORTATION MANAGEMENT INFORMATION SYSTEM (ATMIS)

The Ports of Los Angeles and Long Beach have deployed the ATMIS to monitor truck traffic within the Ports using vehicle detection devices and closed-circuit television cameras. A traffic management center operated jointly by the Ports provides traveler information, including real-time traffic conditions and incidents on changeable message signs in the vicinity of the Port area.

AUTONOMOUS COMMERCIAL VEHICLES

Autonomous vehicle technology is also being tested outside the SCAG region. For instance, on May 5, 2015, State of Nevada awarded the first license for an autonomous commercial truck to operate on a public highway to Daimler Trucks North America (DTNA). This autonomous vehicle technology is expected to help reduce accidents, improve fuel consumption, reduce highway congestion and in turn, address environmental impacts. This pilot project links together sophisticated camera and radar technology with systems providing lane stability, collision avoidance, speed control, braking, steering, and an advanced dash display to allow for safe autonomous operation on public highways.

Trucks such as the Daimler truck may have applications in the SCAG region once the technology becomes commercially available. The autonomous commercial truck is not a driverless truck; however, it provides a state-of-the-art dash interface and connectivity for a better driving experience. It is able to greatly improve the way data from the truck's performance is communicated to the driver. The highway pilot informs the driver visually on its status and also accepts commands from the driver. Taking connectivity to another level, video displays inside the truck are capable of replacing exterior mirrors. Not only does this boost fuel efficiency by up to 1.5 percent, but the use of tiny cameras on the exterior of the truck greatly reduces blind spots. With the safety features on the trucks, drivers can optimize their time on the road by handling other important logistical tasks, from logging to routing. The technology contributes to improved safety and efficiency, while allowing for improved communication through connectivity and integration.

GOODS MOVEMENT ENVIRONMENTAL STRATEGIES

EXISTING AND PROJECTED ENVIRONMENTAL CONDITIONS

Ships, trucks, trains and other goods movement equipment are among the largest contributors to regional air pollution, which must be reduced to comply with federal law and improve quality of life. Criteria pollutants such as NO_x, $PM_{2.5}$, SO_x and CO can have significant public health impacts, including contributing to asthma and other respiratory ailments, increased stress and increased cancer risk. In addition, noise, safety issues, aesthetic changes, vibrations and natural resource depletion associated with goods movement impact quality of life and may have health implications. Freight transport is also a major producer of greenhouse gas (GHG) emissions and a user of energy in the form of diesel fuel.

Currently, much of the SCAG region fails to meet federal ozone and fine particulate air quality standards as mandated by the federal Clean Air Act. The South Coast Air Basin (SCAB) which includes most of the SCAG region, has a deadline to reduce ozone concentrations to 80 parts per billion (ppb) by 2023 under the revoked 1997 eight-hour ozone standards and to 75 ppb by 2031 under the current 2008 8-hour ozone standards. Moreover, new federal ozone standards are expected to be finalized by the EPA in the 2015/2016 time frame. Currently, the proposed range is 65-70 ppb, with an expected new attainment deadline of 2037. This translates to a need to reduce NO_x emissions in the South Coast Air Quality Management District (SCAQMD) by 65 percent by 2023 and 75 percent beyond projected 2023 emissions by 2032 (beyond the benefits of all adopted programs) in order to attain federal ozone standards.[36]

In addition, both the South Coast Air Basin and the urbanized area of Imperial County have been designated as a "Moderate" nonattainment area under the new 2012 annual $PM_{2.5}$ standards. The statutory attainment deadline is 2020 and the new annual $PM_{2.5}$ standard is 12 micrograms per cubic meter (µg/m3) versus the previous standard of 15 µg/m3. If appropriate measures to meet federal standards are not adopted, federal transportation funds may be jeopardized and permitting of stationary facilities may be restricted. The federal government may also take over air regulation if state plans are not adequate to meet federal standards.

Goods movement sources include trucks, locomotives, cargo handling equipment, marine vessels and aircraft. These sources, combined with all mobile sources in the region, emit approximately 90 percent of regional NO_x.[37] In 2014, heavy-duty trucks contributed 71 percent of NO_x emissions and locomotives contributed nine percent, of NO_x emissions from

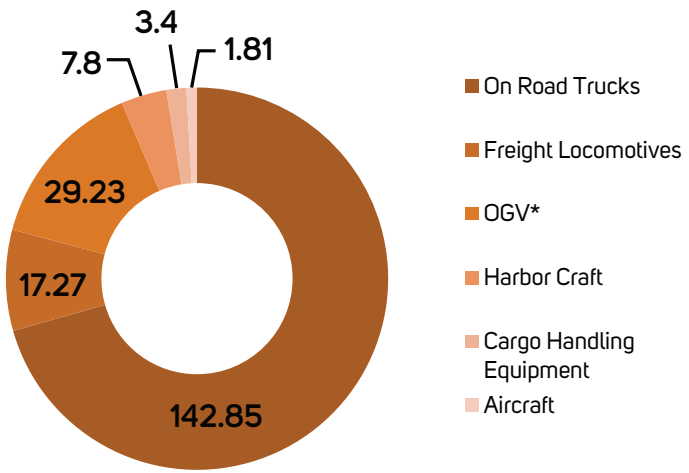
goods movement related sources. **FIGURE 8** shows the distribution of emissions from various goods movement sources.

Several regional and state efforts are intended to reduce criteria pollutants such as NO_x and $PM_{2.5}$. Many of the regulations and programs in place will likely have co-benefits for GHG reductions. The California Air Resources Board's (CARB) truck and bus regulation, as well as state and local incentive programs, were put into place to accelerate the introduction of cleaner technology. The Heavy Truck and Bus rule, passed in 2008, first implemented in 2012 and then amended in 2014, requires that by 2023 nearly all heavy duty vehicles (HDVs)will have engines that are model year 2010 or newer. Additionally, various incentive programs have since funded deployment of hybrid-electric and cleaner fueled trucks. Given existing programs and control measures, truck NO_x emissions are expected to decrease from 142.85 tons per day (tpd) in 2014 to 56.4 (tpd) in 2032.[38] This forecast is displayed **FIGURE 9**.

Additional state programs are under development as part of the California Sustainable Freight Strategy (SFS). Though not finalized, the SFS is intended to create a sustainable freight system that is primarily powered by zero-emission technologies and near zero-emissions technologies, when a zero emissions option is not a viable option. The plan defines sustainability broadly and is intended to meet environmental, economic, energy and transportation objectives. CARB is working closely with other state agencies including Caltrans and The Governor's Office of Business and Economic Development ("GO Biz") to make this a fully integrated plan. To date, the sustainable freight initiative has involved broad outreach statewide, technology assessments and identification of near-term and longer-term actions that include fleet turnover and improved system efficiency.

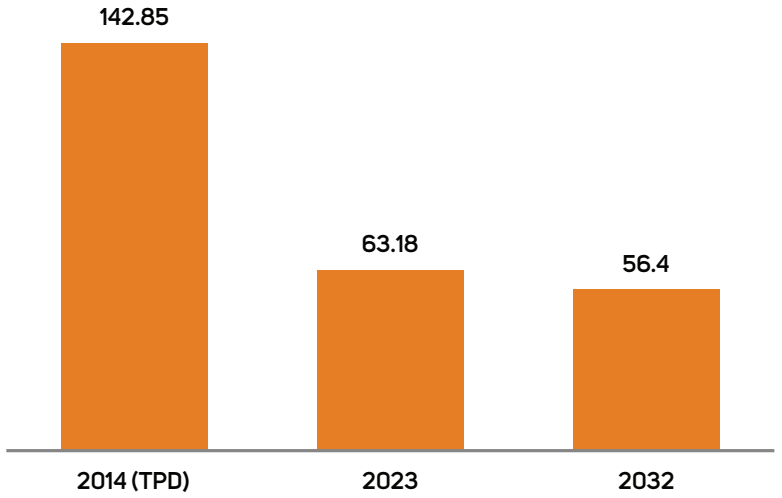
GHG emissions are also produced by goods movement sources. On a national scale, heavy-duty vehicles were only four percent of registered vehicles on the road in 2010, but they accounted for approximately 25 percent of on-road fuel use and greenhouse gas emissions in the transportation sector.[39] In September 2011, the EPA and the US DOT's National Highway Traffic Safety Administration (NHTSA) finalized the first round of standards for medium- and heavy-duty vehicles, creating fuel efficiency standards for model year 2014-2018 vehicles. Stricter Phase 2 standards are expected to be finalized in 2016. The proposed new standards would be for model year vehicles from 2021-2027 and are expected to cut national GHG emissions by approximately 1 billion metric tons and conserve about 1.8 billion barrels of oil over the lifetime of the vehicles sold under the program.[40] The U.S. Department of Energy has also started a Super Truck (2010) program to develop and demonstrate more fuel efficient trucks that will increase engine efficiency and overall fuel economy from about 6.5 miles per gallon to about 9.75 miles per gallon. To date, the four manufacturers involved in this program have improved engine efficiency and fuel economy. For instance, Cummins and PACCAR's Peterbilt Motors Company have reached over ten miles per gallon under real world driving conditions on a Class 8 tractor-trailer.[40]

FIGURE 8 2014 Distribution of NOx Emissions from Goods Movement Sources



*Source: SCAQMD (June 2015) "Preliminary Draft AQMP White Paper Goods Movement: * Ocean Going Vessels*

FIGURE 9 Truck Emissions Baseline and Forecast NO_x (Tons Per Day)



*Source: SCAQMD (June 2015) "Preliminary Draft AQMP White Paper Goods Movement: * Ocean Going Vessels*

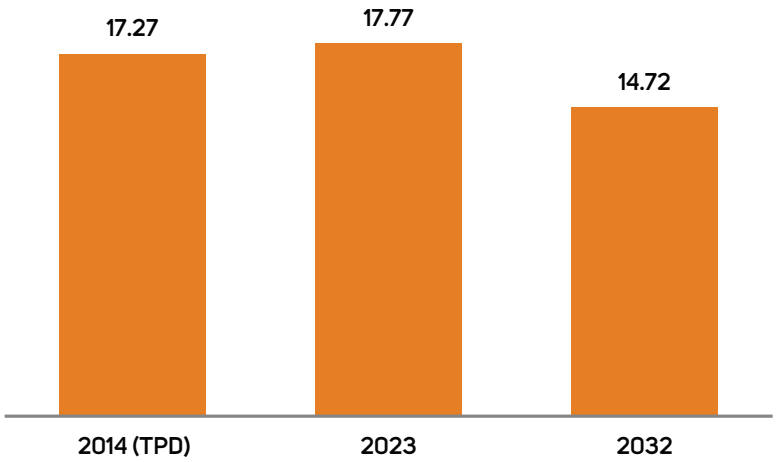
At the state level, reducing GHG emissions is a priority, as established by landmark legislation such as AB 32 and SB 375. In April 2015, Governor Brown signed Executive Order B-30-15, which calls for a reduction in GHG to 40 percent below 1990 levels by 2030 as a way of ensuring that the earlier targets of Executive Orders B-16-2012 and S-03-05, which require transportation GHG emissions to be reduced 80 percent below 1990 levels by 2050, are met. Between 2012 and 2016, the State of California has continued to implement GHG reduction measures to meet these goals, with some implications for freight. For instance, the Low Carbon Fuel Standard requires a minimum of ten percent reduction in carbon intensity of transportation fuels, based on a life cycle analysis of the fuel, by 2020. Beginning January 2015, GHG emissions from transportation fuels are included under the Cap-and-Trade Program. Additionally, in 2013, CARB adopted the Federal Phase 1 standards (passed in 2011) for heavy duty vehicles manufactured for use in California. This harmonization of standards is set to reduce new vehicle emissions by four to five percent per year from 2014-2018.[41] While a regional forecast is not available for GHG emissions, CARB reports that GHG emissions from goods movement sources statewide will continue to increase. For instance, GHG emissions from trucks increase from 20 million metric tons CO_2 in 2012 to just over 30 million metric tons of CO_2 in 2040.[42] Because most control measures to date focused on reducing criteria pollutants harmful to human health, CO_2 emissions show a different trend by increasing over time, rather than decreasing.[43]

It is also a regional priority to reduce rail pollutants and work toward the objective of a zero- and near zero-emission freight rail system. At the federal level, regulations are in place that will contribute to future reductions in rail emissions, including the U.S. EPA Locomotive Engine Standards, the 2008 EPA rulemaking to reduce locomotive idling and the EPA non-road locomotive and marine (NRLM) fuel sulfur rule. The EPA Tier 4 locomotive standards also become effective for all new engines in 2015, and Tier 4 are now available from General Electric (GE). GE was able to achieve the Tier 4 standard without using Selective Catalytic Reduction (SCR) for after-treatment, eliminating the need for an extra urea storage tank and reducing the complexity and cost of using a Tier 4 engine. GE estimates that these engines will reduce emissions by 70 percent as compared to a Tier 3 engine.[44] Given current regulations, NO_x emissions from rail are expected to decrease from 17.27 tpd in 2014 to 14.72 in 2032. The emissions forecast for rail emissions is shown in **FIGURE 10**.

In the South Coast Air Basin, attaining the national ozone standards will require reductions in emissions of NO_x well beyond reductions resulting from current rules, programs and commercially-available technologies. Previous regulations and incentive programs have improved vehicle emissions performance, but as the region grows, existing measures are not enough to realize attainment of the ozone standards in the 2023 and 2031 time frames. With the projected changes in both truck and rail emissions, greater advancements in technology are needed to meet regional attainment objectives. As such, the 2016 RTP/SCS includes an action plan to facilitate technology development and reduce emissions.

The 2016 RTP/SCS Goods Movement Environmental Strategy was developed to address community health concerns, federal attainment requirements and climate change issues, while contributing to our economic and energy security goals. Accordingly, the strategy emphasizes coordinated solutions for mobility, economy, energy and environment so that investments can provide multiple benefits. This 2016 RTP/SCS continues to focus on the long-term goal of a zero-emission goods movement system where technically feasible and economically viable, while also integrating near zero-emissions technologies that serve as bridging options to continue to reduce emissions below today's levels. It is important to note that the term "zero-emission" as used throughout this document refers to technologies that are zero tailpipe emissions, where emissions are not released at the location of the vehicle, but may still be produced off-site through the production of energy needed to power the vehicle. For instance, electric vehicles may be zero tailpipe emissions while in use, but emissions are still being generated at the location of the power plant that is producing energy to power or charge the vehicle. Similarly, emissions may be generated in the production and transportation of fuels used to power the vehicle. Though this plan supports immediate accelerated deployment of existing proven technologies that will serve to improve the region's air quality, this investment must be balanced with investment in our long-term goal of zero- and near zero-emission freight system. Continued innovation, partnerships with the private sector and building on lessons learned will help us achieve the goal of a robust zero- and near zero-emission freight system.

FIGURE 10 Rail Emissions Baseline and Forecast NOx (Tons Per Day)



SCAQMD (June 2015) "Preliminary Draft AQMP White Paper Goods Movement:

GOODS MOVEMENT ENVIRONMENTAL STRATEGY AND ACTION PLAN

ACTION PLAN FOR ADVANCEMENT OF ZERO-EMISSION TECHNOLOGY

In the 2008 RTP, recommendations for truck emissions reduction strategies included truck replacement, engine repowering, exhaust treatment device retrofits and alternative fuels. In 2012, the RTP/SCS included near-term measures similar to those in 2008, in addition to near zero-emission strategies. Further, the 2012 RTP/SCS included a Technology Advancement Plan to develop and deploy a fully zero-emission goods movement system in the 2035 time frame. Since the 2012 RTP/SCS, several key action steps have been taken. The 2016 RTP/SCS proposes an updated environmental action plan for the goods movement system that builds on regional progress to date. As the four phases of the updated action plan are reviewed below, the text also points to progress made related to specific action steps identified in 2012.

The technology development and deployment plan put forth in this Appendix is inclusive of all stages of technology development and deployment: beginning from an initial definition of key operational parameters, moving through prototype development, initial demonstration and evaluation, and eventually a staged roll-out. This start-to-finish framework is useful as there are many potential technologies available, each at different stages of readiness.

The four phases of the action plan applicable to technology solutions are (**FIGURE 11**):

- **Phase 1:** Project Scoping and Evaluation of Existing Work
- **Phase 2:** Evaluation, Development and Prototype Demonstrations
- **Phase 3:** Initial Deployment and Operational Demonstration
- **Phase 4:** Full-Scale Demonstrations and Commercial Deployment

PHASE 1: PROJECT SCOPING AND EVALUATION OF EXISTING WORK

The project scoping stage of technology development is intended to define the needs that the new technology must provide. In addition to meeting the overriding goal of zero emissions, new technologies must have adequate range, power and charging capability to serve business needs. This stage of exploring market needs and potential applications that could meet those needs has already begun.

Project scoping also includes an understanding of the best state of technologies. Zero-emission freight technologies are evolving and some technologies are moving closer to market readiness. It is important to stay aware of progress made in this area. In 2012, the Zero-Emission Freight Collaborative was formed to foster the regional development of zero-emission technologies and share information on progress made in technology advancement. The collaborative includes SCAG, LACMTA, the Gateway Cities Council of Governments, the Port of Los Angeles, the Port of Long Beach and the South Coast Air Quality Management District. The group shares knowledge and findings about ongoing testing efforts and works together to attract funding to the region for additional testing and development.

This project scoping stage began prior to 2012, and we have learned and tracked information about operational needs and technology readiness. However, ongoing work is needed in this area, particularly to learn how industry could best incorporate new technologies into their daily operations. As several companies have begun to implement energy saving and emissions reducing practices, it is important to determine if these are indeed "best practices" and to determine if these practices can be replicated for other companies operating throughout the region.

FIGURE 11 Phases of Technology Development and Deployment

****PHASE 1 ACTION STEPS ACCOMPLISHED SINCE 2012:**

Continue to research goods movement user-markets and associated infrastructure needs while exploring a range of technologies as appropriate with equipment manufacturers.

