Appendix H

Needs Assessment

Alameda County Goods Movement Plan

Task 3c – Identify Gaps, Needs, Issues and Deficiencies

Technical Memorandum

prepared for

Alameda County Transportation Commission

prepared by

Cambridge Systematics, Inc.

with

AECOM

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1.0 Introduction

Alameda County is one of the most strategic trade locations in the world; and with its connections to national and international markets, the County serves as a natural hub for goods movement throughout the Bay Area and the surrounding Northern California megaregion (including Sacramento region, Northern San Joaquin Valley, and the Central Coast). Goods movement in Alameda County includes diverse elements of the supply chain – everything from local trucks delivering groceries to area residents; to electronics components that serve as inputs to the County's and region's manufacturers; to California-produced wine, nuts, and cheeses that utilize the Port of Oakland as an agricultural export gateway.

Because of these reasons, it is vital that the goods movement system –including roads, rail lines and terminals, air and seaports, and intermodal connectors – is efficient, effective, and reliable. This will enable trade to flourish and sustain the high quality of life that is a hallmark of Northern California. In order to accomplish this, a Vision for Alameda County goods movement has been established:

> *The Goods Movement system will be safe and efficient, provide seamless connections to international and domestic markets to enhance economic competitiveness, create jobs, and promote innovation while reducing environmental impacts and improving local communities' quality of life*

This vision is supported by Plan Goals that rely on collaboration with public and private sectors and community partners to maintain, operate, and invest in the goods movement system to:

- Reduce environmental and community impacts from goods movement operations to create healthy communities and a clean environment, and improve quality of life for those communities most impacted by goods movement;
- Provide safe, reliable, efficient, and well-maintained goods movement facilities;
- Promote innovative technology strategies to improve the efficiency of the goods movement system;
- Preserve and strengthen an integrated and connected, multimodal goods movement system that supports freight mobility and access, and is coordinated with passenger transportation systems and local land use decisions; and
- Increase economic growth and prosperity that supports communities and businesses.

Each of these Plan Goals was selected to help the Alameda County Transportation Commission (CTC) and its public and private partner stakeholders create plans that address the key issues in the County and the region. When each of these goals is considered and ultimately realized, the goods movement system will meet the region's Vision.

This technical memorandum identifies gaps, needs, issues, and deficiencies for each mode and function of the Alameda County goods movement system as they relate to these goals. In an earlier technical memorandum[1], a process was described for evaluating the condition of the goods movement system using performance measures related to each of the goals. Through the examination of trend information and other quantitative and qualitative data sources (such as stakeholder interviews), this document uses the performance measures to provide insight into which parts of the goods movement system are working well today and expected to in the future and indicates weaker system components where improvements should be considered. This report also identifies opportunities in the goods movement system that can be pursued through investments, policies, and programs. This needs assessment will provide the basis for developing strategies in the next phase of the planning process to address needs and pursue opportunities.

The evaluation of the goods movement system is organized in this technical memorandum around the major functional elements of the goods movement system as follows:

- **Section 2.0 –Goods Movement System on Local Streets and Roads Issues.** These are issues that affect the networks of city streets that move freight to and from final origins/destinations; much of the goods movement system ultimately serves the needs of consumers who access the system through the network of local truck routes throughout the County. This system also includes last-mile connectors that provide the critical links between major freight facilities (global gateways, domestic rail terminals, warehouse/industrial centers, and industrial parks) and the inter- and intraregional systems.

- **Section 3.0 – Interregional and Intraregional Issues.** These are issues that affect the primary highways and rail lines that serve to connect the megaregion and Alameda County to the rest of the State and to domestic markets beyond. Key interregional and intraregional truck corridors in the Bay Area include I-80, I-580, I-680, I-880, and U.S. 101. Union Pacific Railroad (UP) rail connections along the Martinez Subdivision and Oakland Subdivisions and the BNSF Railway's TRANSCON line are important interregional rail corridors, too.

- **Section 4.0 – Global Gateway Issues.** These are issues that affect the major maritime facilities and international airport that handle international trade cargo. It covers those entry and exit points that are essential to moving high volumes of trade into and out of the region.

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[1] *Alameda CTC and MTC Goods Movement Plans: Multimodal Performance Measures*.

The modal elements that make up the global gateways function include the marine terminals at the Port of Oakland and the air cargo facilities at Oakland International Airport (OAK), along with the road and rail facilities in the immediate vicinity of these gateway facilities.

- **Section 5.0 – Cross-Cutting Issues.** These are issues that not only cross modal boundaries, but also may apply to any or several of the various system functions of local streets and roads, inter- and intraregional corridors, and global gateways.

1.1 Opportunities for Alameda County

While the focus of most of the remaining sections of this report is on identifying gaps and deficiencies in the different functional elements of Alameda County's goods movement system, it is important to note that with proper investments and policies, Alameda County residents and businesses can realize even greater benefits from the goods movement system than they do today. Technologies, operational strategies, and planning practices are available to ensure that these benefits can be realized while still providing the residents of the County – even those who live near major goods movement infrastructure – with a high quality of life and economic opportunity. Strategies to address the gaps and deficiencies identified in this report will be developed in the next phase of this plan development process. This section of the report describes opportunities that also should be the focus of strategies in the plan.

The opportunities described below have a high degree of overlap, which is important because it means that a well-crafted plan of investments and policies will be mutually reinforcing for many of the following opportunities.

1.1.1 Opportunity #1. Goods Movement Systems to Support Emerging Industries

Other reports already prepared for this plan and discussions with stakeholders noted that more than 32 percent of jobs in Alameda County are in economic sectors that represent more than two-thirds of freight transportation spending in the County. These sectors include retail and wholesale trade, construction, and manufacturing (largely traditional industries). In addition, goods movement through Alameda County includes exports of substantial amounts of high-value agricultural products and electronics/precision instrumentation produced throughout Northern California.

While these sectors represent the bulk of freight transportation demand today, there are a host of emerging industries and opportunities that were mentioned by various stakeholders in the business community and were documented to a limited extent in prior studies for this plan. Some of these emerging sectors include:

- **Biotech.** This includes biopharmaceutical research and production, biomedical equipment, and biomedical instrumentation. There are clusters of these industries emerging throughout the East Bay, but there is a particularly notable cluster of pharmaceutical companies in the Berkeley/Emeryville area. These industries ship small quantities of high-value products and rely on small trucks for pickup and delivery (usually integrated carriers, such as Federal Express and United Parcel Service) and use air shipping services extensively. Instrumentation manufacturers who are exporters also may ship through the Port of Oakland. Proximity to skilled workforce, specialized scientific facilities, and port and airport facilities are factors in location decisions that will affect goods movement routes.

- **Artisanal food products.** With agricultural production areas and a strong consumer base for products nearby, Alameda County is becoming an incubator for small artisanal food producers. This includes specialty foods, small wineries, and craft breweries. The County has had a strong tradition of food processing industry that has been eroded over time. But some of these older facilities can be adapted to modern food production techniques, and the region's remaining wholesale food markets represent an important link in the supply chain. Some of these businesses do outgrow their start-up facilities and move to other regions where they can acquire larger facilities at lower cost and with better access to national distribution networks. But for early stage producers, Alameda County is a good location. Access to intraregional corridors for local distribution and to the airport will be important to the growth of these industries.

- **Clean energy and advanced transportation.** The Tesla factory in Fremont is the most visible player in this market in Alameda County, but there are other producers of solar panels and plans for biofuel production that could turn into a growth opportunity for the region. These products may be shipped by rail or truck or may use the Port of Oakland for export.

- **Advanced manufacturing for traditional industries.** Industries such as machinery production could experience a revival in Alameda County as advanced manufacturing technologies make it possible to produce cost competitive products, taking advantage of proximity to the region's highly skilled technology workforce. In addition, smaller-scale prototypes or artisanal manufacturers also may take advantage of lower-cost, older industrial space that is still available in Alameda County. Goods movement demands of these industries will affect all of the functional elements of the Alameda County goods movement system.

While looking at the land use patterns along the County's major and minor truck routes, it is clear that there is a well-defined industrial corridor along I-880/I-80 with a substantial amount of the industrial land located west of the freeways, creating somewhat of a buffer between the industrial facilities and neighborhoods. While land use planning is conducted by the cities individually, the goods movement planning process creates an opportunity for the cities to consider their joint economic development needs and to plan for preservation of this industrial corridor. The goods movement plan can support this effort by investing in infrastructure that preserves the viability of existing truck routes, and by providing guidance on how to effectively plan truck routes and manage truck traffic to improve efficiency while protecting residential neighborhoods.

1.1.2 Opportunity #2. E-commerce, Omni-Channel Retailing, and Advanced Retail Distribution Strategies

This opportunity involves both an opportunity and a challenge. The opportunity is related to providing facilities and infrastructure that can capitalize on Alameda County's unique transportation assets and location to create a competitive advantage as a center of third-party logistics activity, integrated carrier hubs and major activity centers, and import- and export-oriented logistics facilities. As e-commerce expands and as retailers adopt advanced supply chain management strategies, West Coast locations – especially those located near international gateways, such as the Port of Oakland and Oakland International Airport – will have a competitive advantage as distribution points for order fulfillment and handling reverse logistics. Importers and exporters will be looking for advanced warehousing and distribution facilities as will their third-party logistics (3PL) providers. The Oakland Army Base (OAB) redevelopment and adjacent industrial and warehouse zones along the I-880 corridor stretching south to San Leandro will be ideal locations for these types of activities. While certain types of warehousing and logistics centers will be highly automated and will provide more limited employment opportunities, certain types of "pick and pack" operations and value-added services will be more labor intensive and will provide higher skill-level jobs. To realize this opportunity, the County will need to continue to invest in its roadway and rail infrastructure in partnership with the private sector, and it will need to ensure that truck routes and truck services that support the local movement of goods amongst these facilities are planned and managed to reduce neighborhood impacts. The Alameda CTC needs to work collaboratively with the Port of Oakland, 3PLs, regional agencies, and the Federal government to ensure that the region's airports, Oakland International Airport (OAK) in particular, can function effectively to meet future air cargo demands, especially for international service (which currently is very limited at OAK for air cargo).

Whether major logistics activities are conducted in Alameda County or not, e-commerce and advanced retail distribution strategies will impact the local truck route systems in the County and will require monitoring and adjusting truck routes and truck restrictions. The volume of smaller delivery trucks will continue to increase and their destinations will increasingly be in neighborhoods and commercial areas. Truck access, curbside management, and coordination of truck activity with other modal users will present challenges. The Alameda County Transportation Commission (CTC) can help meet these challenges with guidance to the cities on how to plan truck routes and truck management, and can provide supporting investments in technology and novel delivery strategies that can more effectively manage truck operations to improve roadway utilization. By targeting these investments properly, Alameda CTC can exert a strong influence on the shape of a countywide truck route system.

1.1.3 Opportunity #3. Bulk Export Growth and Expanded Rail Service Needs

The freight forecasts developed for this project show an increasing demand for bulk export movements through Bay Area seaports, including the Port of Oakland. This includes agricultural products; mineral ores; and waste, scrap, and recycled materials. The Port of Oakland and the City of Oakland already are working with developers to make investments in bulk terminal improvements, including modern cold storage facilities for agricultural shippers. Other ports in the Bay Area also are making plans for similar cargo. The most effective way to move this type of cargo to the port is by rail, and there are railyard improvements at the OAB that will make this possible. The Knight - Yard improvements at the OAB will also provide capacity to handle rail manifest traffic (i.e., the smaller shipments of a few carloads at a time in nonintermodal trains). This will create the opportunity for domestic shippers and international shippers of manufactured products to make greater use of the rail system by creating another rail yard within the Bay Area to handle this type of traffic.

In the recent past, the largest source of growth in rail markets has been in intermodal rail. The Port of Oakland and the Class I rail carriers (the Union Pacific Railroad and the BNSF Railway) have been planning for expanded intermodal service to the Port of Oakland based on the historically high rates of growth in containerized imports that were seen at all West Coast ports, but recent changes in the Pacific Rim trade lanes suggest a more modest rate of growth in international intermodal cargo from the Port (although the rates of growth will still be fairly robust). In addition to the international cargo, there also is an increasing demand for domestic intermodal cargo bringing products from the rest of the U.S. to the Bay Area, and allowing Bay Area manufacturers to take advantage of lower-cost, long-distance service by rail as compared to trucking. Under current operations, most of that domestic intermodal traffic is handled at the intermodal terminals in the San Joaquin Valley (SJV). This creates truck traffic on I-580 as trucks bring the cargo from the SJV railyards into the Bay Area. With the OAB redevelopment, there is now an opportunity to bring some of those trains directly into Oakland and to distribute the product from there. The OAB Environmental Impact Report (EIR) suggests that at full buildout the additional throughput of domestic intermodal cargo that will be handled at the OAB could take more than 700 trucks a day off of I-580.

In order to accommodate this combined demand for international and domestic intermodal, bulk unit trains, and manifest trains, the UP has suggested that they will begin to use their existing rail lines somewhat differently than they do today. They will reserve as much capacity as is needed to handle their priority traffic (primarily intermodal) on the Martinez Subdivision (along I-80), and will bring bulk and manifest trains on the Oakland Subdivision (through the Altamont and Niles

Canyon and on up to Oakland from the south). In order to accommodate this expanded demand for rail and to provide capacity to grow commuter rail services, public-private investment partnerships will be necessary to add new track, improve operations and remove bottlenecks, and address effects that increased rail traffic will have on communities through examination of quiet zones and grade separations at crossings.

These are some of the most significant opportunities that can be realized through a coordinated goods movement plan for Alameda County. Other opportunities will be identified and evaluated in the next phase of the plan when strategies for the future are developed.

1.2 Stakeholders Issues Identification Process

The foundation for the detailed needs assessment that is presented in this plan was the identification of key goods movement issues by reaching out to affected stakeholders and review of previous reports on goods movement. The intent of this goods movement plan is to be actionable and focused on the needs of freight stakeholders and community members. As a result, an extensive outreach process was designed to allow stakeholders' voices be heard and incorporated into this plan. A variety of outreach techniques were used throughout the process aimed at gathering the most pertinent information required at different plan development stages. For example, for the needs assessment, stakeholder input was solicited in three ways including:

1. One-on-one interviews and small group meetings with stakeholders;

2. A survey of representatives of the Alameda County Technical Advisory Committee (ACTAC) which includes all of the cities in Alameda County, the County planning and public works department, AC Transit, MTC, Caltrans, the Port of Oakland, and the Bay Area Air Quality Management District; and

3. A stakeholder roundtable meeting.

Some of the key findings that help frame issues that were examined in the needs assessment are presented below.

1.2.1 ACTAC SURVEY

An on-line survey was conducted with the ACTAC members to determine the issues that they thought should be the focus of planning efforts. There were two open-ended questions asked in the survey that helped inform issue identification:

1. What are the most important goods movement issues in Alameda County?

2. What other issues should Alameda County focus on regarding goods movement?

Some of the responses that helped inform this needs assessment included the following:

- Neighborhood impacts in West and East Oakland;
- Locomotive noise at at-grade crossings and prioritizing separations and other improvements for at-grade crossings;
- Truck parking on residential streets and pedestrian and bike conflicts;
- Planning and funding for future infrastructure needs at the Port of Oakland;
- Improving inland rail connections to the Port of Oakland;
- Marine terminal congestion and gate queuing;
- Congestion on major freeway corridors (I-580 named specifically);
- Downtown loading and unloading of trucks;
- Increasing opportunities to move more goods by rail;
- Deterioration of local streets and roads due to truck traffic;
- Access to industrial areas adjacent to residential areas and controlling cut-through traffic;
- Revisit the truck prohibition on I-580;
- Move Capitol Corridor off of Mulford line and coordinate passenger/freight traffic with UP;
- Need for wider curb returns in commercial areas;
- Need for more truck parking;
- Citizen complaints about truck routes that overlap with passenger corridors, such as collectors that connect to freeways for commuters;
- Need to extend overweight corridor from the Port of Oakland to San Leandro;
- Air quality and diesel emissions;
- Truck-auto conflicts and safety;
- Sea level rise and impacts on goods movement infrastructure;

- Limited truck access to City of Alameda;
- Land use changes resulting in loss of industrial land and movement of truck-oriented uses to the San Joaquin Valley (and associated return truck traffic to the Bay Area); and
- Trucks blocking or damaging transit infrastructure; and
- Goods movement supportive businesses locating in local communities, increasing truck traffic and impacts.

1.2.2 Interest Group Meetings

Early in the outreach process, interest groups were identified and one-on-one meetings and small group meetings were conducted. The interest groups included private-sector goods movement organizations (shippers, carriers and logistics service providers); businesses; environmental organizations; community and public health groups; and other key stakeholders from across Alameda County. The information gleaned from these stakeholders has been incorporated into this needs assessment. Table 1.1 provides a summary of the one-on-one interest group outreach done as part of this needs assessment and the corresponding key issues identified.

Table 1.1 Summary One-on-One Interest Group Outreach

Stakeholder Types	Stakeholder
Business Chambers and Commerce	East Bay Leadership Council, Bay Area Council, East Bay EDA, San Leandro Chamber of Commerce, Oakland Chamber of Commerce, Hispanic Chamber of Commerce
Carrier	California Trucking Association (CTA)
Government Agencies	Bay Area Air Quality Management District, Port of Oakland
Government Agencies	CMA Directors (Cordelia and Walnut Creek)
Carrier	Federal Express
Maritime	California Capital and Investment Group
Community	Ditching Dirty Diesel Collaborative
Public Health	California Air Resources Board (CARB) Sustainable Freight Initiative
Railroads	Union Pacific
Railroads	ACE and Capitol Corridor
Shippers/Receivers	East Bay Biomedical Manufacturing Network
Shippers/Receivers	East Bay Transportation and Logistics Partnership
Trade Unions	Alameda Labor Council (including Teamsters, International Brotherhood of Electrical Workers)
Trade Unions	International Longshore and Warehouse Union (ILWU)

Second, a roundtable was conducted in July 2014 to collect additional needs and issues important to various stakeholders and members of the public. The roundtable brought in more than 100 stakeholders from all levels of government and private businesses, as well as members of the public, over a one-half-day period. The roundtable included two panel discussions, as well as small group breakouts that allowed the collection of specific feedback. Some of the key feedback received from participants that are relevant for this technical memorandum include the following:

- Education of the general public and end users of the goods movement system is important to raise awareness of the benefits, needs, and tradeoffs;
- Cities need to consider goods movement in zoning, land use planning, and General Plans;
- Communication and partnerships across local, regional, state, and national agencies will lead to increased competitiveness of U.S. industries;
- Public health, noise, and quality of life impacts must be addressed through the planning process;
- Last-mile connections are the missing link in goods movement systems planning; and
- Environmental improvements in the goods movement system can drive economic and workforce development.

2.0 Goods Movement System on Local Streets and Roads Issues

A substantial amount of goods movement occurs on local streets and roads throughout Alameda County. The local street and road system serves the following purposes:

- Local pickup and delivery at retail, commercial, and residential locations;
- Last-mile connections to industrial centers and freight hubs (including Global Gateways); and
- Alternatives to freeway routes and, in some cases, primary routes for intercity goods movement within the County.

Local streets and roads are operated and maintained primarily by the cities in Alameda County (and the County for roads in the unincorporated areas); and as such, are not planned as a countywide system.

However, in 2014 Alameda CTC initiated a Countywide Multimodal Arterial Plan intended to identify the county's arterial network. That study will be complete after the Countywide Goods Movement Plan is done. Both the multimodal arterial and the goods movement plans will inform Alameda County's update to the long-range countywide plan that is expected to be adopted in summer 2016. In light of the importance of this element of the County's goods movement system, we discuss the performance of the local streets and roads as a system that provides distinct functions. In keeping with this approach, we begin this chapter with a discussion of truck routes, how they are designated, and how they can be described and planned for as a system. This is followed by a discussion of how the truck route system on local streets and roads throughout the County performs relative to the applicable goals and performance measures developed for the Goods Movement Plan. Table 2.1 summarizes the overall assessment of the needs of the truck route system on local streets and roads.

Table 2.1 Summary of Countywide Needs Assessment of Truck Route System on Local Streets and Roads

Goals	Measures	Metrics	Report Section	Rating	Rating Explanation[2]	Gaps and Opportunities
Reduce and mitigate impacts from goods movement operations to create a healthy and clean environment, and support improved quality of life for those communities most burdened by goods movement	Equity	Freight impacts, such as light, noise pollution, safety, air pollution, and encroachment on specific, adjacent communities most affected	2.5, 2.8 (Only limited to land use and parking issues)		Land use conflicts and parking issues are observed throughout the County in locations with high levels of industrial activity. Other types of community impacts are discussed in cross-cutting issues section.	Need to develop truck management strategies for affected neighborhoods, provide truck services within industrial areas and away from commercial neighborhoods, and increase enforcement. Develop regional truck parking strategies.
Provide safe, reliable, efficient, resilient, and well-maintained goods movement facilities and corridors	Freight-related crashes	Truck-involved crashes and crash rates (including crashes with bikes and pedestrians)	2.7		Volume of truck-involved crashes is not very high, but is concentrated on certain routes, including Hesperian Blvd and Mission Blvd.	Need safety examination of freeway access and connections to local truck routes where most crashes occur.
	Freight infrastructure conditions	Bridge conditions ratings	2.6		Bridge conditions generally sufficient	
		Freight (truck) highway and arterial routes pavement conditions ratings	2.6		Pavement conditions of truck routes generally better than other routes.	Specific local truck route have poor condition. Where these are last-mile connectors, may suggest need for a new funding program.

[2] The current and future years are different depending on the particular issue. Please refer to each section for more detail.

Goals	Measures	Metrics	Report Section	Rating	Rating Explanation[2]	Gaps and Opportunities
Preserve and strengthen an integrated and connected, multimodal goods movement system that supports freight mobility and access, and is coordinated with passenger transportation systems and local land use decisions	Travel time delay	Travel time delay on freight (truck) routes	2.4	●	Major arterial truck routes have good to medium Level of Service (LOS), except Hesperian Blvd and portions of other routes. Tier 3 routes that connect to freeways or Tier 2 routes have poor LOS.	Application of ITS technologies to manage truck and auto flows. Examine time-of-day management of various users of the system to use capacity more effectively.
	Multimodal connectivity and redundancy	Freight routes access from/to locations with significant freight activities	2.2	●	Connectivity to major freight activity centers is generally good, but there are some locations where better options are needed. Better connectivity of truck routes via Santa Rita Rd to I-580 and Whipple Rd to Mission Blvd is needed. Need designation of more East-West Tier 3 routes in Fremont. Lack of overweight corridor connectivity between Oakland and San Leandro.	Consider making San Leandro St the primary intercity route connecting San Leandro and Oakland with more limited truck operations on International Blvd Evaluate similar opportunity for Hesperian Blvd and Industrial Blvd in Hayward. Consider truck route option for Warm Springs Blvd in Fremont to provide an alternative route to the freeways.
	Coordinate with passenger systems	Freight system element shared use with passenger system and addresses passenger/freight conflicts	2.3	●	The greatest areas of conflict are on the major Tier 2 truck routes that also are high frequency bus routes. Some bike lanes are on truck routes (access to Shoreline Park in West Oakland).	Examine options for shifting truck traffic off of Industrial Blvd to avoid conflict with BRT. Examine Complete Streets strategies, including trucks on major intercity arterial truck routes.

Goals	Measures	Metrics	Report Section	Rating	Rating Explanation[2]	Gaps and Opportunities
	Compatibility with land use decisions	Locations and corridors with significant freight activities in proximity to noncompatible land uses currently and in the future	2.5	● (red)	There are many places where truck routes represent a boundary between industrial and residential land uses. Complaints about truck impacts in these cases. Land use conflicts are creating impacts on neighborhoods in West and East Oakland.	Need guidelines for land use planning in industrial areas. Support enforcement of truck restrictions.

High – ● (green); Medium – ● yellow; and Low - ● red.

2.1 Local Truck Routes Designation

As noted previously, local truck routes in Alameda County are owned and operated by the 14 incorporated cities and the County (for unincorporated areas). Outreach to all of the cities and the County was conducted to obtain information about designated truck routes. All of the cities and the County have some form of truck route designation. Typically, trucks are not required to travel on designated truck routes, but these are preferred routes for trucking and typically have been designated because they provide access to freight facilities or through movements on streets that have been built to standards that are appropriate for trucks. In many cases, cities also identify truck-restricted routes. In these cases, it is illegal for trucks to travel on the restricted routes. Routes may be prohibited for all trucks, trucks of a particular size and/or weight, trucks carrying hazardous materials (this restriction often applies to tunnels), or for trucks that do not have a specific destination along the route. Some cities designate truck routes as "through" routes intended for trucks making intercity movements or local routes for connections to local destinations. In our analysis of the County's truck route system, the first step was to map the routes and to examine them as a countywide system. In so doing, we identified three different tiers of truck routes based on observing their function and the way they were designated by the cities:

- Tier 1 truck routes refer to state highways that are designated to handle a majority of the through truck traffic (such as I-80, I-238, I-580, I-680, I-880, and State Routes 84 and 92 bridge approaches). They provide Bay Areawide and interregional connectivity. The performance and condition of the Tier 1 truck routes are evaluated in the next chapter that deals with inter- and intraregional corridors.

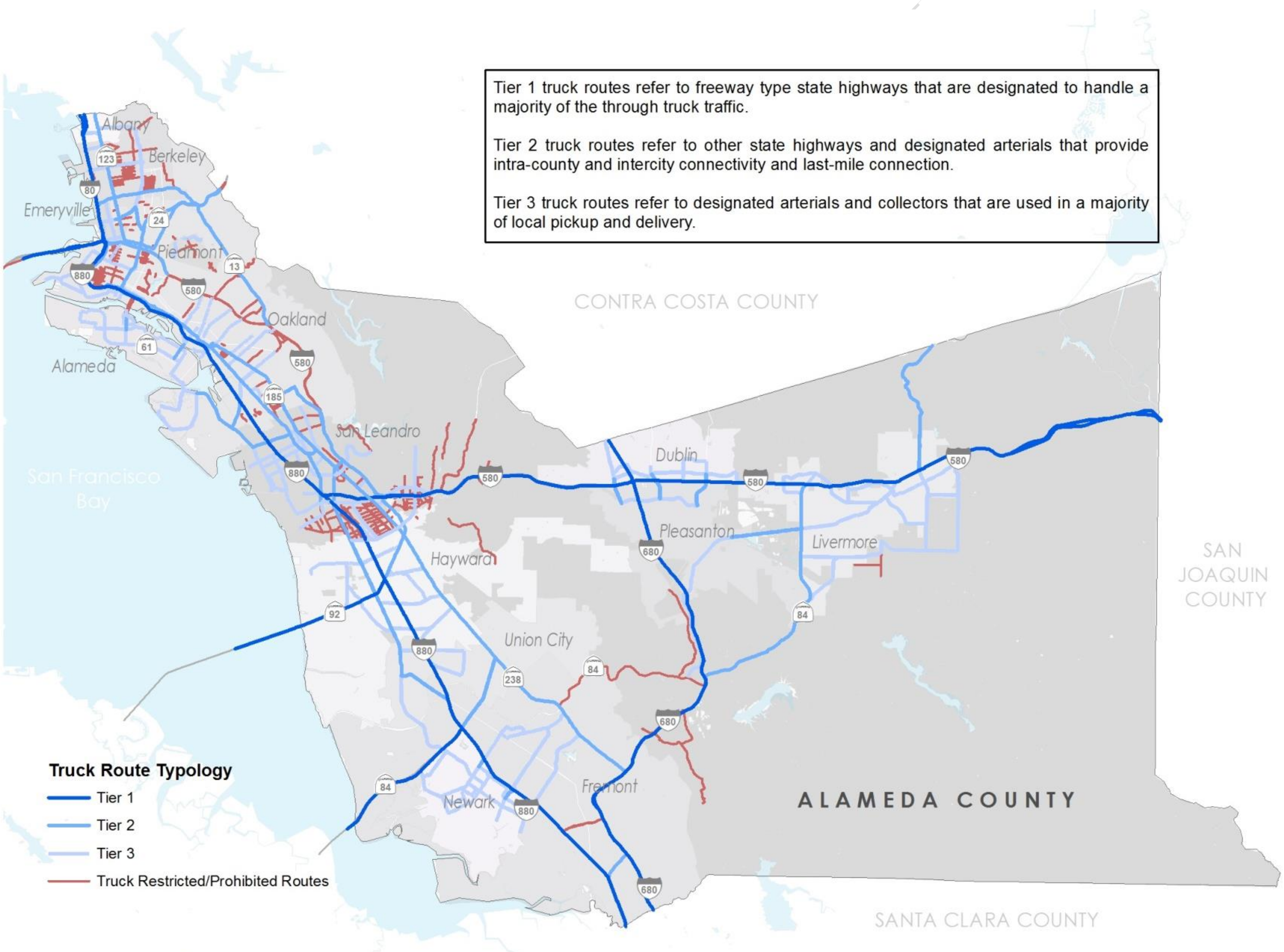
- Tier 2 truck routes refer to other state highways and designated arterials that provide intra-county and intercity connectivity and last-mile connection to the Port of Oakland and Oakland International Airport (OAK). Sometimes, they act as an alternate route to Tier 1 roadways, and other times they are used for local pickup and delivery.