In the past four years, many studies have been done to evaluate new technologies and the role that they may play in the SCAG region as well as to better understand market criteria and operational parameters. At least two studies were conducted that began to define operational criteria for trucks in the SCAG region. These studies analyzed performance parameters and operational needs for drayage and regional truck trips. One key finding was that flexibility is critical as trucks often rotate between routes and markets. Operators commonly reported that a vehicle must have sufficient power for operation (400 horsepower [HP], 1,200-1,800 foot pounds [ft-lbs] of torque) and be able to travel at least a 200 mile range. Additionally, vehicles generally refuel every 2-3 days and have a lifespan of approximately 600,000 miles. Please see the studies below for additional information:

- Characterization of Drayage Truck Duty Cycles at the POLB and POLA, (TIAX, LLC, prepared for POLA and POLB); March 2011.[45]
- Key Performance Parameters for Drayage Trucks Operating at the Ports of Los Angeles and Long Beach, (CALSTART, prepared for LACMTA and Gateway Cities COG); November, 2013.[46]

The studies listed below are a sampling of work that has been completed to date to evaluate technological readiness, emissions benefits and potential operational performance. This work continues to date as technologies evolve towards full commercialization. Please see the following studies for more information:

- Evaluation of Environmental Mitigation Strategies, (ICF on behalf of SCAG); April 2012
- Zero Emission Catenary Hybrid Truck Market Study (Gladstein Neandross & Associates (GNA) on behalf of SCAQMD); March 2012
- Moving California Forward, Zero and Low Emission Freight Pathways (GNA on behalf of the California Cleaner Freight Coalition); November, 2013
- Pathways to Near-Zero-Emission Natural Gas Heavy Duty Vehicles (GNA on behalf of Southern California Gas Company); May 2014
- DRAFT–Port of Los Angeles Zero Emission White Paper, (POLA), June 2015.

PHASE 2: EVALUATION, DEVELOPMENT AND PROTOTYPE DEMONSTRATIONS

As technology development progresses, Phase 2 includes the development, design validation and initial demonstration of several types of advanced prototype vehicles and testing of the initial prototype. Phase 2 includes performance assessment of new technologies, including addressing market risks/uncertainties. As prototypes are developed and demonstrated, significant evaluation will also occur.

Developing and testing zero-emission prototypes requires considerable investment from both public and private sector partners. It is the original equipment manufacturers (OEMs) that must invest in research and development, with the assurance that there will be a market for their product when it becomes commercially viable. Both large companies and smaller startups have invested in new technology development. Particularly for smaller companies, it is important to receive public financial support for prototype development. Several successful partnerships already exist where public funding combines with private sector investment to develop technology prototypes. Once prototypes are available, it is beneficial for them to be tested in operational service with industry operators. Existing partnerships allow for trucking companies and terminal operators to integrate and experiment with new technologies in their everyday business operations.

****PHASE 2 ACTION STEPS SINCE 2012:**

Convene Logistics Working Groups

Since 2012, the region has formed the Los Angeles County Zero Emission Truck Collaborative. This group includes LACMTA, the Gateway Cities COG, POLA, POLB, SCAQMD and SCAG. This group meets to coordinate on advanced technology initiatives including applying for advanced technology funding, evaluating new technology proposals and collaborating on technology demonstrations.

Determine a set of market criteria to move trucks forward to successful commercialization

See examples listed in Phase 1.

Secure funding commitments for the development of vehicle prototypes and infrastructure demonstrations

Since 2012, the region has secured several funding commitments to continue with zero-emission technology research and demonstration. For instance, the POLA and POLB Technology Advancement Program (TAP), provides funding to test new technologies in ongoing terminal operations. Ports partner with industry and provide $3 million annually to develop and test new clean air technologies. The TAP addresses clean air technologies for rail, truck, ship, cargo handling equipment and harbor craft. In addition, several grants have been secured including:

- Several funders (including the SCAQMD, the California Energy Commission (CEC), the U.S. EPA and several regional partners) have contributed roughly $13.5 million to construct and demonstrate a one-mile Overhead Catenary System (OCS) in the City of Carson and develop prototype trucks to assess compatibility with the OCS. In-kind contributions from OEMs increase the total value of this project.
- In 2012, the SCAQMD received a U.S. Department of Energy (DOE) grant of $4.2 million to develop and test 13 zero-emission drayage trucks using various technologies.
- In 2014, a second DOE grant of $9.5 million was granted to SCAQMD for the development and demonstration of zero-emission fuel cell range extended electric drayage trucks and hybrid electric drayage trucks.

Moreover, the state Cap-and-Trade Program's Greenhouse Gas Reduction Fund may also emerge as a funding source for the development of clean vehicle prototypes and infrastructure demonstrations. Regional partners have submitted applications in response to recent competitive grant solicitations for various categories of low carbon transportation initiatives.

Develop and demonstrate truck and truck wayside power prototypes

The 2012 RTP/SCS included a $35 million line item for a wayside power system to be demonstrated in two phases. Phase 1, a one-mile test track, has begun in the City of Carson.

Further study of operational impacts of zero-emission rail technologies/ Evaluate practicability of applying existing electrified rail technologies

Regional and state efforts such as the CARB Technology Assessments for rail and the SCAQMD Goods Movement White Paper have continued to explore operational impacts of zero-emission rail technologies. Additionally, several demonstration projects have been completed.

Select truck technologies for continued fleet evaluation under Phase 3/ Identify vehicle technologies and wayside power applications to be tested under operational demonstrations in Phase 3

Evaluation of technologies has begun throughout the course of several demonstration projects. As technologies evolve and more is learned about them, SCAG maintains a technology neutral position.

PHASE 3: INITIAL DEPLOYMENT AND OPERATIONAL DEMONSTRATION

Phase 3 is an opportunity to scale up research and development efforts to evaluate not just a prototype, but the performance of a larger fleet of vehicles. In this phase, industry partners are critical to test and evaluate larger vehicle fleets in everyday business operations. In addition, these tests may serve in part as initial deployment of cleaner vehicles. Assuming a successful demonstration, the industry partner may opt to continue to use these emergent technologies. Another opportunity for initial deployment is the use of incentive programs, where all, or a portion of, the incremental cost of the new technology is subsidized. For instance, the CARB Multi-Source Facility Demonstration Project, provides over $23 million to demonstrate technologies that are within three years of commercialization.[47] This type of program provides an opportunity to see how new technologies work in practice, while at the same time hastening their placement into service. In the initial deployment phase, incentive programs can continue to support industry in this transition.

PHASE 4: FULL SCALE DEMONSTRATIONS, COMMERCIAL DEPLOYMENT AND INFRASTRUCTURE CONSTRUCTION (IF WAYSIDE POWER IS NEEDED)

The prior stages of technology testing and demonstrations will have prepared the region for Phase 4 deployment using the commercialization, regulatory and market steps determined in prior phases. Any new technology deployment must be coordinated with infrastructure planning, and key decisions will be incorporated into RTP updates and future State Implementation Plan revisions. During Phase 4, technologies will be deployed as they meet the criteria for deployment established by regional stakeholders. As various technologies are currently in different stages of readiness, it is assumed that their deployment will be staggered throughout the 2020-2040 timeframe.

In this stage, there may be a greater role for planning agencies as it will be critical to provide infrastructure that supports the deployment of new technologies. If wayside power is deemed applicable, this may be incorporated into infrastructure planning. Additionally, the public sector must continue to use incentives, regulatory and market mechanisms to facilitate full commercialization and work with private sector users and developers to make sure that advanced technologies are integrated into regional transportation networks.

TIMELINE AND KEY ACTION STEPS

FIGURE 12 shows updated action steps and time frames to implement the phases outlined previously. Further details are provided in **TABLE 15** and **TABLE 16**. The time frames suggested in this plan are broad and will likely capture a majority of technologies that can serve the region's needs. However, as innovation is continuous, these time frames may not catch all technologies, and the development of particular technologies may either exceed or lag behind proposed time frames. The ability to create partnerships and procure funding for research and development efforts will also influence the timeline for technology

development. As explained below, this plan of technology development, evaluation and eventual deployment will be undertaken in close cooperation with regional partners and industry stakeholders.

AGENCY AND PARTNER ROLES AND RESPONSIBILITIES FOR ACTION

In addition to the phases described above, significant regional actions will be needed in order to realize this vision of a zero- and near zero-emission freight transportation system that meets regional objectives for long-term sustainability and can also meet the performance objectives required by industry. SCAG may act together with key partner agencies such as the Port of Los Angeles, the Port of Long Beach, the SCAQMD and the region's county transportation commissions to update and implement this plan as needed. Stakeholders must work together to share and evaluate new information as it becomes available.

Important roles for these partners include:

- Identify funding to support technology evaluation and demonstration efforts in the financially constrained RTP.
- Advocate for additional federal funding to support technology evaluation and demonstration efforts.
- Advocate for additional state funding to support technology evaluation and demonstration efforts.
- Advocate for state funding to support deployment incentives to keep costs manageable for industry.
- Demonstrate the holistic importance of new technology development for co-benefits such as energy security, energy cost certainty, climate protection and green-sector job development.
- Evaluate mechanisms for advanced technology implementation such as incentives, differential tolls and public private partnerships.
- Continue to lead demonstration projects and evaluate and share the results with partner agencies and private sector partners.
- Continue to engage and collaborate with the private sector to continuously solicit feedback on operational parameters and real world operating conditions.
- Encourage private sector partners to participate in operational demonstrations. Partners are needed to evaluate the performance of technologies in a real world setting.
- Support partnerships with OEMS for technology development and send a consistent signal to OEMs that there will be market demand for the new technologies they are investing in and creating.

FIGURE 12 Timeline and Key Actions Steps

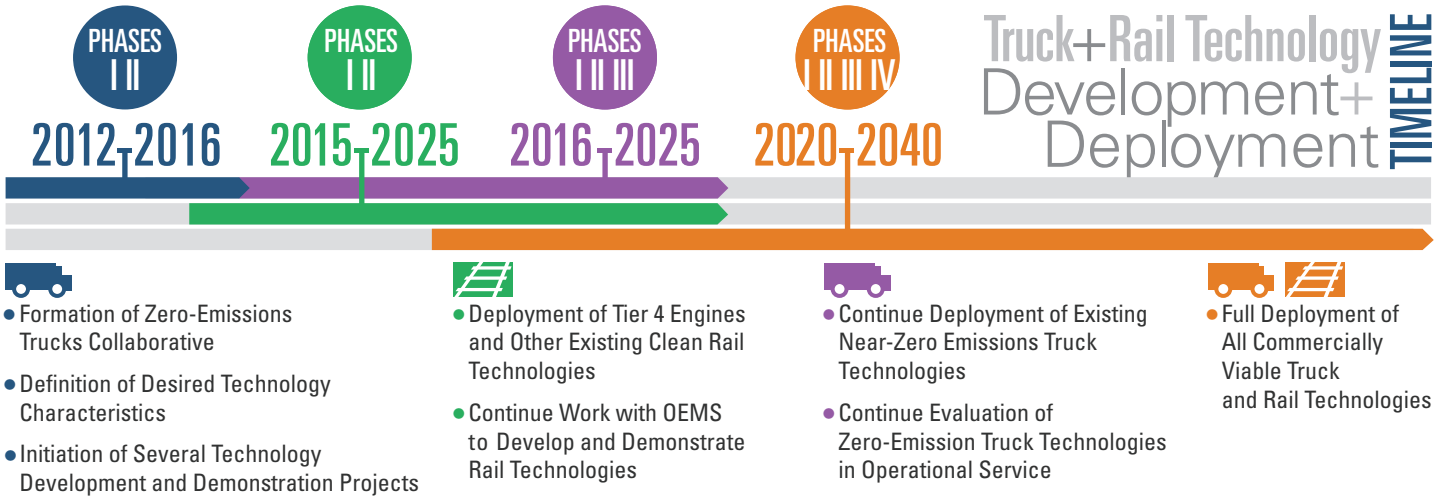


TABLE 15 Timeline for Zero-Emission Truck Deployment

Years	Phase	Trucks
2012-2016	1, 2	The 2012 RTP/SCS includes an environmental action plan for a zero- and near zero-emission freight transportation system, including a line item for a near-term demonstration of the Zero Emission Container Movement System project for $35 million. The Zero-Emission Trucks Collaborative comprising LACMTA, SCAQMD, Port of LA and Port of Long Beach, Gateway Cities Council of Governments, and SCAG is formed. Original Equipment Manufacturers (OEMs) continue development and testing of zero- and near zero-emission truck models, including battery electric and fuel cell models. Several technology development and demonstration projects are initiated. See "Phase 2" description above for more detail.
2016-2020	1, 2, 3	Continue deployment of existing near zero-emission truck technologies (described below under "Near-Term Truck Technologies") Continue development and evaluation of wayside power and other technologies. Continue to partner with federal, state and private funding partners to finance technology development. Continue to collect and evaluate information from ongoing zero-emission technology demonstrations. As feasibility is demonstrated, ensure that the "tests" remain in service and begin to scale up efforts. Begin initial deployment, with industry partners who can put test trucks into immediate service. Continue investigation of mechanisms (i.e., regulatory, market based, incentive based) to facilitate technology deployment.
2020-2040	1,2, 3, 4*	If applicable, plan for wayside power system. Begin deployment of appropriate zero- and near zero-emission trucks (see examples under "Long Term Truck Technologies" below) and continue operational demonstration.

**Stages 1 and 2 will likely be completed prior to this time frame. However, to allow for continuous innovation in new and improved products, we assume that project scoping and early phases of the development/deployment cycle will continue to occur as new products and technologies are considered.*

TABLE 16 Timeline for Zero Emission Rail Deployment

Years	Phase	Rail
2012-2016	1, 2	The 2012 RTP/SCS includes an environmental action plan for a zero- and near zero-emission freight transportation system, including near-term measures for genset and switcher engines and recommends further study of viable zero- and near zero-emission rail technologies. Original Equipment Manufacturers (OEMs) finalize development of Tier 4 engines and continue to build hybrid electric locomotive prototypes. Partner agencies continue demonstration projects.
2015-2025	1, 2	As old locomotives are replaced, Tier 4 will be deployed as required by the U.S. EPA. Encourage use of retrofit kits on existing engines as they are serviced or re-manufactured. Continue to work with OEMs to develop and demonstrate zero- and near zero-emission technologies.
2020-2040	1, 2, 3, 4*	As zero- and near zero-emission rail technologies can be practicably applied to the region, fully deploy such technologies.

**Stage 1 will likely be completed prior to this timeframe. However, to allow for continuous innovation in new and improved products, we assume that project scoping and early phases of the development/deployment cycle will continue to occur as new products and technologies are considered.*

In addition to facilitation of development, demonstration and deployment, it is important that SCAG and other regional partners continue to advocate for additional funding for technology development efforts as well as the proper regulatory and market structure to deploy these technologies. In the past, the Southern California National Freight Gateway Collaboration has successfully advocated for additional technology investment with the National Freight Advisory Committee, FHWA and CALTRANS. In fact, the California Freight Mobility Plan includes a $3 billion line-item for the development of new technologies.

Regional partners may also facilitate a greater understanding of potential market and regulatory mechanisms to support and enable zero- and near zero-emission truck commercialization and widespread deployment. Models may include incentives, buy-down rebates, preferred or exclusive access to port service, exclusive or preferred access to corridors, etc. Truck manufacturers and technology developers will be included to determine a set of market criteria (i.e. the minimum market size and volumes of vehicles needed to move forward to successful commercialization.) Incentive structures may be financial, such as subsidies or financing of incremental capital costs of new clean technologies; or non-financial, such as reduced tolls for zero-emission vehicles, expedited access to freight facilities, dedicated lanes for advanced clean technology trucks, or public recognition programs for companies utilizing advanced clean technologies.

NEAR-TERM AND LONG-TERM TECHNOLOGIES FOR COMMERCIAL DEPLOYMENT

The 2016 RTP/SCS recommends a two-pronged environmental strategy to be implemented in the four phases outlined in the previous section. SCAG recognizes that not all technologies have advanced to the stage where they can be implemented immediately. As the region works to advance and deploy current prototype technologies (i.e., those that are currently in Phase 2), focus should be placed on commercializing and implementing existing solutions as well (i.e., implementing those that are currently in Phases 3 & 4). For trucks, several near-zero emission clean-fuel trucks and hybrid trucks are currently available but require a more aggressive deployment. Technological advancement also has increased efficiency and reduced emissions of the conventional combustion engine. Additional zero-emission vehicle types are in the prototype stage but need further testing to advance to full commercialization. It is worth pointing out that operational strategies discussed elsewhere in this Appendix can also reduce emissions by improving overall system efficiency. For instance, the bottleneck strategy described in earlier sections and the rail strategy, which proposes new grade separations, can reduce emissions by improving operating conditions and reducing congestion.

For rail, near -erm technologies for switcher locomotives can reduce emissions at railyards. With cleaner Tier 4 locomotive engines currently available, accelerated replacements of locomotives with Tier 4 engines are also needed to reduce emissions. A longer-term objective of a zero-emission rail system, or the ability to operate in zero-emissions mode while in the region, can be reached through further technology development. This section will briefly describe both near- and long-term technologies that have the potential to reduce emissions and help the region meet attainment deadlines. The technologies identified in this section serve as examples of potential near- and long-term options for further study and do not constitute specific technologies under the financially constrained RTP/SCS.

NEAR-TERM TRUCK TECHNOLOGIES

The trucking market offers unique challenges due to heavy weights, operational performance requirements and high incremental costs. However, several reduced-emissions trucks are currently commercially available and many zero- and near zero-emission trucks are under development for future deployment. Three categories of potential near-term improvements are trucks using a cleaner fuel, such as natural gas, hybrid-electric trucks and improvements to the existing combustion engine.

CLEANER FUEL TRUCKS

Alternative fuels include compressed and liquefied natural gas (CNG, LNG), liquefied petroleum gas (LPG, i.e., propane), ethanol, methanol, dimethyl ether (DME), hydrogen and nonpetroleum biodiesel fuels.[48] Natural gas trucks use compressed natural gas (CNG) or liquefied natural gas (LNG) to power an internal combustion engine. Natural gas trucks have already been deployed and may experience greater market penetration if more fueling infrastructure is provided. Range may be a concern due to limited on-board fuel storage and there are remaining concerns with vehicle cost and methane emissions.[49] Nevertheless, several efforts are underway to expand use of natural gas trucks in the region as a near-term solution and a few notable success stories have occurred within the SCAG region. For instance, Ryder trucks has secured over $20 million in grant funding from US DOE's American Recovery and Reinvestment Act, the California Energy Commission and the SCAQMD to deploy 200 natural gas trucks operating within the SCAG region. Additionally, two publicly available natural gas fueling stations were constructed.[50] Southern California Gas Company (SoCalGas) has also been involved in several technology development projects and has worked with OEMs to develop and test several engines and vehicles. These projects have been funded by partners including the CEC, DOE, SCAQMD, in addition to funding invested by SoCalGas.

Renewable natural gas, also known as biomethane, is another alternative fuel source and is widely used by United Parcel Service (UPS) in their fleet of compressed natural gas vehicles. RNG is produced as organic matter from landfills, wastewater treatment plants and

agricultural sources decomposes and is thus viewed by some as a more sustainable fuel.[51] As of 2013, AQMD reports 526 heavy duty natural gas public fleet vehicles in operation and an additional 3,692 medium and light duty public fleet vehicles.[52]

HYBRID-ELECTRIC TRUCKS

Hybrid-electric trucks contain an internal combustion engine as well as an electric motor, generator and energy storage device (e.g., a battery). The electric motor and generator absorb energy via regenerative braking and store that energy to offset acceleration and power demands of the vehicle. However, when battery power is insufficient, the truck draws power from a conventional engine. The incremental cost of this truck remains a barrier to market penetration, though some of this has been offset through incentive programs. In Southern California[53] there were 603 hybrid and 66 zero-emission vehicles deployed through the State Hybrid Truck and Bus Voucher Incentive Project (HVIP) since January 1, 2012.[54] CARB estimates that an additional 420 vehicles will be funded statewide in 2015. A full report of CARB's Technology Assessment for this category is not available. However a summary power point can be found at http://www.arb.ca.gov/msprog/tech/presentation/hybridtrucks.pdf.[55]

COMBUSTION ENGINE IMPROVEMENTS

While the majority of this Environmental Strategy seeks to develop and deploy a regional fleet of zero-emission trucks, it is important to recognize the value of near-term improvements to the existing combustion engine. Improvements to engine efficiency will reduce fuel used and emissions produced in the near-term and lessons learned will help in the design of more power efficient zero-emission vehicles as the fleet converts to full zero-emissions. Improvements to internal combustion engines are discussed at length in the CARB Draft Technology Assessment: Engine/Powerplant and Drivetrain Optimization and Vehicle Efficiency, released June 2015. This report discusses the potential to obtain increased efficiency in the existing internal combustion engine through engine technologies (such as waste heat recovery) and vehicle efficiency technologies (such as automatically inflating tires and improved aerodynamics). For a complete list, please see the CARB report.[56] Technologies to improve engine efficiency have already been developed and advanced through the US DOE Supertruck program (see description above).

LONG-TERM TRUCK TECHNOLOGIES

The long-term goal is to develop and deploy a fleet of zero-emission trucks, or trucks that can operate in zero-emission range while in the region. Two broad categories of trucks are under development to meet this goal including battery-powered electric and fuel cell. Depending on the truck design and compatibility, wayside power solutions may be used to extend the range of these configurations. In addition to developing zero-emission vehicles, charging and fueling infrastructure is also a consideration that must be planned over the long term.

BATTERY-ELECTRIC TRUCKS

Battery-electric trucks replace the entire engine and drive train of a conventional vehicle with an electric motor and generator. The battery can provide all the power needed to power the truck and would ideally be recharged through normal operations; for instance, regenerative breaking could recharge the battery. However, this would likely not be enough power and therefore battery-powered electric trucks could allow for the battery to be recharged through plugging into the grid, using an on-board hydrogen fuel cell or connecting to a wayside power system. Several prototype models of battery-powered electric trucks exist but current obstacles include cost, charging time and range. Current battery charges are estimated to allow for a 100-mile range.[57]

FUEL-CELL TRUCKS

There are many applications for a fuel cell vehicle. For instance, a battery-powered electric vehicle may have an electric motor that is powered by a battery. In addition to charging the battery through the means described above, a fuel cell would draw hydrogen from an onboard storage tank and then generate the electricity needed to recharge the battery. Calstart estimates that by using a charged battery, then recharging the battery onboard via the fuel cell, this configuration could have a range of up to 400 miles. This would be limited only by the amount of on-board hydrogen storage.[58] While fuel cells offer greater range, the system is more complicated and adds infrastructure cost (i.e., hydrogen fueling in addition to charging equipment) and possibly additional maintenance costs. Fuel cells are also less efficient from a wells-to-wheels perspective, because of the electrolysis needed to make H_2 and the need to transport and distribute the fuel. A fuel cell truck will require 2.5 times the energy cost as a battery-powered electric truck.[59]

CHARGING INFRASTRUCTURE FOR ZERO-EMISSION TRUCK TECHNOLOGIES

The deployment of the technologies discussed above cannot be completed without supporting infrastructure to provide either fuel or power to the vehicle. For electric technologies, this implies a network of electric heavy-duty vehicle charging stations. Fuel cell vehicles, and alternative fuel near zero-emission vehicles, such as hydrogen and natural gas, would require their own unique refueling infrastructure. Alternatively, wayside power systems could allow a vehicle to charge or draw power during on-road operations.

Wayside power technologies allow a vehicle to charge while in operation, drawing power as it moves along the road. Ideally, these systems would allow for trucks to enter and exit seamlessly and change lanes, and they could be shared with standard trucks. They offer the potential to extend the range of a vehicle that is charged from a stationary power source by

providing additional power in motion. An example of this is the Overhead Catenary System (OCS) that is currently the subject of a demonstration project led by SCAQMD (see above for more detail on the demonstration project). This system allows vehicles to charge through use of an overhead pantograph that is connected to overhead wires drawing power from the electric grid. Catenary systems are well-established and efficient in light-rail applications, trolley cars and buses and even mining trucks. For in-road power, the roadway itself provides power to the vehicles, which must be equipped with pick-up devices. Examples include in-road power such as third rail or linear synchronous motor (LSM).

Both in-road or distributed charging systems draw power, which leads to emissions being produced during electricity generation. Therefore, the increased use of renewable energy sources will help move the vehicles described above which are designed to be zero tailpipe emissions closer to a truly zero-emissions vehicle.

NEAR-TERM RAIL EMISSION REDUCTION STRATEGIES

A fully zero-emission rail system offers unique challenges as freight rail operates as a national system and locomotives cannot remain captive to the region. For instance, CARB estimates that 8,400 of 10,000 interstate line-haul locomotives operated in the SCAB in 2013.[60] Any new technology will require an operational strategy to change out locomotive types, or will require compatible infrastructure nationwide to provide power and/or fuel to locomotives. Even near term improvements are difficult, as the normal life of a locomotive may be up to 50 years.[61] Even given these challenges, several near zero- and zero-emission rail technologies are under development and investigation. Near zero-emission opportunities include acceleration of Tier 4 engines, use of after-treatment technologies that can be compatible with Tier 4 and earlier engine types, and further development of liquid natural gas tender cars.

EXISTING TECHNOLOGIES

EPA standards for locomotives became effective in 2015, requiring that all new locomotives purchased after that date must meet Tier 4 standards. In addition, any re-manufactured locomotive must be retrofited with stricter emission controls. In 2015 General Electric released a commercially viable Tier 4 line-haul locomotive. Relative to Tier 2 engines, Tier 4 engines produce between 75-85 percent less NO_x and PM emissions[62]; they also offer combustion improvements, enhanced cooling and exhaust gas recirculation. While Tier 2 locomotives are estimated to cost $2.3 million per unit, Tier 4 locomotives are estimated to cost $3 million.[63] CARB anticipates full scale commercialization in 2017. SCAG encourages partnerships to accelerate the transition to these new engines.

Distributed power units are currently in use by Union Pacific Railroad (UP) on two thirds (2/3) of its gross ton miles. Distributed power units are spread throughout the train rather than all in the front, making the train less prone to derailments and facilitating more even braking. These units also provide a fuel savings of four to six (4-6) percent compared to standard locomotive power. [64]

TECHNOLOGIES IN DEVELOPMENT

To go beyond the Tier 4 standard, Selective Catalytic Reduction (SCR) for NO_x and Diesel Oxidation Catalysts (DOCs) and Diesel Particulate Filters (DPFs) for PM are estimated to reduce NO_x and PM emissions 70 percent beyond the Tier 4 standard at a cost of approximately $4 million per unit.[65] These units may require additional maintenance costs, but are otherwise compatible with the national fleet. These units, as applied to Tier 4 locomotives, are still in the conceptual phase. However, DOCs, DPFs and a third technology called Exhaust Gas Recirculation (EGR) have all been tested by UP in intermediate length halls of approximately 200 miles. The smaller size of this engine allowed for all after treatment to be applied simultaneously.[66]

Liquid natural gas has also been considered as a fuel for rail locomotives. It is estimated that use of LNG with a Tier 4 locomotive would lead to NO_x and PM reductions of 70 percent beyond the Tier 4 locomotive.[67] Tender car prototypes currently exist; however, there are operational considerations such as the need to carry an additional tender car to store the LNG fuel and the need for fueling infrastructure.

UP and BNSF are working with stakeholders such as locomotive and engine manufacturers, cryogenic fuel tank suppliers, natural gas/LNG suppliers, the Federal Railroad Administration and first responders to evaluate how natural gas could safely and economically be incorporated into their operations.

LONG TERM EMISSION REDUCTIONS STRATEGIES FOR RAIL

The longer term goal of a fully zero-emission system could potentially be accomplished with an electric catenary or linear synchronous motor system. A hybrid-electric engine or a battery tender car could also provide additional battery power to allow for locomotives to operate in zero-emissions mode where battery power is available. The CARB Sustainable Freight Strategy promotes a long-term vision of zero-emission rail as the technology permits. Without a full system conversion, this goal would allow for zero-emission track miles where possible as facilitated by battery or fuel cell tender cars to allow locomotives to operate in zero-emission mode when these tender cars can provide power. Similarly, LNG tender cars may allow for operation in near zero-emission mode.

ELECTRIFICATION TECHNOLOGIES

Electrification technologies require further evaluation to more precisely address questions about cost, funding and how to best implement such systems with minimal operational impacts. Because of the cost and potential operational challenges associated with mainline electrification, such a strategy should be considered a longer-term initiative, requiring further studies as well as proof of concept and prototype testing of zero-emission locomotive technologies that have the potential to minimize cost and operational impacts, as discussed under the phased implementation section of this Appendix. Construction of any electrified rail system in Southern California would be a large investment and would need the participation of the BNSF and UP railways.

ELECTRIC CATENARY RAIL SYSTEMS

These are perhaps the most technologically ready; however, construction of an electrified rail system in Southern California would be a major undertaking in terms of labor, timeline and cost for the SCAG region and would require a large investment as well as cooperation and investment by the BNSF and UP railways. Though electric catenary systems are widely used for passenger and light rail and electric freight rail has been used in other countries, locomotives would need to be re-engineered for use with trains of the size and length operated in the United States.[68]

DUAL-MODE LOCOMOTIVES

These have been deployed for passenger rail applications, but would need development for freight applications. They have the ability to operate on a catenary or with traditional diesel power. The ability to operate in both modes could potentially reduce operational difficulties associated with the need to remove the engine at the end of the electrified system. However, additional operational considerations remain to be addressed.

LINEAR SYNCHRONOUS MOTORS

This technology propels rail cars by creating an electromagnetic field from motors embedded in the railway. One advantage of LSM is that overhead electric lines would not be needed, allowing the electric rail system to extend further into ports and railyards. Because the propulsion comes from the track, locomotives would not need to be switched when leaving the electrified portion of the system. LSM technology is in its early stages and costs cannot be estimated, however demonstration projects are underway.

OPTIONS FOR ZERO-EMISSIONS OPERATION

While the scale of a fully electrified system may be challenging, opportunities may exist to supplement locomotive power with zero-emissions options. One option is the hybrid electric locomotive engine, where a battery is built into the frame of the engine and can recharge through regenerative braking. Prototypes of this model currently exist.[69] Battery tender cars could also supplement a main engine with zero-emission propulsion by using the battery power. In contrast with the hybrid electric locomotive, the tender car would need to be charged prior to use, likely at railyards. The number of tender cars required to move a train long distances is challenging as space is at a premium on interstate trains. Similarly, facilitating the change out of the tender car is a big operational challenge for this type of system. Conventional locomotives generally refuel every 1,000 miles[70], so a tender car system that offered less power would create operational challenges. Currently these are in the conceptual stage.

Hydrogen Fuel Cell locomotives would also allow for zero-emission miles, but would require a national fueling infrastructure and have similar challenges as described above. These are conceptual for line-haul locomotives but prototypes exist for a switcher and a green goat.

IMPLEMENTING THE ENVIRONMENTAL STRATEGY

Broad deployment of zero- and near zero-emission transportation technologies in the 2023 to 2040 time frame is a critical and significant undertaking with technological, cost and operational challenges. As outlined above, the 2016 RTP/SCS describes a process to develop and deploy needed technologies, along with key action steps for public sector agencies to help move the region to that objective. Industry stakeholder participation will be necessary, including the efforts of numerous state and federal resources agencies, transportation agencies, commercial technology developers/manufacturers, and logistics experts. The 2016 RTP/SCS reaffirms zero- and near zero-emission technologies as a priority, and establishes the regional path forward to such a goods movement system.

TABLE 17 Constrained Grade Separations (Not Listed in Priority Order)

County	Crossing Street	Under Construction	Complete	Planned
LOS ANGELES	VALLEY VIEW AVENUE		X	
LOS ANGELES	REEVES AVE			X
LOS ANGELES	S. WILMINGTON		X	
LOS ANGELES	MONTEBELLO/MAPLE			X
LOS ANGELES	BALDWIN AVENUE		X	
LOS ANGELES	RAMONA ST	X		
LOS ANGELES	MISSION RD	X		
LOS ANGELES	DEL MAR AVE	X		
LOS ANGELES	SAN GABRIEL BLVD	X		
LOS ANGELES	PUENTE AVENUE	X		
LOS ANGELES	NOGALES ST	X		
LOS ANGELES	TURNBULL CYN RD			X
LOS ANGELES	FAIRWAY DRIVE	X		
LOS ANGELES	FULLERTON RD			X
LOS ANGELES	DURFEE AVE			X
LOS ANGELES	DEL AMO BLVD		X	
LOS ANGELES	PASSONS BLVD		X	
LOS ANGELES	ROSECRANS AVE			X
ORANGE	KRAEMER BLVD		X	
ORANGE	LAKEVIEW AVENUE	X		
ORANGE	PLACENTIA AVENUE UNDERCROSSING		X	
ORANGE	RAYMOND AVENUE	X		
ORANGE	STATE COLLEGE	X		
ORANGE	TUSTIN AVENUE/ROSE DRIVE	X		
ORANGE	JEFFERY ROAD		X	
ORANGE	ORANGETHORPE AVENUE	X		
ORANGE	STATE COLLEGE BLVD			X
ORANGE	SANTA ANA BLVD			X
ORANGE	17TH STREET			X
RIVERSIDE	AUTO CENTER DRIVE		X	
RIVERSIDE	IOWA AVENUE		X	
RIVERSIDE	MAGNOLIA AVENUE	X		
RIVERSIDE	MARY STREET			X
RIVERSIDE	MCKINLEY ST			X

Source: SCAG

TABLE 17 Constrained Grade Separations (Not Listed in Priority Order) Continued

County	Crossing Street	Under Construction	Complete	Planned
RIVERSIDE	CLAY STREET	X		
RIVERSIDE	RIVERSIDE AVENUE		X	
RIVERSIDE	STREETER AVENUE		X	
RIVERSIDE	AVENUE 52		X	
RIVERSIDE	AVENUE 56	X		
RIVERSIDE	SUNSET AVENUE	X		
RIVERSIDE	CHICAGO AVE			X
RIVERSIDE	PIERCE ST			X
RIVERSIDE	BELLGRAVE AV			X
RIVERSIDE	MADISON ST			X
RIVERSIDE	SPRUCE ST			X
RIVERSIDE	JURUPA RD			X
RIVERSIDE	TYLER ST			X
RIVERSIDE	RADIO ST			X
RIVERSIDE	ADAMS ST			X
RIVERSIDE	VIELE AVE			X
RIVERSIDE	CALIFORNIA AVE			X
RIVERSIDE	22ND ST			X
RIVERSIDE	SAN GORGONIO AVE			X
RIVERSIDE	HARGRAVE ST			X
RIVERSIDE	AVENUE 62			X
RIVERSIDE	AVENUE 66			X
RIVERSIDE	3RD STREET			X
SAN BERNARDINO	GLEN HELEN PARKWAY		X	
SAN BERNARDINO	GREEN TREE BLVD EXTENSION			X
SAN BERNARDINO	LENWOOD ROAD	X		
SAN BERNARDINO	PALM AVE	X		
SAN BERNARDINO	LAUREL ST.	X		
SAN BERNARDINO	MT. VERNON			X
SAN BERNARDINO	MAIN ST			X
SAN BERNARDINO	N. VINEYARD AVE	X		
SAN BERNARDINO	S. MILLIKEN AVE	X		
SAN BERNARDINO	SOUTH ARCHIBALD AVE			X
SAN BERNARDINO	CAMPUS AVE			X

Source: SCAG

TABLE 17 Constrained Grade Separations (Not Listed in Priority Order) Continued

County	Crossing Street	Under Construction	Complete	Planned
SAN BERNARDINO	HUNTS LANE		X	
SAN BERNARDINO	SAN ANTONIO AVE			X
SAN BERNARDINO	RAMONA AV AT STATE AVE		X	
SAN BERNARDINO	CENTRAL AVENUE			X
SAN BERNARDINO	MONTE VISTA			X
SAN BERNARDINO	EUCALYPTUS ST			X
SAN BERNARDINO	VISTA ROAD			X
SAN BERNARDINO	LEMON ST/MAUNA LOA ST			X
SAN BERNARDINO	VALLEY BOULEVARD			X
SAN BERNARDINO	N. MILLIKEN AVE		X	
SAN BERNARDINO	BEAUMONT			X
VENTURA	RICE AVE/FIFTH STREET			X