- Tier 3 truck routes refer to designated arterials and collectors that are used in a majority of local pickup and delivery. They are not intended for through truck traffic.

- Not part of the tier definition, but in addition, many of the cities in Alameda County also allow trucks on streets other than the designated truck routes, but subject to weight, length, or commodity restriction. Exception can be made on weight restriction for special pickup and delivery.

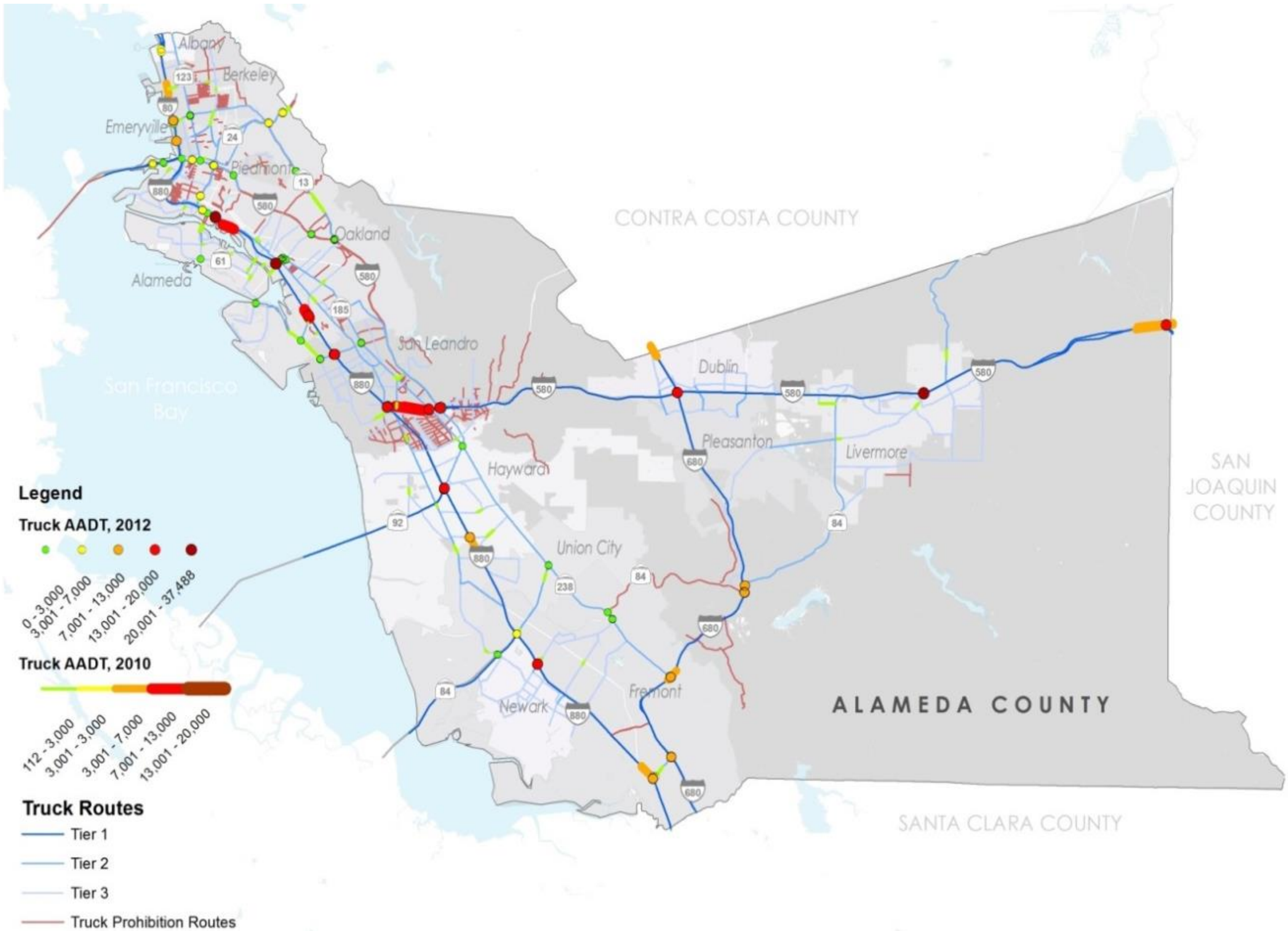
Figure 2.1 presents a map of the countywide truck route system. An interactive version that allows users to zoom in to see truck routes in closer detail and toggle land use information on and off can be accessed here: http://ags.camsys.com/ACTCGoodsMovement/. Figure 2.2 presents a map of truck counts that shows bi-directional truck volumes.

Figure 2.1 Alameda County Truck Routes and Truck Restricted/Prohibited Routes, 2014



Source Cambridge Systematics Analysis; Truck Routes and restriction information collected from cities.

Figure 2.2 Alameda County Truck Routes and Truck Counts, 2012



Source: Caltrans Truck Counts, 2012; Cambridge Systematics Analysis.

Part of the evaluation of the performance of local streets and roads is to determine how effectively the current system of designated truck routes performs as a countywide system. The designation of preferred truck routes is based on some of the following considerations:

- **Connectivity.** How well does the system connect to major areas of goods movement activity? Since connectivity is in itself one of the performance measures used in this report to evaluate the needs of the Goods Movement System, it is discussed in more detail in the following section (Section 2.2).

- **Ability to serve high levels of demand.** Since there were limited truck counts available on local roadways, it was difficult to evaluate the degree to which the designated truck routes are preferred routes for truckers and serve high levels of demand. Instead, we examined proximity to major corridors of industrial/warehouse activity to determine if the designated routes effectively serve demand. We also examined whether there were other routes parallel to the designated truck routes and of similar functional classification to identify other potential alternatives. In looking at these parallel routes, we also considered whether they would create greater potential for conflicts with other non-goods movement land uses and/or modal users. This also is discussed in later sections of this report.

- **Physical restrictions.** Trucks of different sizes cannot travel on certain roads because of the size of the vehicles and physical restrictions of the roads. This includes vertical clearances of viaducts, overpasses, and tunnels; lane widths that are appropriate for trucks; and weight limits on bridges for structural reasons. Since there was no comprehensive road inventory for local streets and roads that allowed for checking these physical restrictions, it has been assumed that the current designations by the cities already take this factor into account.

2.2 Truck Routes Connectivity

Multimodal connectivity and redundancy is one of the performance measures that was identified as a way of measuring the degree to which the system addresses the goal of providing an integrated and connected multimodal system. In the analysis of truck route connectivity, the following factors were considered:

- Do all major goods movement centers (primarily industrial and warehousing land uses) have access to the system?

- Is there sufficient city-to-city connectivity that links major industrial areas and provides route alternatives to congested freeways?

- Are there direct routes connecting industrial and warehouse areas to Tier 2 and Tier 1 roads? Are there multiple routes?

- Are there gaps in the system, particularly at jurisdictional boundaries?
- Do designated truck routes connect to truck-prohibited routes (these locations are sources of potential conflict)?

Figure 2.3 presents a summary map of all of the countywide truck route system with the existing land uses. Figures 2.4 through 2.7 provide maps for each of the four planning areas in the County that provide a closer look at many of these issues.

Last Mile Connectivity

The land use maps in Figures 2.4 through 2.7 show that all of the major warehouse and industrial areas, the Port of Oakland, and OAK all have good connectivity to the Tier 2 and Tier 3 networks; and there often are redundant routing options. There are some locations where two freeways represent alternative choices for accessing the Tier 1 connection, where an industrial/warehouse area can only access one of these options. For example, the industrial warehouse area in Pleasanton along Sunol Boulevard has good access to I-680, but does not have a connection to I-580 via Santa Rita Road. A similar situation, but involving connectivity from a Tier 2 route, exists in Union City: There are major industrial districts on both sides of I-880 with connections via Alvarado Boulevard in the west (and eventually connecting to Union City Boulevard, which also acts as a parallel alternative to the freeway through the industrial area and connecting to Hayward) and Whipple Road in the east. However, Whipple Road is not designated as a truck route east of Central Avenue and, therefore, there is no access to the industrial areas from Mission Boulevard (which is the primary intercity arterial highway that acts as an alternative to I-880), as shown on Figure 2.5. City staff in Union City noted that Whipple Road necks down as it goes through residential areas after it crosses Central Avenue and may not be a suitable truck route. However, this limits the utility of Mission Boulevard as a potential reliever route for trucks and provides limited access to the industrial area from the east.

There are also city-to-city routes that provide alternatives to the freeway, and generally good access to adjacent industrial areas. The principal intercity arterial truck routes are:

- East Stanley Boulevard to Sunol Boulevard connecting Livermore and Pleasanton;
- Mission Boulevard (SR 238) connecting Fremont, Union City, and Hayward;
- Hesperian Boulevard to East 14^{th} Street to either San Leandro Street or International Boulevard connecting Hayward, San Leandro, and Oakland; and
- San Pablo Avenue connecting Albany, Berkeley, and Emeryville.

All of these routes are major arterials that have other uses and may present certain challenges in terms of managing truck uses (see Section 2.3 for discussion of potential modal conflicts). In addition, many of these roads have minimal industrial warehouse uses that can be accessed directly from them (without using a Tier 3 route) and often pass through residential neighborhoods for long stretches. This is especially true of Mission Boulevard, Hesperian Boulevard (except for the very south end in Hayward), and International Boulevard. San Pablo Avenue has industrial/warehouse uses that directly abut I-80 less than a block away and can be accessed from several east-west Tier 2 routes, but several of these blocks have truck restrictions in nearby neighborhoods; and this situation generally requires good signage, adequate truck parking in the industrial areas, and enforcement.

The one case in which there is a pair of parallel Tier 2 routes is the case of International Boulevard and San Leandro Street between San Leandro and Oakland.

There is no truck route connectivity between East County and the other planning areas other than Tier 1 freeway routes (primarily I-580, but also including I-680 to the south). SR 84 is truck restricted between I-680 and Mission Boulevard through Niles Canyon.

There are several other issues related to connectivity that are noted below:

- In an effort to reduce neighborhood impacts, most of the residential streets in West Oakland are truck restricted. 7th Street is the last leg in the Tier 2/Tier 3 system southeast of the Port of Oakland, and it ends its truck route designation at Union Street. While the extension of 7th Street through the West Oakland neighborhood is not prohibited for truck use, it is surrounded by restricted routes. All of these issues are discussed in more detail in a case study of West Oakland that will be provided in a separate report.

- As previously noted, Hesperian Boulevard in Hayward is the primary intercity route, but it has many non-compatible uses and will require special strategies to accommodate trucks. For access to the industrial areas to the west, Industrial Boulevard to Clawiter it provides more direct access to industrial areas and is further away from residential areas in most segments. There are a number of land use-related issues that are associated with this type of situation (industrial areas adjacent to residential neighborhoods with a truck route separating the two areas) that are discussed later in the section on Land Use Conflicts.

- In the industrial area in Fremont where the Tesla plant is located stretching from just west of I-880 to Warm Springs Boulevard, there are very few Tier 3 truck routes that are designated and limited connectivity from the industrial area to the west of I-880 to the Tesla plant and adjacent industrial areas. This may be leading to short truck trips on this section of I-880 (a generally congested segment during peak periods) when local roads might serve as a better alternative. To some extent, the lack of east-west connectivity of truck routes across I-880 in this area is as much a function of lack of any connectivity as it is the lack of truck route designations. Another issue in this area is the fact that Warm Springs Boulevard is not designated as a truck route, even though it provides a north-south alternative to the freeways for traffic moving to and from the industrial areas. Warm Springs is not a truck-restricted route so trucks could use it, but trucks are not being directed to it. Designating Warm Springs as a truck route would, however, create similar potential conflicts as would be the case on Industrial Boulevard in Hayward, as Warm Springs Boulevard represents the dividing line between an industrial/warehouse zone and a residential zone. In addition, a walkable Priority Development Area (PDA) is also planned there.

- There are several places where bridges and tunnels represent restrictions either for all trucks or trucks carrying hazardous materials, and these bridges and tunnels connect to truck routes. On the Bay Bridge, there is a restriction for flammable materials in tank trucks, but not for the portion of I-80 approaching the Bridge. SR 24 has similar restrictions for trucks through the Caldecott Tunnel, but not on the Alameda County side. Finally, the tunnel to Alameda (SR 260) has restrictions for hazardous materials. These are safety issues and there is no viable alternative to these restrictions. However, there is an alternative route (29th Street) south of SR 260, which can be used for truck travel.

Interjurisdictional Route Connectivity

One issue that has sometimes been raised in discussions with truck drivers and the cities is discontinuities in truck routes at city boundaries. While there are a few cases of this at the Oakland-San Leandro border (Bancroft Avenue), at the Alameda-Oakland border (High St), at the Oakland-Emeryville border (Peralta St/High St), at the Hayward-Union City border (Industrial Parkway SW) and Fremont-Newark border (Central Ave), this does not seem to be an issue with major thoroughfares. It would seem that lack of information on cross-jurisdictional routes is the issue here.

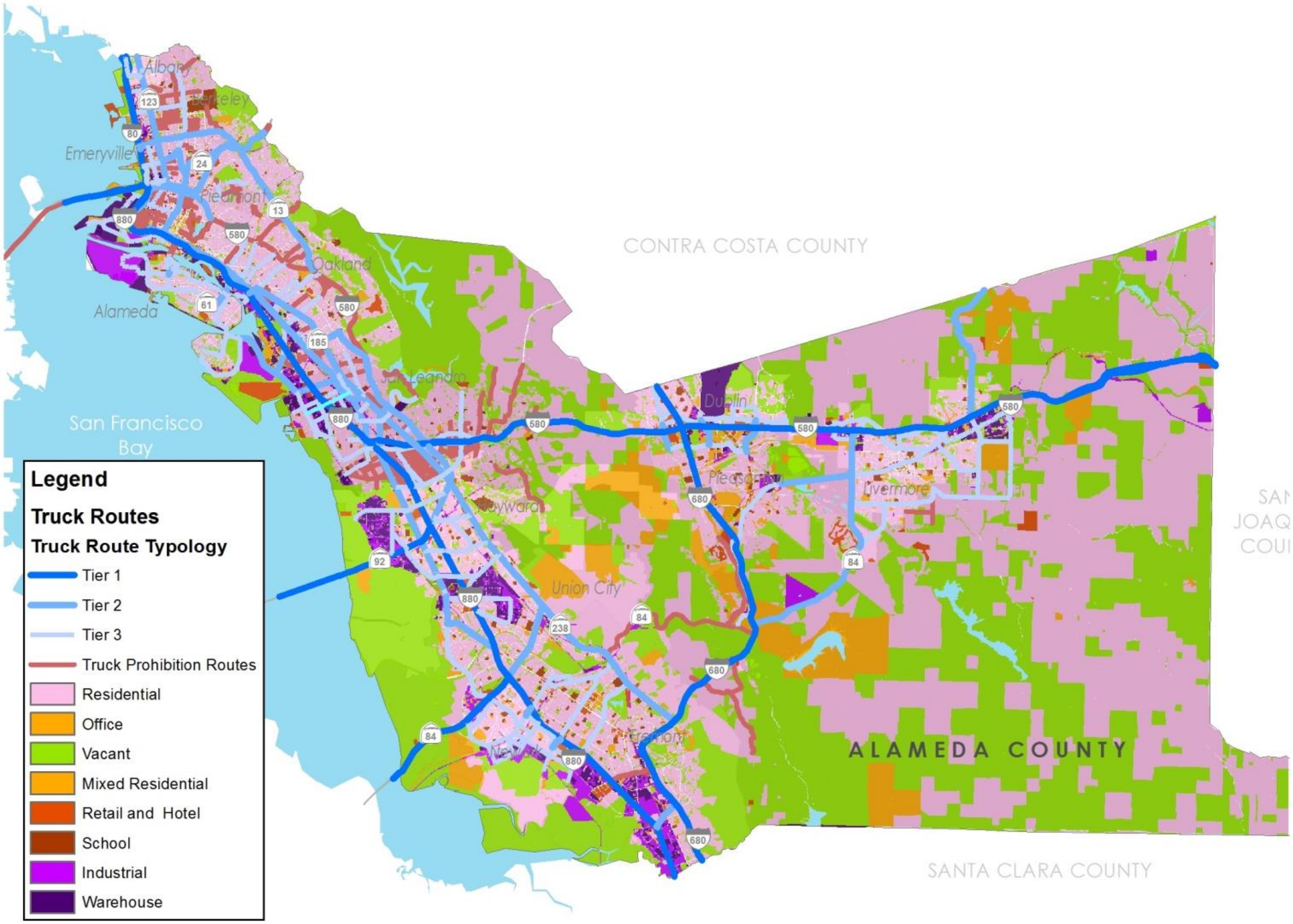
In addition, one issue related to discontinuities in truck routes was noted for the overweight network between Oakland and San Leandro. The City of Oakland has designated a series of roads southeast of the marine terminal area and the middle harbor as an overweight corridor. Often referred to as the "green zone," this overweight network is shown in Figure 2.8 (the green lines).

Figure 2.3 Permitted Heavy Weight Corridor Routes (Green Zone) by Port of Oakland

Source: Port of Oakland web site.

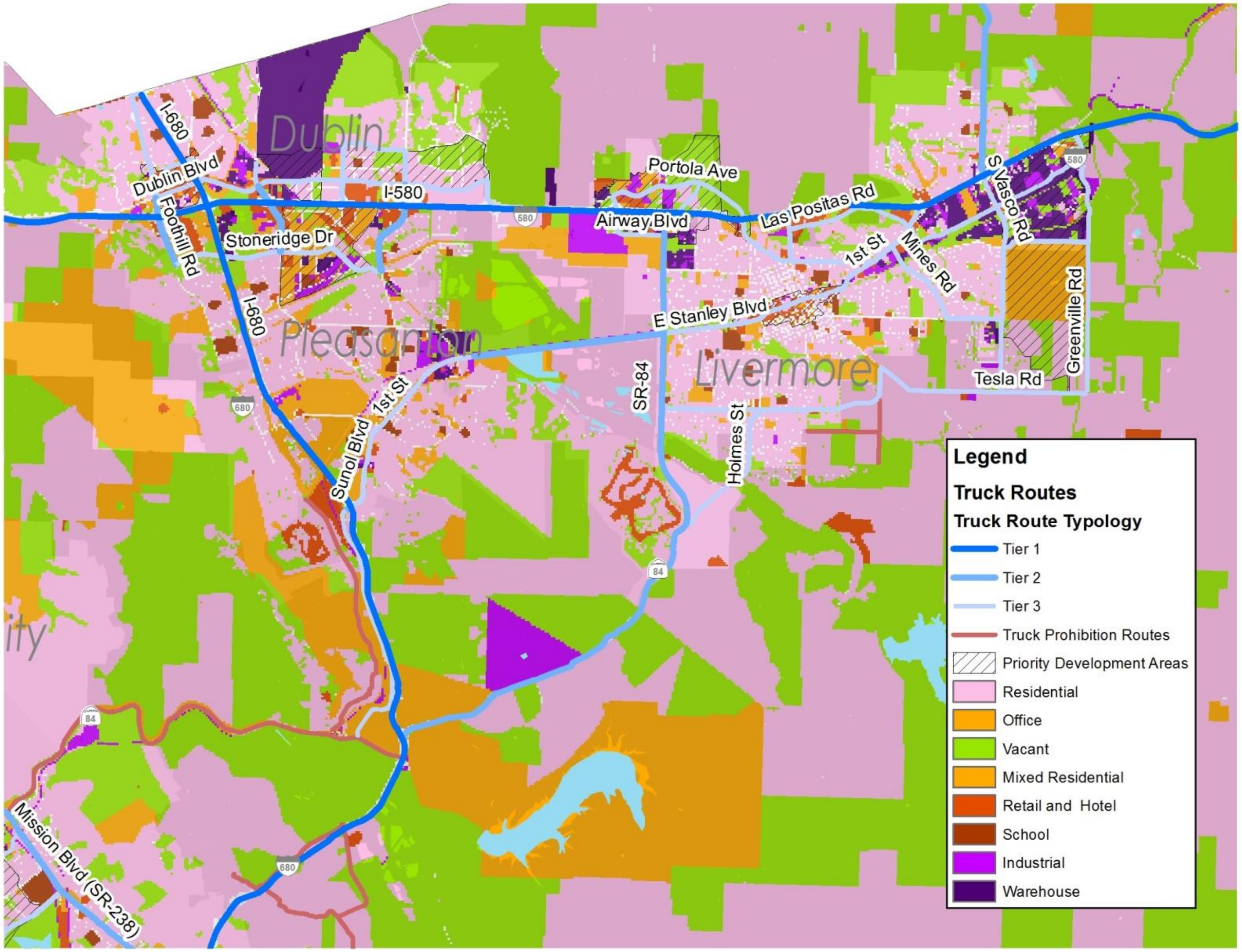
One of the benefits of the overweight corridor is that it allows shippers of certain products (often bulk agricultural products and other heavy containerized cargo) to carry loads that exceed the general legal limits on roadways, but that take advantage of the higher load limits on ocean-going vessels. The Port of Oakland is investing in new modern cold storage facilities on its property within the green zone designated roads, and one of the attractions to shippers and 3PLs that serve these industries is the ability to move cargo from the cold storage facilities to the marine terminals and intermodal terminals via this overweight network. At least one case has been reported of a major shipper with a cold storage facility in San Leandro that would like to move overweight loads to the Port of Oakland, but the overweight network does not extend to San Leandro. Caltrans also restricts the movement of overweight loads on this portion of I-880 because of bridge weight limits. While this may be a limited case, it may be worth further investigation to see if there are other shippers that would benefit from extending the overweight corridor and seeing if it can be connected to San Leandro Street as a through route.

Figure 2.4 Existing Truck Routes and Land Uses in Alameda County



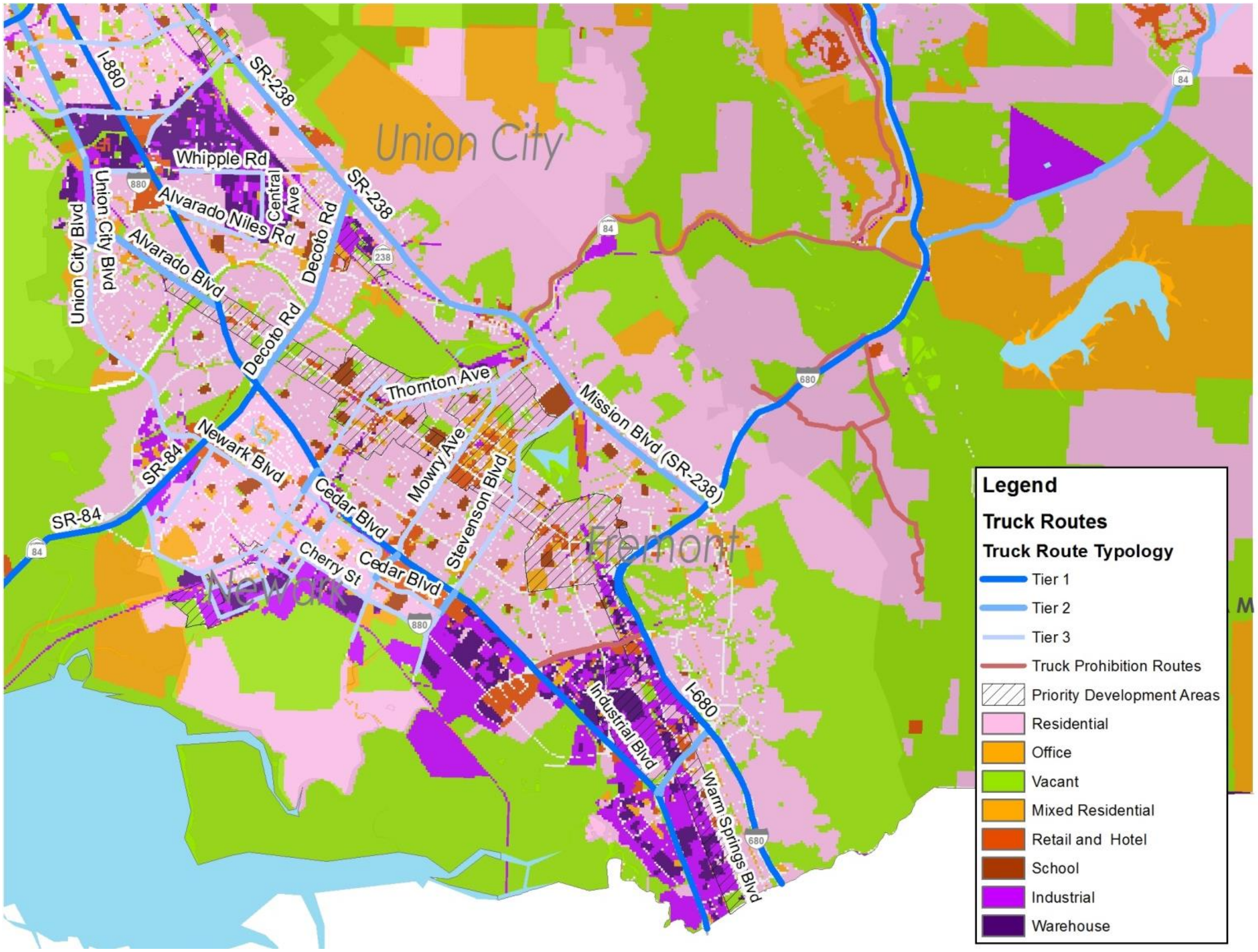
Source: Cambridge Systematics Analysis; Truck Routes and restriction information collected from cities; Land use information from MTC.

Figure 2.5 Existing Land Uses around Truck Routes – East Alameda County



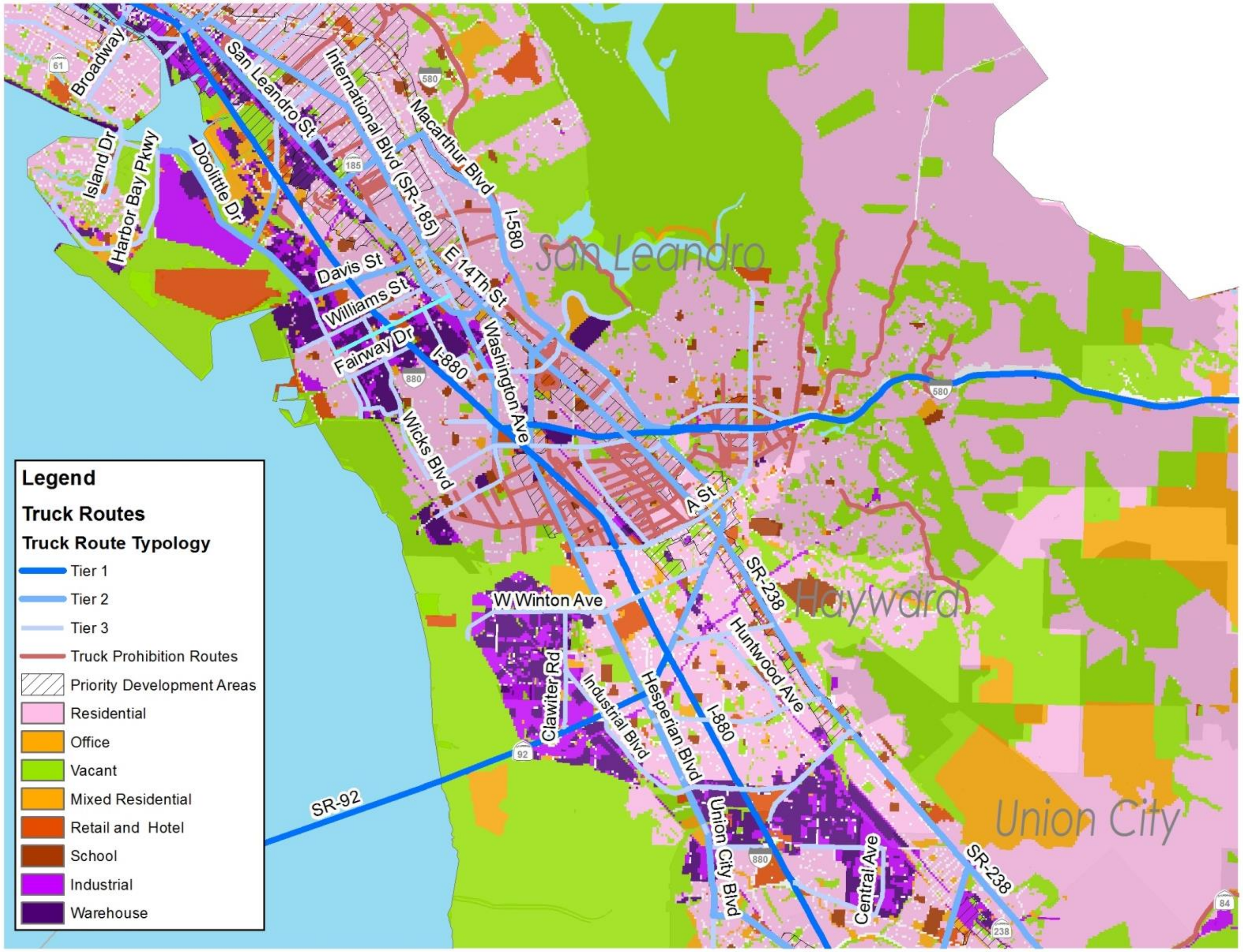
Source: Cambridge Systematics Analysis; Truck Routes and restriction information collected from cities; Land use information from MTC.

Figure 2.6 Existing Land Uses around Truck Routes – South Alameda County



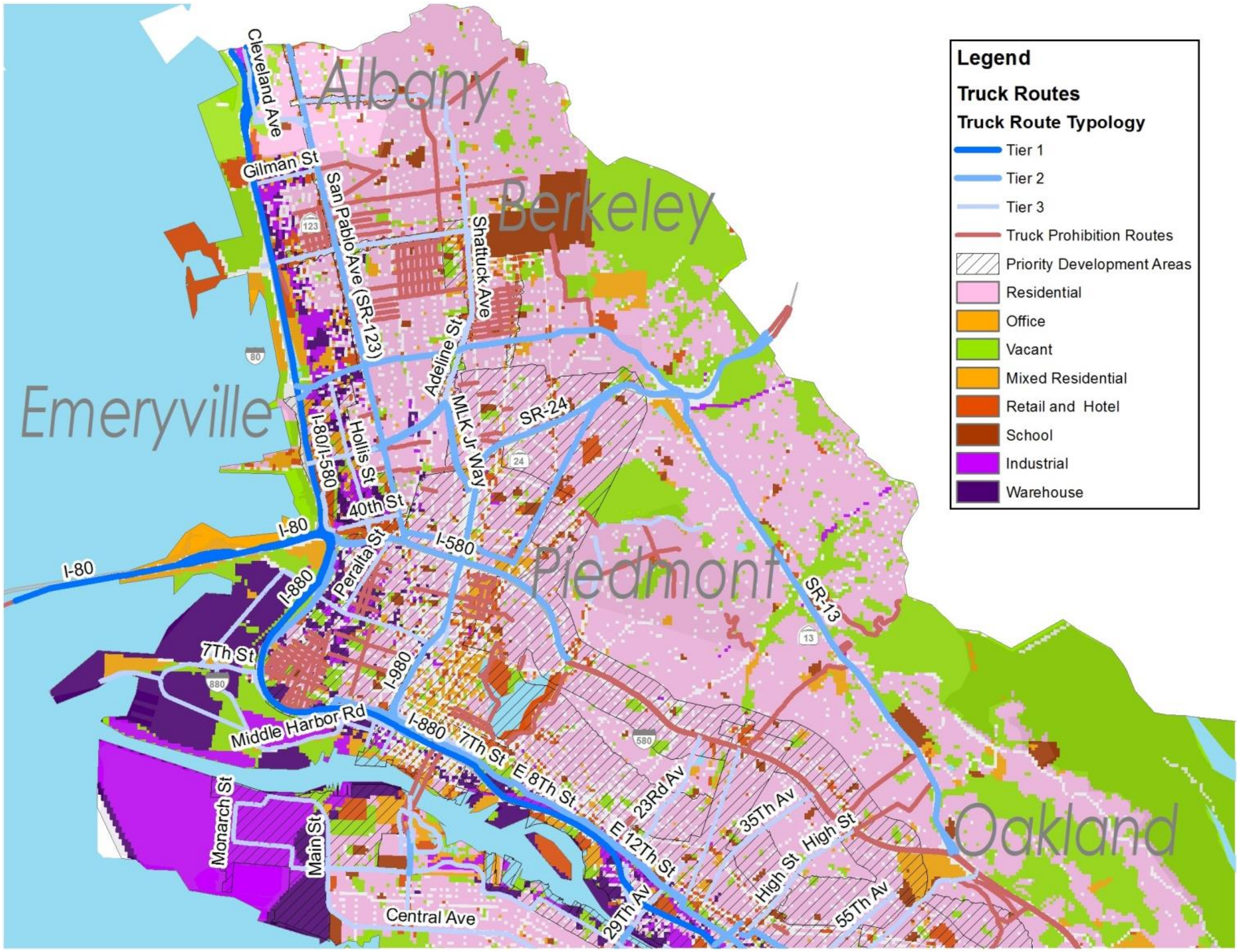
Source: Cambridge Systematics Analysis; Truck Routes and restriction information collected from cities; Land use information from MTC.

Figure 2.7 Existing Land Uses around Truck Routes – Central Alameda County



Source: Cambridge Systematics Analysis; Truck Routes and restriction information collected from cities; Land use information from MTC.

Figure 2.8 Existing Land Uses around Truck Routes – North Alameda County



Source: Cambridge Systematics Analysis; Truck Routes and restriction information collected from cities; Land use information from MTC.

2.3 Local Truck Route Conflicts with Other Modes

Trucks, especially the larger, combination vehicles, often create conflicts when they share the same roadways with other modal users. In the case of transit, buses that make frequent stops along curbs can represent a constraint for trucks that also are sharing curbsides for on-street loading. Also, frequent stops for buses can reduce average travel speeds for following trucks more than following autos because of the slow acceleration and deceleration characteristics of trucks. Transit routes also include signs, kiosks, and bus shelters that can create horizontal clearance obstacles for trucks, particularly when the turning radius and projections from the truck body are not considered as part of the travel envelope that is required to accommodate larger trucks. Transit operators experience damage to signs and shelters caused by trucks side-swiping these structures. Finally, transit operations typically are associated with higher levels of pedestrian activity, which could present truck safety issues.

Bike lanes on major truck routes also can create safety hazards and operational problems. Curbside bike lanes can overlap truck loading and unloading areas creating sightline problems for the bicyclist. Also turning movements involving trucks and bike lanes can be hazardous if not planned properly. There also are a number of bike lanes in Alameda County accessing waterfront trails near the Port of Oakland and adjacent industrial properties where trucks and bikes are likely to encounter conflicts.

In recent years, there has been a movement throughout the country to develop Complete Streets[3] plans to accommodate all modal users, and Alameda CTC and MTC have required cities to adopt Complete Streets policies in order to be eligible for certain funding sources. However, at this time, most of the Complete Streets guidance and standards provide little information about how to accommodate goods movement. In the future, delivery truck activity is likely to increase in commercial and residential areas, creating new challenges for how to reconcile goods movement needs with the needs of other users.

In order to assess the potential for modal conflicts, in Figure 2.9, high- and medium-frequency bus routes in Alameda County are overlaid on the truck route system. Not surprisingly, many of the major arterial highway truck routes that provide intercity alternatives to the freeways and that provide access to retail and commercial centers also are medium- and high-frequency bus routes. These include:

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[3] Complete Streets is a transportation policy and design approach that requires streets to be planned, designed, operated and maintained to enable safe, convenient and comfortable travel for all users regardless of their mode of transportation.

- AC Transit Route 51B has the second highest bus frequencies among AC transit lines, with 194 daily weekday revenue trips in January 2014. This route traverses University Avenue in Berkeley, which is also a Tier III truck route.

- AC Transit Route 73 had 138 daily weekday revenue trips in January 2014. This East-West route traverses Hegenberger Road, a Tier III truck route.

- AC Transit Route 72R, the "San Pablo Rapid" line (with 134 daily weekday revenue trips in January 2014) , along with AC Transit Route 72, and 72M traverse the majority of San Pablo Avenue, a Tier II truck route.

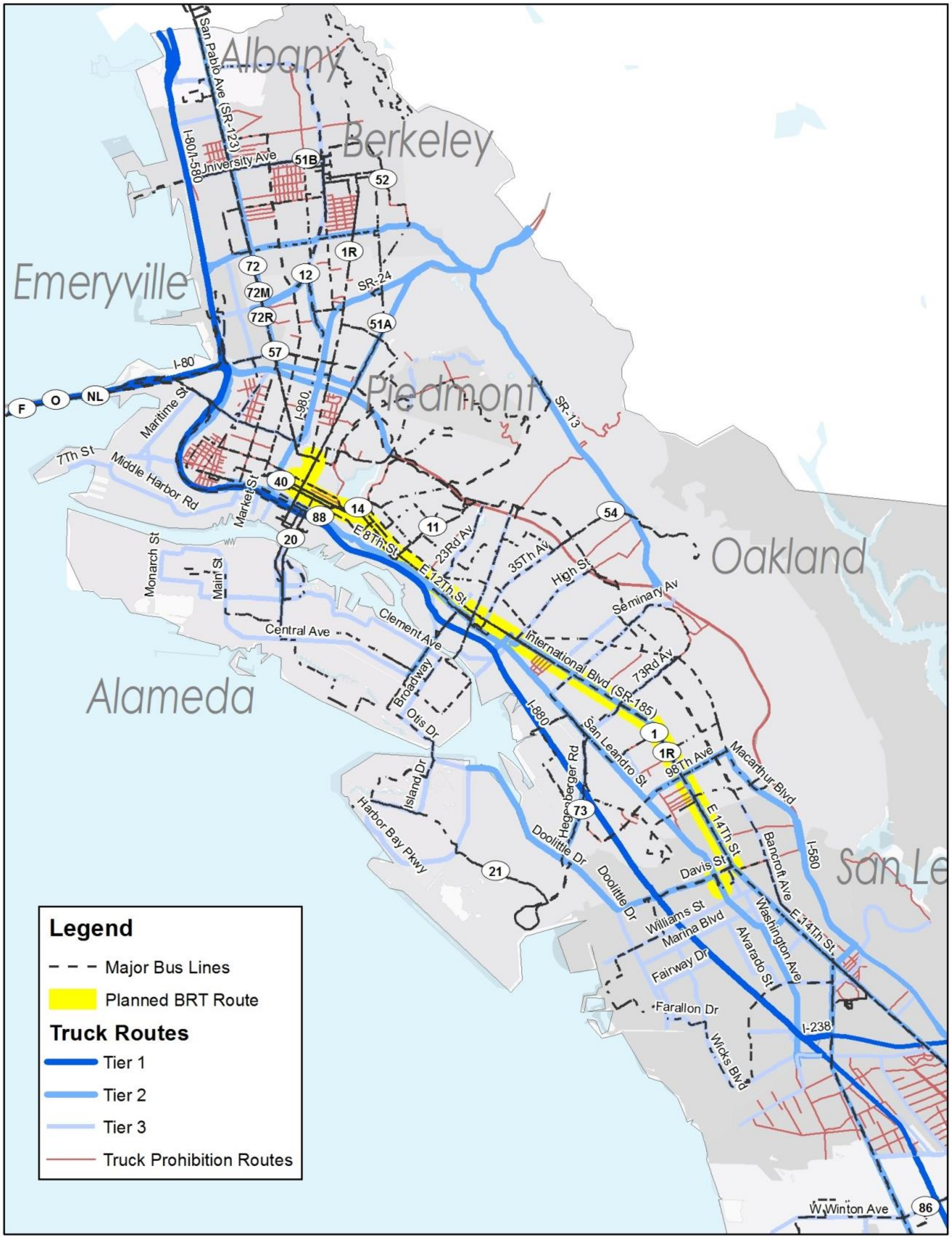
- AC Transit Routes 1 and 1R are two bus lines that traverse through International Blvd, a major Tier II truck route. Together, there are more than 250 buses that run on the line on a weekday.

There are also high-frequency routes on Hesperian Boulevard and Mission Boulevard.

In addition to these existing bus routes, Figure 2.9 also presents the routing for a new Bus Rapid Transit (BRT) route that is being planned by AC Transit. The route is along International Boulevard in Oakland and San Leandro and extends along one of the primary intercity arterial truck routes connecting Hayward, San Leandro, and Oakland. While BRT offers many amenities that make transit ridership more attractive, there are certain aspects of BRT roadway cross-sections and operations that can be problematic for larger trucks. BRT will restrict curbside loading zones, may result in narrower lane widths for non-bus traffic, and will restrict turns in order to facilitate the continuous and more rapid movement of the buses through intersections. This will create potential obstacles for trucks delivering goods to businesses along International Boulevard, but also will create new accessibility issues to the industrial areas to the west of International Boulevard. Given that San Leandro Street is closer to the existing industrial/warehouse land uses and is not a high frequency bus route, the cities along this corridor could consider shifting truck traffic to San Leandro Street as the primary intercity route for trucks and emphasizing International Boulevard for more local-serving truck traffic.

Note that this chapter was intended to discuss conflicts with both transit and bike networks. Since the Alameda CTC Arterials Plan project team is currently doing the analysis related to the bike network, this analysis is not included in this report at this time.

Figure 2.9 Existing Alameda-Contra Costa Transit District (AC Transit) Bus Routes and Planned BRT in Alameda County



Source: Bus routes and frequency information from Parsons Brinkerhoff; Cambridge Systematics Analysis.

Note: Major bus lines include bus lines with daily weekday frequencies of more than 50 trips.

2.4 Levels of Service (LOS)

Congestion is an ubiquitous problem in the Bay Area and local truck routes are no exception. Truck traffic typically peaks in the mid-day period as truck drivers try to avoid the peak congestion periods. But trucks making local deliveries must make them when the shippers and receivers are open for business; and with increasing congestion, this narrows the window within which trucks can operate. This means that trucks are increasingly operating in peak hours in order to extend their operating day. In addition, the Port's hours of operations also lead to trucks on the road during peak hours. To the extent that there are truck routes parallel to those with high levels of congestion or if trucks can change their operations to avoid peak periods, trucks can operate more efficiently. This will have a direct impact on the costs of trucking and the profitability of truck operations.

In order to assess congestion levels on truck routes, Alameda CTC provided data on the LOS on the arterial network for the year 2014. The LOS was determined using a variety of sources that measure roadway speeds and travel times over multiple days to determine average conditions. LOS is expressed with a letter rating from A through F, with A being free-flow conditions and F being highly congested. The LOS was compiled for all of the Tier 2 and 3 truck routes. The local road LOS for the morning peak period (7AM to 9AM.) and the evening peak period (4PM to 6PM) is mapped in Figures 2.10 and 2.10; and the locations with the worst LOS are presented in Tables 2.2 and 2.3.

In general, Tier 3 truck routes that provide connectivity to the freeways and the Tier 2 truck routes experience the worst LOS, indicating the last-mile connectivity is most difficult for trucks during the peak periods. For instance, if Tier 1 route is congested, access to Tier 2 and 3 routes will be difficult due to spillover effects. Conversely, truck traffic to freeways from Tier 1 and Tier 2 routes also affect performance of freeways. Trucks which have slow acceleration and deceleration may not be able to clear intersections to get on to freeway ramps. Of Tier 2 truck routes, Hesperian Boulevard has the worst LOS along most of its length, but portions of San Pablo Avenue, International Boulevard, and Mission Boulevard also have poor LOS for at least part of the day. It should be noted that San Leandro Street parallel to International Boulevard does not experience poor LOS during peak periods.

During strategy development options for encouraging off-peak truck activity, Smart Corridors (intelligent transportation systems (ITS)), and selective roadway widening will be examined to determine if there are ways to improve truck route mobility, especially as part of a strategy to provide alternatives to congested freeways.

Table 2.2 Major Arterials with Poor LOS

Route	Truck Route Tier	End Point 1	Jurisdiction	End Point 2	Length (Miles)	AM Peak (7-9) LOS	PM Peak (4-6) LOS
SR 262 (Mission) – WB	2	I-680 NB	Fre	I-880 SB	1.67	F	D
SR 84 – EB[a]	Hazmat Restricted	Sunol Rd	Fre	Plea-Sunol Rd	0.55	F	F
SR 112 (Davis) – WB	2/3	E 14th	SL	San Leandro	0.28	F	E
SR 185 (14th) – SB	2	Bayfair	Unin	170th	1.19	E	E
150th Ave – WB	2	I-580	SL	Hesperian	0.49	E	E
SR 84/Thornton(Fre)-WB	3	Fremont	Fre	I-880 SB	1.26	E	D
Hegenberger – EB	3	SR 61	Oak	Edgewater	0.77	E	E
Hesperian – SB	2	Lewelling	Unin	Grant	0.27	E	E
Hesperian – SB	2	14th	SL	Fairmont	0.31	E	E
Adeline – NB	2	MLK Jr – South	Berk	MLK Jr – North	0.28	E	E
Adeline – SB	2	MLK Jr – North	Berk	MLK Jr – South	0.29	E	D
SR 13 Ashby – WB	2	San Pablo	Berk	I-80 Ramps	0.64	E	E
Decoto – WB	2	Alv-Niles Rd	UC	Fremont CL	0.65	E	D
SR 123 San Pablo – NB	2	Allston	Berk	University	0.19	E	D
SR 185 (International Blvd) – SB	2	42nd	Oak	46th St	0.29	E	F
SR 185 (International Blvd) – NB	2	73rd Ave	Oak	Seminary	0.80	E	D
SR 238 (Mission) – SB	2	Stevenson	Fre	680 NB Ramp	2.35	E	E
Hesperian – NB	2	Tennyson	Hay	SH 92 – WB	0.49	E	F

Source: Alameda CTC LOS Monitoring Report (2014)

[a] This is actually on a restricted route with Hazmat restrictions.

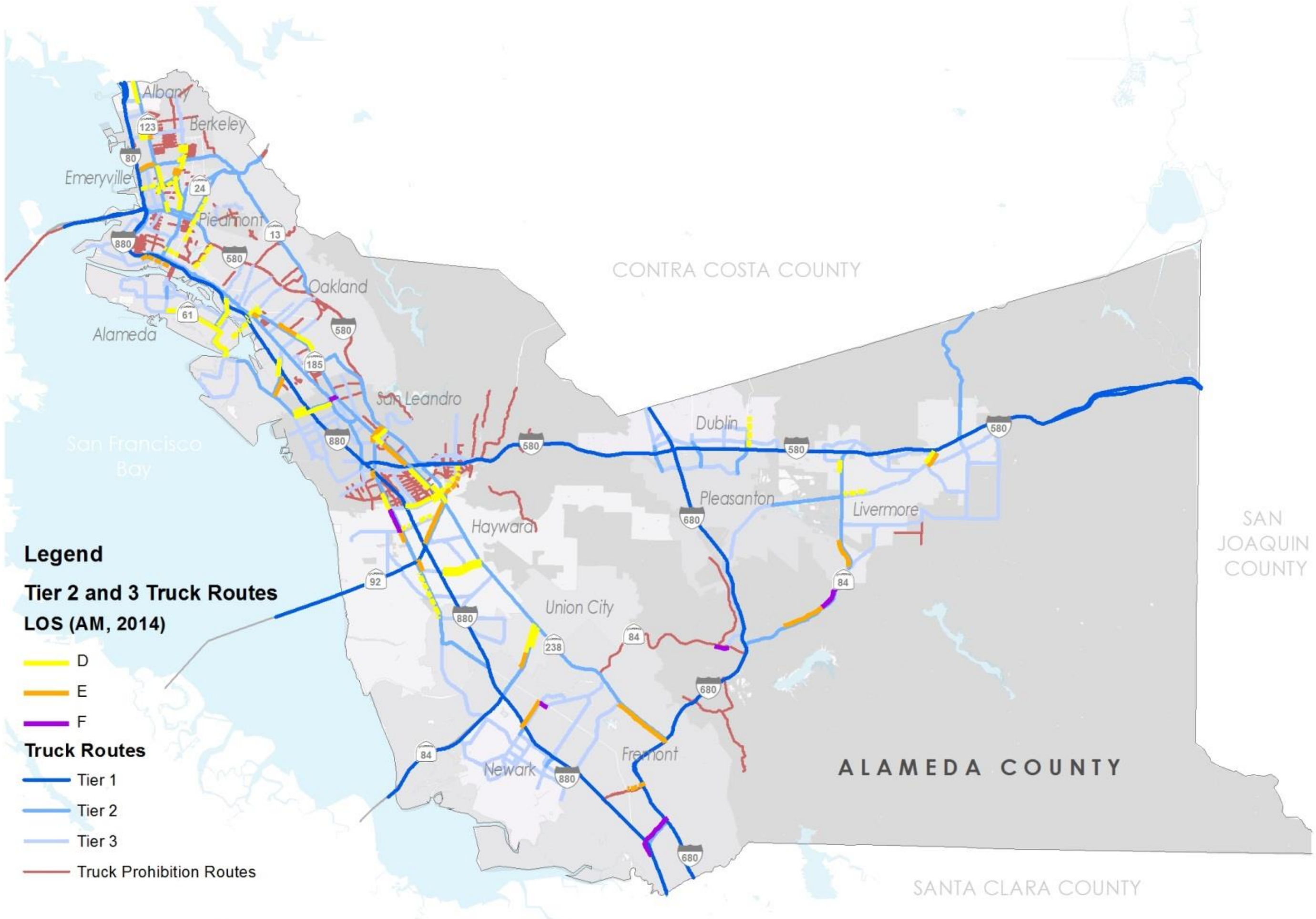
Table 2.3 Minor Arterials with Poor LOS

Route	Truck Route Tier	End Point 1	Jurisdiction	End Point 2	Length (Miles)	AM Peak (7-9) LOS	PM Peak (4-6) LOS
Broadway-NB	2	Grand Ave	Oakland	Broadway/ College Ave	1.91	D	D
A Street-EB	3	Foothill Boulevard/ A St	Hayward	Redwood Rd/ Grove Way	0.80	E	D
Hesperian Boulevard-Union City Blvd-NB	2	Union City/ Alvarado Blvd	Union City	Whipple Rd	0.98	C	E
Powel Street-Stanford Avenue-EB	3	San Pablo Ave	Emeryville, Berkeley	MLK Jr Way	0.76	D	D
Powel Street-Stanford Avenue-WB	3	San Pablo Ave	Emeryville	NB I-80 off-ramp	0.75	D	D
International Boulevard-SB	2	Fruitvale Ave	Oakland	42nd Ave	0.62	C	D
High Street-WB	3	Foothill Blvd	Oakland	NB I-880 OFF Ramp	0.61	D	D
A Street-EB	3	Redwood Rd/ Grove Way	Hayward	EB I-580 on-ramp/Grove Way	0.42	D	D
Hesperian Boulevard-Union City Blvd-SB	2	Hesperian/Union City Blvd/ Overbridge	Union City	Whipple Rd	0.30	D	E
Hesperian Boulevard-Union City Blvd-NB	2	Whipple Rd	Union City	Hesperian/ Union City Blvd/ Overbridge	0.30	C	E
Hesperian Boulevard-Union City Blvd-SB	2	Tennyson/ Hesperian	Hayward	Industrial Blvd	1.05	D	E
Hesperian Boulevard-Union City Blvd-SB	2	Industrial Blvd	Hayward	Hesperian/ Union City Blvd/ Overbridge	0.57	D	F
Automall Parkway-WB[a]	Weight Restricted	NB I-680 ON Ramp	Fremont	Fremont Blvd	0.75	E	D
Tassajara Road-NB	3	WB I-580 OFF ramp	Dublin	Central Parkway	0.49	D	E
Tassajara Road-NB	3	Central Parkway	Dublin	Somerset Ln/ N Dublin Ranch Dr	0.68	D	D
E. Stanley Blvd – Railroad Avenue – 1st Street-SB	3	Murrita Blvd	Pleasanton, Alameda County	SR 84/ Isabel Ave	0.91	D	E
High Street-EB	3	Fernside Blvd	Alameda, Oakland	NB I-880 off-ramp	0.50	D	F
Broadway (Connection to I-880)-NB	2	I-880 off-ramp	Oakland	5th St/ Broadway	1.26	E	E

Source: Source: Alameda CTC LOS Monitoring Report (2014)

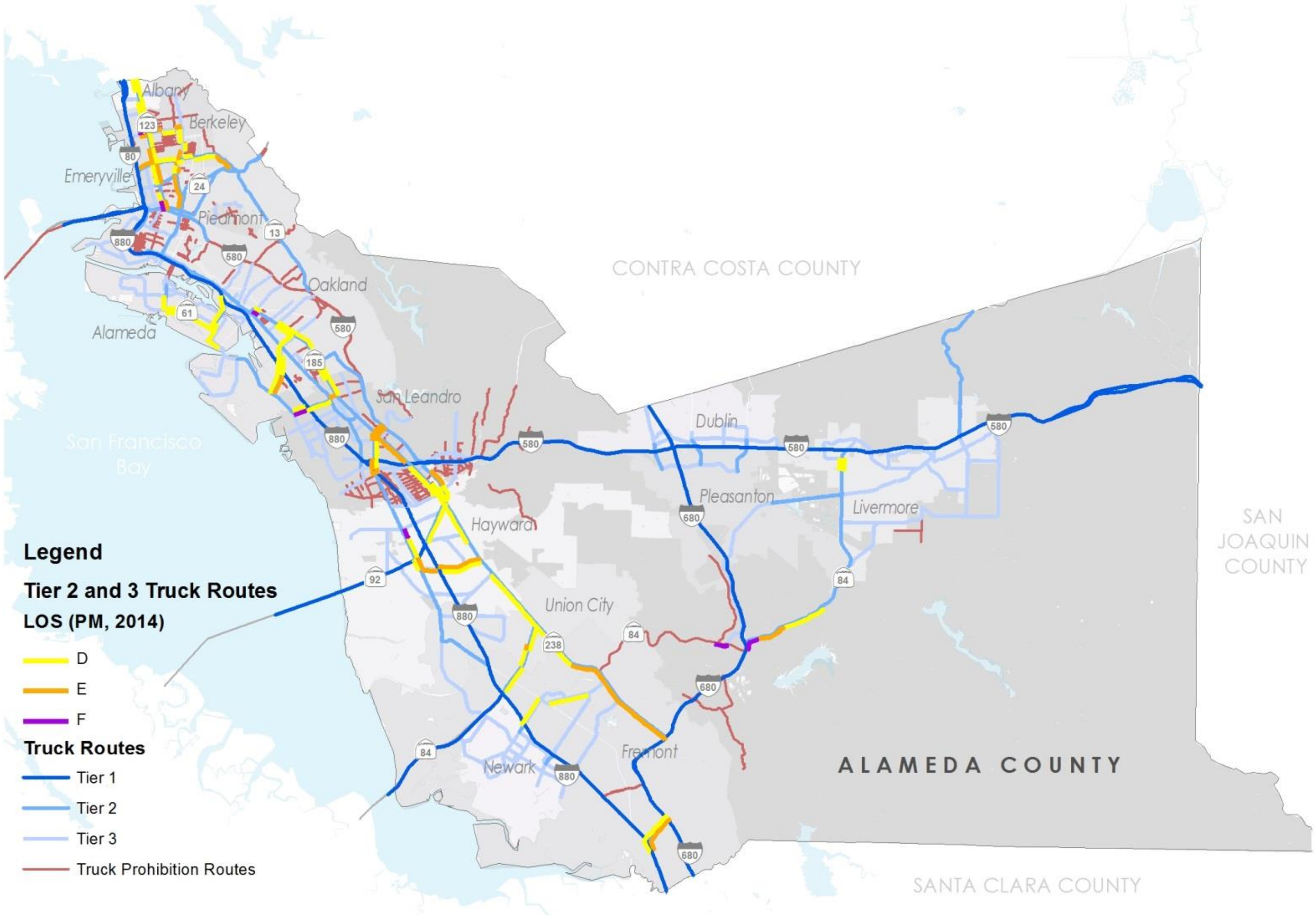
[a] There is a 5 Ton weight restriction on Automall Parkway per City of Fremont Regulations.