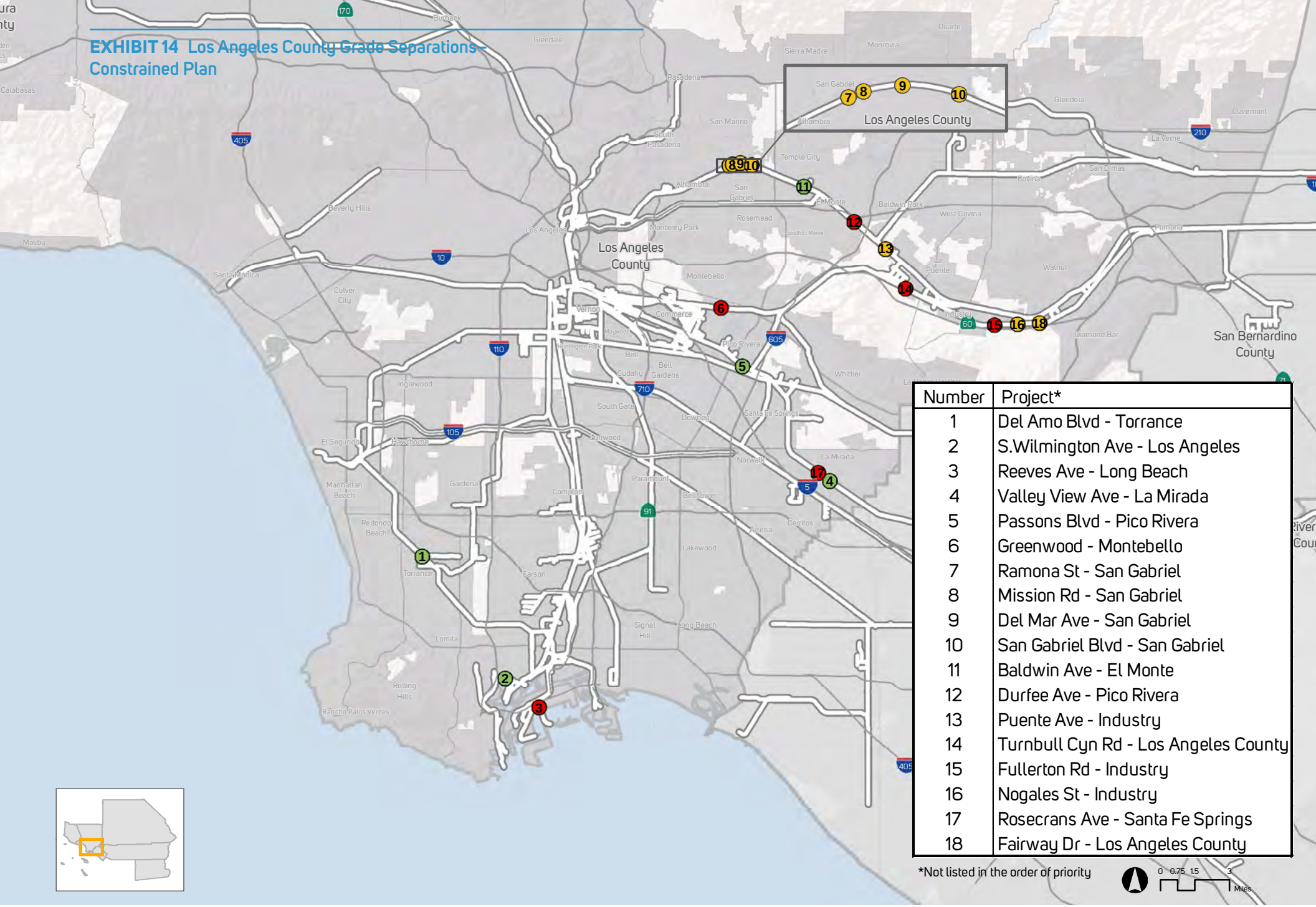
Source: SCAG

TABLE 18 Strategic Grade Separations (Not Listed in Priority Order)

County	Crossing Street
Imperial	Ward Rd (Imperial County)
Imperial	SR-78/SR-111 (Brawley)
Imperial	Malan St (Brawley)
Imperial	Mead Rd (Brawley)
Imperial	Keystone Rd (Imperial County)
Imperial	Aten Rd (Imperial)
Imperial	Evan Hewes Hwy (Imperial County)
Imperial	Dog Wood Rd (Imperial County)
Imperial	Herber Ave (Imperial County)
Imperial	West Cole Rd (Calexico)
Los Angeles	San Antonio Ave (Pomona)
Los Angeles	Lemon Ave (LA Subdivision)
Orange	Jefferson St (Anaheim)
Orange	Van Buren Ave (Placentia)
Orange	Richfield Rd (Placentia)
Orange	Kellogg Dr Undercrossing (Anaheim)
San Bernardino	Hinckley Ave (San Bernardino County)
San Bernardino	Shadow Mountain Rd (San Bernardino County)
San Bernardino	Phelan Rd (San Bernardino County)
San Bernardino	Archibald Ave (Rancho Cucamonga)
San Bernardino	Vine Ave (Ontario)
San Bernardino	Sultana Ave (Ontario)
San Bernardino	Bon View Ave (Ontario)
San Bernardino	Olive St (San Bernardino)
San Bernardino	Alessandro Rd (Redlands)
Ventura	Route 118 (Ventura County)
Riverside	Smith Ave (Corona)
Riverside	Railroad St (Corona)
Riverside	Cota St (Corona)
Riverside	Buchanan St (Riverside)
Riverside	Rutile St (Jurupa Valley)
Riverside	Harrison St (Riverside)
Riverside	Gibson St (Riverside)
Riverside	Jackson St (Riverside)
Riverside	Washington St (Riverside)
Riverside	Brockton Ave (Riverside)
Riverside	Apache Trail (Riverside County)
Riverside	Panorama Rd (Riverside)
Riverside	Cridge St (Riverside)
Riverside	Palmyrita Ave (Riverside)
Riverside	Center St (Riverside County)
Riverside	Main St (Riverside County)
Riverside	San Timoteo Canyon (Calimesa)
Riverside	Shetidan St (Corona)
Riverside	Pennsylvania Ave (Beaumont)
Riverside	7th St (Riverside)
Riverside	Broadway (Riverside County)
Riverside	Tipton Rd (Palm Springs)
Riverside	Ave 54 (Coachella)
Riverside	Ave 58 (Riverside County)

Source: SCAG

EXHIBIT 14 Los Angeles County Grade Separations – Constrained Plan



Number	Project*
1	Del Amo Blvd - Torrance
2	S.Wilmington Ave - Los Angeles
3	Reeves Ave - Long Beach
4	Valley View Ave - La Mirada
5	Passons Blvd - Pico Rivera
6	Greenwood - Montebello
7	Ramona St - San Gabriel
8	Mission Rd - San Gabriel
9	Del Mar Ave - San Gabriel
10	San Gabriel Blvd - San Gabriel
11	Baldwin Ave - El Monte
12	Durfee Ave - Pico Rivera
13	Puente Ave - Industry
14	Turnbull Cyn Rd - Los Angeles County
15	Fullerton Rd - Industry
16	Nogales St - Industry
17	Rosecrans Ave - Santa Fe Springs
18	Fairway Dr - Los Angeles County

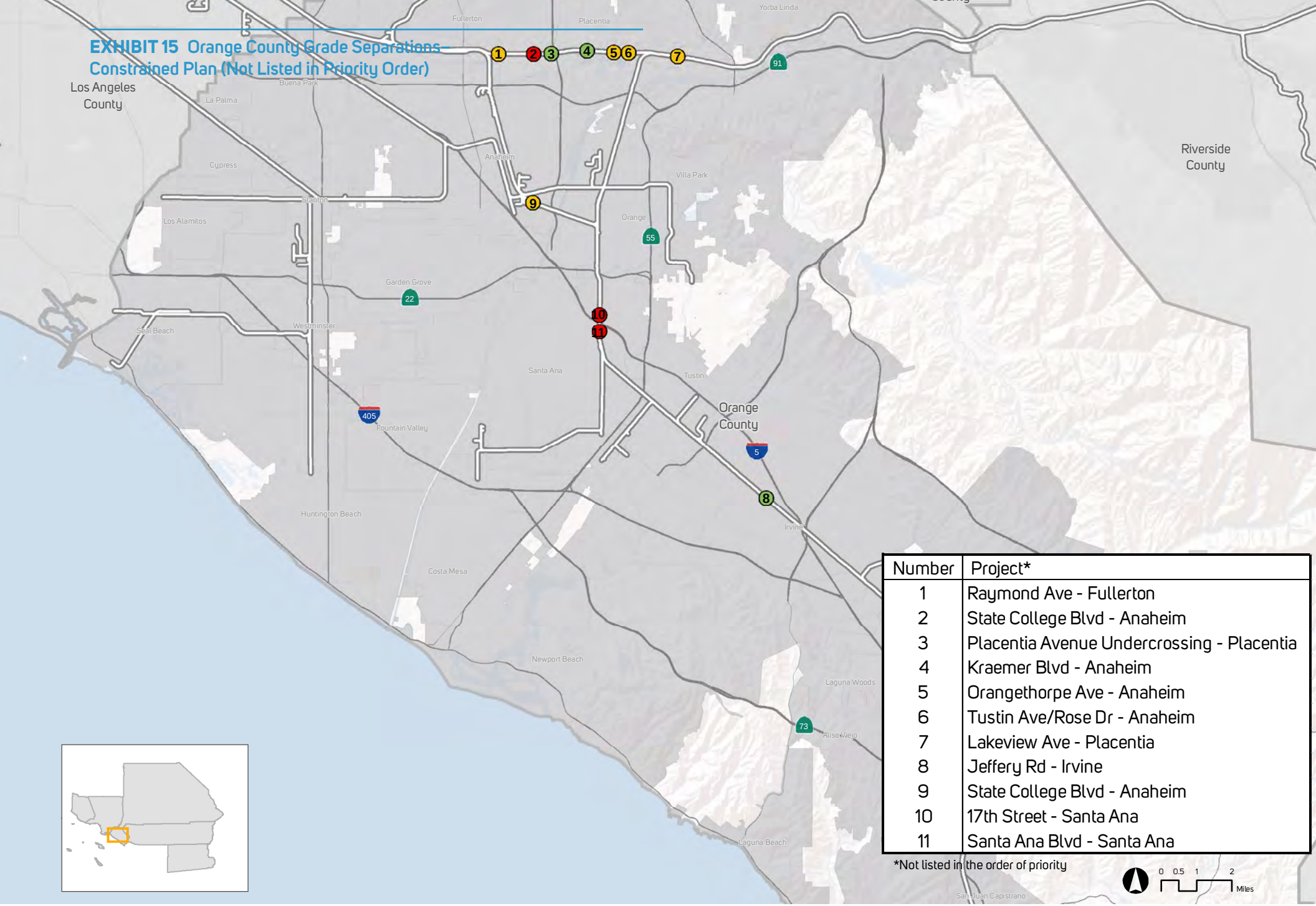
*Not listed in the order of priority

0 0.75 1.5 3 Miles

Constrained Plan Status (as of November 2015): Complete Under Construction Planned Regional Rail Lines

Source: SCAG

EXHIBIT 15 Orange County Grade Separations – Constrained Plan (Not Listed in Priority Order)



Number	Project*
1	Raymond Ave - Fullerton
2	State College Blvd - Anaheim
3	Placentia Avenue Undercrossing - Placentia
4	Kraemer Blvd - Anaheim
5	Orangethorpe Ave - Anaheim
6	Tustin Ave/Rose Dr - Anaheim
7	Lakeview Ave - Placentia
8	Jeffery Rd - Irvine
9	State College Blvd - Anaheim
10	17th Street - Santa Ana
11	Santa Ana Blvd - Santa Ana

*Not listed in the order of priority

0 0.5 1 2 Miles

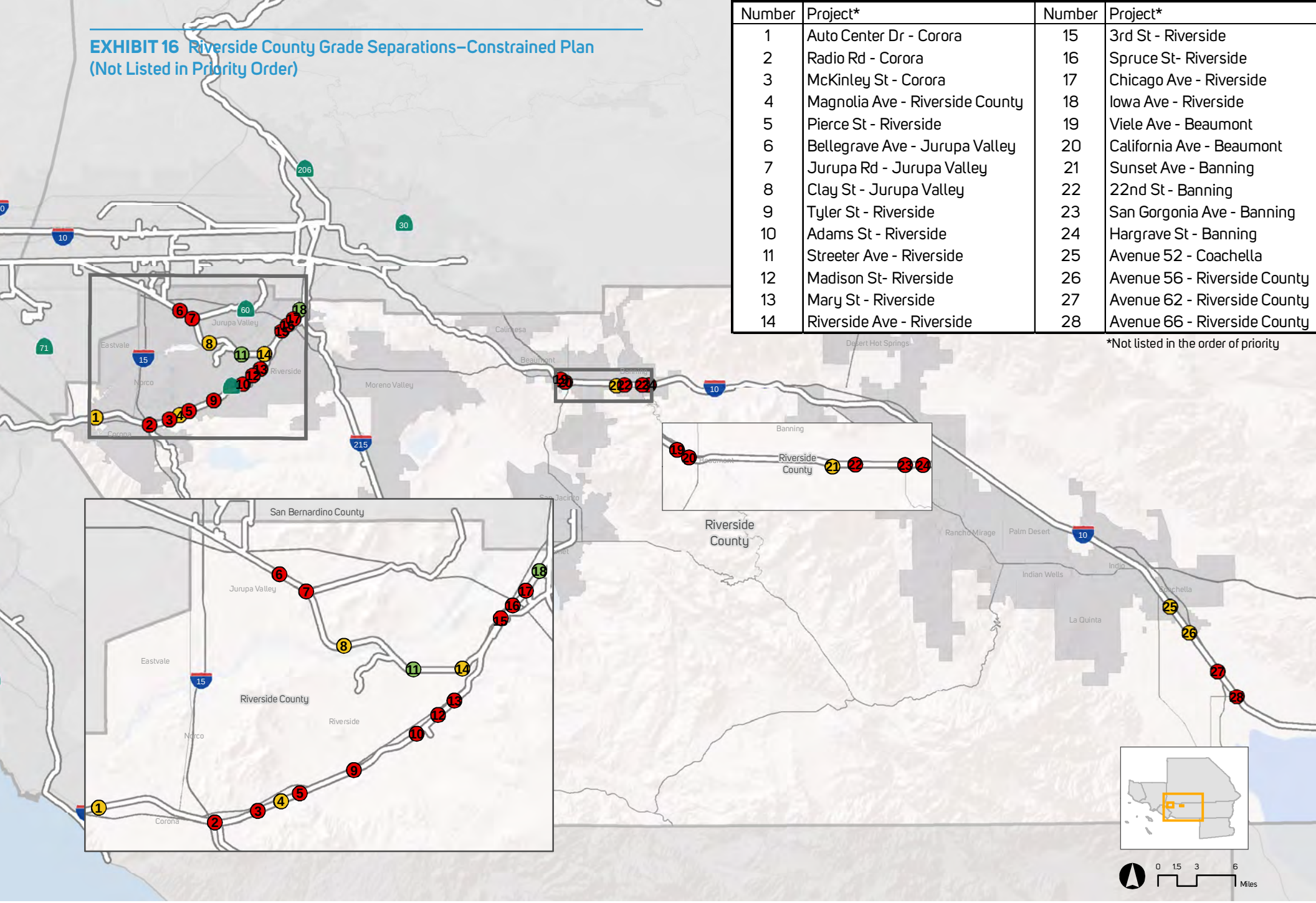
Constrained Plan Status (as of November 2015): Complete Under Construction Planned Regional Rail Lines

Source: SCAG

EXHIBIT 16 Riverside County Grade Separations–Constrained Plan (Not Listed in Priority Order)

Number	Project*	Number	Project*
1	Auto Center Dr - Corora	15	3rd St - Riverside
2	Radio Rd - Corora	16	Spruce St- Riverside
3	McKinley St - Corora	17	Chicago Ave - Riverside
4	Magnolia Ave - Riverside County	18	Iowa Ave - Riverside
5	Pierce St - Riverside	19	Viele Ave - Beaumont
6	Bellegrave Ave - Jurupa Valley	20	California Ave - Beaumont
7	Jurupa Rd - Jurupa Valley	21	Sunset Ave - Banning
8	Clay St - Jurupa Valley	22	22nd St - Banning
9	Tyler St - Riverside	23	San Gorgonia Ave - Banning
10	Adams St - Riverside	24	Hargrave St - Banning
11	Streeter Ave - Riverside	25	Avenue 52 - Coachella
12	Madison St- Riverside	26	Avenue 56 - Riverside County
13	Mary St - Riverside	27	Avenue 62 - Riverside County
14	Riverside Ave - Riverside	28	Avenue 66 - Riverside County

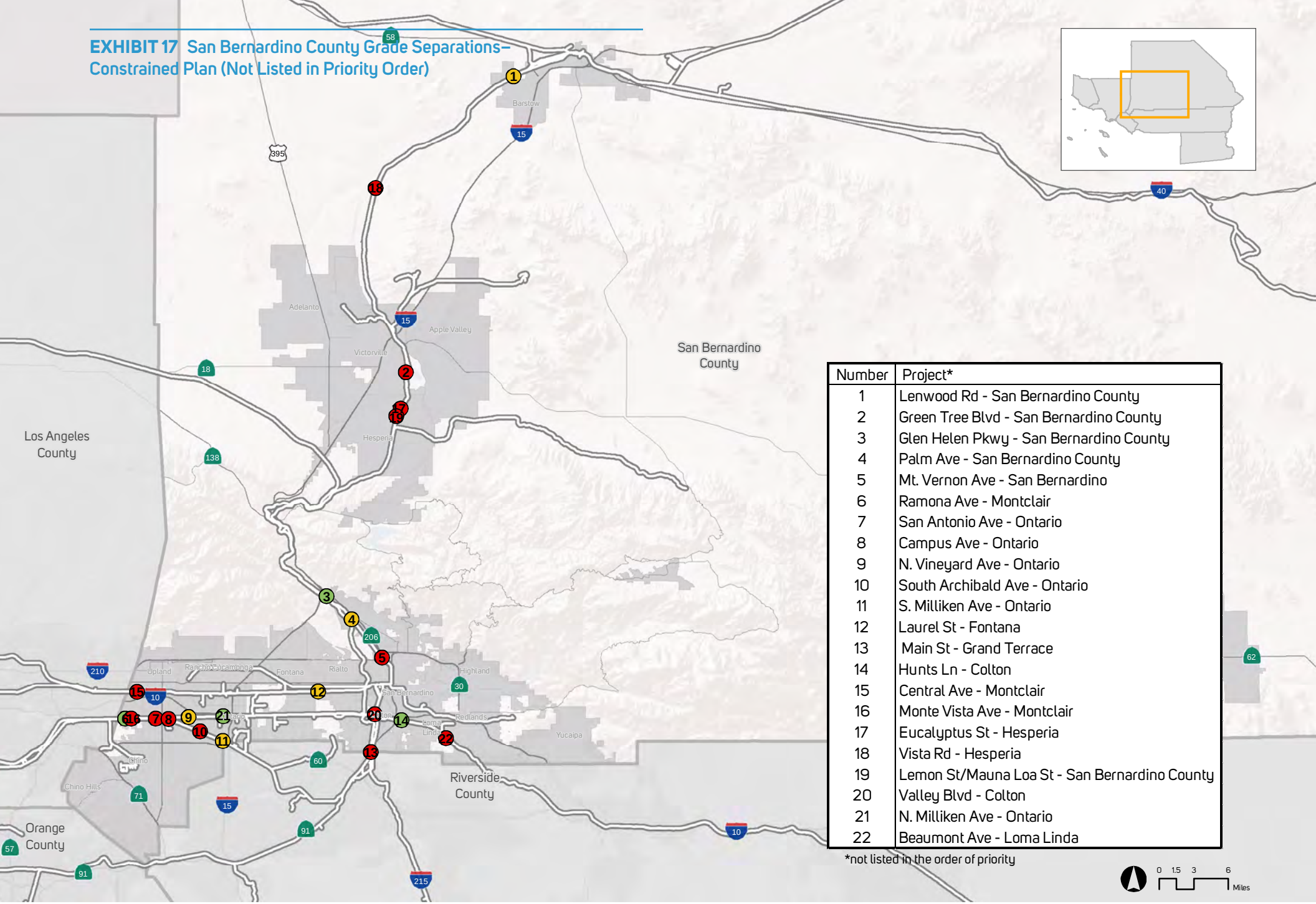
*Not listed in the order of priority



Constrained Plan Status (as of November 2015): Complete Under Construction Planned Regional Rail Lines