Figure 2.10 LOS Conditions on Local Road Truck Routes, AM Peak



Source: Alameda CTC LOS Monitoring Report (2014), Cambridge Systematics analysis.

Figure 2.11 LOS Conditions on Local Road Truck Routes, PM Peak, 2014



Source: Alameda CTC LOS Monitoring Report (2014), Cambridge Systematics analysis.

2.5 Truck Routes Conflicts with Land Use

Section 5.3 of this report provides a broad discussion of land use issues, including industrial land supply and land use conflicts and their relevance to goods movement planning as this affects all of the goods movement functions. The specific issues that are most relevant to the local street and road system are cases where local truck routes pass through residential areas, where these routes exist at the boundaries between industrial and residential zones, and where transitions in land use can threaten the long-term viability of truck routes and industrial areas. Most of the Tier 2 truck routes pass through residential areas. This is because these routes provide intercity connectivity for trucks over relatively long distances for a local truck route; and as such, they will inevitably pass through land use transitions. This cannot be avoided and the best practices for accommodating truck movements and Complete Streets will need to be applied in these cases.

Figures 2.4 through 2.7 presented earlier in this section present land use information overlaid with the Tier 2 and Tier 3 truck routes. The following locations are examples of those that were identified where truck routes are at the boundary between industrial land uses and residential land uses:

- East 7th Street, 8th Street, and 12th Street in Oakland;
- Whipple Road and Alvarado Niles Road, and Decoto Road in Union City;
- Industrial Boulevard in Hayward; and
- Cherry Street in Newark.

In most cases, these truck routes are important for access to industrial/warehouse zones, and there are no logical alternatives for designating truck routes. While buffers including light industrial, retail, or mixed-use development zones (especially if parking and visual screens such as trees can be placed along the boundary between the industrial zones and the residential zones) are preferred to directly contiguous industrial and residential zones, in many cases, legacy land use decisions have created these land use conflicts, and proper truck management is the only course of action for the future. Public works and planning officials in a number of the cities with these conditions hear neighborhood complaints about trucks using collectors that also are used by autos, trucks parking in neighborhoods, and cut through truck traffic. There are strategies that can be applied to these situations that will protect critical industrial corridors while minimizing the likelihood of neighborhood impacts. In cities including San Leandro, Oakland, and Berkeley, there often are truck prohibitions in neighborhoods on collectors that connect to truck routes. This is the beginning of a truck management strategy, but must be augmented with strategies to ensure that truck services (such as fueling and restaurants), truck parking, and access to industrial sites from the main truck route combined with information about preferred routes in order to meet the needs of goods movement while mitigating impacts on communities.

In Alameda County, there are 43 identified priority development areas (PDAs) which are part of the regional growth pattern in Plan Bay Area. PDAs are areas where jobs and housing growth are focused. Growth in these areas will both increase demand for goods movement delivery and require complete streets considerations for higher density uses of all modes of transportation. PDAs are outlined in Figures 2.4 to 2.7.

2.6 Pavement and Bridge Conditions

Pavement and bridge surface quality on truck routes are issues of concern that often are cited by city public works staff and truck drivers alike. Some city staff reported that their local roads with heavy-truck traffic experience high levels of pavement wear, and that funding is not sufficient to maintain these roads properly. Drivers complain that poorly maintained roads can cause damage to vehicles and damage to goods in transit. If roads and bridges are designed to proper standards and trucks operate with proper axle loads, damage to bridges and pavement can be managed effectively.

In order to make a general assessment of the relative condition and cost of maintaining truck routes as compared to other local streets and roads, an analysis was conducted using the MTC Streetsaver database. This database provides a rating (Pavement Condition Index or PCI) for all streets and roads on a scale of 1 to 100, with 100 being the best condition. Pavement with a PCI score in the 80 to 89 range is considered "very good," and shows only slight or moderate distress, requiring primarily preventive maintenance. The "good" category ranges from 70 to 79, while streets with PCI scores in the "fair" (60-69) range are becoming worn to the point where rehabilitation may be needed to prevent rapid deterioration. Because major repairs cost five to 10 times more than routine maintenance, these streets are at an especially critical stage. Roadways with PCI scores of 50 to 59 are deemed "at-risk," while those with PCI scores of 25 to 49 are considered "poor." These roads require major rehabilitation or reconstruction. Pavement with a PCI score below 25 is considered "failed." These roads are difficult to drive on and need reconstruction.[4] The analysis aggregates the ratings for all truck routes in each city and compares that to the aggregate rating for all non-truck route roads. In addition, the maintenance expenditures for the truck routes were compared to those of the non-truck routes. The results are presented in Table 2.4.

[4] http://www.mtc.ca.gov/news/press_releases/rel624.htm.

Note that the table does not include conditions of state routes nor freeways. The pavement conditions of state routes and freeways are collected by Caltrans using a different methodology, and are discussed in Section 4.1.4.

Table 2.4 Alameda County and Jurisdictions Truck Route Pavement Conditions and Maintenance Cost Comparison

Jurisdiction	2013 PCI of Truck Route Segments	2013 PCI of Non Truck Route Segments	2013 PCI for Arterials & Collectors Combined	2013 Total Network PCI	Arterials/Collectors lane miles	Avg. Annual Truck Route Maintenance Cost ($/lane mile)	Avg. Annual Arterial & Collector Maintenance Cost ($/lane mile)	Average. Annual Network Maintenance Cost
Alameda	74	64	74	67	139	$14,199	$12,930	$13,282
Alameda County	74	69	73	71	544	$58,205	$18,055	$18,892
Albany	56	53	59	55	21	$6,814	$17,735	$17,331
Berkeley	67	56	61	58	138	$30,019	$23,802	$25,243
Dublin	88	83	84	85	135	$3,370	$5,238	$4,570
Emeryville	73	71	74	73	39	$5,935	$11,470	$10,198
Fremont	67	59	66	61	580	$10,058	$16,278	$15,896
Hayward	71	65	72	67	305	$10,094	$14,717	$14,069
Livermore	75	76	75	77	251	$7,014	$9,008	$8,611
Newark	80	73	77	76	156	$7,247	$18,223	$14,121
Oakland	65	56	61	58	906	$23,779	$12,426	$13,286
Piedmont	76	65	72	67	26	$7,291	$9,637	$9,183
Pleasanton	75	77	78	78	291	$7,474	$12,000	$11,898
San Leandro	68	54	64	57	155	$15,092	$18,094	$17,471
Union City	74	78	79	79	189	$3,199	$15,006	$14,568
Total						$209,790	$214,619	$208,619
Notes:	Area weighted PCI of sections belonging to truck route in jurisdiction	Area weighted PCI of sections NOT belonging to truck route in jurisdiction	Area weighted PCI of sections belonging Arterial and Collectors ONLY in jurisdiction	2013 PCI, all section except 'Other'		The annual cost per lane mile for maintenance done between 2001 and 2014 for all sections on a truck route that are arterials or collectors. Costs based on Starting PCI of treatment to determine type of treatment, and unit costs.	The annual cost per lane mile for maintenance done between 2001 and 2014 for all sections NOT on a truck route that are arterials or collectors. Costs based on Starting PCI of treatment to determine type of treatment, and unit costs.	The annual cost per lane mile for maintenance done between 2001 and 2014 for all sections that are arterials or collectors. Costs based on Starting PCI of treatment to determine type of treatment, and unit costs.

PCI Rating: - Good or very good condition; – Fair condition; – At risk, poor, or failed condition.

Source: MTC.

While there are clearly individual cases where truck routes are in especially poor condition (several of these cases will be described in the West Oakland case study), the analysis at the city level does not show any consistent pattern. In fact, overall truck routes in Alameda County have slightly better pavement condition than non-truck routes, which may reflect that many truck routes are also major collectors and arterials which receive more frequent repaving and that many local roads receive wear and tear from garbage trucks. There also was no discernible pattern with respect to maintenance expenditures. Some cities did spend considerably more on truck routes per-lane mile than did other cities, but there was no consistent pattern. The relationship between the relative cost of maintaining truck routes and the relative condition was inconsistent. While there may be an argument to be made that more funding should be made available to the cities to maintain their local streets and roads, this analysis does not provide sufficient evidence that maintenance of truck routes should be given any particular priority.

In addition to pavement conditions, conditions on the bridges that connect the roadways should also be determined. The National Bridge Inventory Data is obtained from MTC to determine the ratings for bridges. This analysis used the Sufficiency Rating (SR) of the bridges, which is a composite score of structural adequacy and safety, serviceability and functional obsolescence, and essentiality for public use. A score of a 100 percent would represent an entirely sufficient bridge and zero percent would represent an entirely insufficient or deficient bridge.

Another reason for looking at SR is eligibility for funding, under the Highway Bridge Program (HBP). FHWA uses the SR and a status flag indicating whether a bridge is Structurally Deficient (SD) or Functionally Obsolete (FO) to establish eligibility for HBP funds. To be eligible for rehabilitation, a bridge must have an SR of 80 or less; to be eligible for replacement, bridge must have an SR of less than 50. A bridge must be classified as either structurally deficient OR functionally obsolete as well. We determined that out of the 303 bridge (out of the 697) that have a SR, the average SR is 84.69, which is above the threshold for rehabilitation. Also, none of the bridges are eligible for funding given the aforementioned criteria. This can indicate that overall the bridge conditions in Alameda County are actually quite good, though it should be caveated that a significant share of bridges lack a conditions rating. Figure 2.12 shows the bridge conditions on the Tier 2 and Tier 3 truck routes. Bridges with poorer conditions are seen scattered around the County.

Figure 2.12 Bridge Conditions on Tier 2 and Tier 3 Truck Routes

Note: Sufficiency rating is a composite score used to determine the integrity of a bridge in the National Bridge Inventory.

Source: National Bridge Inventory Data obtained from MTC.

2.7 Local Roads Safety

Truck safety is an issue for both truck drivers and users of the roadway. Providing a safe goods movement system is an important goal for Alameda County. This section focuses on safety on local roads (Tier 2 and Tier 3 truck routes), while Section 4.1.3 focus on safety on the interregional and intraregional corridors.

To understand the level of safety on roads related to truck travel, data on truck-involved crashes was analyzed. Table 2.5 shows for the years 2008 through 2012, the total number of injury and fatal traffic crashes in Alameda County, as well as the number of those crashes that were truck involved. It is important to see that while truck-involved crashes made up about 4 percent of total injury crashes, they comprised a higher percentage of fatal crashes in all years except one. This indicates that truck-involves crashes are more severe, which, when taken into consideration its weight and size, can be easily understood.

Table 2.5 Alameda County Total Number of Injury and Fatal Traffic Crashes on Local Roads – 2008 to 2012

	Injury Crashes			Fatal Crashes		
Year	All Types	Truck Involved	% Truck-Involved	All Types	Truck Involved	%Truck Involved
2008	6,935	268	4%	82	7	9%
2009	6,337	246	4%	62	9	15%
2010	6,295	220	3%	62	6	10%
2011	6,194	236	4%	57	7	12%
2012	6,544	238	4%	72	3	4%

Source: SWITRS.

To determine the characteristics of truck-involved crashes in Alameda County, the Caltrans Statewide Integrated Traffic Records System (SWITRS) data was obtained for the years 2008 to 2012. In addition, GIS-based data was obtained through the Transportation Injury Mapping System (TIMS) portal[5]. Multiple years of data are usually used to obtain more data points to more easily identify trends and patterns. The crash data is then spatially merged with the truck routes GIS data developed for this project, in which all crashes within a 75-foot buffer of a roadway is joined to the roadway. Finally, the number of crashes is spatially merged to the

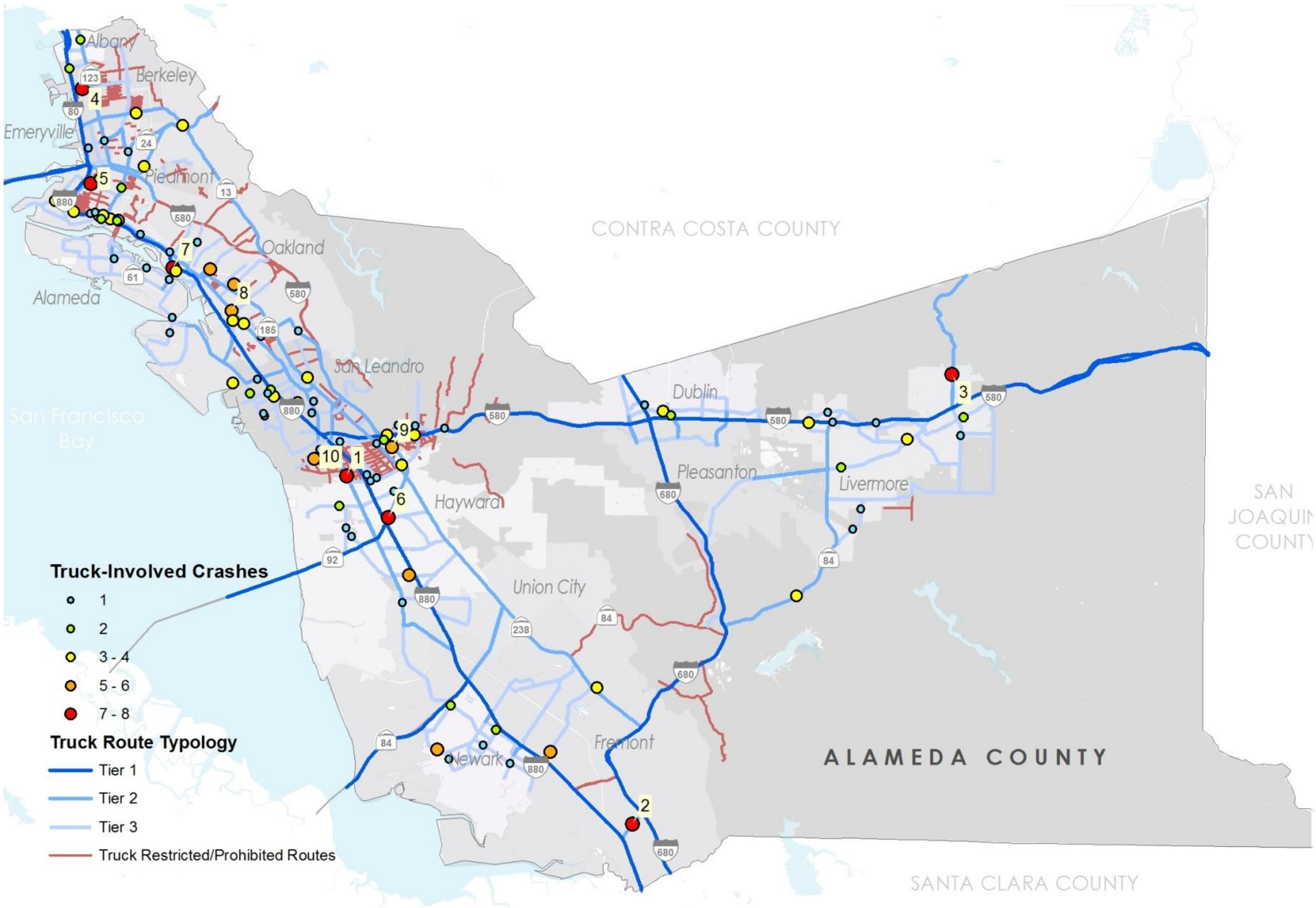
[5] http://tims.berkeley.edu/. Note that only injury crashes are included in this database, thus, property damage-only crashes are not included.

roadway network and clustered. It should be noted that, while normalizing the number of crashes by either segment length or Vehicle Miles Traveled (VMT) to generate crash rates produces more accurate comparisons of crash frequency, because the lengths of the segments are generally similar, simply reporting the number of crashes can also generate useful results. In addition, crash rates also can over-emphasize segments with very little traffic, or have very short segment lengths, producing results that are not sufficiently meaningful. The analysis in this section, thus, focuses on understanding the total number of crashes and not crash rates.

The locations (clusters) with the highest number of truck-involved crashes are shown in Figure 2.13. For some of these locations, proximity to interstate highway on-/off-ramps seem to be a recurring factor for the crashes. There are also non-interstate locations that are present.

To better understand the safety issues at a more localized level, several case studies also document safety issues at a finer level.

Figure 2.13 Top Truck Crash Locations in Alameda County



Source: SWITRS, Cambridge Systematics Analysis.

2.8 Truck Parking Issues

Most parking of trucks is not in the public eye because it occurs on private property and is conducted appropriately. However, when parking occurs in non-ideal situations (such as on freeway on-/off-ramps or in residential areas) that community concerns are provoked. Truck drivers have four basic reasons for parking their trucks, which creates the need for temporary and long-term (more than 10 hour) parking:

1. To serve customers at the customer's site;
2. To stop temporarily for personal needs and/or to await instructions as to what to do next for loading and unloading;
3. For the driver to rest during the mandated rest period; and
4. At the end of the day when the truck returns to its home base.

While truck drivers strive to park in designated areas in each of these situations, inappropriate parking occurs most often when local regulations prohibit parking in certain locations that are near services and when there is insufficient legal parking in nearby industrial areas. While prohibitions are often intended to preserve community quality of life amenities, they do not lessen the need for temporary or long-term truck parking in their jurisdictions, particularly in communities that have businesses and industries that rely on trucks to pick up/drop off goods. The following narrative describes several of the situations that create the need for additional truck parking, as well as other goods movement system considerations, in Alameda County.

2.8.1 Hours of Service (HOS) Rule Needs

The most recently adopted HOS rule for drivers became effective in July 2013. The rule contains a number of requirements related to the amount of time operating a truck, the working day length, rest periods, and time off. The rule stipulates an 11-hour daily driving limit and 14-hour work day limit. In addition, the maximum average work week for truck drivers is 70 hours (which is a decrease from the previous maximum of 82 hours). Drivers who reach the maximum 70 hours of driving within a week may resume driving if they rest for 34 consecutive hours, including at least two nights when their body clock demands sleep the most – from 1:00 to 5:00 a.m. Also, truck drivers must take a 30-minute break during the first eight hours of their shift. On December 16, 2014, an updated HOS rule was passed by congress that included more stringent regulations regarding the restart. However, this rule was suspended immediately, and thus currently has no effect.[6]

[6] http://www.fmcsa.dot.gov/regulations/hours-service/hours-service-drivers

Based off of the current HOS rules, each of these stipulations is important to ensure the goods movement system is as safe as possible, but they also create several unintended consequences. By reducing the truck drivers' work week by 12 hours, the productivity of each truck is reduced. For companies to maintain the same level of productivity after the rule change, they will need to put more trucks with more drivers on the road (see truck driver shortage discussed in Section 5.4). More trucks on the road will likely lead to increased congestion levels on those roads that are already utilized by high volumes of trucks. The shortened work week, increased number of, and longer rest periods also will require more places for a larger number of trucks to park during those breaks. In some cases, short-term parking can accommodate the 30-minute rest required after eight hours of driving, but longer-term parking will be needed to accommodate the periods of longer rest, including the required 1:00 a.m. to 5:00 a.m. period. During an interview with a local 3PL company, it was confirmed that this is a particular problem for drivers serving the Port of Oakland from bases in the San Joaquin Valley and for independent owner operators who do not have access to a company parking area to park for overnight rests.

2.8.2 Port-Related Parking Needs in West Oakland

Much of the industrial parking needs/conflicts in Alameda County have been identified in the West Oakland area – an area adjacent to the Port of Oakland. Truck parking in residential areas can create particular problems including creating blind spots for drivers, cyclists and pedestrians. Pass through truck traffic, as well idling trucks can create adverse health concerns, including air, noise, light, bioharzards pollution which depreciates land values. Despite these impacts, there has been limited enforcement of illegal parking activities. In August 2014, the West Oakland Specific Plan was approved and identifies a comprehensive, multifaceted strategy for facilitating the development of selected vacant and/or underutilized commercial and industrial properties within the West Oakland community. It also includes examination of issues of conflicting land use and transportation, including truck parking. The plan notes that, as the Port of Oakland grew, container storage, trucking, and recycling operations often replaced the former industrial activities in West Oakland, resulting in trucking-related services covering approximately 34 acres within West Oakland's 1,900 acres. Additional acreage is devoted to truck-related services that include tire sales, repair shops, fueling, and other businesses and services associated with port truck traffic. While the plan acknowledges the need to maintain industry in West Oakland, it also recommends relocating heavy industries and truck-generating businesses to outside of West Oakland, and that truck services should be relocated to the OAB. The plan notes that reducing truck parking in West Oakland should be a priority in order to facilitate the increased use of transit and bikes, and to make roads pedestrian friendly. It recommends maintaining those truck routes necessary to serve Port of Oakland activities, but prohibits additional encroachment of truck routes into West Oakland neighborhoods. In order to accomplish this, several measures are recommended, including the enforcement of truck parking laws by increasing the number of parking monitors in the neighborhood, increasing number of Oakland Police Officers and Port security patrols, funding extended hours of enforcement, funding a resident-based "monitor and enforce" program, and creating a central truck-sighting hot line for residents to report truck violations.[7]

While these measures are a fairly aggressive means to remove neighborhood/truck conflicts, they do not help satisfy the truck parking needs that are evident. The master plan for the OAB does include 30 acres of truck parking at full buildout; and in August 2014, an agreement was signed to develop 17 acres of land on the site to provide a portion of that truck parking. This development will provide 24-hour a day service for truckers traveling through the Port, and provide space other than West Oakland neighborhoods for trucks to rest. A second benefit to the development is that the City of Oakland has granted the operator exclusive right to sell truck fuel at the site for 10 years. This element has been incorporated into the design to encourage trucks to buy gas on the Base rather than driving into neighborhoods for fuel. It has not been determined whether this will fully satisfy the industrial parking needs in West Oakland and adjacent to the Port. As part of strategy development, additional analysis should be conducted of the level of likely parking need after implementation of the increased truck parking at the OAB.

2.8.3 Corridor Parking Needs

In 2008, the Alameda County Congestion Management Agency (ACCMA), a predecessor agency to the Alameda CTC, and California Department of Transportation (Caltrans) undertook a study[8] to better understand the truck parking needs in Alameda County, and identify ways to accommodate parking in order to lessen traffic congestion. The study noted that a particular need in Alameda County is along the I-80, I-580, and I-880 corridors, where the highest incidents of truck traffic, trucks parking, and congestion occur. These are inter- and intraregional routes where freight and passenger vehicles compete for limited roadway capacity.

In the 2008 study, truck operators in Alameda County reported that they experienced significant shortages of space for parking their trucks. Drivers surveyed noted that preferred locations for stops (greatest needs) were on I- 880 and 238 in Hayward, Oakland, San Leandro, and San Lorenzo. They also noted that, when feasible, they planned their trip to allow them to get out of the Bay Area by evening, in large part because of the lack of known, desirable locations where they can "spend the night." A unique dynamic that is important to the truck parking discussion is that virtually every stop made is at the driver's discretion; the company/dispatcher does not suggest locations, and decisions about locations are made based on observation and/or talking to other drivers.

[7] West Oakland Specific Plan – Final Plan, June 2014.

[8] *Truck Parking Feasibility and Location Study – Final Report*, Tioga Group, Inc., 2008.

The study concluded that there is a shortage of truck parking facilities, in part, because no one provides for them, and public agencies often are put in the position of reacting to individual complaints of inappropriate truck parking rather than planning for truck parking as a community requirement. In addition, commercial truck stop operators cannot find suitable sites, and if they do, they often face very onerous local conditions and objections. The study also made recommendations within three categories. The top recommendations in each category included:

1. **Policy actions.** Alameda CTC (as successor to ACCMA) should work with the local jurisdictions to identify and adopt guidelines for accommodating and developing truck parking facilities, including identifying ways to accommodate truck parking in local land use development and redevelopment processes. Local jurisdictions should be encouraged to adopt and implement the guidelines.

2. **Implementation actions.** Alameda CTC should develop a one-page fact sheet highlighting the benefits trucks provide to Alameda County and its communities, and why temporary and long-term truck parking areas are needed.

3. **Other actions.** Alameda CTC should pursue additional grants or other funding and to continue to work with local community groups, the air district, Metropolitan Transportation Commission (MTC), Caltrans, and the trucking industry to gather input on the issue of truck parking in Alameda County.

2.8.4 Urban Delivery Issues

Another growing issue in the urban goods movement system is the increasing amount of delivery traffic in busy downtown districts and in neighborhoods. The amount of truck traffic in areas where there has traditionally been more limited traffic is growing as a result of the increasing use of e-commerce as a way of making and fulfilling retail sales. This is resulting in insufficient loading and unloading spaces, double-parking or illegal parking of trucks, and encroachment of trucks in neighborhoods. This also creates conflicts between trucks and other users of the urban street system (see discussion of this issue in the Local Streets and Roads section of this report). In order to develop strategies to address this issue, it is important to understand the time of day patterns of trucks and other urban street users to see if changes in time of day restrictions could reduce conflicts and more effectively use limited urban street right of way. Another aspect of this problem is creating requirements for off-site access and loading areas in densely populated areas. Many cities are beginning to experiment with a variety of strategies to address this issue including the development of package and parcel consolidation centers or local pick-up/drop-off centers for urban parcel delivery, night-time delivery, and time of day street controls.