Source: SCAG

EXHIBIT 17 San Bernardino County Grade Separations–Constrained Plan (Not Listed in Priority Order)



Number	Project*
1	Lenwood Rd - San Bernardino County
2	Green Tree Blvd - San Bernardino County
3	Glen Helen Pkwy - San Bernardino County
4	Palm Ave - San Bernardino County
5	Mt. Vernon Ave - San Bernardino
6	Ramona Ave - Montclair
7	San Antonio Ave - Ontario
8	Campus Ave - Ontario
9	N. Vineyard Ave - Ontario
10	South Archibald Ave - Ontario
11	S. Milliken Ave - Ontario
12	Laurel St - Fontana
13	Main St - Grand Terrace
14	Hunts Ln - Colton
15	Central Ave - Montclair
16	Monte Vista Ave - Montclair
17	Eucalyptus St - Hesperia
18	Vista Rd - Hesperia
19	Lemon St/Mauna Loa St - San Bernardino County
20	Valley Blvd - Colton
21	N. Milliken Ave - Ontario
22	Beaumont Ave - Loma Linda

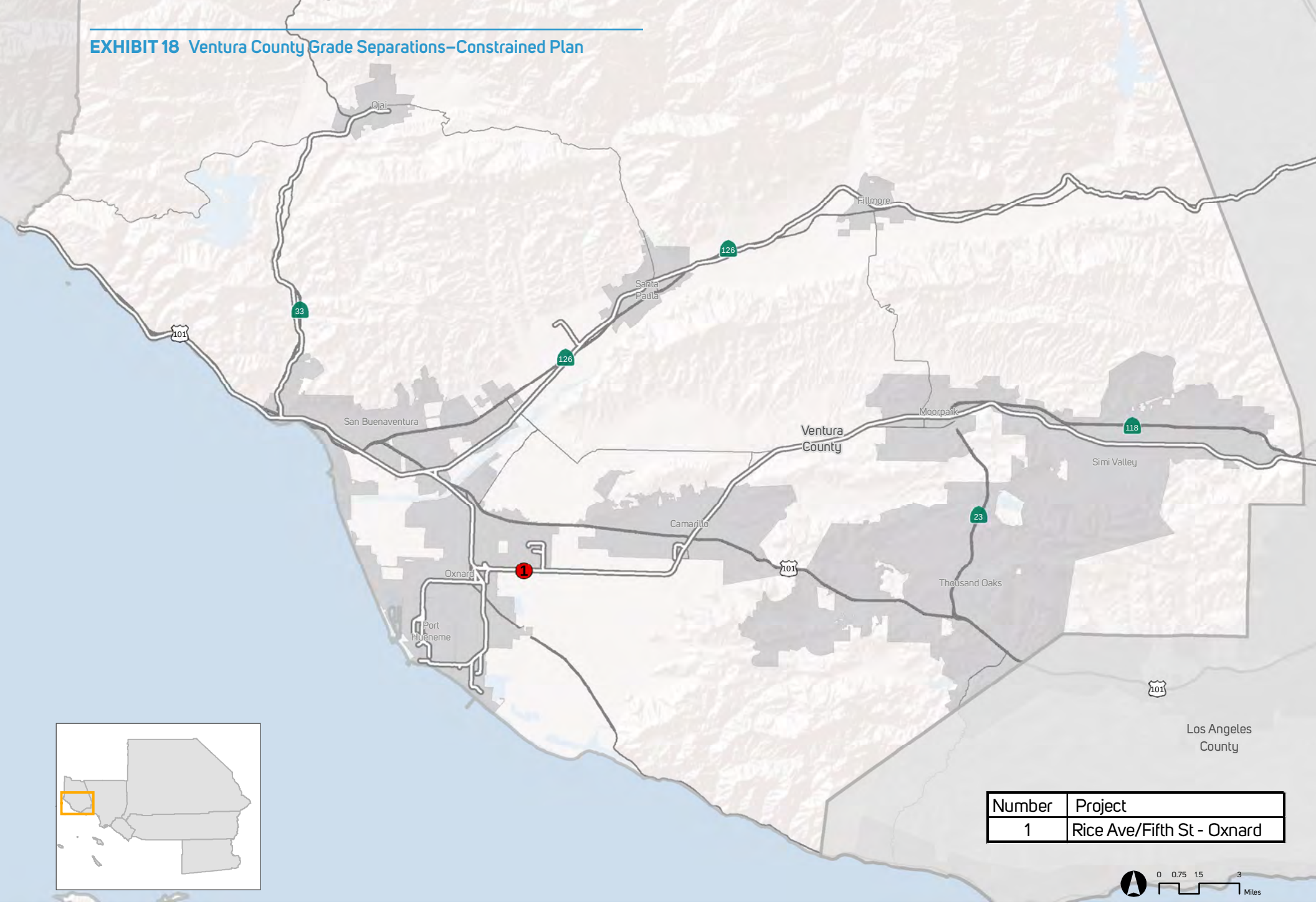
*not listed in the order of priority

0 1.5 3 6 Miles

Constrained Plan Status (as of November 2015): Complete | Under Construction | Planned | Regional Rail Lines

Source: SCAG

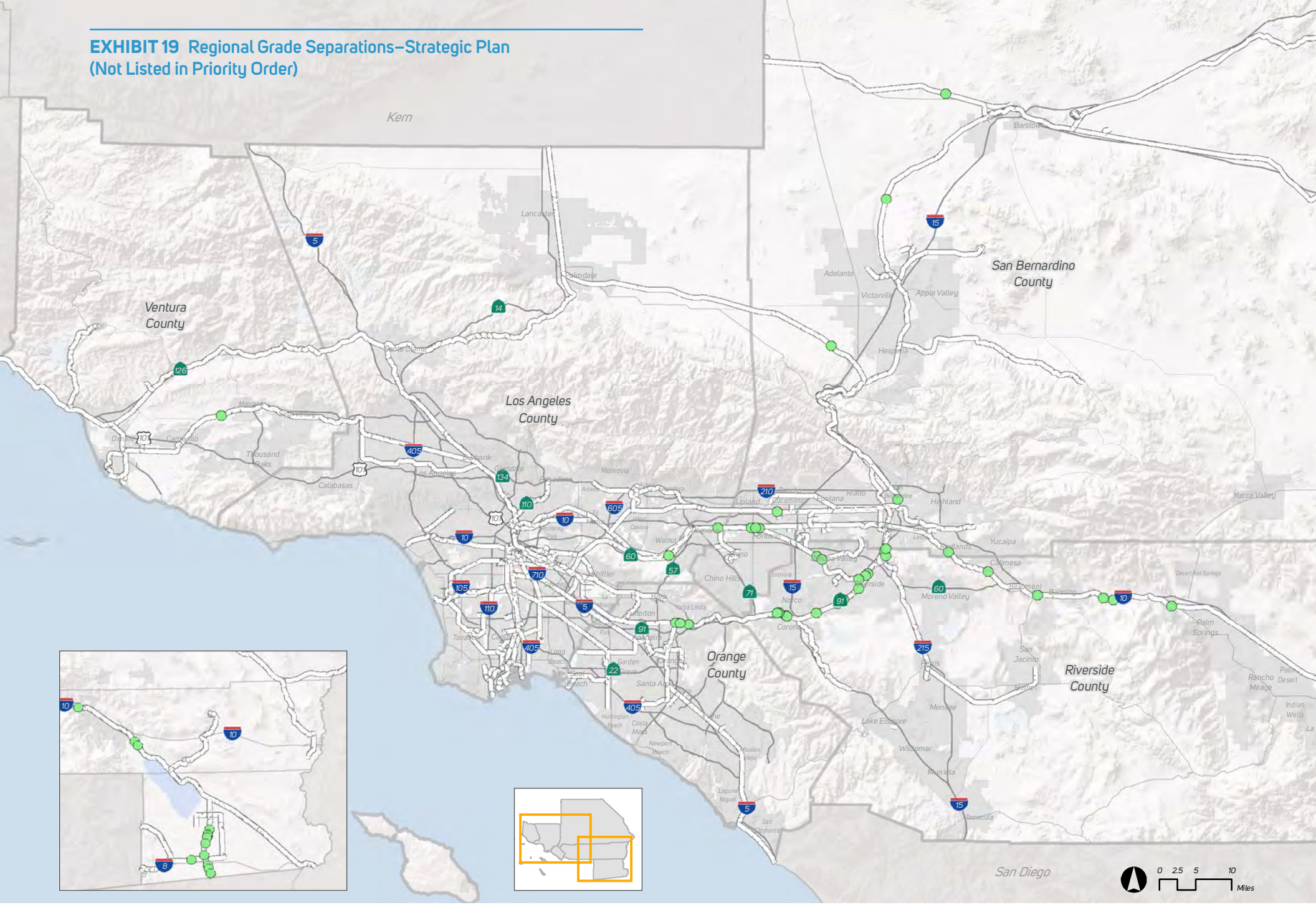
EXHIBIT 18 Ventura County Grade Separations–Constrained Plan



Constrained Plan Status (as of November 2015): Planned Regional Rail Lines

Source: SCAG

EXHIBIT 19 Regional Grade Separations–Strategic Plan (Not Listed in Priority Order)



Regional Grade Seperations Identified under Strategic Plan (as of November 2015): Grade Seperations Regional Rail Lines

Source: SCAG

TABLE 19 Regional Goods Movement Project List

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A. ROADWAY ACCESS TO MAJOR GOODS MOVEMENT FACILITIES				
A.1	Los Angeles	ROUTE 005: PHASE 1 OF 3-- IN SANTA CLARITA FROM ROUTE 14 TO PICO CANYON/LYONS AVENUE IN THE SOUTHBOUND DIRECTION AND FROM ROUTE 14 TO GAVIN CANYON ROAD IN THE NORTHBOUND DIRECTION. CONST TRUCK CLIMBING LANES. (EA 2332A, PPNO 3189), (SAFTETEA-LU#465 FUNDED PAED FOR THIS PHASE INCLUDED IN LA0G440).	$131,000	S
A.2	Los Angeles	ROUTE 005: PHASE 2,FROM SR-14 TO PARKER ROAD, CONSTRUCT HOV/ HOT, TRUCK & AUX LANES (EA 2332C, PPNO 3189A & EA 2332E PPNO 3189B), SAFTETEA-LU#465. PE & RW $ ARE PROGRAMMED FOR EA 2332E ONLY.	$46,877	S
A.3	Los Angeles	SR-47 EXPRESSWAY: REPLACEMENT OF SCHUYLER HEIM BRIDGE (Segment 1): ACTA completing PE, ROW, and Design Support during Construction; SAFETEA-LU #712 & #3797.	$91,583	S
A.3	Los Angeles	SR-47 EXPRESSWAY: CONSTRUCT 4 LANE EXPRESSWAY AND 2-LANE FLYOVER TO SCHUYLER HEIM BRIDGE	$420,000	L
A.4	Los Angeles	ROUTE 047: REPLACEMENT OF SCHUYLER HEIM BRIDGE TO INCLUDE 2 THRU LANES AND 1 AUX LANE NB; AND 3 THRU LANES AND 1 AUX LANE SB EA 13820, PPNO 0444E).	$278,993	S
A.5	Los Angeles	WIDEN AND RECONSTRUCT WASHINGTON BOULEVARD FROM WESTERN CITY BOUNDARY AT VERNON [350' WEST OF INDIANA STREET] TO I-5 FREEWAY AT TELEGRAPH RD., WIDEN FROM 2 LANES TO 3 LANES IN EACH DIRECTION, INCREASE TURN RADIUS AND MEDIANS, UPGRADE TRAFFIC SIGNALS AND STREET LIGHTING AND IMPROVE SIDEWALKS.	$32,000	S
A.6	Los Angeles	BRIDGE NO. 53C0065, OCEAN BLVD, OVER ENTRANCE CHANNEL, UP RR, 1.0 MI E STATE ROUTE 47. REPLACE EXISTING 5 LANE GERALD DESMOND BRIDGE (GDB) WITH NEW 6 LANE BRIDGE.	$1,288,101	S
A.7	Los Angeles	COMMERCE GOODS MOVEMENT ATLANTIC BOULEVARD: WASHINGTON BOULEVARD TO COMO STREET : (1) IMPLEMENTS SOUTHBOUND RIGHT-TURN OVERLAP SIGNAL PHASING FROM ATLANTIC BL ONTO WASHINGTON BL TO IMPROVE MOBILITY FOR TRUCKS AND VEHICLES. (2) STREETSCAPE IMPROVEMINTS, SUCH AS RAISED MEDIANS, CROSSING IMPROVEMENTS, AND SIDEWALK IMPROVEMENTS TO IMPROVE PEDESTRIAN SAFETY AND REDUCE PEDESTRIAN/VEHICLE CONFLICT.	$1,172	S
A.8	Los Angeles	OLYMPIC BL AND MATEO STREET GOODS MOVEMENT IMP-PHASE II. IMPROVEMENT OF FREEWAY ACCESS BY WIDENING WB OLYMPIC BL BET MATEO ST & SANTA FE AV FOR A RIGHT-TURN LANE, AND NB MATEO ST BET OLYMPIC BL & PORTER ST FOR INCREASED CURB RETURN.	$4,421	S

** Note: Map ID refers to maps in 2016 RTP/SCS Goods Movement Appendix (pgs. 74 to 77)*
*** Note: Short-term (S) (2012-2020); Medium-term (M) (2020-2030); Long-term (L) (2030-2040+)*

TABLE 19 Regional Goods Movement Project List Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.9	Los Angeles	AT I-110 NB AT JOHN S GIBSON BLVD NB RAMPS & NB SR-47/I-110 CONNECTOR. WIDEN SB 47 TO NB 110 CONNECTOR FROM 1 TO 2 LNS BEGIN AT SB 47 PM 0.72 (STATION 535+00) JUST W OF FRONT ST ON-RAMP. ADDL THROUGH LN CONTINUES ON NB 110 & ENDS JUST N OF THE J S GIBSON OFF-RAMP. WIDEN NB 110/J S GIBSON ON-RAMP TO IMPROVE ACCESS TO FWY & INTERSECTION OF J S GIBSON/110 NB RAMPS W/IMPROVED TURN RADII & RE-STRIPING.	$34,733	S
A. 10	Los Angeles	PROJECT WILL IMPROVE FLOW OF TRAFFIC FROM I-110 FWY ON/OFF-RAMPS AT C STREET BY CONSOLIDATING TWO CLOSELY SPACED INTERSECTIONS INTO ONE.	$23,980	S
A.11	Los Angeles	WB SR-60/SB SR-57 GRAND AVENUE OFF RAMP INTERCHANGE : ADD WB SR-60 AUXILIARY LANE FROM SB SR-57 TO GRAND AVENUE OFF-RAMP TO IMPROVE TRUCK MOBILITY AND REDUCE CONGESTION.	$21,303	M
	Los Angeles	RECONSTRUCT SR 60/GRAND AV INTERCHANGE - WIDEN GRAND AV: SB ADD 1THRU LN (2 EXSTNG); NB ADD 1 THRU LN (3 EXSTNG), REPLACE GRAND AV OC, ADD EB LOOP ON-RAMP, CONSTRUCT ADDITIONAL EB THRU LN FROM GRAND AVE TRAP LN TO SR57 ADD LN, ADD TWO BYPASS RAMP CONNECTORS, ADD AUX LANES EB AND WB FROM EAST TO WEST JUNCTION OF THE CONFLUENCE.	$257,900	S
A.12	Los Angeles	I-605 CORRIDOR "HOT SPOT" INTERCHANGES IN GATEWAY CITIES	$3,200,000	L
A.13	Los Angeles	I-710 EARLY ACTION PROJECTS	$711,600	M
A.14	Los Angeles	SR 47/NAVY WAY INTERCHANGE: CONSTRUCTION OF INTERCHANGE AT SR-47 / NAVY WAY TO ELIMINATE TRAFFIC SIGNAL AND MOVEMENT CONFLICTS; THIS PROJECT WAS A S.CA TRADE CORRIDOR TIER II TCIF PROJECT AS SUBMITTED TO THE CTC IN 2008; PROJECT REMOVES LAST SIGNAL ON SR 47 BETWEEN DESMOND AND V. THOMAS BRIDGES, NHS INTERMODEL CONNECTOR ROUTE	$57,593	M
A.15	Los Angeles	SR 47-V. THOMAS BRIDGE/FRONT ST INTERCHANGE: NEW WESTBOUND SR 47 ON- AND OFF-RAMPS AT FRONT STREET JUST WEST OF THE VINCENT THOMAS BRIDGE AND ELIMINATE THE EXISTING NON-STANDARD RAMP CONNECTION TO THE HARBOR BOULEVARD OFF-RAMP; FRONT STREET IS AN NHS CONNECTOR. THE PROJECT ALSO INCLUDES REALIGNED EASTBOUND AND WESTBOUND SR47 ON-RAMPS.	$37,285	M
A.16	Los Angeles	ALAMEDA STREET DOWNTOWN LA: GOODS MOVEMENT, PHASE I. THIS PROJECT WILL PROVIDE CONGESTION RELIEF, IMPROVE MOBILITY/REDUCE CONFLICTS, AND IMPROVE SAFETY FOR BOTH AUTOS AND TRUCKS BY PROVIDING INTERSECTION IMPROVEMENTS. PROJECT WILL ALSO REMOVE ABANDONED RAIL LINES, REPAIR PAVEMENT, ADD NEW STREET LIGHTING, AND CONSTRUCT PEDESTRIAN IMRPOVEMENTS.	$7,132	S

** Note: Map ID refers to maps in 2016 RTP/SCS Goods Movement Appendix (pgs. 74 to 77)*
*** Note: Short-term (S) (2012-2020); Medium-term (M) (2020-2030); Long-term (L) (2030-2040+)*