2.9 Local Roads Case Studies

While this chapter of the needs assessment included extensive data on a countywide level to assess the needs of the local truck route system, there are a number of issues where there are limited countywide data and where a more detailed analysis of a small area can provide insights into problems and potential solutions. This more detailed look at local streets and roads can also help develop guidance for new programs that can help cities implement better truck route planning and truck management programs.

In order to provide this more detailed assessment, five case studies are being developed throughout Alameda County (one of the case studies is more regional and scope and includes portions of West Contra Costa County as part of the update to the regional goods movement plan). The purpose of the case studies is to highlight specific local issues that are likely to be experienced in other parts of the County. They were selected to highlight particular issues and particular local contexts (for example, differences between urban and rural goods movement issues). Each case study is based on readily available data from the local jurisdiction, interviews with stakeholders, and visual observation of the conditions identified by the stakeholders. These case studies will include recommended strategies to address the identified issues and will be provided as a separate technical memorandum as a later addendum to this report.

The case studies include:

- **West Oakland.** This case study is important because of the significance of this particular Global Gateway and is transferable to other major port/rail/major industrial centers in the County and the region. The focus of this study is on the following issues:
  - Local access and circulation issues around marine terminal and supporting truck service sites at the Port of Oakland (including safety, lack of capacity contributing to queuing, poor signage and striping, access management, connectivity to the freeway);
  - Modal conflicts around the Port and Army Base (e.g., bike and pedestrian paths, railroad crossing problems); and
  - Neighborhood impacts (truck route design and enforcement, truck parking, land use conflicts).
- **Tesla Road.** This case study is transferable to similar rural access routes (e.g., Vasco Road, Crow Canyon Boulevard) and other parts of the Region (North Bay). The focus of this study is on the following issues:
  - Conflicts between truck access to major business activity (wineries) and commuter access to freeway along high-speed rural road (cross-section alignment, access management, driveway consolidation);

   - Safety issues related to truck and auto interactions; and
   - Impacts of growth in a relatively undeveloped corridor with growth drivers for truck and auto traffic (capacity).

- **International Boulevard.** This case study is transferrable to other major arterials and multimodal corridors with "Main Street" parking and loading issues, and will illustrate selection of primary and secondary truck routes connecting major cities. The focus of this study is on the following issues:
   - Potential modal conflicts on a "Complete Street" (bus rapid transit (BRT) primarily, but also bike and pedestrian);
   - Truck access to retail and commercial businesses (truck circulation, geometrics, parking/ loading);
   - Truck route designation/preferred routings and east-west connectors (e.g., truck route usage on San Leandro Street vs. International, connections between the two truck routes and the freeway); and
   - Preferred cross-sections and operational treatments.

- **Central County Industrial Access.** This case study involves more cross-jurisdictional coordination issues and access to industrial areas with potential neighborhood impacts. This case study reflects the issues and needs identified by staff in San Leandro, Hayward, and Union City and focuses on areas such as Hesperian and Union City Boulevards, Clawiter, Doolittle, and the Industrial/880 interchange. This case study could be transferable to any of the remaining industrial areas in the County and region. The issues include:
   - Connectivity from the freeway to industrial areas,
   - Diversion from I-880 to local streets and roads, and
   - Spillover impacts on adjacent neighborhoods.

- **Martinez Subdivision Rail Impacts, Emeryville to Richmond.** This is a regional case study that crosses county boundaries and addresses issues associated with a corridor with high-freight and passenger rail activity and growth potential linked to Global Gateway expansion and increased domestic freight rail traffic. This case study is transferable to any rail corridors through urbanized areas with high levels of residential and commercial development and growing freight and passenger rail volumes. The issues address include:
   - Noise impacts, emissions impacts, and potential solutions;
   - Disruption of access and traffic flows leading to high levels of congestion during train passages;

- Physical barrier to pedestrian and bicycle circulation through the community and other route or distance-sensitive travel modes, such as local transit (and impact on this development type); and
- Safety associated with crossing the tracks, particularly for pedestrians at both designated and illegal crossing points.

3.0 Interregional and Intraregional Issues

Interregional and intraregional corridors form the backbone of the goods movement system and connect the local goods movement network to markets throughout Alameda County, the rest of the nation, and international markets via the global gateways. The goods moved on these corridors include products manufactured in the Bay Area, supplies for the manufacturers in the Bay Area, and consumer products supplying the Bay Area population. The issues on these corridors derive not only from local growth, but also external trends as described in Section 1.1. Highways and rail are the core interregional corridor assets, performing both long haul and short haul freight movements. While trucks will continue to service the majority of demand, rail cargo (both intermodal and carload, and international and domestic cargo) is expected to experience high levels of growth, creating both challenges and opportunities. This section details the key interregional and intraregional issues in Alameda County on the roadways as well on the rail lines.

Table 3.1 provides a summary of the assessment of the needs and issues on these corridors, and also indicates some of the opportunities. Both highway and railroad corridors provide for shared use between passenger and goods movement. Most of the highway corridors experience high levels of peak period congestion and poor reliability with particularly poor performance on segments of I-880, I-80, I-580 and I-680. While trucks generally try to avoid peak periods, the trips of trucks traveling on these corridors are long enough that it has become increasingly difficult to avoid the peak. This adds costs to goods movement for Alameda County businesses and ultimately increases the cost of living for residents. Interregional truck traffic is expected to grow at a faster rate than intraregional truck traffic and the interregional corridors will continue to provide poor service for goods movement. There are, however, opportunities to improve operations and to make limited capacity improvements to address these deficiencies. The rail system in Alameda County, with the exception of the busiest portion of the UP's Martinez Subdivision from Oakland to Richmond, has sufficient capacity for the near term. But growth in freight rail and the desire for commuter rail service expansion will strain capacity in the future. The UP's Oakland Subdivision, a lightly used freight rail line today, is likely to experience significant growth and create operational and capacity problems, particularly in the segment west of Niles Junction. The increased train traffic may impact communities along the rail lines and may require application of strategies such as grade crossing improvements and quiet zones. On the roadway system, there are a number of locations along I-880 and I-580 that have particularly high levels of truck involved crashes that may be related to operational deficiencies in the corridor. While incidents at railroad crossings today are relatively low, this situation should be monitored as rail volumes increase.

Table 3.1 Summary of Countywide Needs Assessment of Interregional and Intraregional Corridors

Goals[9]	Measures	Metrics	Report Section	Rating	Rating Explanation	Gaps and Opportunities
Provide safe, reliable, efficient, resilient, and well-maintained goods movement facilities and corridors	Travel Time Reliability	Buffer index on freight (truck) routes[a]	3.1.2		Significant reliability issues along major corridors, with travel times more than double normal. In the AM peak, these include I-580 WB, I-80 NB, I-80 WB, and I-880 SB. In the PM, these include 580 EB, I-80 EB and WB, I-680 NB, and SR 24 EB.	Opportunities to employ integrated corridor management approaches that allow for better management of existing infrastructure from an operations perspective. Opportunities to further explore off-peak truck travel and deliveries to reduce reliability.
	Freight-Related Crashes	Truck-involved crashes[b]	3.1.3		Truck-involved crashes highest along I-880 near Oakland, San Leandro, Hayward, and I-580 near Dublin. Crashes most frequent around interchanges likely due to weaving and geometry.	Opportunities to understand the full benefits of truck-only lanes and truck bypasses at interchanges, and ways to shift truck traffic away from highways through providing other modal alternatives. Additional opportunities to explore safer truck vehicle technologies, as well as continued public education.
		Crashes at at-grade rail crossings	3.2.3		Grade crossings in general do not cause crashes, with the exception of a few locations including High Street and 29th Street in Oakland.	Distribution of grade crossing and grade separation funds to locations with the most crashes, such as High St and 29th St in Oakland.
	Freight Infrastructure Conditions	Bridge conditions ratings	3.1.4		The majority of bridges are of fair quality. Bridge conditions are generally consistent with pavement conditions.	Opportunity to prioritize the maintenance for bridges that are in poor conditions that are also on truck routes.

[9] Goals associated with community impacts are included in Chapter 5.0 – Cross Cutting Issues.

Goals[9]	Measures	Metrics	Report Section	Rating	Rating Explanation	Gaps and Opportunities
		Freight (truck) highway and arterial routes pavement conditions ratings	3.1.4	●	Pavement conditions generally good on major truck routes. State routes such as International Blvd have poorer conditions.	Opportunities to focus maintenance on roadways with poorer conditions that are non freeways.
Promote innovative technology and policy strategies to improve the efficiency of the goods movement system	Use of Innovative Technologies	Use of ITS and innovative technologies	3.1.1	●	Some existing investments in DMS on freeways, and ramp metering. Expected future Adaptive Ramp Metering and Active Traffic Management.	Opportunities to employ integrated corridor management approaches that uses real-time information and big data.
Preserve and strengthen an integrated and connected, multimodal goods movement system that supports freight mobility and access, and is coordinated with passenger transportation systems and local land use decisions.	Travel Time Delay	Travel time delay on freight (truck) routes	3.1.1	●	Significant truck delay on I-880 between Oakland and San Leandro, and I-580 East of Livermore (AM), and I-680 near Fremont, I-880 around Oakland, and also I-80 going from Emeryville to Albany (PM).	Opportunities to explore short-term operational integrated corridor management strategies and other strategies to reduce truck delay, including truck lanes and managed lanes. Long-term opportunities to shift truck to rail and other modes.
		Travel time delay on railways, terminals, ports, airports (measured in terms of capacity here)	3.2.1 3.2.2	●	Mainline rail capacity currently is sufficient, but several lines have poor LOS. Rail volumes will grow by 2 or 3 percent annually, led by intermodal rail growth, which will degrade the network. Capacity on UP-Oakland Subdivision will be strained, and this subdivision has pinch points which limit speeds. Access improvements into the OHIT are planned and will eliminate access problems.	Opportunity to invest in additional rail capacities to support growth in domestic and international traffic and to offset highway traffic.

Goals[9]	Measures	Metrics	Report Section	Rating	Rating Explanation	Gaps and Opportunities
	Coordinate with Passenger Systems	Freight system element shared use with passenger system and addresses passenger/freight conflicts	3.2.1	Low (red)	Existing passenger service makes up a significant share of volumes on freight lines. Martinez Subdivision is one of the most significantly affected. In the future, this is expected to get worse under business as usual scenario.	Opportunities to separate passenger and freight rail traffic and utilize older and/or abandoned rail lines.

High – ; Medium – yellow; and Low - red.

Source: Cambridge Systematics.

3.1 Roadway Issues

A number of highway routes are classified as interregional corridors because their primary, though not exclusive, function is to move freight between regional economic centers. The major highway interregional corridors include I-80 and I-580. The intraregional highway corridors provide primary access to the major goods movement facilities, including the Port of Oakland, Oakland Airport, rail yards, and warehouse/industrial districts and connections to the interregional corridors. These corridors also provide intercity connections within the County in places with the highest concentrations of the County's population and commercial centers, creating potential conflicts between goods movement and people movement. The intraregional system includes I-880 and I-80, as well as I-680, I-238, and SR 92. These roads include all of the Tier 1 truck routes as discussed in Section 2.0, as well as some Tier 2 truck routes.

3.1.1 Congestion and Mobility Issues

Congestion on freeways remains one of the biggest issues in Alameda County, and congestion delay leads to a host of impacts for communities, including pollution, lost time/productivity and other quality of life concerns. For the private sector, congestion drives up logistics costs and ultimately cuts into customer satisfaction and profits. To document the extent of the congestion issue in Alameda County, a truck delay analysis was carried out to understand the locations/segments with the worst delays from a county perspective.

Truck delay is the amount of additional time spent by trucks on a section of road due to congestion. Thus, it is the difference in travel time between a noncongested or free-flow speed and congested speed. Truck delay is then calculated as follows:

$$\text{Delay} = \text{Truck volume} * (\text{Length}/\text{Congested speed} - \text{Length}/\text{Free-Flow Speed})$$

Where the length is the length of the corridor or segment in question. Since delay will be higher for segments that are longer, we normalized delay by segment length. Thus, the delay figures represented in our analysis are divided by segment mileage. To obtain the congested speed and the free-flow speed, as well as the length of segment, this analysis used the INRIX data from 2014 provided to Alameda CTC by MTC to help support the congestion monitoring required of Alameda CTC as a congestion management agency (CMA) under California law. INRIX is a private traffic data firm that collects and compiles roadway speed data from a variety of different sources including GPS tracking systems and probe cars that drive in congested conditions and keep track of their speed. The INRIX data provided by Alameda CTC has information on peak period speeds[10] for roadway segments that are

[10] Since the INRIX data is not available for non-peak periods, we are unable to perform a delay analysis for time periods other than AM and PM peak. It should be noted that truck in general have higher volumes during the midday period when passenger traffic is at relatively low levels.

generally 1 to 2 miles in length. Hourly data are available. To obtain the truck volumes for specific freeway segments, we used the Alameda County travel demand model with several adjustments.[11] However, since this is not available by time of day, the Caltrans Performance Management System (PeMS) is used. Time of day distributions at Caltrans count stations were applied to the daily truck traffic data to obtain estimates of the hourly truck volumes by roadway segment. Forecasts of future year truck volumes were obtained from Alameda CTC's countywide truck forecast model.

Table 3.2 and Figure 3.1 show the top 10 worst truck delay locations in the AM period in Alameda County. These locations are selected not only based on high values of delay, but also on high truck volumes (measured in terms of truck volumes) and poor LOS to make the results more meaningful for benchmarking. For example, a segment with a high level of delay is only important from a countywide goods movement perspective if it also has a large volume of trucks in that location with a capacity issue (poor LOS). In the AM period, locations along I-80 westbound to San Francisco, and I-880 northbound to Oakland experience the worst delays. I-580 westbound close to Livermore also experiences high levels of truck delay delays. The LOS levels at these locations are of Grade F, indicating significant speed reductions during the worst travel times.

Table 3.3 and Figure 3.2 show the top 10 worst truck delay locations in the PM period in Alameda County. In the PM peak period, truck delay is worst along I-680 northbound near Fremont, I-580 around Livermore, and I-80 going from Emeryville to Albany – all major commuter routes. In the future, these same locations will continue to be key bottleneck areas, given existing anticipated levels of growth built in the model.

The INRIX speed data were used in the base year analysis of truck delay, because it is much more accurate than speed data derived from transportation models. This does make it difficult to compare future delays (for which there is no comparable source of speed data) and current delay. In order to provide some indication of which high delay locations are likely to be relatively worse in the future as compared to the other high delay locations, Tables 3.2 and 3.3 provide information on how much truck volumes are likely to grow at each location in terms of Compound Annual Growth Rates (CAGR).

[11] As part of this study, Cambridge Systematics made several adjustments to base year and future year trip assignment of the County truck model. These adjustments are detailed in a memo transmitted to Alameda CTC.

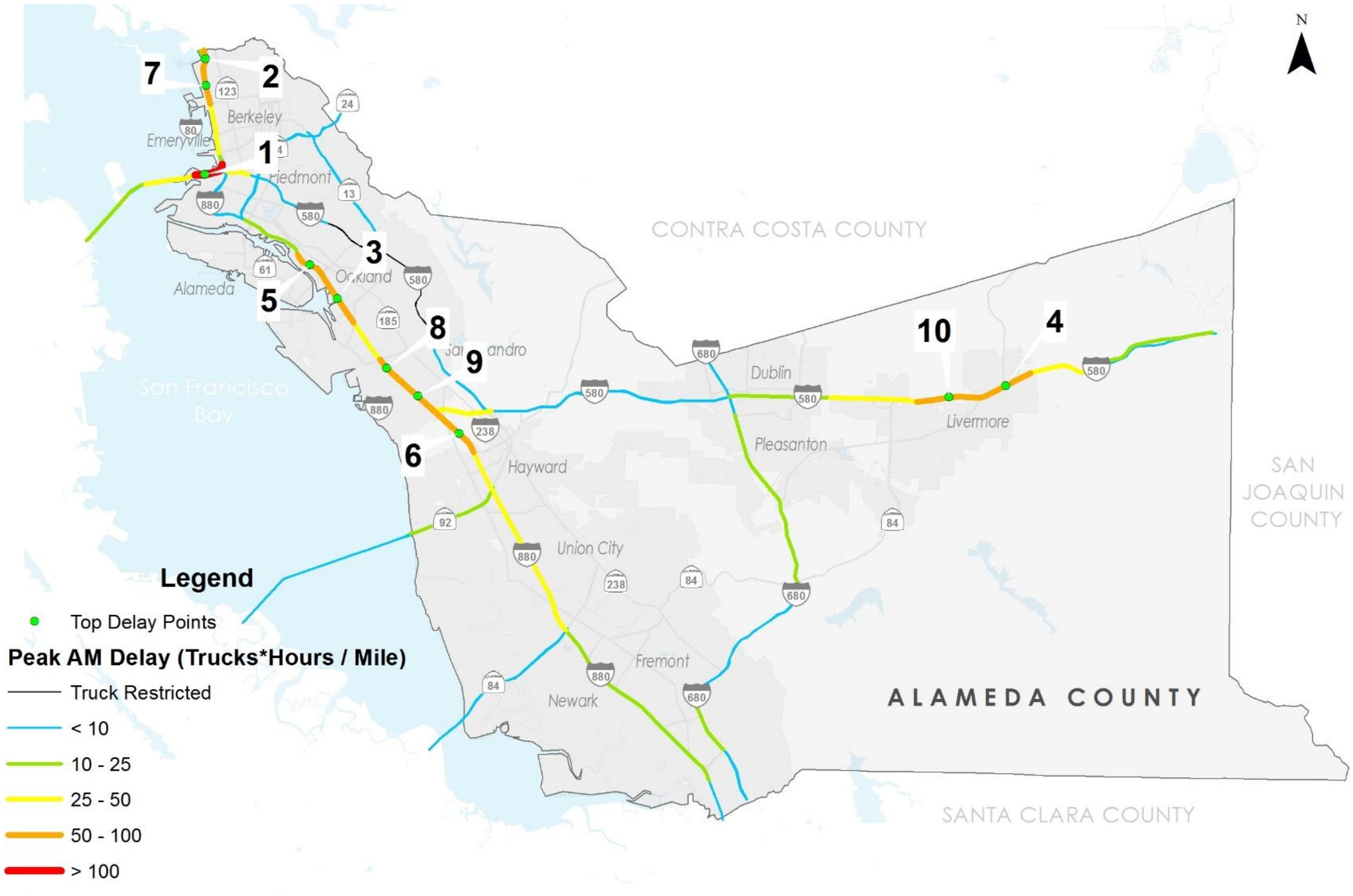
Table 3.2 Top Truck Delay segments in Alameda County, AM Peak, 2010

Rank	Roadway	End Point 1	End Point 2	Distance (Miles)	AM Peak Delay (Hours*Trucks/ Miles)	AM LOS 2014	PM LOS 2014	2010 Truck Volume (2+ Axles)	2040 Truck Volume (2+ Axles)	CAGR
1	I-80 WB	I-580 Split	Toll Plaza	1.31	265.7	F	D	10,506	13,429	0.8%
2	I-80 WB	Contra Costa County Line	Jct. I-580	0.7	85.2	F	C	8,502	11,731	1.1%
3	I-880 NB	Hegenberger	High/42nd	2.34	74.1	F	B	13,464	19,797	1.3%
4	I-580 WB	Greenville Rd	1st St	2.21	71.5	F	A	12,357	19,272	1.5%
5	I-880 NB	High/42nd	23rd (1st on-ramp)	1.25	65.2	F	B	13,762	19,914	1.2%
6	I-880 SB	I-238	A St	1.91	63.7	F	D	10,187	13,045	0.8%
7	I-80 WB	Jct. I-580	University	1.51	61.7	F	F	7,970	10,919	1.1%
8	I-880 NB	Marina Blvd	SR 112/Davis	0.82	57.8	F	B	13,449	19,143	1.2%
9	I-880 NB	I-880/I-238 (split)	Marina Blvd	2.54	55.7	F	A	13,511	19,910	1.3%
10	I-580 WB	1st St	Portola Ave	2.56	54.0	F	A	11,428	17,659	1.5%

Source: INRIX 2014; Alameda County Truck Travel Demand Model; PeMS time-of-day distribution, Cambridge Systematics analysis.

Note: Only locations with truck volumes greater than 5,000 are selected. CAGR = Compound Annual Growth Rate.

Figure 3.1 Top 10 Delay Locations, AM Peak Period, 2010



Source: INRIX 2014; Alameda County Truck Travel Demand Model; PeMS time of day distribution, Cambridge Systematics analysis.

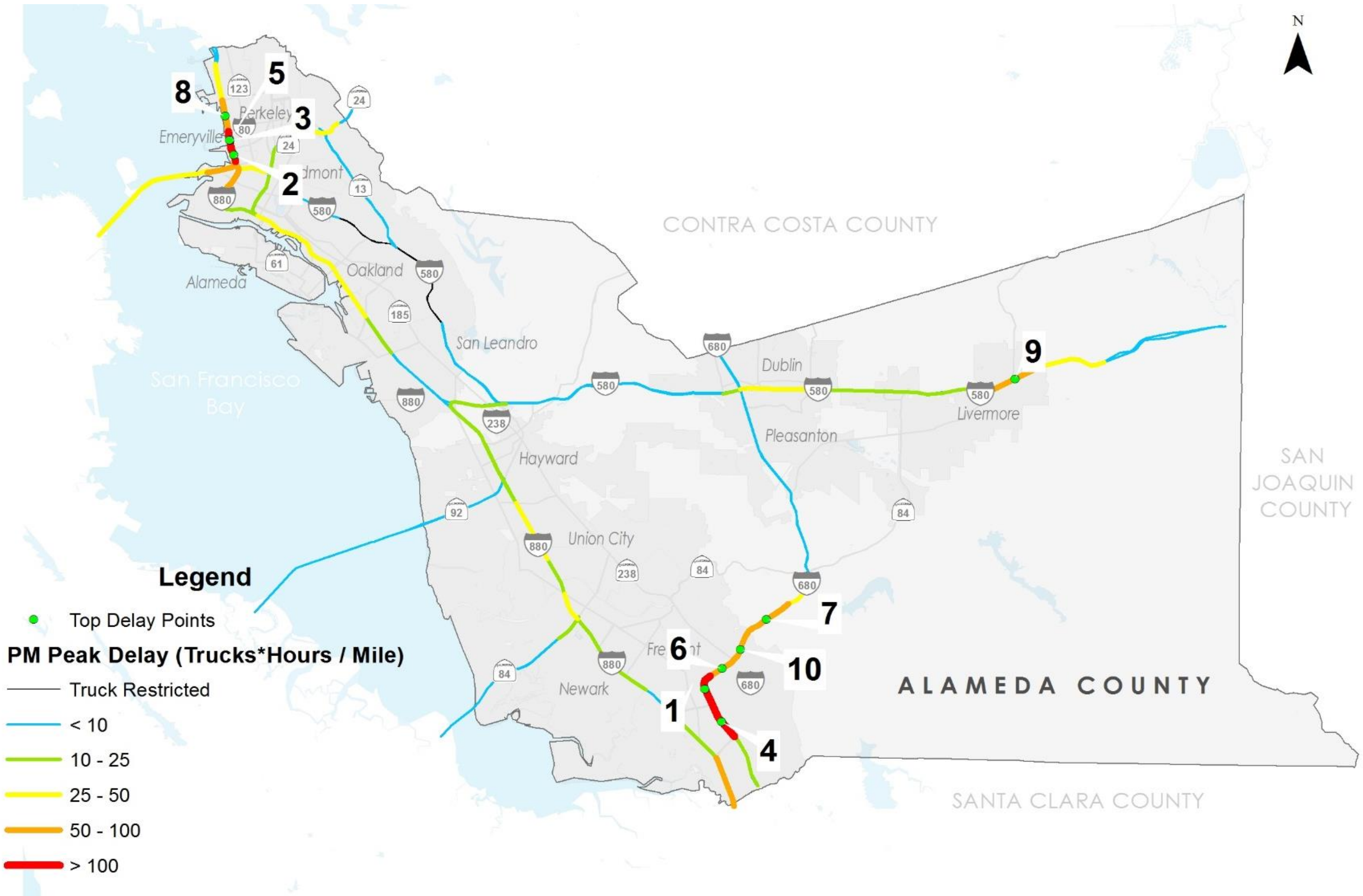
Table 3.3 Top Existing Truck Delay Segments in Alameda County, PM Peak, 2010

Rank	Roadway	End Point 1	End Point 2	Distance (Miles)	PM Peak Delay (Hours*Trucks/ Mile)	AM LOS 2014	PM LOS 2014	2010 Truck Volume (2+ Axles)	2040 Truck Volume (2+ Axles)	CAGR
1	I-680 NB	Durham Rd	Washington Blvd	1.3	179.6	A	F	11,557	16,221	1.1%
2	I-80 EB	I-80/I-580 (Merge)	Powell	0.54	176.7	C	F	11,622	15,152	0.9%
3	I-80 EB	Powell	Ashby	0.72	160.6	A	F	11,916	15,529	0.9%
4	I-680 NB	Rte. 262/Mission	Durham Rd	1.62	157.4	A	F	11,142	16,313	1.3%
5	I-80 WB	Ashby	Powell	0.71	119.3	E	F	10,709	13,861	0.9%
6	I-680 NB	Washington Blvd	Rte. 238/Mission	1.14	96.6	A	F	11,747	16,768	1.2%
7	I-680 NB	Vargas Rd	Andrade Rd	2.21	92.3	A	F	11,799	16,326	1.1%
8	I-80 WB	University	Ashby	1.31	90.8	E	F	10,709	13,861	0.9%
9	I-580 EB	1st St	Greenville	2.13	82.5	A	F	12,563	19,798	1.5%
10	I-680 NB	SR 238/Mission	Vargas Rd	1.1	73.9	A	F	12,801	19,079	1.3%

Source: INRIX 2014; Alameda County Truck Travel Demand Model; PeMS time of day distribution, Cambridge Systematics analysis.

Note: Only locations with truck volumes greater than 5,000 are selected.

Figure 3.2 Top 10 Delay Locations, PM Peak Period, 2010



Source: INRIX 2014; Alameda County Truck Travel Demand Model; PeMS time of day distribution, Cambridge Systematics analysis.

3.1.2 Freeway Travel Time Reliability Issues

In addition to predicable, or recurring delay, travel reliability, which can be affected by unexpected events, such as incidents or weather, are even more important for goods movement. Motor carriers are held to very strict standards for on-time delivery by their customers. Being late can mean missing times when businesses are open or missing cutoff times for intermodal connections at ports, airports, and rail terminals. In order to avoid poor on-time performance, motor carriers must plan for the worst conditions and this can mean wasted time when conditions are not as bad as these worst case scenarios. Motor carriers are reducing this wasted time by using real-time traffic information and sophisticated dispatching programs. But it is impossible to adapt in real-time to all instances of unreliable travel times.

A useful measure of travel time reliability is the buffer time index (BTI). In order to evaluate the reliability of freeway truck route corridors in Alameda County, the BTI was calculated. BTI expresses the amount of extra travel time needed to ensure an on-time arrival 95 percent of the time as a percentage of the average travel time.

Table 3.4 shows the reliability in the AM peak in 2014, while Table 3.5 show the reliability in the PM peak in 2014. In the AM peak, the most unreliable corridor to travel on is I-80 WB, where an additional 67% of travel time must be budgeted into a trip to have high confidence of arriving on time, should a trip traverse the entire corridor. I-580 WB and I-880 SB also have high travel time indices. By contrast, travel on I-80 EB in the morning period is quite reliable. In the PM peak period, a different picture emerges. Both I-80 EB and WB are unreliable in the PM timeframe with BTIs of 1.68 and 1.67. I-680 NB emerges as a route with high unreliability as well. In addition, afternoon travel on SR 24 EB is extremely unreliable, likely due to significant commuter traffic destined to cities such as Walnut Creek where significant populations of Bay Area workers live.

In order to get a better sense of how much this unreliability affects trucks, a new index was calculated by multiplying the BTI with the truck vehicle miles traveled (VMT) over the entire corridor during the time period for which the BTI was calculated, to show how much extra time would be budgeted by trucks on this corridor if they all wish to arrive on –time with certainty. This number is then normalized by the length of each corridor to obtain a *reliability index* that shows the amount of truck traffic that on average experiences this unreliability, during peak periods. As Table 3.4 shows, in the AM peak, the most unreliable corridor for trucks is I-80 WB. In the PM period as seen on Table 3.5, the I-80 EB direction is the most unreliable. This indicates that reliability improvements need to focus on specific corridors and the specific directions along each corridor.

Table 3.4 Corridor-Level Reliability Results, AM Peak, 2014

Corridor	Length	AM Peak Truck VMT	Average BTI	AM Peak Total Reliability (VMT*BTI)	Reliability Index (Total Reliability/Mile)
I-80 WB	6	1,186	1.67	1,981	330
I-880 SB	26.2	4,561	1.04	4,743	181
I-580 WB	28.7	3,735	1.07	3,996	139
I-880 NB	25.5	4,598	0.50	2,299	90
I-680 SB	18.36	3,263	0.42	1,370	75
I-238 EB	2.59	81	0.91	74	28
I-980 WB	2.49	166	0.40	66	27
I-580 EB	32.7	7,156	0.10	716	22
I-680 NB	20.91	3,353	0.11	369	18
SR 24 WB	4.58	161	0.52	84	18
I-980 EB	2.44	166	0.17	28	12
I-80 EB	4.87	1,348	0.044	59	12
I-238 WB	2.48	149	0.084	13	5
SR 24 EB	4.53	126	0.11	14	3

Source: INRIX 2014 Data and Cambridge Systematics Calculations.

Table 3.5 Corridor-Level Reliability Results, PM Peak. 2014

Corridor	Length	PM Peak Truck VMT	Average BTI	PM Peak Total Reliability (VMT*BTI)	Reliability Index (Total Reliability/Mile)
I-80 EB	4.87	1,896	1.68	3,185	654
I-80 WB	6	1,669	1.67	2,787	465
I-580 EB	32.7	10,068	1.38	13,894	425
I-680 NB	20.91	4,717	1.66	7,830	374
I-880 NB	25.5	6,470	1.37	8,864	348
I-880 SB	26.2	6,418	0.87	5,584	213
I-238 WB	2.48	210	1.15	242	97
I-980 WB	2.49	233	1.00	233	94
SR 24 EB	4.53	177	2.20	389	86
I-680 SB	18.36	4,591	0.23	1,056	58
I-980 EB	2.44	233	0.59	137	56
I-580 WB	28.7	5,255	0.30	1,577	55
I-238 EB	2.59	114	0.84	96	37
SR 24 WB	4.58	227	0.24	54	12

Source: INRIX 2014 Data and Cambridge Systematics Calculations.

One of the most important ways of improving both delay and reliability is to adopt a corridor management system. Beyond the traditional field device deployments of detection, surveillance, and dynamic message signs (DMS) by Caltrans, there currently are several projects planned that will implement Integrated Corridor Mobility (ICM) strategies along I-80, including Adaptive Ramp Metering (ARM) and Active Traffic Management (ATM). At its heart, ATM strives to actively manage the system in real-time while leveraging advanced simulation models to project traffic conditions into the future 20 minutes. By providing operators in a traffic management center (TMC), small tailored simulation traffic models with which they can project out in time the impacts of an incident, they can better manage the system by not only ensuring the correct first responding vehicles get to the scene, but they can provide better traveling information to the public as well. One such project currently being planned is the I-80 SMART Corridor Project. This project will implement ramp metering and incident management along I-80 from the San Francisco-Oakland Bay Bridge Toll Plaza in Alameda County to the Carquinez Bridge in Contra Costa County. The purpose of the project is to optimize the use of the existing infrastructure within the corridor by implementing strategies to reduce congestion, reduce travel time, provide real time information to drivers and improve safety. [12] This type of strategy also can be considered for other corridors including I-880 and I-580.

3.1.3 Truck-Involved Crashes Safety Issues

On the interregional and intraregional goods movement systems, trucks and passenger vehicles face unique safety challenges due to the high volumes of traffic and higher speed. The factors leading to the truck-involved crashes are also somewhat different than on local streets. To understand safety issues on interregional and intraregional corridors, the methodology described in Section 2.8 is used.

Table 3.6 shows the top truck-involved crash segments on Tier 1 freeways in Alameda County. Not surprisingly, many crashes also occur near interchanges. These could be due to congestion and driver behavior (e.g., weaving, lane changing, etc.), as well as interchange geometry. Heavy trucks are slow to accelerate and decelerate and they also block the view of drivers in automobiles who must follow closely behind them in heavy traffic. If merge and weave sections at the interchanges are too short or ramps are spaced very close together, trucks may have a difficult time entering the traffic stream and autos may enter the traffic stream too abruptly for trucks to decelerate and avoid hitting the autos. There are a number of other operational characteristics of congested routes with heavy truck traffic that can lead to safety hot spots.

Table 3.6 Top Truck-Involved Crash Segments in Alameda County, 2008 to 2012

Rank	Road Name	End Point 1	End Point 2	Crashes	Length (Miles)

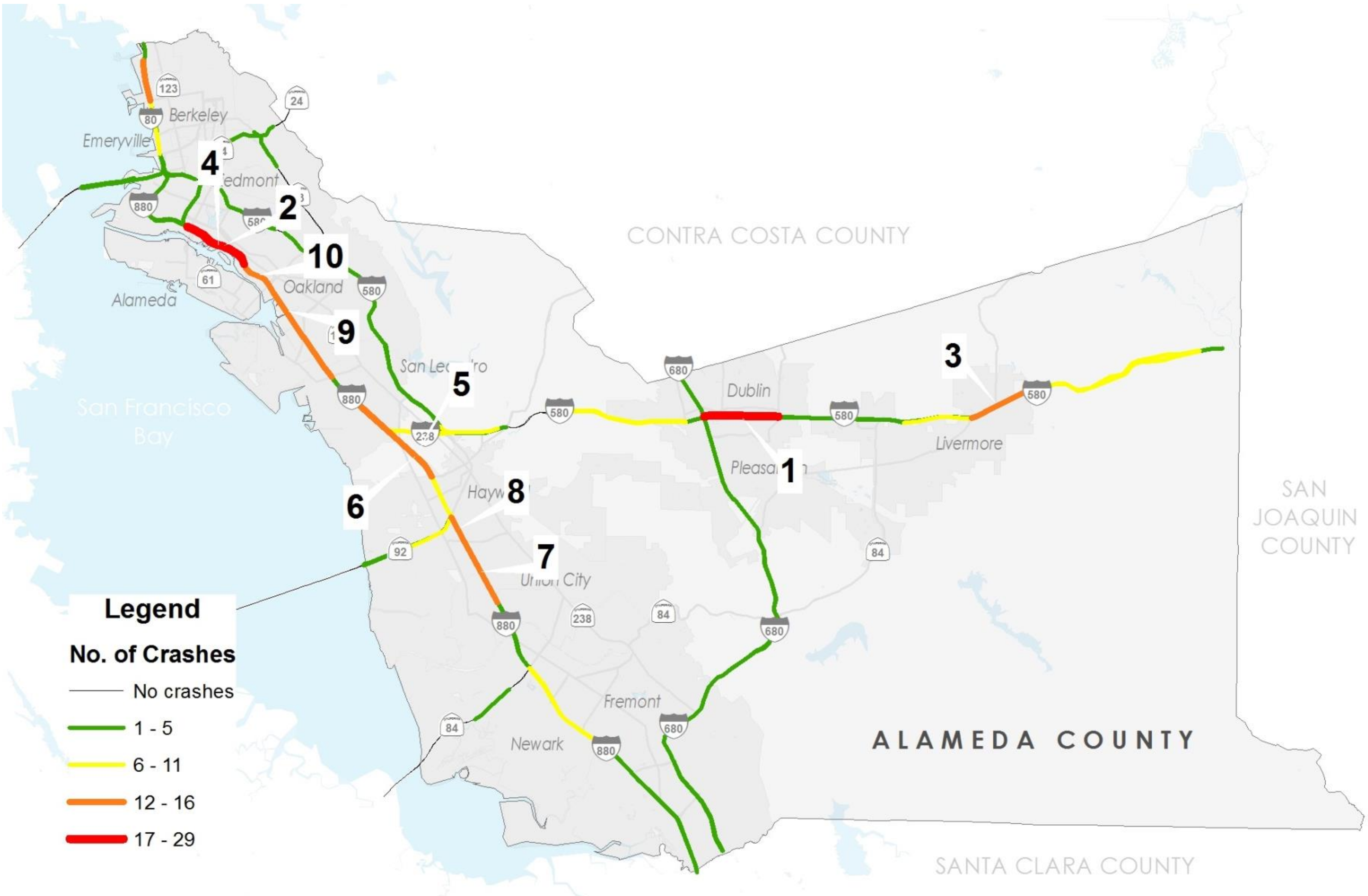
[12] http://www.alamedactc.org/GoI80.

1	I-580 WB	Tassajara Rd	I-680	29	2.78
2	I-880 NB	23rd (1St on-ramp)	Jct 980 (off-ramp)	22	2.63
3	I-880 SB	I-980	23rd	16	2.74
4	I-880 SB	I-238	A St	16	1.91
5	I-580 EB	1st St	Greenville	16	2.13
6	I-880 NB	A St	I-238	16	1.95
7	I-880 SB	High/42nd	Hegenberger	15	2.36
8	I-880 SB	Rt 92	Tennyson	15	1.01
9	I-880 SB	Tennyson	Alv-Niles	15	2.6
10	I-880 SB	23rd St	High/42nd	13	1.1
11	I-880 NB	I-880/I-238 (split)	Marina Blvd	13	2.54
12	I-880 SB	Marina Blvd	SR 238 WB (merge)	12	2.55
13	I-80 WB	Jct I-580	University	12	1.51
14	I-880 NB	SR 112/Davis	Hegenberger	12	1.83
15	I-880 SB	A St	Rt 92	11	1.7
16	I-238 WB	I-580	I-880	11	2.48
17	I-580 EB	Portola	1st St	11	2.56
18	I-580 WB	San Ramon Rd	Eden Canyon	11	4.82
19	I-580 WB	Center	I-580/238	11	2.26
20	I-238 EB	I-880	I-580	10	2.59

Source: SWITRS 2008-2012, Cambridge Systematics Analysis.

In Alameda County, the worst crash spot is at I-580 WB at I-680 interchange, with 29 truck-involved crashes in the five year period. Figure 3.3 also shows the segments with the highest crashes in visual format, and also the location of the top 10 of these segments. While there have been significant interchange improvements on I-880, the large number of safety hot spots suggests that a closer look at the issues causing these hot spots will need to be conducted during strategy development of the plan.

Figure 3.3 Number of Truck-Involved Crashes per Segment on Interregional and Intraregional Corridors in Alameda County



Source: SWITRS 2008-2012, Cambridge Systematics Analysis.

It is also useful to look at the severity of the crashes and the time of day distribution of crashes. According to Table 3.7, I-580 and I-880 have a number of fatal and severe injury crashes. Crashes in these categories cause not only loss of life, but also incur significant societal costs. It is estimated that a death has an equivalent value of more than $1.4 million, and a nonfatal disabling injury has an equivalent value of $78,900 in 2012. This is significantly higher than the $8,900 per accident costs of a property damage-only crash.[13] Table 3.9 also shows the injury crash types on the three major freight corridors. Looking at the time-of-day distributions, we can see that most of these accidents actually happen during the day, and especially during the midday period, indicating traffic congestion around these times are likely to be more important crash factors than those related to nighttime driving. This is further confirmed when we look at the crash type. Sideswipe crashes usually indicate lane switching and weaving in heavily congested conditions; whereas, rear-end crashes indicate not braking fast enough in bumper to bumper traffic.

Table 3.7 Severity of Truck-Involved Crashes along the Three Top Truck Crash Corridors, 2008 to 2012

Corridor	Fatal	Injury (Severe)	Injury (Complaint of Pain)	Injury (Other Visible)	Total
I-580	6	4	83	37	**130**
I-680		2	29	17	**48**
I-880	4	10	144	49	**207**

Source: SWITRS

Table 3.8 Time-of-Day Distribution of Truck-Involved Crashes along the Three Top Truck Crash Corridors, 2008 to 2012

Corridor	0:00-2:59	3:00-5:59	6:00-8:59	9:00-11:59	12:00-14:59	15:00-17:59	18:00-20:59	21:00-23:59	Total
I-580	7	6	23	18	29	30	10	7	**130**
I-680		5	9	13	6	11		4	**48**
I-880	7	14	31	59	48	28	11	9	**207**

Source: SWITRS.

[13] http://www.nsc.org/news_resources/injury_and_death_statistics/Pages/EstimatingtheCostsofUnintentionalInjuries.aspx.

Table 3.9 Truck-Involved Crash Types along the Three Top Truck Crash Corridors, 2008 to 2012

Corridor	Head On	Sideswipe	Rear End	Broad-side	Hit Object	Overturned	Total
I-580	2	41	68	5	11	1	**130**
I-680		11	20	5	8	4	**48**
I-880		82	95	10	12	3	**207**

Source: SWITRS.

3.1.4 Pavement and Bridge Conditions

Pavement and bridge surface quality are important for a good logistics system. Poor pavement conditions can affect vehicle operating maintenance costs and can cause freight damage, both of which are extremely important for interregional and intraregional travel.

To determine the pavement damage on Tier 1 freeway truck routes, Caltrans pavement data is used which provides segment level pavement conditions based on the international roughness index grouped into three categories. As seen in Table 3.10 below, I-580 has the highest number of lanes in distressed conditions. A significant majority of the distressed lane-mileage on I-580 is located between the Bay Bridge approach and I-238. While much of this section is prohibited for use by large trucks, a scan of Google Street View seems to support Caltrans' data – the pavement is in rough condition despite this prohibition.

By contrast, I-880 – until quite recently one of the most unpleasant/bumpy drives in the region – has been repaved and reconstructed through Alameda County in the last few years, which is reflected in the data below showing its pavement quality as quite good. The other two highways with the greatest distressed pavement are I-680 and SR 185 (International Boulevard in Oakland). It is well-known that International Boulevard has a significant number of potholes, which, with the development of the BRT will be fixed.

Table 3.10 Pavement Conditions of Major Freeways and State Routes, 2014

Section Length (mi)	Pavement Condition (Number of Lane Miles)			
Route	Distressed	Maintenance	Good/ Excellent	% Distressed
I-580	105	32	206	31%
I-680	32	13	92	23%
I-80	1		63	2%
I-880	5	18	232	2%
I-980	1	3	3	12%
SR 123 (San Pablo Ave)	18	-	2	89%
SR 13 (Ashby Ave)	15	8	10	44%
SR 185 (International Blvd, E 14th St, Mission Blvd)	36	2	0	94%
SR 238 (Mission Blvd)	9	1	43	17%
SR 24	8	2	15	33%
SR 61 (Broadway/Otis Dr/Doolittle Dr/Davis St)	16	5	4	63%
SR 84 (Dumbarton Br)	17	21	51	19%
SR 92 (San Mateo Br, Jackson St)	8	1	24	25%
Total	**284**	**108**	**755**	**25%**

Source: Caltrans Pavement Conditions Data.

In Section 2.6, the conditions of bridges on highways were addressed. The analysis of bridge condition data shows that out of the 212 bridge (out of the 397) that have a sufficiency rating (SR), the average SR is 82.99, which is above the threshold for rehabilitation, and is on par with the condition with bridges on Tier 2 and Tier 3 truck routes. Also, none of the bridges is eligible for funding given the aforementioned criteria. This can indicate that overall the bridge conditions in Alameda County are actually quite good, though it should be caveated that a significant share of bridges lack a conditions rating. Figure 3.4 shows the bridge conditions on the Tier 1 truck routes. Bridges with poorer conditions are seen scattered around the County.

Figure 3.4 Bridge Conditions on Tier 1 Truck Routes

Source: National Bridge Inventory Data obtained from MTC.

3.2 Rail Needs

Similar to highways, efficient utilization of existing infrastructure is an essential component of railway service planning and marketing. Unlike highways, as private entities, capacity to deliver current and future freight volumes is also what railroads sell. Complicating the problem for goods movement is the competing interest of passenger rail, which shares the freight rail corridors but serves a distinctly different function. Freight rail going through population centers also creates safety issues at at-grade crossings and noise impacts experienced by neighboring residential and commercial areas. This section describes the infrastructure of the two Class I freight railroads in Alameda County (Union Pacific Railroad and BNSF Railway) and the adjacent areas that affect their ability to deliver current and future freight volumes and support existing and planned passenger train services. A more detailed discussion of infrastructure is provided below since understanding the different freight rail lines is critical to understanding the issues discussed. Additional information about the freight railroad infrastructure in Alameda County is contained in an earlier task report for this study, *Alameda County Goods Movement Plan: Infrastructure, Services, and Trends*.

3.2.1 Union Pacific Railroad (UP)

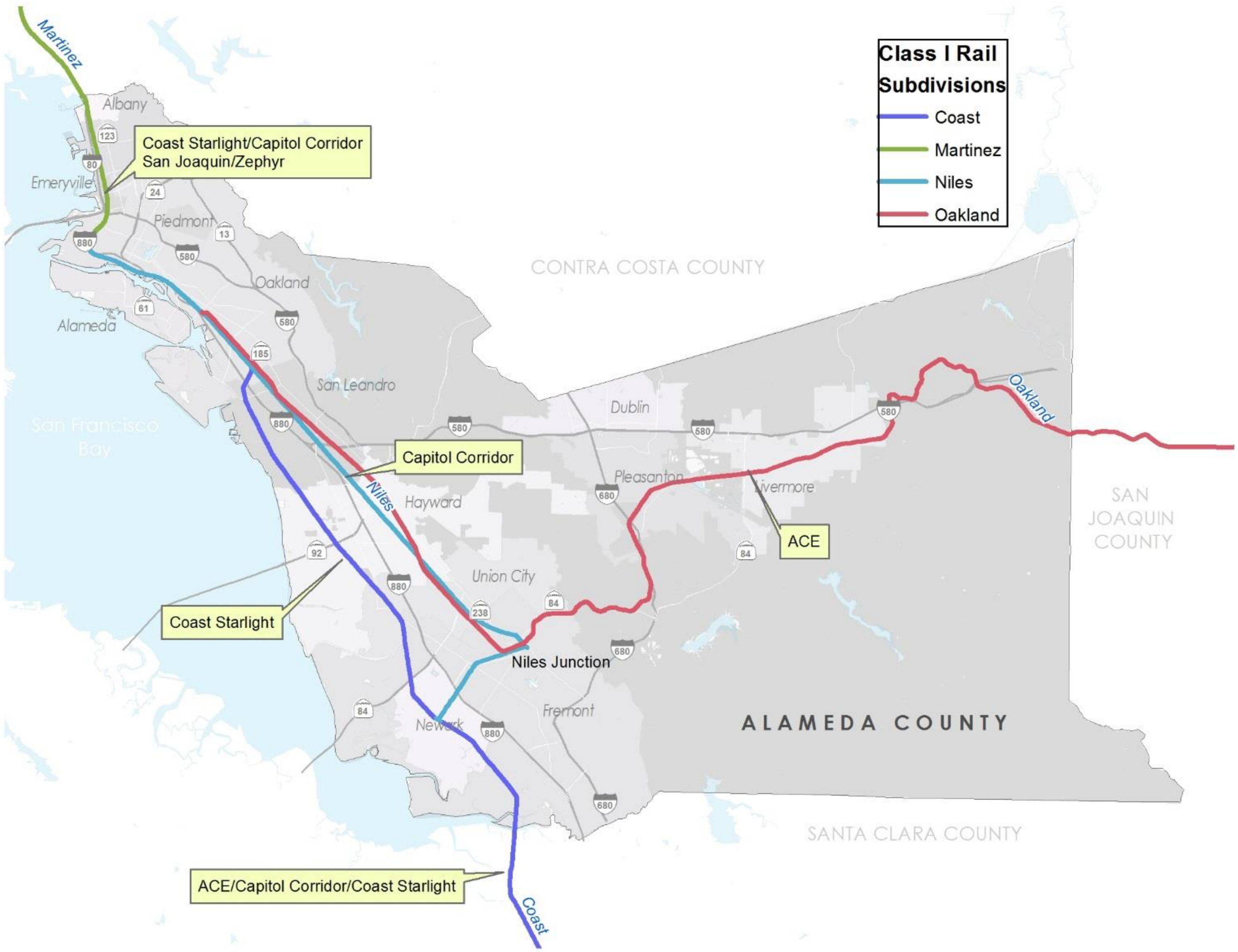
The UP maintains and manages the following subdivisions that have at least a portion of their lines in Alameda County (Figure 3.5):

- **Martinez Subdivision.** Oakland – Martinez – Sacramento – Roseville;
- **Niles Subdivision.** Oakland – Niles Junction – Newark;
- **Coast Subdivision.** Oakland – Newark – San Jose; and
- **Oakland Subdivision.** Oakland – Niles Junction – Stockton.

Martinez Subdivision

The Martinez Subdivision is UP's principal gateway to the San Francisco Bay Area from the east, hosting both transcontinental traffic via the former Southern Pacific (SP) Overland Route and traffic from the Pacific Northwest. The Martinez Subdivision between Oakland and Martinez is one of the busiest segments of the northern California rail system. In addition to UP's own traffic, BNSF Railway (BNSF) connects to the Port of Oakland via trackage rights on this portion of the Martinez Subdivision, and various state-supported intercity passenger services (*San Joaquin*, *Capitol Corridor*), and Amtrak's *California Zephyr* and *Coast Starlight* account for 44 weekday passenger train movements over this segment. Freight traffic on this line increased with the rerouting of port-related traffic from the Oakland Subdivision (Oakland to Stockton via Niles Junction) after UP gained access to this more direct route to Sacramento and points north and east as part of the SP acquisition in 1996.

Figure 3.5 Rail Subdivisions in Alameda County



Source: Cambridge Systematics.

Niles Subdivision

The Niles Subdivision is the route between Oakland and Niles Junction where it runs parallel to the Western Pacific (WP) Oakland Subdivision (now owned by UP). This route hosts *Capitol Corridor* trains as well as the Amtrak *Coast Starlight* and supports speeds up to 79 mph for passenger trains and 60 mph for freight trains. ACE regional rail trains use the segment between Newark and Niles Junction. The 30-mile route between Oakland and Newark has two main tracks and centralized track control (CTC) signaling[14]. BNSF has trackage rights between Oakland and Niles Junction.

Coast Subdivision

The Coast Subdivision is a combination of the former SP Mulford and Coast Lines. The Mulford Line ran from Oakland to San Jose via Newark. The Coast Line ran from San Francisco to San Jose and then to Los Angeles. In 1991 the 51.4-mile railroad right-of-way from San Francisco to San Jose was sold by Southern Pacific to the Peninsula Corridor Joint Powers Board for $219 million. *Capitol Corridor* and ACE trains as well as the Amtrak *Coast Starlight* use the segment between Newark and San Jose. Through trains do not operate on the segment between Newark and Oakland, but freight service to customers is provided by local trains.

Oakland Subdivision

The Oakland Subdivision between Oakland and Stockton was the western most route segment of the Western Pacific Feather River Route and the original route of the *California Zephyr*. The Oakland Subdivision connects with the two main tracks of the Niles Subdivision at Melrose in Oakland. It is basically a single track mainline with passing sidings controlled by a CTC system. It parallels the Niles Subdivision from Melrose to Niles Junction where there is a second connection to the Niles Subdivision. At the present time, this northern portion is used only for local movements, and there is no through-train operation. UP's Oakland Subdivision is currently a relatively uncongested low-volume freight route, with the biggest capacity constraint being the west end between Melrose and Niles Junction. On this portion, traffic from UP's Coast Subdivision and the Oakland Subdivision from Stockton are combined over a single track.

The portion of the Oakland Subdivision between Union City and Oakland was relegated to secondary status after Union Pacific merged with Southern Pacific in 1996. UP chose to operate on SP's parallel route, the Coast/Mulford Line, instead of the Oakland Subdivision. The only portion of the legacy WP route that has been abandoned is the extreme west end between

[14] CTC signaling is a form of controlling how trains move through a network of track. It consolidates train dispatching decisions that would otherwise be made by local dispatchers. By centralizing control, the host railroad is able to more efficiently and safely use its track and thus, can accommodate more trains per day than would be possible with localized signal controls.

Melrose in East Oakland and Magnolia in West Oakland, including the street running in downtown Oakland on Third Street in front of the former Western Pacific passenger depot, now converted for office use.

The portion of the Oakland Subdivision from Niles Junction to Lathrop is used by both UP freight trains and Altamont Corridor Express (ACE) commuter passenger trains. At Lathrop, the Oakland Subdivision, which continues north to Stockton, also connects with the two main tracks of the Fresno Subdivision of the UP. The Fresno Subdivision parallels the Oakland Subdivision from Lathrop to Stockton.

ACE trains leave the Oakland Subdivision at Niles Junction, operating on the Niles Subdivision to Newark and then south to San Jose on the Coast Subdivision. Since the UP acquisition of the SP, ACE trains frequently operate via the Fresno Subdivision rather than the Oakland Subdivision between Lathrop and Stockton. The Stockton passenger station used by ACE is actually located on the Fresno Subdivision, and by using the Fresno Subdivision, the ACE trains avoid the congestion around the UP's Lathrop Intermodal Facility and the UP's Stockton Yard.

Traffic levels have actually decreased significantly on the Oakland Subdivision since the UP acquired the SP in 1996. Much of the traffic that used to traverse the Oakland Subdivision between Sacramento, Stockton and Oakland, San Jose and Milpitas now takes the more direct, shorter route to Sacramento by utilizing the Martinez Subdivision. In capacity studies conducted in 2013 by UP as part of the Northern California Unified Service Concepts Analysis (a working group including UP and the passenger rail service providers), they reported freight train volumes of 10 train movements per day on the Oakland Subdivision between Lathrop and Niles but this volume appears high as compared to analysis of train demand from data on commodity movements in the Bay Area. The 2013 California State Rail plan estimated approximately 4 trains per day on this portion of the Oakland Subdivision. At Niles Junction, the preferred freight route to Oakland switches to the Niles Subdivision ,where there are larger numbers of freight trains, and then connects to the Coast Subdivision at Newark in order to make the connection to Oakland . If the UP numbers represent more typical projected operations on the Oakland Subdivision, there could be a greater need for additional capacity on the portion of the subdivision from Lathrop to Niles than is indicated in this report. Factors that could affect future freight growth on the Oakland Subdivision will be described later in this report. ACE service is now operating 8 trains each weekday. ACE had reached a tentative agreement with the UP to run up to 12 trains per day between Stockton and San Jose.