TABLE 19 Regional Goods Movement Project List Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.17	Los Angeles	ALAMEDA STREET WIDENING FROM ANAHEIM STREET TO 300 FT. SOUTH OF PCH : (1) WIDENS ALAMEDA ST BETWEEN ANAHEIM ST AND 300 FT SOUTH OF PACIFIC COAST HIGHWAY FROM 2 TO 3 LANES IN EACH DIRECTION FOR CONGESTION RELIEF AND IMPROVE GOODS MOVEMENT MOBILITY.	$9,709	S
A.18	Los Angeles	ANAHEIM STREET WIDENING - FARRAGUT AVENUE TO DOMINGUEZ CHANNEL : WIDEN ANAHEIM ST BETWEEN FARRAGUT AV AND DOMINGUEZ CHANNEL FROM 2 TO 3 LANES IN EACH DIRECTION FOR CONGESTION RELIEF AND IMPROVE GOODS MOVEMENT MOBILITY. THIS UPGRADES THE ARTERIAL TO MAJOR HIGHWAY STANDARDS.	$6,566	S
A.19	Los Angeles	PHASE 2 AND 3 OF 3: IN LA/SANTA CLARITA: PHASE 2: CONSTRUCT HOV LANE NORTHBOUND FROM ROUTE 14 TO WELDON CANYON RD; PHASE 3: CONSTRUCT HOV, TRUCK, & AUX LANES FROM SR-14 TO PARKER RD OC.	$410,000	S
A.20	Los Angeles	HARBOR BLVD IMPROVEMENTS - AS PART OF THE SAN PEDRO WATERFRONT DEVELOPMENT PROJECT, HARBOR BLVD WILL BE RESTRIPED, AND THE MEDIAN IS REMOVED/RECONSTRUCTED AS NEEDED TO PROVIDE THREE NBT AND SBT LANES BETWEEN THE RECONSTRUCTED SAMPSON WAY/HARBOR BLVD. INTERSECTION AND THE WB ON RAMP/FRONT STREET INTERSECTION. THIS WILL RESULT IN THE REMOVAL OF PARKING AND THE BIKE LANE ON THE NORTHBOUND SIDE. THE PARKING AND 5' BIKE LANE ON THE SOUTHBOUND SIDE, SOUTH OF O'FARRELL STREET WILL BE PRESERVED. NORTH OF O'FARRELL STREET, THE PARKING AND THE PARKING LANE ON THE SOUTHBOUND SIDE WOULD NEED TO BE REMOVED TO ACCOMMODATE THE NORTHBOUND DUAL LEFT-TURN LANE. THE INNERMOST NORTHBOUND THROUGH LANE AT THE EB OFF-RAMP INTERSECTION WOULD BECOME A FORCED LEFT-TURN LANE AT THE SR 47 WB ON-RAMP. THIS IMPROVEMENT IS PROJECTED TO BE NEEDED BY THE YEAR 2024.	$1,134	M
A.21	Los Angeles	HARBOR BLVD. & 7TH STREET INTERSECTION- THE PROJECT INCLUDES A RECONFIGURED INTERSECTION AT THE JUNCTION OF HARBOR BLVD, SAMPSON WAY, AND 7TH STREET. WORK INCLUDES RETAINING WALL, STREET WORK, GRADING, PAVING, LIGHTING, RESTRIPING AND A NEW SIGNALIZED INTERSECTION.	$15,905	S
A.22	Los Angeles	SAMPSON WAY TO 22ND STREET & MINER STREET - SAMPSON WAY WOULD BE REALIGNED AND EXPANDED TO TWO LANES IN EACH DIRECTION AND WOULD CURVE NEAR THE MUNICIPAL FISH MARKETS TO MEET WITH 22ND STREET IN ITS WESTWARD ALIGNMENT EAST OF MINER STREET. IN THE PROPOSED PROJECT, HARBOR BLVD. WOULD REMAIN IN PLACE AT ITS CURRENT CAPACITY WITH TWO LANES IN EACH DIRECTION. PROPOSED ENHANCEMENTS WOULD BE CONSISTENT WITH DESIGN STANDARDS FOR THE COMMUNITY REDEVELOPMENT AGENCY (CRA) PACIFIC CORRIDOR AND THE CITY OF LOS ANGELES PLANNING DEPARTMENT COMMUNITY DESIGN OVERLAY. ALIGNMENT EAST OF MINER STREET.	$34,614	M

** Note: Map ID refers to maps in 2016 RTP/SCS Goods Movement Appendix (pgs. 74 to 77)*
*** Note: Short-term (S) (2012-2020); Medium-term (M) (2020-2030); Long-term (L) (2030-2040+)*

TABLE 19 Regional Goods Movement Project List Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.23	Los Angeles	ALAMEDA CORRIDOR SOUTH TERMINUS/HENRY FORD AVE. RAIL CROSSING ADVANCED WARNING SYSTEM.	$5,000	M
A.24	Los Angeles	PIER B STREET FREIGHT CORRIDOR RECONSTRUCTION : (1) REALIGNS PIER B ST BETWEEN PICO AV AND PIER A WY AND WIDENS INTO 2 LANES IN EACH DIRECTION TO IMPROVE GOODS MOVEMENT MOBILITY AND ENHANCE PEDISTRIAN TRAVEL. (2) CONSTRUCTS NEW SIDEWALK ON THE SOUTH SIDE OF PIER B ST. (3) CONSTRUCTS J-HOOK FLYOVER TO CONNECT PIER B ST WITH ANAHEIM ST.	$105,791	S
A.25	Orange	SR-57 FROM LAMBERT TO LA COUNTY LINE - ADD 1 NB TRUCK CLIMBING LANE (PE ONLY)(PPNO 3847A)	$124,600	L
A.26	Orange	ADD ONE MF LANE ON N/B SR-57 FROM 0.4 MI N/O SR-91 TO 0.1 MI N/O LAMBERT RD (5.1 MILES) EA 0F0321 (YORBA LINDA TO LAMBERT SEGMENT) SPLIT PROJECT WITH ORA120332	$50,550	COMPLETE
A.27	Orange	ADD ONE MF LANE ON N/B SR-57 FROM 0.4 MI N/O SR-91 TO 0.1 MI N/O LAMBERT RD (5.1 MILES) EA 0F0311 (SR91/ORANGETHORPE TO YORBA LINDA SEGMENT) SPLIT PROJECT WITH ORA081901	$49,828	COMPLETE
A.28	Orange	CONNECT EXISTING AUXILIARY LANE THROUGH INTERCHANGES ON WB SR-91 BETWEEN SR-57 AND I-5 WITH ITS ELEMENTS PPNO 4516A EA 0C5700	$65,677	S
A.29	Orange	SR-91: ADD 1 MF LANE E/B BTWN 91/55 CONNECTOR & SR-241 -- W/B BTWN SR-241 & IMPERIAL HWY; MODIFY W/B ON RAMPS FROM LAKEVIEW AVE TO IMPRV MERGE (ADD AUX LANE BETWEEN NB 55 - TO - EB 91 ON-RAMP AND LAKEVIEW OFF RAMP). PROJECT SPLIT PARENT	$85,986	COMPLETE
A.30	Orange	ADD 1 ML LANE EACH DIRECTION (I5 FROM 57 TO 91)	$305,924	L
A.31	Orange	SR-91 WB (SR-55 THROUGH TUSTIN INTERCHANGE) EXTEND LANE AND RECONSTRUCT AUX. LANE. PPNO 4587A EA 0C560)	$46,270	S
A.32	Orange	EXIST 4 MF N/B; WIDEN TO 5 MF LANES N/B FROM 0.3 MI S/O KATELLA TO 0.3 MI N/O LINCOLN (2.92 MILES) -- 0F0400	$41,086	COMPLETE
A.33	Orange	ADD 1 MF LANE EACH DIRECTION FROM I-5 TO SR-55 AND ADD SB AUX LANES FROM 133 TO IRV CTR DR	$424,620	L
A.34	Orange	I-405 FROM SR-73 TO I-605 ADD 1 MF LANE IN EACH DIRECTION, AND ADDITIONAL CAPITAL IMPROVEMENTS. COMBINED WITH ORA045, ORA151, ORA100507 AND ORA120310. PHASE 1 PROJECT LISTED UNDER ORA030605.	$1,300,000	M

** Note: Map ID refers to maps in 2016 RTP/SCS Goods Movement Appendix (pgs. 74 to 77)*
*** Note: Short-term (S) (2012-2020); Medium-term (M) (2020-2030); Long-term (L) (2030-2040+)*

TABLE 19 Regional Goods Movement Project List Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.35	Orange	I-5 (I-405 TO SR-55) - IN THE CITIES OF IRVINE AND TUSTIN. ADD 1 MF LANE NB FROM TRUCK BYPASS ON RAMP TO SR-55, ADD 1 MF LANE SB FROM SR-55 TO ALTON AND 1 AUX LANE FROM ALTON TO TRUCK BYPASS. (PA&ED AND PS&E PHASE) PROJECT WILL UTILIZE $917,600 TOLL CREDIT MATCH.	$452,000	M
A.36	Orange	ADD 1 MF LANE EB FROM 55 TO 57, AND 1 MF LANE WB FROM KRAEMER TO STATE COLLEGE; IMPROVE INTERCHANGES; AND ADD AUX LANES.	$481,827	L
A.37	Orange	ADD 1 LANE EACH DIRECTION FROM SR 241 TO COUNTY LINE, AND OTHER OPERATIONAL IMPROVEMENTS. SEE RIVERSIDE COUNTY FOR ADDITIONAL DETAILS.	Included in RIV071250B	L
A.38	Riverside	ON I-10 NEAR BEAUMONT: ADD/CONSTRUCT NEW EASTBOUND TRUCK CLIMBING LANE FROM SAN BERNARDINO COUNTY LINE TO 1-10/SR60 JCT (EA: 35300)	$35,709	M
A.39	Riverside	ON SR-60 NEAR BEAUMONT: CONSTRUCT NEW EASTBOUND AND WESTBOUND TRUCK LANES FROM GILMAN SPRINGS RD TO 1.47 MILES WEST OF JACK RABBIT TRAIL AND UPGRADE EXISTING INSIDE AND OUTSIDE SHOULDERS TO STANDARD WIDTHS (10-FT INSIDE SHOULDER AND 10-FT OUTSIDE SHOULDER) (EA: 0N69U) - CMAQ PM2.5 BENEFITS PROJECT. $802.9 TC WILL BE UTILIZED FOR CMAQ ENG IN FY 14/15	$126,282	S
A.40	Riverside	CONSTRUCT NEW INTERCHANGE	$282,443	L
A.41	Riverside	ON VAN BUREN BLVD NEAR MARCH AIR RESERVE BASE: WIDEN FROM 4 TO 6 LANES FROM APPROXIMATELY 0.5 MILES WEST OF I-215 TO BARTON ST	$6,700	COMPLETE
A.42	Riverside	CONSTRUCT NEW IC AND RAMPS AND WIDEN OC FROM 2 TO 6 LANES	$67,863	L
A.43	Riverside	WIDEN FROM 2 TO 6 LANES	$68,423	L
A.44	Riverside	CONSTRUCT 4 LANE BRIDGE/INTERCHANGE AND RAMPS ACROSS SR-86S	$92,843	L
A.45	Riverside	RECONSTRUCT/WIDEN IC FROM 2 TO 4 LANES AND RECONSTRUCT/WIDEN RAMPS	$26,851	M
A.46	Riverside	ON SR-91/I-15: SR91 - ADD 1 MFL EA DIR (SR241-SR71)(I15-PIERCE); I15 - ADD TEL MED DIR CONNCT SB15 TO WB91 & EB91 TO NB15, 1 TEL EA DIR HIDDEN VALLEY-SR91 DIR CONNCT.	$404,847	M
A.47	Riverside	AT SR86S/AVENUE 52: WIDEN AND CONSTRUCT NEW 6 THROUGH LANE IC FROM E/O COACHELLA STORMWATER CHANNEL BRIDGE TO E/O TYLER ST. IMPROVEMENTS INCLUDE: REALIGN POLK ST AND RELOCATE AVE 52 AND POLK ST INTERSECTION, EXTENDED RAMP ACCELERATION/DECELERATION LANES, BIKE LANES, SIDEWALKS, AND RECONSTRUCT TRAFFIC SIGNALS (EA: OC960).	$33,000	M

** Note: Map ID refers to maps in 2016 RTP/SCS Goods Movement Appendix (pgs. 74 to 77)*
*** Note: Short-term (S) (2012-2020); Medium-term (M) (2020-2030); Long-term (L) (2030-2040+)*

TABLE 19 Regional Goods Movement Project List Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.48	Riverside	AT SR86S/AVENUE 50: WIDEN AND CONSTRUCT NEW 6THROUGH LANE IC FROM E/O COACHELLA STORMWATER CHANNEL BRIDGE TO E/O TYLER ST. IMPROVEMENTS INCLUDE: EXTENDED RAMP ACCELERATION/DECELERATION LANES, RELOCATE/REALIGN AVE 50 AND TYLER ST, BIKE LANES, SIDEWALKS, SIDEWALKS, AND RECONSTRUCT TRAFFIC SIGNALS (SAFETEA LU 1702, CA583, #2543)(EA:0C970)	$32,160	S
A.49	Riverside	IN WESTERN RIVERSIDE COUNTY IN THE CITY OF MORENO VALLEY ALONG SR 60 - WIDEN FROM TWO TO THREE LANES IN EACH DIRECTION IN THE EXISTING MEDIAN TO PROVIDE ONE ADDITIONAL GENERAL PURPOSE LANE IN EACH DIRECTION FROM REDLANDS BLVD. TO GILMAN SPRINGS RD.	$7,500	M
A.50	San Bernardino	I-10 AT CEDAR AVE. BETWEEN SLOVER AND VALLEY- RECONSTRUCT I/C-WIDEN FROM 4-6 LANES WITH LEFT AND RIGHT TURN LANES. ADD AUX LANE ON E/B ON AND OFF RAMPS	$62,930	S
A.51	San Bernardino	I-10 TIPPECANOE RECONFIGURE INTERCHANGE & LOCAL RD IMP/MOD (HP 1366)(WESTBOUND - PHASE II)(FORMERLY PART OF RTP ID 44810)	$57,358	COMPLETE
A.52	San Bernardino	SR210 LANE ADDITION - ADD 1 MIXED FLOW LANE IN EACH DIRECTION FROM HIGHLAND AVE(S/B). TO LUGONIA (REDLANDS) INCLUDES AUX. LANES BETWEEN BASE LINE AND 5TH STS AND AN ACCELERATION LANE AT 5TH ST. E/B ON RAMP AND DECELRATION LANE AT HIGHLAND AVE E/B OFF RAMP. (UNDER 1/4 MILES LENGTH)	$134,267	M
A.53	San Bernardino	I-10 AT GROVE INTERCHANGE AND GROVE AVE. CORRIDOR - RELOCATE I/10 & 4TH ST. I/C TO GROVE AVE. AND WIDEN GROVE AVE BETWEEN I-10 TO HOLT (4-6 LNS); WIDEN GROVE AVE FROM STATE ST TO 350 FT N OF HOLT BLVD INCLUDING RR BRDGE(4-6 LNS); LEFT TURN LANES AT HOLT.	$13,034	M
A.54	San Bernardino	I-10/CHERRY AVENUE INTERCHANGE - INTERCHANGE RECONSTRUCT - REPLACE O/C, WIDEN O/H AND WIDEN I/C FROM SLOVER TO VALLEY FROM 4-6 LANES WITH DOUBLE LEFT TURNS TO RAMPS	$76,114	COMPLETE
A.55	San Bernardino	I-15/I-215 I/C IMPROVMTS-DEVORE I/C S/O GLEN HELEN PARKWY TO N/O KENWOOD & I-215 FROM S/O DEVORE RD. I/C TO I-15 (16.0-17.8) ADD 1 M/F LN IN EA DIR TO EXISTG 3 M/F LNS FROM 3800 FT S/O GLEN HELEN PARKWY TO 3100 FT N/O I-215 I/C ADD 1 DECEL LN FROM 3200 FT S/O 15/216I/C OFFRMP TO S/B DEVORE ON I-215. CONSTRUCT TRUCK BYPASS LNS.	$324,669	S
A.56	San Bernardino	SR-60 AT ARCHIBALD AVENUE WIDEN ON AND OFF RAMPS (2-3 LANES EACH WAY)	$7,900	M
A.57	San Bernardino	WIDEN 5TH ST FROM CITY CRK TO SR210; RESTRIPE 5TH ST FROM 4-6LNS BTW CHURCH AVE & SR210; RESTRIPE 210 UNDERCROSSING 4-5LNS BTW RAMPS WITH ADD. TURN LN. CONSTRUCT TRUCK ACCL. LN ON SB SR210 ON-RAMP AND FWY MAINLINE INCLUDING WIDENING OF EXISTING FWY BRIDGE	$5,070	S

** Note: Map ID refers to maps in 2016 RTP/SCS Goods Movement Appendix (pgs. 74 to 77)*
*** Note: Short-term (S) (2012-2020); Medium-term (M) (2020-2030); Long-term (L) (2030-2040+)*

TABLE 19 Regional Goods Movement Project List Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
A.58	San Bernardino	I-10/PEPPER IC: WIDEN BRIDGE FROM FIVE TO SIX LANES TO PROVIDE FOR ONE ADDITIONAL SOUTHBOUND TURN LANE AND ADD AUXILIARY LANES TO FREEWAY	$39,815	S
A.59	San Bernardino	I-10 @ MT VERNON AVE INTERCHANGE IMPROVEMENTS	$37,125	M
A.60	San Bernardino	I-10/MOUNTAIN VIEW AVE INTERCHANGE IMPROVEMENTS	$82,889	L
A.61	San Bernardino	ON I-10 ADD/CONSTRUCT NEW EASBOUND TRUCK CLIMBING LANE FROM LIVE OAK CANYON ROAD TO SINGLETON RD INCLUDING TRANSITION BETWEEN COUNTY LINE AND CALIMESA BLVD	$50,024	M
A.62	San Bernardino	I-10 @ CALIFORNIA ST INTERCHANGE IMPROVEMENTS	$73,137	L
A.63	Ventura	GROUPED PROJECTS FOR PAVEMENT RESURFACING AND/OR REHABILITATION - LOCAL STREETS & ROADS SCOPE: PROJECTS ARE CONSISTENT WITH 40 CFR PART 93.126 EXEMPT TABLES 2 CATEGORIES - PAVEMENT RESURFACING AND/OR REHABILITATION, EMERGENCY RELIEF (23 U.S.C. 125), WIDENING NARROW PAVEMENTS OR RECONSTRUCTING BRIDGES (TO ADD TRAVEL LANES)	$31,167	S
A.64	Ventura	HUENEME RD FROM OXNARD CITY LIMITS TO RICE RD - WIDEN FROM 2 TO 4 LANES	$6,953	M
A.65	Ventura	IN OXNARD HUENEME RD SAVIERS TO ARCTURUS WIDEN AND CONSTRUCT FROM 2 TO 4 LANES (SAFETEA-LU PROJECT #735'TIP')	$2,924	S
A.66	Ventura	IN OXNARD AT RICE AVE (SANTA CLARA) RECONSTRUCT INTERCHANGE (T21-#664) (SAFETEA-LU #1565) (SAFETEA-LU #2639 AND 'TIP') (TCSP - 2010 APPROP EARMARK)	$83,997	COMPLETE
A.67	Imperial	WIDEN AND IMPROVE TO 6 LANE FREEWAY WITH INTERCHANGES AT HEBER, MCCABE, AND JASPER AND OVERPASS AT CHICK RD.	$999,136	L
A.68	Imperial	EXPANSION OF THE CALEXICO EAST PORT OF ENTRY - THE PROPOSED PROJECT IS TO INCREASE THE NUMBER OF COMMERCIAL VEHICLE INSPECTION LANES AND BOOTHS FROM EXISTING 3 TO 6 LANES AND BOOTHS; AND WIDEN BRIDGE OVER THE ALL-AMERICAN CANAL (CANAL SERVES AS U.S./MEXIC	$90,000	L
SUBTOTAL - ROADWAY ACCESS TO MAJOR GOODS MOVEMENT FACILITIES			$14,025,890	