3.2.2 BNSF Railway

The BNSF does not own or operate any mainline track within Alameda County. However, UP recently granted BNSF limited joint facility rights over the UP's Martinez Subdivision. BNSF is permitted to operate up to eight trains per day between the Port of Oakland and Bakersfield.

This raised the traffic levels on the Martinez Subdivision and lowered freight traffic on the BNSF's Stockton Subdivision. BNSF also has haulage rights on the UP Overland Route between Sacramento and Denver.

3.2.3 Mainline Capacity Issues

Capacity is a measure of the ability to move a specific amount of traffic over a defined rail line with a given set of resources under a specific service plan. As described above, the existing railway infrastructure in Alameda County and adjacent counties in Northern California is the rationalized remnants of several Class I railroads operating in the Bay Area. Increased demand for freight rail services and the desire to operate more passenger trains is constraining the ability of the existing railroads to support this growing demand. As demand approaches capacity, there will be increasing delays for all users of the system.

Rail line capacity is a function of a number of factors, including the number of tracks, the frequency and length of sidings, the capacity of the yards and terminals along a corridor to receive the traffic, type of control systems, geography, and the mix of train types, propulsion power, track speed, and individual railroad operating practices. Furthermore, it varies with changes in infrastructure and operating conditions.

Determining the capacity of any particular rail line is complex. Numerous approaches have been developed to evaluate railway capacity. Network simulation modeling is usually required by the track owners before any modifications are made. However, general rules have been developed by railroads to determine the theoretical and practical capacity of rail lines. Three variables are generally used to estimate the capacity of rail corridors: the number of tracks, the type of control system, and the mix of train types.

Typically, a corridor serving multiple train types will have a lower capacity than a corridor serving a single train type. For example, a railroad corridor with two tracks, a centralized traffic control (CTC) system, and a mix of merchandise/bulk trains, intermodal/auto trains, and passenger trains would typically operate at a capacity of about 75 trains per day. The same corridor, serving all intermodal trains, would typically operate at a capacity of about 100 trains per day.

Table 3.11 illustrates the practical capacities of the rail lines in Alameda County and the adjacent areas that support passenger trains, which are the most constrained portions of the freight system. The railroad subdivision and segments are identified as well as the number of main tracks and type of signaling. In instances where short segments of the rail line are either double or triple tracked, the lower average capacity was used to show the practical limitations of the rail line to support increased traffic volumes. Rail network simulation models would be required to determine the exact capacity of each line illustrated.

Table 3.11 Practical Capacity of Rail Lines in Alameda County Area

Subdivision	From:	To:	Number of Main Tracks	Signaling	Average Capacity
UP Coast	San Jose	Newark	3/1[15]	CTC	**30**
UP Coast	Newark	Oakland	1	ABS	**18**
UP Martinez	Sacramento	Martinez	3/2	CTC	**75**
UP Martinez	Martinez	Richmond	2	CTC	**75**
UP Martinez	Richmond	Emeryville	3/2	CTC	**75**
UP Martinez	Emeryville	Oakland	2	CTC	**75**
UP Niles	Newark	Niles Junction	2	CTC	**75**
UP Niles	Niles Junction	Oakland	1	CTC	**30**
UP Oakland	Niles Junction	Stockton	1	CTC	**30**
BNSF Stockton	Stockton	Port Chicago	2/1	CTC	**30**

Source: Altamont Press, "California Region Timetable 20" March 2009.

a This means that in some places there are three tracks, and in other places there is one track. The rest of the table follows the same numbering scheme.

Existing train volumes on freight rail lines in and around Alameda County are highlighted in Table 3.12. The table aggregates current average daily freight and scheduled passenger trains to obtain total daily trains. In addition, Figure 3.6 shows the passenger and freight train volumes on these subdivisions, along with the passenger train operations along the lines.

[15] This means that in some places there are three tracks, and in other places there is one track. The rest of the table follows the same numbering scheme.

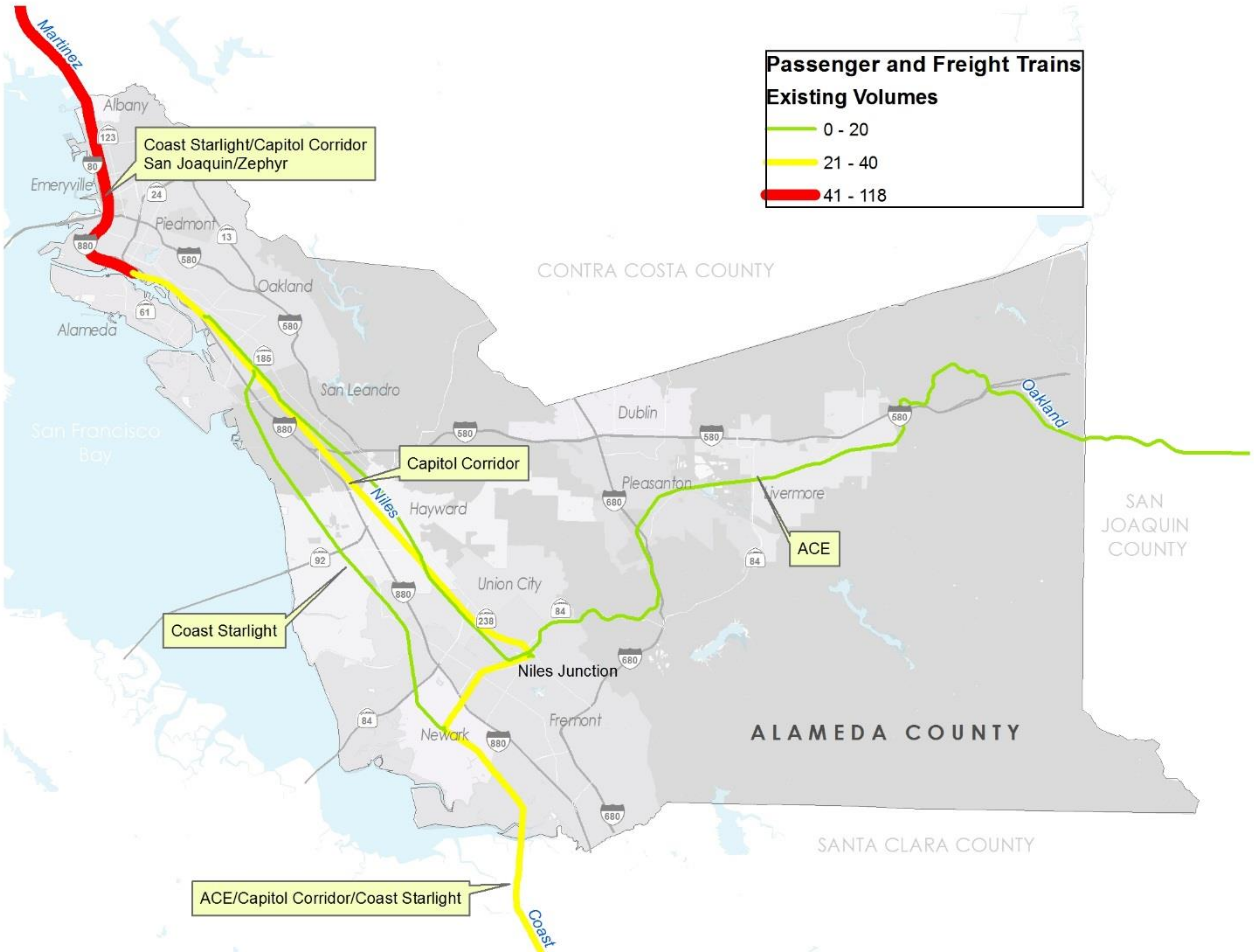
Table 3.12 Average Daily Train Volumes in Alameda County and Bay Area

Subdivision	From:	To:	Class I Freight Railroads	Average Daily Freight	Daily Passenger Trains	Total Daily Trains
Coast	San Jose	Newark	UP	8	22	**30**
Coast	Newark	Oakland	UP	6	2	**8**
Martinez	Sacramento	Martinez	UP	18	34	**52**
Martinez	Martinez	Richmond	UP/BNSF	18	42	**60**
Martinez	Richmond	Emeryville	UP/BNSF	17	42	**59**
Martinez	Emeryville	Oakland	UP/BNSF	17	40	**57**
Niles	Newark	Niles	UP	6	24	**30**
Niles	Niles	Oakland	UP	2	16	**18**
Oakland	Niles	Stockton	UP	4	8	**12**
Stockton	Stockton	Port Chicago	BNSF	10	8	**18**

Sources: Freight train counts based on 2010 BNSF and 2008 UP train count data. Passenger train counts based on weekday published timetables for summer 2014.

Note: UP provided base year and forecasted train volumes for the year 2008 in its 2013 RTC Simulation for the Northern California unified rail service. It showed higher base year freight volumes than what is reported here by about 7 trains, and slightly higher future year volumes by about 3 trains. This may reflect different assumptions about what constituted typical base year operations. But a more significant difference is the split between what comes in and out of Oakland by the northern route vs. the southern route. UP assumed a higher share of freight trains coming via the south than reported here in the base year, and much higher growth in trains in the south, with less growth in the north. This may reflect different assumptions about the effect of capacity constraints on the Martinez subdivision.

Figure 3.6 Existing Train Volumes on Rail Lines in Alameda County



Source: AECOM.

Note: Capitol Corridor is on Niles Subdivision.

The v/c ratios for the railroad segments that support passenger services in Alameda County and the adjacent area are tabulated in Table 3.13.

Table 3.13 Rail Lines Level of Service in Alameda County Area

Subdivision	From:	To:	Number of Main Tracks	Total Daily Trains	Average Capacity	v/c Ratio	LOS
UP Coast	San Jose	Newark	3/1	30	30	100%	F
UP Coast	Newark	Oakland	1	8	18	44.4%	C
UP Martinez	Sacramento	Martinez	3/2	52	75	69.3%	C
UP Martinez	Martinez	Richmond	2	53	75	70.6%	C
UP Martinez	Richmond	Emeryville	3/2	59	75	78.6%	D
UP Martinez	Emeryville	Oakland	2	57	75	76.0%	D
UP Niles	Newark	Niles	2	30	75	40.0%	B
UP Niles	Niles	Oakland	1	18	30	60.0%	C
UP Oakland	Niles	Stockton	1	12	30	40.0%	B
BNSF Stockton	Stockton	Port Chicago	2/1	18	30	60.0%	C

Source: AECOM calculations.

While railroad capacity analysis does not typically use the concept of LOS that is used in highway analysis, in a study conducted for the Association of American Railroads (AAR)[16], Cambridge Systematics developed an LOS indicator for railroads based on volume to capacity ratios (v/c) that is similar to the familiar highway congestion rating. These are described for each rail line in the following paragraphs.

Currently, the existing railroad network in Alameda County and adjacent area has sufficient capacity to accommodate current train volumes without excessive delays. The UP Coast Subdivision between San Jose and Santa Clara with three main tracks is operating at LOS A. However, the line drops down to single track at Great America through to Newark restricting the flow of train volumes. From Newark to Elmhurst, this line operates at LOS C even with the relatively small volumes of train traffic due to the single-track and the less sophisticated signaling system. The UP Martinez Subdivision is at LOS D between Richmond and Oakland and adding more trains to this segment of the network may result in unstable operating conditions seriously degrading *Capitol Corridor* on-time performance.

[16] *National Rail Freight Infrastructure Capacity and Investment Study*, prepared by Cambridge Systematics for the Association of American Railroads, September 2007.

The Niles Subdivision supports 14 *Capitol Corridor* and two *Coast Starlight* daily trains between Oakland and Niles Junction and two freight trains. This segment of the railroad network is operating at LOS C. From Niles Junction to Newark this line picks up additional ACE trains running to San Jose as well as freight trains crossing from Niles Canyon to the Coast Subdivision. However, because this is a double-tracked segment, it operates at LOS C. The Oakland Subdivision is a single track line that runs through Niles Canyon and over the Altamont Pass along the legacy WP Feather River Route. The line has many curves restricting speeds in some segments of the line to 30 mph or less. Pinch points exist in Lathrop where level crossings with other UP lines occur. The Oakland Subdivision is at LOS B. However, the level crossing and interlockings at Niles Junction and Lathrop restrict the flow of trains through this critical segment of the railroad network impeding the flow of trains. The BNSF Stockton Subdivision also has an LOS of A. Adding trains to this segment of the network will degrade current LOS and may cause perturbations decreasing on-time performance of the *San Joaquin* intercity trains.

The freight railroads have a need to protect their ability to deliver current and future freight volumes and have an inherent right to retain existing capacity for future freight growth. Adding more freight trains to the system will degrade on-time performance of passenger trains unless new capacity is added in the form of longer passing sidings, station dwell time takes place off the mainline, more crossovers are added and other infrastructure improvements are made to improve fluidity. This simply means that passenger train operators will need to partner with freight railroad hosts to invest in additional infrastructure to provide the needed capacity enhancements that allow rail line LOS to be at level C or better.

3.2.4 Freight and Passenger Rail Growth

Many sources of data on forecast rail traffic have been examined for this report including the California State Rail Plan, UP analysis, and plans for the Oakland Army Base rail terminals and yards. They all point to robust growth in rail traffic. Freight volumes in general are expected to increase by 2 to 3 percent over the next year or so. [17] Intermodal freight volume grew 5.2 percent nationwide in the past 12 months, making it an important driver of overall volume growth. It currently represents approximately 46 percent of total carloads. Crude oil will remain the fastest-growing segment of the major freight rail categories, which grew 25 percent in 2013. The UP is assuming a 4 percent annual growth rate for freight train volumes over the next 10 years. Increasing freight volumes will severely restrict fluidity over the network degrading LOS and passenger train on-time performance.

[17] Moody's Investors Service, "Moving to Positive Outlook on Broad-based Freight Growth," June 14, 2014.

The 2013 California State Rail Plan[18] provided a wealth of information on rail movements; in particular it provided train volume estimates and forecasts. Freight train volumes were estimated by rail segment for 2020, 2025 and 2040, and by train service type (i.e., intermodal, automobiles, bulk, and general merchandise). In addition, passenger train forecasts were also available by segment up to 2025. Future train volumes reported in the State Rail Plan for rail segments in the Bay Area are as indicated in Table 3.14, and shown in Figure 3.7.

Table 3.14 Future Train Volumes in Alameda County Area

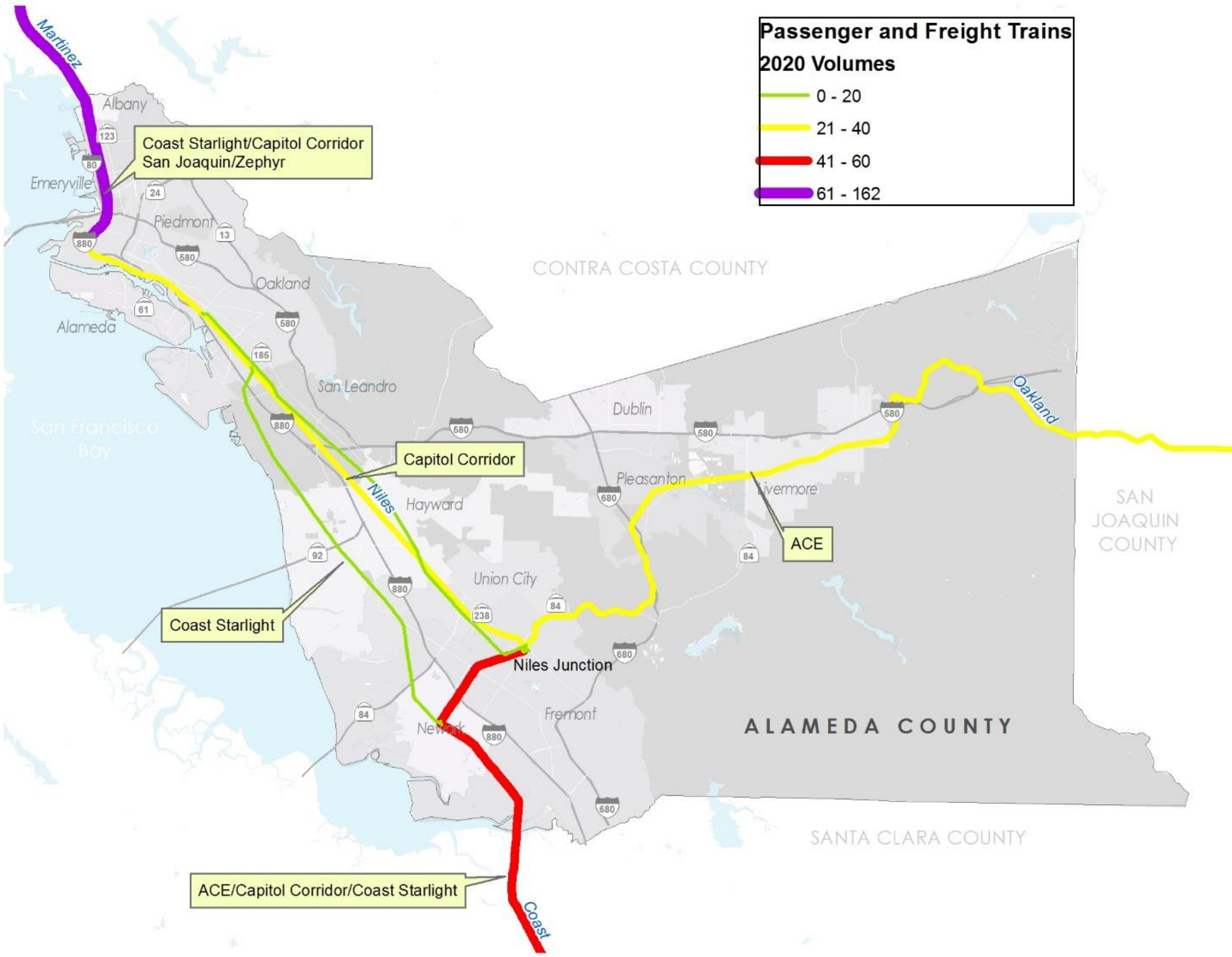
Subdivision	From:	To:	2020 Daily Train Volumes			2040 Daily Train Volumes		
			Freight	Passenger	Total	Freight	Passenger	Total
UP Coast	San Jose	Newark	10	32	42	12	N/A	N/A
UP Coast	Newark	Oakland	8	2	10	12	N/A	N/A
UP Martinez	Sacramento	Martinez	22	34	56	36	N/A	N/A
UP Martinez	Martinez	Richmond	22	44	66	36	N/A	N/A
UP Martinez	Richmond	Emeryville	30	44	74	50	N/A	N/A
UP Martinez	Emeryville	Oakland	30	42	72	50	N/A	N/A
UP Niles	Newark	Niles	8	36	44	12	N/A	N/A
UP Niles	Niles	Oakland	2	24	26	2	N/A	N/A
UP Oakland	Niles	Stockton	11[a]	12	23	15	N/A	N/A
BNSF Stockton	Stockton	Port Chicago	12	10	22	20	N/A	N/A

Source: California State Rail Plan, May 2013.

[a] Oakland Army Base Area Outer Harbor Intermodal Terminal Project Environmental Impact Report, August 2012.

[18] AECOM with Cambridge Systematics, *California State Rail Plan*; California Department of Transportation, Rail Division; September 2013.

Figure 3.7 Future Train Volumes on Rail Lines in Alameda County



Source: AECOM.

These forecasts reflect several important trends in the way the rail system in Alameda County is expected to be operated in the future which is different than today. One major driver of changes in rail volumes and flow patterns are the plans for the Oakland Army Base redevelopment. The OAB when completed will add a new intermodal terminal (the Outer Harbor Intermodal Terminal), will add capacity at UP's Railport intermodal terminal, will add capacity at a new bulk terminal, and will add capacity for manifest trains. These terminals will serve a mix of intermodal, bulk, and manifest traffic that will come from both international and domestic sources. The UP also may change the way it uses its available mainline capacity connecting to these terminals. It is likely that the UP will carry its premium services (intermodal) on the Martinez Subdivision and the heavier bulk and manifest traffic on the Oakland and Niles Subdivisions accessing the Port of Oakland from the south, as separating these two types of freight traffic generally results in more efficient operations. These trends provide some indication of how much growth in rail traffic there will be and on which routes it will travel.

By 2035, there will be about 10 additional intermodal trains per day based on the forecast for intermodal growth in and out of the Port of Oakland rail terminal expansion.[19] The apparent split in traffic will be about 6 trains from the Port's new Outer Harbor Intermodal Terminal (OHIT) if it is ultimately built on the OAB site, and 4 from UP's Railport intermodal terminal (OHIT and Railport are described below in Section 3.2.2). The growth ranges from about 10 additional freight trains a day to about 20.5 additional freight trains per day using the Martinez Subdivision. In addition, passenger train volumes are also expected to increase as outlined in Table 3.14. This growth in train volumes will impact LOS as indicated. These forecasts, which are taken from the California State Rail Plan, provide growth rates that are generally consistent with the Oakland Army Base forecasts and the UP forecasts when both international and domestic traffic on the Martinez Subdivision are taken into account. What is different among all of these sources is the timing of the growth. The California Rail Plan forecasts show lower rates of growth for the period until 2020 and higher rates of growth from 2020 to 2040, whereas the OAB forecasts anticipate a big bump up in traffic when the projects are brought online (by 2020) and a slowing of growth beyond 2020. The UP forecasts, which include non-intermodal traffic on the Martinez Subdivision only extend to 2018 and have somewhat lower rates of growth than the OAB forecast in this period (reflecting a mix of international and slower growing domestic traffic).

On the Oakland, Coast and Niles Subdivisions, where it is assumed UP will carry its non-intermodal cargo coming from/ going to the Port of Oakland, there is expected to be significant growth on the Niles to Lathrop segment and this will impact capacity in this corridor. The changes in capacity utilization and LOS are presented in Table 3.15.

[19] Oakland Army Base Area Outer Harbor Intermodal Terminal Project Environmental Impact Report, August 2012.

Table 3.15 Rail Lines 2020 Forecast Level of Service in Alameda County Area

Subdivision	From:	To:	Number of Main Tracks	Total Daily Trains	Average Capacity	v/c Ratio	LOS
UP Coast	San Jose	Newark	3/1	42	30	140.0%	F
UP Coast	Newark	Oakland	1	10	18	55.5%	C
UP Martinez	Sacramento	Martinez	3/2	56	75	74.7%	D
UP Martinez	Martinez	Richmond	2	66	75	88.0%	E
UP Martinez	Richmond	Emeryville	3/2	74	75	98.7%	E
UP Martinez	Emeryville	Oakland	2	72	75	96.0%	E
UP Niles	Newark	Niles	2	44	75	58.7%	C
UP Niles	Niles	Oakland	1	26	30	86.7%	E
UP Oakland	Niles	Stockton	1	23	30	76.7%	D
BNSF Stockton	Stockton	Port Chicago	2/1	22	30	73.3%	D

Source: AECOM calculations.

As indicated, the planned future growth in train volumes for freight and passenger services degrades the overall network. Only a segment of UP Coast Subdivision between Newark and Oakland and the segment of UP Niles Subdivision between Newark and Nil are operating at LOS C. But with anticipated freight growth beyond 2020, the Coast Subdivision will be at LOS D (close to E) and the Niles Subdivision between Newark and Niles will degrade to D (if desired growth in Capitol Corridor service is considered. The rest of the network degrades to LOS D, E and F.

The UP Oakland Subdivision through Niles Canyon degrades to LOS D but there are likely investments that would be needed to resolve operational issues and specific capacity choke points (e.g. Lathrop, Niles Junction) along this route which is only lightly used for freight service today. Significant investment in system capacity will be required to support forecast and planned service expansions. The anticipated growth in bulk and manifest traffic moving to Oakland along with growth in ACE service is responsible for this strain on capacity. This does not take into account potential growth in bulk movements to the Port of San Francisco, which is hoping to expand bulk export opportunities (and these products would likely use this line). While the Coast Subdivision continues to be the southern route connecting to the Port of Oakland with the best level of service (as compared to the Niles Subdivision), tradeoffs between the Coast Subdivision and the Niles Subdivision taking into account potential investments and future passenger operations should be considered when planning for the entire freight network serving Alameda County and the Bay area in the future.

3.2.5 Rail Access and Operations Issues

Rail traffic in Alameda County is anchored by the Port of Oakland (discussed in Section 4.1). It has two intermodal rail terminals to facilitate container traffic, the Oakland International Gateway (OIG) joint intermodal terminal and Railport. The Port of Oakland is working to resolve several intermodal terminal capacity and access issues through the construction of a new Outer Harbor Intermodal Terminal (OHIT) – an intermodal rail terminal complex to be located on 160 acres of the former Oakland Army Base (OAB)[20].

- **Oakland International Gateway.** The OIG is a near-dock joint intermodal terminal owned by the Port of Oakland and operated by BNSF. It is located adjacent to UP's Railport and the container ship docks that line the Oakland harbor. The construction of OIG eliminated the 12-mile trip over local roads between the port and BNSF's former Richmond Intermodal Facility. The former Richmond Intermodal Facility now functions as a yard for merchandise and bulk commodity trains. However, there is a significant access bottleneck at OIG. In order to access the OIG, BNSF trains must cross through the UP terminal and cross UP tracks at-grade. This movement causes significant delays and operational issues for both railroads.
- **Railport – Oakland.** A near-dock terminal operated by UP, Railport is located adjacent to OIG. This facility functions similarly to OIG, and directly connects to regional warehouse facilities, where container goods are unloaded, sorted, consolidated, and sometimes stored for short periods of time.

Together, these two intermodal terminals have a capacity of approximately 700,000 lifts (1 million 20-foot equivalent units (TEUs)). In 2008, the Port of Oakland projected that it would need to increase lift capacity by an additional two million TEUs to accommodate growth in overall cargo volumes and shift a larger share of its inland moves to intermodal rail.[21] Recent slowdowns in trade-related traffic have temporarily postponed this need for additional capacity as originally projected. Nevertheless, this additional capacity will be required in the future to support continued population growth. Also, as the Port pursues its growth strategy, it will be trying to build import volumes so that imports and exports stay roughly equivalent over time. To do this, there will need to be increased rail service for international intermodal cargo. While older logistics systems supporting Pacific Rim trade often used the rail system as a land bridge from West Coast ports to the Midwest and East Coast with containers traveling in-tact (often referred to as inland point intermodal or IPI), a new strategy has been developing in which the cargo in

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[20] The base was decommissioned in 1999 as a result of the Base Realignment and Closure Act.

[21] Port of Oakland, 2008 TCIF Funding Nomination for the OHIT.

international containers is unloaded and re-loaded into larger domestic containers. This practice, which is referred to as transloading, is done for a variety of reasons including:

- Since there has been an historical imbalance of imports and exports in Pacific Rim Container trade, ocean carriers often provide lower rates to shippers who return their containers faster so they can be returned to Asia where they are needed. By transloading, shippers can take advantage of these lower rates.

- Making the inland move in a 53 foot domestic container instead of a 40-foot international container allows shippers to reduce the number of containers needed to transport a given amount of cargo, thus reducing inland transportation costs.

- By transloading after cargo arrives at a U.S. port, shippers can postpone decisions about what cargo is going to what inland destinations and better match inventory with demand.

Transloading also creates economic activity near the port because it often involves value added services including, bar-coding products, putting clothes on hangars for store display, and sometimes finishing activities to meet local demands. The Oakland Army Base redevelopment plans include modern warehousing facilities that will provide space for transloading near the Port of Oakland.