** Note: Map ID refers to maps in 2016 RTP/SCS Goods Movement Appendix (pgs. 74 to 77)*
*** Note: Short-term (S) (2012-2020); Medium-term (M) (2020-2030); Long-term (L) (2030-2040+)*

TABLE 19 Regional Goods Movement Project List Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
B. FREIGHT CORRIDOR SYSTEM				
B.1	Los Angeles	I-710 CORRIDOR USER-FEE BACKED CAPACITY ENHANCEMENT - WIDEN TO 5 MIXED FLOW + 2 DEDICATED LANES FOR CLEAN TECHNOLOGY TRUCKS (EACH DIRECTION) AND INTERCHANGE IMPROVEMENTS, FROM OCEAN BLVD IN LONG BEACH TO THE INTERMODAL RAILROAD YARDS IN COMMERCE/VERNON	$5,110,000	M
B.2	Various	EAST-WEST FREIGHT CORRIDOR SEGMENT 1 (FROM I-710 TO JUST WEST OF I-605)	$2,413,086	L
B.3	Various	EAST-WEST FREIGHT CORRIDOR SEGMENT 2 (FROM JUST WEST OF I-605 TO JUST EAST OF SR-57)	$9,102,359	L
B.4	Various	EAST-WEST FREIGHT CORRIDOR SEGMENT 3 (FROM JUST EAST OF SR-57 TO I-15)	$3,777,816	L
B.5	Various	I-15 FREIGHT CORRIDOR (INITIAL SEGMENT) (SR-60 TO I-10)	$856,570	L
SUBTOTAL - FREIGHT CORRIDOR SYSTEM			$21,259,831	
C. ZERO-EMISSION TECHNOLOGY				
NA	Los Angeles	LOS ANGELES REGIONAL DIESEL EMISSIONS REDUCTION PROGRAM FOR ENGINE RETROFIT PROVIDES INCENTIVE GRANTS TO OWNER OPERATORS OLD DIESEL TRUCKS TO UPGRADE EQUIPMENT TO REDUCE EMISSIONS	$449	S
NA	Los Angeles	EXPAND DIESEL EMISSIONS REDUCTION PROGRAM OF GATEWAY CITIES COG	$2,676	S
NA	Various	ZERO-EMISSION GOODS MOVEMENT	$3,000,000	L
SUBTOTAL - ZERO EMISSION TECHNOLOGY			$3,003,125	
D. OFF DOCK AND NEAR DOCK INTERMODAL YARD PROJECTS				
D.1	San Bernardino	TRACK AND INTERMODAL YARD IMPROVEMENTS (PHASES 1 THROUGH 4)	$799,616	L
D.2		SCLA RAIL SERVICE FROM AIR EXPRESSWAY APPROX. 5 MILES NO TO COLUSA RD. BETWEEN PHANTOM EAST & MOJAVE RIVER-PUT IN NEW RAIL LINE FROM BNSF TO SCLA.(FOR FREIGHT)PROJECT IN CONNECTION WITH NEW INTERMODAL/MULTIMODAL FACILITY ON SCLA PROPERTY	$250,000	S
D.3	Los Angeles	INTERMODAL FACILITIES (SCIG/ICTF)	$1,000,000	S
SUBTOTAL - OFF DOCK AND NEAR DOCK INTERMODAL YARD PROJECTS			$2,049,616	

** Note: Map ID refers to maps in 2016 RTP/SCS Goods Movement Appendix (pgs. 74 to 77)*
*** Note: Short-term (S) (2012-2020); Medium-term (M) (2020-2030); Long-term (L) (2030-2040+)*

TABLE 19 Regional Goods Movement Project List Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
E. MAINLINE RAIL				
"E.1-A to E.1-N"	Various	"Rail package — mainline rail capacity expansion: Barstow to Keenbrook–BNSF San Bernardino Subdivision; Colton Crossing to Redondo Junction–UP Mojave Subdivision; Devore Road to West Colton (inc. Rancho Flying Junction)–UP Alhambra Subdivision; West Colton to City of Industry–UP Los Angeles Subdivision; UP Yuma Subdivision."	$3,092,400	-
E.2	San Bernardino	· Colton Crossing: in Colton from 0.2 miles (0.3 KM) west of Rancho Avenue to 0.9 miles (1.5 KM) east of La Cadena Drive; construct railroad to railroad grade separation; (Cost included in the Rail package - mainline rail capacity expansion).	$201,994	COMPLETE
E.3	Orange	· BNSF Line - 10 miles of triple track from Fullerton to Orange/Riverside County line; (Same as Atwood to Fullerton and Esperanza to Fullerton); (Cost included in the Rail package - mainline rail capacity expansion).	$70,000	L
SUBTOTAL - MAINLINE RAIL			$3,364,394	

** Note: Map ID refers to maps in 2016 RTP/SCS Goods Movement Appendix (pgs. 74 to 77)*
*** Note: Short-term (S) (2012-2020); Medium-term (M) (2020-2030); Long-term (L) (2030-2040+)*

TABLE 19 Regional Goods Movement Project List Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
F. ON-DOCK RAIL				
-	Los Angeles	**PORT OF LOS ANGELES**		
F.1 - LA		WBCT On-Dock Rail: Addition of 2 new loading tracks	$806,021	
F.2 - LA		YTI On-Dock Rail: Addition of 1 new loading track		
F.3 - LA		Pier 400 Rail Expansion-Phase 1		
F.4 - LA		Pier 300 Rail Expansion: Addition of 2 new loading tracks		
F.5 - LA		Seaside Yard: Dedicated on-dock rail yard for Berth 226-236 terminal (Evergreen)		
F.6 - LA		Terminal Island Support Yard		
F.7 - LA		Berth 200 Railyard Expansion: Additional Storage/working tracks		
F.8 - LA		Evergreen/TICTF - adding 1 new loading track		
F.9 - LA		Port of LA Container Movement Enhancement Program: WBCT wharf improvements, YTI wharf improvements, Pier 300 wharf improvements, and Evergreen/STS wharf improvements		
F.10 - LA		Pier 400 Second Lead Track		
-		**PORT OF LONG BEACH**		
F.1 - LB		Pier G South Working Yard Rehabilitation.	$316,500	
F.2 - LB		Middle Harbor Terminal Rail Yard (3 Phases).		
F.3 - LB		Pier A On-Dock Rail Yard Expansion To Carrack.		
F.4 - LB		Pier A On-Dock Rail Yard East of Carrack.		
F.5 - LB		Pier G Metro Track Improvements.		
SUBTOTAL - ON-DOCK RAIL			$1,122,521	

** Note: Map ID refers to maps in 2016 RTP/SCS Goods Movement Appendix (pgs. 74 to 77)*
*** Note: Short-term (S) (2012-2020); Medium-term (M) (2020-2030); Long-term (L) (2030-2040+)*

TABLE 19 Regional Goods Movement Project List Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
G. RAIL ACCESS IMPROVEMENTS TO PORT OF LONG BEACH & PORT OF LOS ANGELES				
G.1 - LA	Los Angeles	PORT TRUCK TRAFFIC REDUCTION PROGRAM: WEST BASIN RAILYARD. INTERMODAL RAILYARD CONNECTING PORT OF LA WITH ALAMEDA CORRIDOR TO ACCOMMODATE INCREASED LOADING OF TRAINS AT THE PORT, THEREBY REDUCING TRUCK TRIPS TO OFF-DOCK RAILYARDS.(LAF5204)		S
	Los Angeles	PORT OF LOS ANGELES RAIL EFFICIENCY PROGRAM (ALAMEDA CORRIDOR-WEST BASIN AREA GAP CLOSURES) THIS PROJECT WILL ELIMINATE TWO SHORT GAPS IN TRACKAGE BETWEEN THE WEST BASIN AREA OF THE PORT OF LOS ANGELES AND THE ALAMEDA CORRIDOR (INCREASING THE NUMBER OF TRACKS FROM ONE TO TWO IN THIS AREA). THIS DOESN'T CHANGE ANY ON-DOCK RAILYARD CAPACITY ASSUMPTIONS, AND THUS DOESN'T CHANGE ANY PROJECTIONS OF TRAIN OR TRUCK VOLUMES IN THE RTP. THE PROJECT HOWEVER DOES REDUCE TRAIN DELAYS AND IDLING.		
G.2 - LB	Los Angeles	Pier B Street Realignment - Pier B Street Intermodal Railyard Expansion. Project will expand Pier B Street Intermodal Railyard to facilitate additional rail shipments and realign and widen Pier B Street.		M
G.3 - LB	Los Angeles	Pier F Support Yard - this project provides storage tracks on the Pier F Road cul-de-sac, which are useful for support functions such as set out of bad order rail cars and possibly engine tie-up.		S
G.4 - LB	Los Angeles	Track Realignment at Ocean Blvd - this project will create improved lead tracks to the Metropolitan Stevedoring Co. (Metro) rail yard and to Pier F on-dock rail yard.	$1,076,625	S
G.5 - LB	Los Angeles	Terminal Island Wye Track Realignment - this project will provide for double tracking the south leg of the Wye to accommodate simultaneous train switching moves from these various activities on Terminal Island.		S
G.6 - LB	Los Angeles	Reconfiguration of Control Point (CP) Mole - the new control point at the Mole will enable increased train speeds and reduced train delays caused by manual switch operations.		S
G.7 - LB	Los Angeles	Navy Mole Road Storage Yard - the proposed project includes three new tracks along the west side of Pier T. This project will also involve relocating the existing utilities.		S
G.8 - LB TO G.9 - LB	Los Angeles	Pier B Rail Yard (Phase III - 12th Street Alternative) expansion of Pier B Street intermodal railyard.		M
G.10 - LB	Los Angeles	New Cerritos Channel Rail Bridge		L
G.11 - LB	Los Angeles	TRIPLE TRACK S/O THENARD		L
SUBTOTAL - RAIL ACCESS IMPROVEMENTS TO PORT OF LONG BEACH & PORT OF LOS ANGELES			$1,076,625	

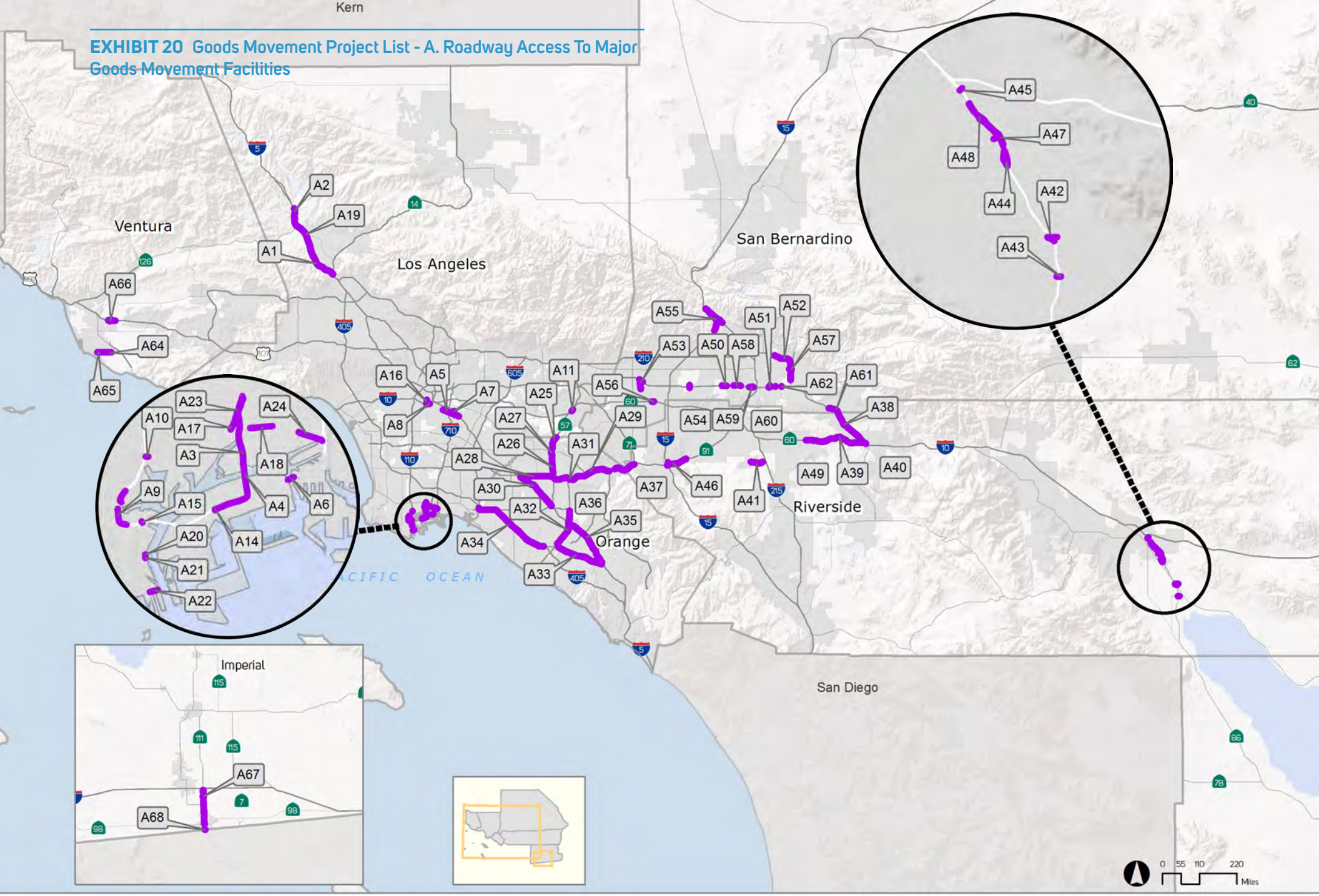
** Note: Map ID refers to maps in 2016 RTP/SCS Goods Movement Appendix (pgs. 74 to 77)*
*** Note: Short-term (S) (2012-2020); Medium-term (M) (2020-2030); Long-term (L) (2030-2040+)*

TABLE 19 Regional Goods Movement Project List Continued

Map ID	County	Project Description	Project Cost ($YOE, Thousands)	Timeframe (Short, Medium, Long)
H. RAIL-HIGHWAY GRADE SEPARATIONS				
SEE EXHIBITS B1 THROUGH B5	Various	RAIL PACKAGE- GRADE SEPARATIONS. (SEE DETAILED LIST) * Note: the total includes the non-goods movement grade separation total of $334,753,000	$4,795,109	S
SUBTOTAL - RAIL-HIGHWAY GRADE SEPARATIONS			$4,795,109	
I. BOTTLENECK RELIEF PROJECTS				
I.1-I.22	Various	GOODS MOVEMENT - BOTTLENECK RELIEF STRATEGY	$5,000,000	L
SUBTOTAL - BOTTLENECK RELIEF PROJECTS			$5,000,000	
J. FUTURE INITIATIVE THAT COULD SERVE GOODS MOVEMENT				
J.1	"Los Angeles/ San Bernardino"	HIGH DESERT CORRIDOR - CONSTRUCT NEW 4-6 LANE FACILITY: EAST-WEST FACILITY BETWEEN SR-14 AND US-395 (CONNECTING AT SAN BERNARDINO COUNTY); EAST-WEST FACILITY BETWEEN I-5 AND SR-14; AND NORTH-SOUTH FACILITY BETWEEN SR-14 AND SR-138. (INCLUDES Project IDs 1122004 & LA962212)	$5,000,000	L
NA	Various	GOODS MOVEMENT - ITS STRATEGY	$3,000,000	L
NA	Various	FREIGHT ARTERIAL O&M	$7,000,000	L
SUBTOTAL - FUTURE INITIATIVE THAT COULD SERVE GOODS MOVEMENT			$15,000,000	
TOTAL GOODS MOVEMENT PROJECTS			$70,697,111	

** Note: Map ID refers to maps in 2016 RTP/SCS Goods Movement Appendix (pgs. 74 to 77)*
*** Note: Short-term (S) (2012-2020); Medium-term (M) (2020-2030); Long-term (L) (2030-2040+)*

EXHIBIT 20 Goods Movement Project List - A. Roadway Access To Major Goods Movement Facilities

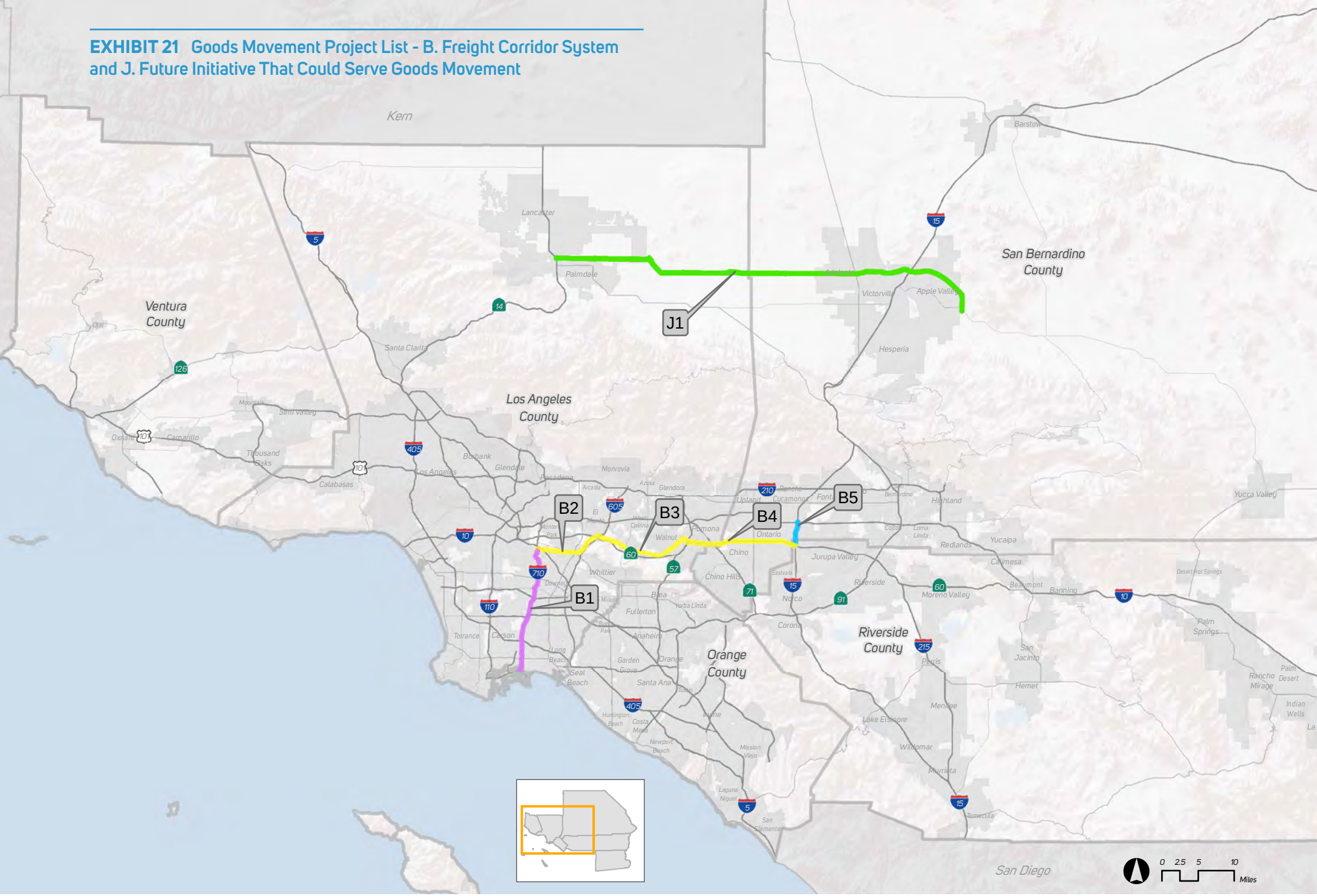


A - Raodway Access To Major Goods Movement Facilities

Note: Projects A12, A13, A63 are not mapped. See Project Listing

(Source: SCAG, 2015)

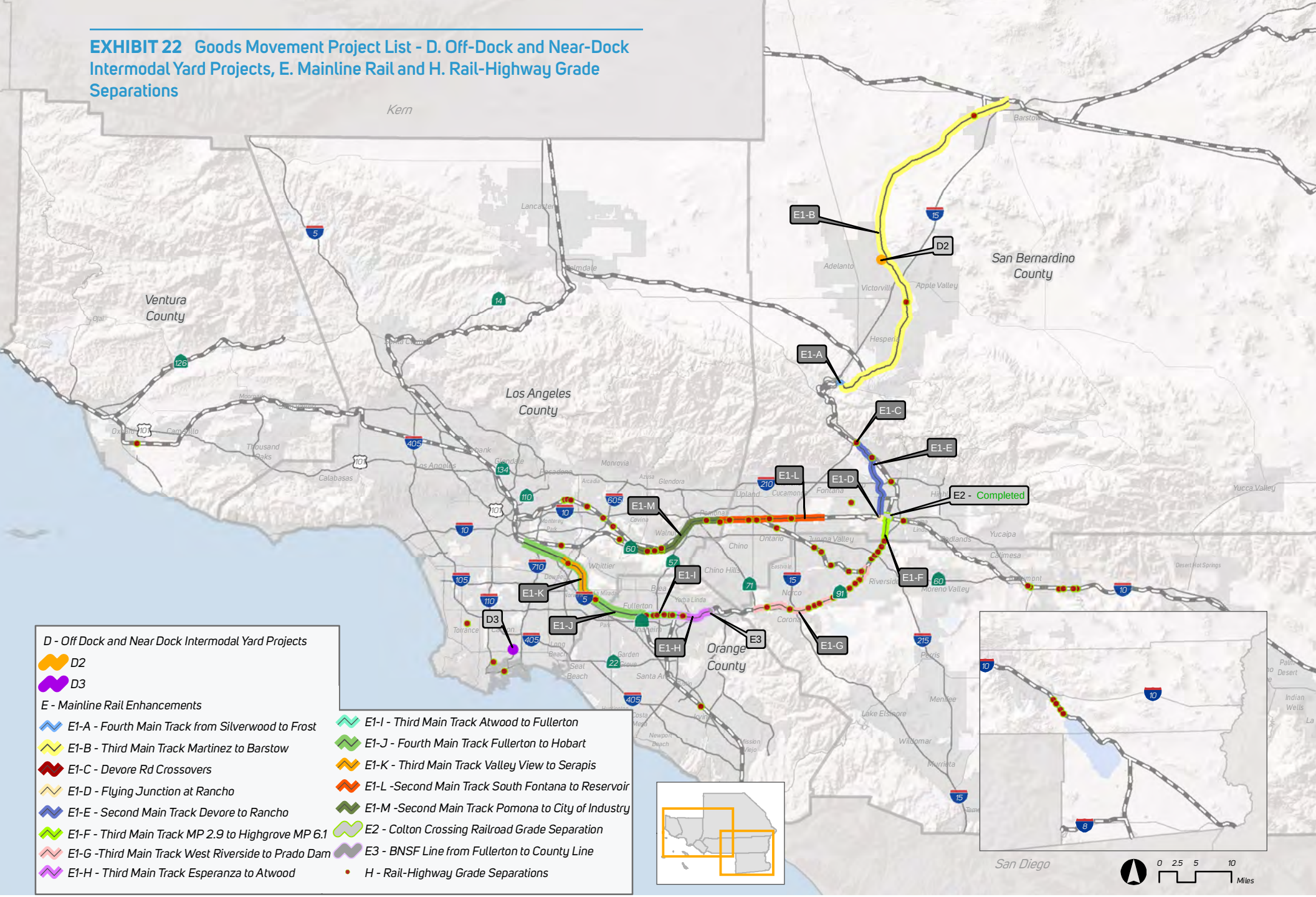
EXHIBIT 21 Goods Movement Project List - B. Freight Corridor System and J. Future Initiative That Could Serve Goods Movement



I-710 Freight Corridor | Potential East-West Freight Corridor | I-15 Freight Corridor | High Desert Corridor

Source: SCAG

EXHIBIT 22 Goods Movement Project List - D. Off-Dock and Near-Dock Intermodal Yard Projects, E. Mainline Rail and H. Rail-Highway Grade Separations



D - Off Dock and Near Dock Intermodal Yard Projects

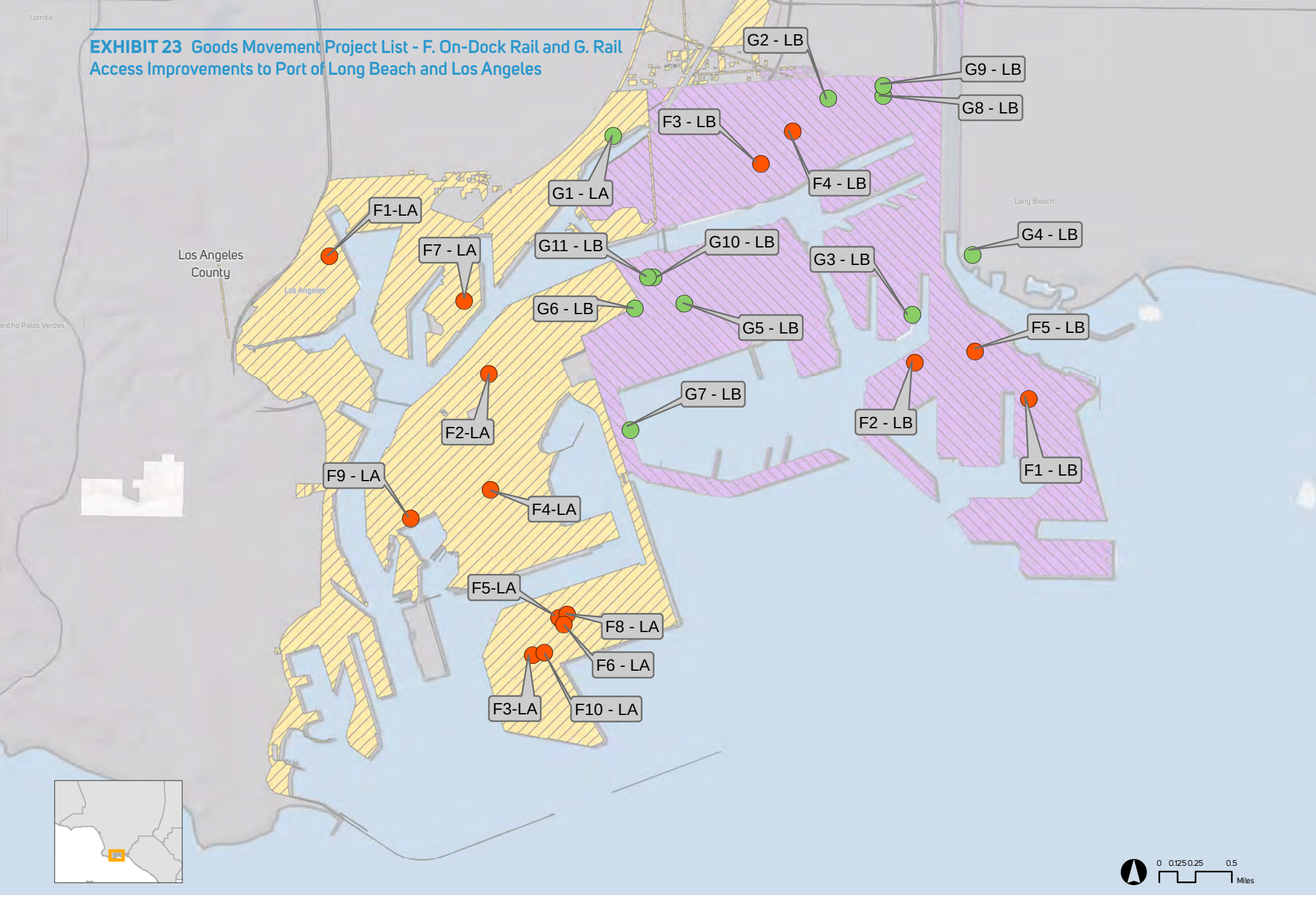
- D2
- D3

E - Mainline Rail Enhancements

- E1-A - Fourth Main Track from Silverwood to Frost
- E1-B - Third Main Track Martinez to Barstow
- E1-C - Devore Rd Crossovers
- E1-D - Flying Junction at Rancho
- E1-E - Second Main Track Devore to Rancho
- E1-F - Third Main Track MP 2.9 to Highgrove MP 6.1
- E1-G -Third Main Track West Riverside to Prado Dam
- E1-H - Third Main Track Esperanza to Atwood
- E1-I - Third Main Track Atwood to Fullerton
- E1-J - Fourth Main Track Fullerton to Hobart
- E1-K - Third Main Track Valley View to Serapis
- E1-L -Second Main Track South Fontana to Reservoir
- E1-M -Second Main Track Pomona to City of Industry
- E2 - Colton Crossing Railroad Grade Separation
- E3 - BNSF Line from Fullerton to County Line
- H - Rail-Highway Grade Separations

Source: SCAG

EXHIBIT 23 Goods Movement Project List - F. On-Dock Rail and G. Rail Access Improvements to Port of Long Beach and Los Angeles



F - On Dock Rail

G - Rail Access Improvements to Port of Long Beach and Port of Los Angeles

Port of Los Angeles (LA)

Port of Long Beach (LB)

Source: SCAG

NOTES

1 American Association of Port Authorities and U.S. Trade Online, U.S. Census

2 U.S. Trade Online, U.S. Census and Port of Hueneme

3 U.S. Trade Online, U.S. Census

4 CoStar Reality Information, Inc. www.costar.com, based on November 2014 data downloads

5 Industrial Warehousing in the SCAG Region Study, SCAG, based on the Avison-Young methodology for port-related and non-port related warehousing needs

6 SCAG's Regional Travel Demand Model

7 UPS Solutions: Defining Logistics, How It Relates to Your Supply Chain—and Why It's Crucial for Your Company https://www.ups.com/content/us/en/bussol/browse/article/what-is-logistics.html

8 The U.S. Census, County Business Patterns, https://www.census.gov/econ/cbp/

9 Food manufacturing includes all sectors under the NAICS category for 311. This sector transforms livestock and agricultural products into products for intermediate or final consumption. It includes animal food manufacturing, cereal manufacturing, vegetable and fruit canning, etc

10 US Census County Business Patterns https://www.census.gov/econ/cbp/

11 The Industrial Warehousing in the SCAG Region Study, Task 3 Trend Report, SCAG, 2015

12 The U.S. Census, County Business Patterns, https://www.census.gov/econ/cbp/

13 2012 Annual Re-Shoring Report, MIT Forum.

14 Regional Economic Model Inc. TranSight SCAG, CA, US v3.6.5

15 Source: American Association of Port Authorities (AAPA).

16 The San Pedro Bay Ports QuickTrip–Train Builder, Oct 20, 2014, "By Lifts & TEUs Estimation" tab

17 Originally these FTZs were located primarily along the border, but recent changes to the Mexican Customs Law now allow them to operate anywhere in the Mexican territory and several FTZs have opened in mainland Mexico, creating logistic hubs such as San Luis Potosí and Guanajuato.

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20 E-commerce Evolutions–Element 4: Distribution and Fulfillment Centers, NAIOP, May 2015, http://www.naiop.org/en/E-Library/Business-Trends/Distribution-and-Fulfillment-Centers.aspx

21 Retailers must overcome logistics lag for same-day delivery, Kris Bjornson, JLL, April 2014, http://www.joneslanglasalleblog.com/investor/retailers-must-overcome-logistics-lag-for-same-day-delivery/

22 Same-day delivery is transforming the CRE industry, Kris Bjornson, JLL, June 2015, http://www.joneslanglasalleblog.com/investor/same-day-delivery-is-transforming-the-cre-industry/?utm_source=us-retail-ecom&utm_medium=jll-website&utm_campaign=featuredpost

23 Employment Development Department, Labor Force Data for May 2014 and May 2015

24 Ibid.

25 San Pedro Bay Ports Container Forecast, February, 2015

26 American Transportation Research Institute (ATRI). *Cost of Congestion to the Trucking Industry*. April 2014.

27 American Transportation Research Institute (ATRI). *Congestion Impact Analysis of Freight Significant Highway Locations* - 2015

28 For purposes of accounting and reporting, the Surface Transportation Board designates three classes of freight railroads based upon their operating revenues for three consecutive years using the following scale: Class I–$250 million or more; Class II–less than $250 million but more than $20 million; and Class III–$20 million or less. These operating revenue thresholds are stated in 1991 dollars and are adjusted annually for inflation using a Railroad Freight Price Index developed by the Bureau of Labor Statistics (BLS).

29 California Department of Transportation, http://www.dot.ca.gov/hq/paffairs/news/pressrel/13pr082.htm

30 Federal Communications Commission https://www.fcc.gov/encyclopedia/positive-train-control-ptc

31 Federal Railroad Administration

32 For further information on the Modified Status Quo Routing of UP Trains, see 2011 Regional Rail Study completed by Dr. Robert Leachman, Leachman and Associates, LLC for SCAG.

33 New Cerritos Channel Rail Bridge and Third Track at Thenard are joint port projects; however, the cost of these two projects are listed under the Port of Los Angeles.

34 See previous note.

[35] U.S. Trade Online, U.S. Census and Port of Hueneme

[36] SCAQMD (June 2015) "Preliminary Draft AQMP White Paper Goods Movement."

[37] SCAQMD (April 20, 2011) The Need for Zero-Emission Technologies, presentation for Zero-Emission Transportation and Roundtable Discussion, April 20, 2011

[38] SCAQMD (June 2015) "Preliminary Draft AQMP White Paper Goods Movement."

[39] White House Office of the Press Secretary (February 18, 2014) "Fact Sheet: Opportunity For All: Improving the Fuel Efficiency of American Trucks–Bolstering Energy Security, Cutting Carbon Pollution, Saving Money and Supporting Manufacturing Innovation" Retrieved at https://www.whitehouse.gov/the-press-office/2014/02/18/fact-sheet-opportunity-all-improving-fuel-efficiency-american-trucks-bol

[40] USEPA at http://www3.epa.gov/otaq/climate/regs-heavy-duty.htmWhite House Office of the Press Secretary (February 18, 2014) "Fact Sheet: Opportunity For All: Improving the Fuel Efficiency of American Trucks–Bolstering Energy Security, Cutting Carbon Pollution, Saving Money and Supporting Manufacturing Innovation" Retrieved at https://www.whitehouse.gov/the-press-office/2014/02/18/fact-sheet-opportunity-all-improving-fuel-efficiency-american-trucks-bol

[41] CARB (March 14, 2014) "First Update to the Climate Change Scoping Plan, Appendix C, Focus Group Working Papers, Transportation" Retrieved from http://www.arb.ca.gov/cc/scopingplan/2013_update/transportation.pdf

[42] CARB (April 2015) "Sustainable Freight, Pathways to Zero and Near-Zero Emissions Discussion Document" Retrieved at: http://www.arb.ca.gov/gmp/sfti/sustainable-freight-pathways-to-zero-and-near-zero-emissions-discussion-document.pdf

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[44] General Electric (2014) "Fact Sheet on Evolution Tier 4 Locomotive" Retrieved at http://www.getransportation.com/sites/default/files/3%20EvoSeries%20Tier%204_locomotives.pdf

[45] TIAX, LLC, funded by POLA/POLB (March, 2011) "TIAX characterization of Drayage Truck Duty Cycles at the POLB and POLA"

[46] CALSTART, prepared for Metro and GWC COG (November 15, 2013) "Key Performance Parameters for Drayage Trucks Operating at the Ports of Los Angeles and Long Beach"

[47] For more information on this program see http://www.arb.ca.gov/msprog/aqip/solicitations/msc1514solicit.pdf

[48] Port of Los Angeles (July 2015) "Draft Port of Los Angeles Zero Emissions White Paper" Retrieved at: http://www.portoflosangeles.org/pdf/Zero_Emmissions_White_Paper_DRAFT.pdf

[49] http://www.arb.ca.gov/msprog/tech/presentation/trucksummary.pdf

[50] Gladstein, Neandross and Associates (GNA), (2014), "Case Study, Ryder System Inc." Retrieved from: http://www.gladstein.org/gna-casestudies/ryder-system-inc-2/

[51] UPS (May 5, 2015) "Press Release: UPS Becomes Nation's Largest User of Renewable Natural Gas in Shipping Industry" Retrieved from: https://www.pressroom.ups.com/pressroom/ContentDetailsViewer.page?ConceptType=PressReleases&id=1430830163276-554

[52] SCAQMD (February 6, 2013) Power Point from Clean Fuels Advisory Program, Mobile Source Update, Retrieved from: http://www.aqmd.gov/docs/default-source/technology-research/clean-fuels-program/clean-fuels-program-advisory-group—-february-6-2013/mobile-source-update.pdf?sfvrsn=10

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[55] CARB (September 2, 2014) power point, Heavy Duty Hybrid Vehicles Technology Assessment, retrieved at: http://www.arb.ca.gov/msprog/tech/presentation/hybridtrucks.pdf

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APPENDIX

TRANSPORTATION SYSTEM | GOODS MOVEMENT

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