All of these factors suggest that in addition to increased demand for intermodal capacity at the Port of Oakland due to growth in cargo volumes, there will also be an increasing share of the port cargo moving by rail as compared to trucking. The Port's plans call for increasing the share of rail movements will grow from about 21% today to 40% by 2020. This will slow the rate of growth in truck movements to and from the Port and will reduce the relative impact of Port growth on local connector routes and the interregional corridors.

As part of the build out of intermodal rail terminal facilities at the Port of Oakland, Railport may be expanded to meet future demand. The Oakland Army Base Environmental Impact Report indicates potential to increase annual number of intermodal container lifts at Railport from about 386,000 annually in 2011 to 669,000 annual lifts in 2035. Based on demand forecasts, if this expansion does not take place, the UP would not have less capacity to handle domestic intermodal demand at Railport and mostly likely this demand would need to be handled at nearby intermodal terminals in the San Joaquin Valley (UP's Lathrop Yard) with containers being transferred to Bay Area customers by truck on I-580. The additional number of domestic containers that would be handled at the Oakland Army Base rail complex (not all of which would be at Railport) could be as much as 259,000 per year. Assuming 365 day per year operations, this equates to eliminating over 700 truck trips per day.

Outer Harbor Intermodal Terminal (OHIT)

In August 2003, the US Army jointly transferred 322 acres of the former Oakland Army Base (OAB) to the City of Oakland and the Port of Oakland. The City of Oakland and the Port of Oakland have a singular vision for developing the former army base into a vital international trade and industry center known as the Oakland Global Trade and Industry Center (OGTIC). The Port of Oakland prepared a rail master plan that identified several opportunities:

- **Near-Dock Intermodal Rail**, which involves the construction of intermodal loading tracks and support tracks near marine terminals. Cargo is drayed from the marine terminal(s) to the intermodal rail yard on either public or private roads.

- **Commodity Unit Trains**, which involves the construction of unit train unloading facilities specific to the type of commodity and adequate support track to service the contracted volumes. Some types of commodities, including lumber and containerized grain, could use the near-dock intermodal terminal facilities. Others, including minerals and aggregates, require separate dedicated unloading facilities.

- **Manifest Rail Cargo**, which involves the construction of a support yard and industrial switching, leads to serve a proposed 106-acre industrial park development along Maritime Street. The facilities could also be used to support temporary open-air transloading operations on vacant land.

  The rail master planning effort looked at these potential rail services and projected train volumes over the next 10 to 20 years. The build-out looked at the identified rail services based on the overall capacity of the planned rail infrastructure. The Master Plan assumed a fully developed adjoining marine container terminal and intermodal rail terminal, bulk unloading terminal, and industrial park with the required rail support infrastructure.

Access improvements into the OHIT were identified to support the additional train traffic generated by the OHIT investment and improve the overall train movements into the existing UP Railport and BNSF Joint Intermodal Facilities. These improvements were envisioned to be implemented over a 20-year period, or sooner if demand warrants.

The Port of Oakland was awarded a $15 million TIGER grant in 2012 for the OHIT Rail Access project, in addition to receiving $242 million in Prop 1B Trade Corridor Improvement Funds. This project is designed to eliminate the bottleneck and access issues at the Joint Intermodal Terminal. As noted, trains accessing the Port's Joint Intermodal Terminal must cross through the UP's yard. This requires all trains accessing the Port to slow significantly (no more than 5 miles per hour) and essentially limits UP operations – causing significant delays to both BNSF and UP operations at the Port. By eliminating this conflict, the freight operations will be improved, with spillover benefits for the over 40 passenger trains (*Capitol Corridor* and *Coast Starlight*) that pass by the port every day and share the corridor.

These funds are being used to construct additional trackage to increase UP train volume limitations on the existing Port of Oakland manifest railcar business for frozen food products, lumber, grain and other commodities. Over time, improvements at OHIT will provide the capacity to respond to demand for higher freight train volumes as UP and BNSF have made significant improvements in their transcontinental routes. UP recently increased the frequency of intermodal trains responding to growing demand for truck-competitive service between western US markets and Chicago. The Northern California-Chicago service, called Nor Cal, connects Chicago, Oakland, and Lathrop intermodal ramps utilizing the Overland route. The service operates between five and seven days per week depending on direction and specific origin/destination points. The intermodal service provides four-day delivery between the West Coast and Chicago.

Other Access Issues and Capacity Constraints

The UP mainline through Oakland is designated as a restricted access corridor by the UP. These designated areas are defined as, "the most operationally challenged" sections of the railroad's national network.[22] The new OHIT yard will increase manifest capacity at the Port of Oakland, allowing shippers to save on shipping costs by both significantly reducing truck drayage costs to the Port of Oakland, and allowing shippers to take advantage of the overweight corridor within the port area. In the port area, shippers can fill containers up to the maximum ocean shipping container weight, rather than a reduced amount due to gross vehicle weight limits on state highways. The overweight corridor within the Port allows shippers to move more freight per container, while maintaining the same ocean transportation freight rate. The reduction in truck drayage also generates emissions, pavement, congestion, and safety benefits due to the reduced truck VMT on interstates and highways between Stockton and the Port of Oakland.

Other access and capacity constraints for other UP subdivisions in Alameda County are described below.

- **Martinez Subdivision.** This is a double-track segment with sufficient projected demand to require at least one additional track. With the completion of work on Donner Summit, which has the potential to increase traffic on the Overland route, the Port of Oakland sees capacity issues on this segment as an impediment to increased freight rail service and associated expansion of port activity.

[22] UP "Guidelines for Rail Service to New Industry Locations", revised March 10, 2014.

- **Oakland Subdivision.** In light of the congestion on the Martinez Subdivision, there is potential for UP to use the Oakland Subdivision as a reliever route. In addition, UP may use this as the preferred route for growth in bulk unit trains and manifest trains going to the Port of Oakland reserving more of the capacity on the Martinez Subdivision for premium intermodal service. UP's Oakland Subdivision is currently a relatively uncongested low-volume freight route, with the biggest capacity constraint being the west end between Elmhurst and Niles Junction. But this could put pressure on the route's limited capacity, which could affect the portion of the Oakland Subdivision from Niles Junction to Stockton. On this portion, traffic from UP's Coast Line and the Oakland Subdivision from Stockton are combined over a single track. This segment of the line has other capacity-related issues related to track class and geometry that limit speeds and potentially limit passenger train operations.

One approach that has been suggested for increasing capacity between Niles Junction and Stockton is reactivating the legacy transcontinental Central Pacific route through Niles Canyon. As described above, this route is currently used by the Niles Canyon Railway (NCRY) to provide tourist rail services between Niles and Sunol. Reactivating this route would provide parallel capacity to the Oakland Subdivision through the canyon, which could be used by additional freight and passenger trains.

Consideration of reactivating this route raises a number of possible concerns and opportunities which would need further study:

- The railway, the right-of-way and associated structures are currently listed on the National Register of Historic Places. This may constrain the types of modifications that could be made along the right-of-way to provide higher speeds and more capacity.

- The tracks would need to be rebuilt for higher speed operation. Tight curves and frequent landslides onto the track may also limit speeds, reliability and capacity.

- Three major bridges would need to be rebuilt. Two of the bridges cross over both Alameda Creek and SR 84, and the other crosses Arroyo de la Laguna. All are more than 100 years old. There could be impacts on riparian and historic resources.

- There may be traffic and safety impacts at the at-grade crossing of Pleasanton Sunol Road near Verona Road. There are also two at-grade crossings in the town of Sunol (also crossed at-grade by the Oakland Subdivision) and another at-grade crossing of Pleasanton Sunol Road by an interchange track with UP. Other community impacts, including the need to consider quiet zones would also need to be evaluated.

- There could be strong community and policy interest in retaining NCRY operations. One possibility is shared use by day of the week, with UP using the route on weekdays and NCRY using it on weekends.

- If shared use occurred, there could be potential benefits to NCRY if the tracks were upgraded and maintained by UP. NCRY currently devotes significant resources to maintaining and extending their track. These resources could be reallocated to other purposes such as acquisition and maintenance of rolling stock and construction of facilities to house the collection. In addition, improved track could allow NCRY to operate at higher speeds, including operation of mainline steam locomotives currently on their property.

There are also possible strategies that could increase capacity on the existing Oakland Subdivision through the addition of sidings and potential changes and improvements to the existing track realignment. All of these options and addressing potential community impacts will be reviewed more fully during the next phase of Alameda CTC's goods movement plan development.

The Capitol Corridor Joint Powers Authority (CCJPA) is supporting several rail capacity projects to keep pace with growing demand for existing services. Third track and siding investments, signal improvements, and station expansions will allow for increased passenger service between San Jose - Oakland - Sacramento. The CCJPA envisions increasing top train speeds from the current 79 mph to 90 mph, where local conditions allow. In southern Alameda County, rail siding extensions, universal crossovers, and a double-track project near Industrial Parkway will address rail congestion in the Oakland to San Jose segment. Additional capacity analysis is currently underway by the UP to verify some of these passenger rail improvements.

3.2.6 At-Grade Highway-Rail Crossing Safety and Delay Issues

The rail system interacts directly with the roadway system where roads cross railroad tracks at-grade. At-grade crossings introduce safety concerns (risk of derailment, emergency response time), noise impacts, and traffic delay issues to the overall transportation system. If nothing is done, these factors could get worse in the future along many lines as discussed above, as traffic continues to increase. This section identifies the major at-grade crossings in Alameda County and presents accident statistics for those crossings on mainline rail routes.

Identification of At-Grade Crossings

To focus on the most important crossings in terms of safety and delay, crossings within the county were screened for relative importance. Crossing safety and traffic delay are related to both roadway traffic volumes and the number of trains using the route. Generally speaking, as traffic and train volumes increase, so do the number of accidents and the amount of traffic delay. To eliminate the lowest volume rail routes, accident data was only collected for those routes serving a mainline function: the Niles Subdivision, the Martinez Subdivision, and the Coast Subdivision south of Newark. To eliminate the lowest volume roadways, the Caltrans California Road System (CRS) maps were reviewed. The CRS maps indicate the functional classification of roadways:

- Interstate,
- Other Freeway or Expressway,
- Other Principal Arterial,
- Minor Arterial,
- Major Collector,
- Minor Collector, and
- Local.

Only those roadways classified as Major Collector or above were included in the data collection effort. Interstate Highways and Freeways are always grade-separated from railroads, and there were no Expressway crossings identified in the county.

The FRA at-grade highway-rail crossing database was reviewed to obtain accident data for the at-grade crossings that fulfilled the above criteria. A list of all such crossings appears in Table 3.16, listed in order from the most accidents to the fewest.

Table 3.16 At-Grade Crossings Accidents on Mainline Routes

City	Street	Functional Classification	Crossing Number	Subdivision	Accident History (Jan 2004-June 2014)			
					Number of Incidents	Killed	Injured	Property Damage Only
Oakland - In	66th Ave	Minor Arterial	749720R	Niles	6	3	0	3
	High St	Other Principal Arterial	749712Y	Niles	5	0	0	5
San Leandro - In	Hesperian Blvd	Other Principal Arterial	749745L	Niles	5	3	1	1
Oakland - In	Fruitvale Ave	Other Principal Arterial	749707C	Niles	4	2	0	2

City	Street	Functional Classification	Crossing Number	Subdivision	Accident History (Jan 2004-June 2014)			
					Number of Incidents	Killed	Injured	Property Damage Only
	105th Ave	Minor Arterial	749725A	Niles	3	1	1	1
	29th Ave	Minor Arterial	749621T	Niles	3	0	0	3
	Broadway	Minor Arterial	749585A	Niles	2	1	0	1
	Webster St	Other Principal Arterial	749587N	Niles	2	0	2	0
Union CITY - In	E St	Major Collector	749779F	Niles	2	0	1	1
	H St	Major Collector	749780A	Niles	2	1	0	1
Berkeley - In	Gilman St	Other Principal Arterial	751199P	Martinez	1	1	1	0
Fremont - In	Dusterberry Way	Minor Arterial	750037J	Niles	1	0	1	0
Hayward - In	Whipple Rd	Minor Arterial	749776K	Niles	1	0	0	1
Oakland - In	50th Ave	Major Collector	749716B	Niles	1	0	0	1
	5th Ave	Minor Arterial	749616W	Niles	1	0	0	1
	85th Ave	Major Collector	749723L	Niles	1	0	0	1
San Leandro - In	Davis St	Other Principal Arterial	749728V	Niles	1	1	0	0
	Lewelling Blvd	Other Principal Arterial	749890K1	Niles	1	0	1	0
	West Blossom Way	Major Collector	749750H	Niles	1	1	0	0
Berkeley - In	Cedar St	Minor Arterial	751183T	Martinez	0	0	0	0
	Hearst St	Major Collector	751179D	Martinez	0	0	0	0
Emeryville	65th St	Major Collector	751151M	Martinez	0	0	0	0
Fremont - In	Fremont Blvd	Other Principal Arterial	750039X	Niles	0	0	0	0

City	Street	Functional Classification	Crossing Number	Subdivision	Accident History (Jan 2004-June 2014)			
					Number of Incidents	Killed	Injured	Property Damage Only
Hayward - In	Tennyson Rd	Other Principal Arterial	749774W	Niles	0	0	0	0
Newark - In	Blacow Rd	Minor Arterial	750035V	Niles	0	0	0	0
	Cedar Blvd	Minor Arterial	750033G	Niles	0	0	0	0
	Central Ave	Minor Arterial	749943G	Coast	0	0	0	0
	Cherry St	Minor Arterial	750032A	Niles	0	0	0	0
	Sycamore St	Major Collector	750030L	Niles	0	0	0	0
Oakland - In	98th Ave	Minor Arterial	749724T	Niles	0	0	0	0
	Grove St (MLK, Jr. Blvd)	Minor Arterial	749581X	Niles	0	0	0	0
	Oak St	Minor Arterial	749591D	Niles	0	0	0	0
San Leandro - In	Alvarado St	Minor Arterial	749738B	Niles	0	0	0	0
	Halcyon Drive	Minor Arterial	749744E	Niles	0	0	0	0
	Marina Blvd	Minor Arterial	749736M	Niles	0	0	0	0
	Paseo Grande	Major Collector	749749N	Niles	0	0	0	0
	Williams St	Minor Arterial	749734Y	Niles	0	0	0	0
Union City - In	Decoto Rd	Other Principal Arterial	749781G	Niles	0	0	0	0
San Leandro - In	Washington Ave	Minor Arterial	Missing	Niles	n.a.	n.a.	n.a.	n.a.

Source: U.S. DOT Crossing Inventory.

Crossings on Secondary Rail Routes

Though the mainline routes described above currently carry the large majority of freight and passenger trains, two other routes have the potential to carry more trains if they are developed as reliever routes. The Oakland Subdivision runs between Oakland (near High Street) and the Alameda – San Joaquin County line east of Altamont Pass, where it continues to Lathrop and Stockton. The Oakland Subdivision could be used to carry additional freight traffic between Oakland and the Central Valley as the Martinez Subdivision becomes more congested. Table 3.17 identifies the 31 at-grade crossing on the Oakland Subdivision involving roadways classified as

Major Collectors or higher. If additional rail traffic on the Oakland Subdivision was to be considered, these crossings would need further investigation.

Table 3.17 At-Grade Crossings on UP Oakland Subdivision

City	Street	Functional Classification
Hayward	A St	Other Principal Arterial
	B St	Other Principal Arterial
	Grove Way	Major Collector
	Industrial Pkwy	Minor Arterial
	Sunset Blvd	Major Collector
	Whipple Rd	Minor Arterial
Livermore	Junction Ave	Major Collector
Oakland	105th Ave	Minor Arterial
	50th Ave	Major Collector
	66th Ave	Minor Arterial
	75th Ave	Major Collector
	81st Ave	Major Collector
	85th Ave	Major Collector
	98th Ave	Minor Arterial
	Seminary Ave	Minor Arterial
Pleasanton	Castlewood Dr	Minor Arterial
	Santa Rita Rd	Major Collector
San Leandro	Blossom Way	Major Collector
	Davis Street	Other Principal Arterial
	Halcyon Drive	Minor Arterial
	Hampton Rd	Major Collector
	Hesperian Blvd	Other Principal Arterial
	Lewelling Blvd	Other Principal Arterial
	Marina Blvd	Minor Arterial
	Medford Ave	Major Collector
	Parrott St	Minor Arterial
	Williams St	Minor Arterial
Sunol	Bond St	Major Collector
	Main St	Major Collector
Union City	Decoto Rd (Decoto-Cntrvll Rd)	Other Principal Arterial

City	Street	Functional Classification
	H St	Major Collector

Source: AECOM.

Similarly, the Coast Subdivision between Oakland and Newark offers an alternative route to both the Niles and Oakland Subdivisions. If the Coast Subdivision were considered for additional rail traffic, the 18 crossings listed in Table 3.18 would also need further investigation.

Table 3.18 At-Grade Crossings on UP Coast Subdivision - Oakland to Newark

City	Street	Functional Classification
Hayward	Baumberg Ave	Major Collector
	Clawiter Rd	Major Collector
	Depot Rd	Major Collector
	Winton Ave	Minor Arterial
Newark	Carter Ave	Major Collector
	Haley St	Major Collector
	Jarvis Ave	Minor Arterial
	Thornton Ave	Other Principal Arterial
Oakland	Edes Ave	Minor Arterial
San Leandro	Fairway Dr	Major Collector
	Farallon Dr	Minor Arterial
	Grant Ave	Minor Arterial
	Marina Blvd	Minor Arterial
	Williams St	Minor Arterial
Union city	Alvarado Blvd	Other Principal Arterial
	Dyer St	Other Principal Arterial
	Smith St	Major Collector
	Union City Blvd	Other Principal Arterial

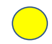
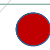
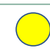
4.0 Global Gateway Issues

After a number of years of declining share of West Coast trade, the Port of Oakland has seen its share begin to grow again and to return to pre-recession levels. While growth is expected to be slower than had been projected before the recession, the Port should be able to grow and continue to provide benefits to the region. The Oakland Army Base redevelopment and associated rail and warehousing investments will make the Port more attractive to shippers. However, there are some significant obstacles to growth that need to be addressed. The marine terminals currently do not handle surges from large ships effectively and there are serious operational problems both within the terminals and at the terminal gates. This combines with some roadway deficiencies to create circulation problems that could be addressed with infrastructure improvements. Major investments are already underway to improve rail access and this is an important ingredient for growth. The Oakland Army Base and the West Oakland Specific Plan create opportunities to address some long-standing land-use issues that have created impacts on the West Oakland neighborhood. But these plans need to be effectively implemented and supported with enforcement resources. Other issues related to air quality and health risk are discussed later in the Cross-Cutting Issues section of this report.

Oakland International Airport functions primarily as a domestic air cargo airport but has capacity to expand international operations. This could be an important complement to San Francisco International Airport (SFO) and create more options for integrated carriers who have major operations at OAK. Despite roadway improvements, access to OAK is still on congested roads.

Table 4.1 presents a summary of the needs assessment for Alameda County's Global Gateway facilities.

Table 4.1 Summary of Countywide Needs for Global Gateways

Goals[23]	Measures	Metrics	Report Section	Rating	Rating Explanation	Gaps and Opportunities
Promote innovative technology and policy strategies to improve the efficiency of the goods movement system.	Use of Innovative Technologies	Use of ITS and innovative technologies, such as zero-emission technologies	4.1		The latest technologies to improve terminal and gate operations and provide information to truck drivers are not currently in use by the Port of Oakland and marine terminal operators. The port does have online cameras and has experimented with online appointment systems.	Freight ITS systems have shown significant benefits at the Southern California ports and should be investigated at the Port of Oakland
Preserve and strengthen an integrated and connected, multimodal goods movement system that supports freight mobility and access, and is coordinated with passenger transportation systems and local land use decisions.	Travel Time Delay	Travel time delay on railways, terminals, ports, airports	4.1.1, 4.1.2, 4.2.3		Port of Oakland has sufficient marine terminal capacity; surges from large ships affect capacity and cause operational issues. Gate queues and turn times are excessive compared to other ports. Berths are not long enough for large ships. OAK has sufficient capacity and modest growth prospects and could handle more international air cargo diverted from SFO	Improve terminal operations by adding more shifts, adding automation to terminal operations, adopt other gate management practices.
	Multimodal Connectivity and Redundancy	Access to rail lines, terminals, ports, and airports from/to locations with significant freight activities	4.1.3		Port of Oakland has a major last mile connector issue on 7th Street due to delays at railroad crossing and poor access by BNSF to Oakland International Gateway. Access to OAK is on very congested local streets.	Build 7th Street grade separation. Port already is funded to improve rail access which will improve the rating.

[23] The goal related to community impacts is discussed in Chapter 5 – Cross Cutting Issues.

Goals[23]	Measures	Metrics	Report Section	Rating	Rating Explanation	Gaps and Opportunities
	Coordinate with Passenger Systems	Freight system element shared use with passenger system and addresses passenger/freight conflicts	4.2.3	High (green)	OAK's increasing passenger services benefits air cargo by offering more belly space (carrying cargo in the belly of passenger planes)	
Increase jobs and economic opportunities that support residents and businesses.	Economic Contribution	Jobs and output generated (including co-benefits of public health strategies)	4.1.2, 4.1.3, 4.2.1, 4,1,2	High (green)	Port makes substantial contributions to local economy and has adopted local hiring commitments at OAB	Training opportnities for resident of communities that live in the vicinity of major freight facilities

High – green; Medium – yellow; and Low - red.

Source: Cambridge Systematics.

4.1 Port-Related Issues

Port throughput directly serves consumers in the region and supports jobs and economic vitality in the Bay Area, but it also affects air quality and mobility in the region, and impacts neighborhoods located near the Port of Oakland.

Over the past seven years, dynamic changes in logistics and supply chains have occurred, and understanding them is important. Just before the economic downturn, trade throughput was at an all-time high and all cargo forecasts indicated that the growth would continue. The sudden decline resulted in major changes to the logistics and supply chain industry. For instance, the industry implemented cost-saving measures, such as increasing transloading, slow steaming (traveling at slower speeds to reduce fuel consumption), consolidating vessel calls (i.e., making fewer vessel calls at smaller ports and using larger ships to call larger ports), reducing marine terminal gate hours, reducing inventory holding, and implementing cargo handling systems to better manage, store and retrieve goods in warehouses, distribution centers, and intermodal marine and railroad terminals. Understanding these changes helps identify issues and needs associated with moving goods and protecting communities that are impacted by goods movement through the Port of Oakland.

4.1.1 Congestion and Delay

In 2013, the Port of Oakland handled 2.4 million TEUs and expects to continue to grow at a rate of two percent for the foreseeable future. Assuming buildout of the Oakland Army Base Redevelopment Project, throughput has been projected to grow to just over 4 million TEUs by 2035. This is a significant reduction from pre-recession forecasts that projected growth to over 5 million TEUs in the same time period. Based on this revised future throughput forecast, the Port facilities were analyzed for future capacity. The analysis found that marine terminals have sufficient backland to accommodate the throughput, but the landside infrastructure (namely roadways and railways) posed potential constraints to growth. Prior analyses conducted in 2004, estimated that the Port roadways would only be able to accommodate 3.3 million to 3.9 million TEUs and the rail network would only be able to accommodate 2.5 million to 3.5 million TEUs per year. The Maritime Development Alternatives Study (MDAS 2004) further estimated that larger vessels with higher amounts of lifts per call would create congestion within the terminals. This is what we are witnessing today at the Port of Oakland. More recently, the new, larger vessels have required the Port to closely review berth availability, something that the MDAS identified would be an issue.

Port volume has not grown as anticipated a decade ago, but many of the landside constraints identified in the MDAS are impacting the flow of goods today. Growing exports and the growing export market potential also requires more investigation.

Terminal Operations

To date, terminal operators have accommodated the larger vessels by eliminating truck chassis storage on the terminals. This increases the amount of land available to store containers and storage is further increased by stacking containers, something that cannot be done if the containers are loaded directly onto a truck chassis. While the terminals have sufficient backland capacity for container storage, the terminal operators have not implemented adequate operational changes to address the cargo surges, such as more shifts or implementation of new technology to help manage the storage and retrieval of containers. In addition, trucker do not have set schedules for picking up or delivering containers from the terminals, so trucks show up at times that work for their own schedule. As a result, truck queuing regularly extends as far north as Maritime Street/Wake Avenue/Engineer Road and northwest on Burma Road, as far west as I-880 on 7th Street, and from the south to Adeline Street and I-880. Truck turn times from the entrance gate to exit gate are more than 60 minutes for up to 50 percent of the trucks. Outside of the gates, trucks have been reportedly waiting two to four hours. Whereas, truckers were previously making three to four turns at the Port per day, they are now making two turns, which is exacerbating the trucker and chassis shortage issues.[24] The MDAS suggested that this would occur once terminals began experiencing more than 1,000 lifts per vessel. Terminals are now handling 1,200 lifts per vessel on a regular basis.

4.1.2 Port Terminal Capacity Constraints

The Port of Oakland maintains berths with minimum 50-foot depths at 90 percent of its terminals. It is "Big Ship Ready", and regularly accommodates vessels in excess of 12,000 TEUs. Berth capacity, more so than depth, backland and transportation infrastructure, will limit the Port's ability to accommodate growth. The Port has the ability to accommodate larger vessels at several terminals, but the larger vessels require longer berths. Facilities that previously operated three berths are now accommodating larger vessels and only able to utilize two of their three berths.

Fleet conversion to larger vessels with greater container-carrying capacity was anticipated due to significant growth in trade from 2000-2006, but the speed at which this conversion has occurred has been faster than would have been expected in light of the slowing of trade growth that occurred after 2006. Vessel operating companies began ordering larger ships, known as the New Panamax and the Triple E classes, and retiring smaller vessels, and even during the 2009 recession, most had few options but to honor their purchases as the ships were already under construction. What is most interesting is the rate of scrapping of relatively young vessels (less

[24] Port of Oakland.

than 20 years)[25]. The push for efficiency gains from fuel consumption and the related environmental benefits have prompted the industry to convert much more quickly than previously anticipated. This quick conversion is impacting port operations, including surges of goods as a large vessel offloads in one day the same amount that a terminal typically once handled over the course of two to three days. The larger vessels are also creating winners and losers as marine terminals with berths capable of accommodating the larger ships continue to attract more cargo, while those that cannot, continue to see throughput decline. West Coast ports also are adjusting to the reality that carriers, through alliances and vessel-sharing arrangements, are concentrating their vessel calls at fewer ports and terminals. Shipping lines seek density. Pushing more freight through fewer ports allows the carriers to use the capacity of their big ships more effectively and achieve the economies of scale inherent in the mega-ships. The cost savings are compelling. Compared to a Panamax vessel with a capacity of 4,800 TEUs, an 8,000-TEU ship offers a 47-percent lower slot cost, and a 14,000-TEU ship has a 60-percent lower slot cost.

The berths at the Port of Oakland are not long enough to accommodate the same number of vessels as they were in 2009. Berth capacity is a growth constraint that the Port is working to address, specifically at Berths 21-25 and Berths 55-59 (TraPac and Ports America Outer Harbor marine terminals).There are few opportunities for the Port to lengthen berths due to constraints such as the BART tube between the TraPac and Ports America's Outer Harbor terminals; the navigation channel and turning basin constraints on the Matson terminal, the Roundhouse Property which is being used for truck parking, and the currently vacant Charles P. Howard Terminal. Adding fill at Berths 20-21 was identified in the MDAS as a potential solution to address the constraint at Berths 21-25, as this extends the lengths of the berths and provides more capacity.

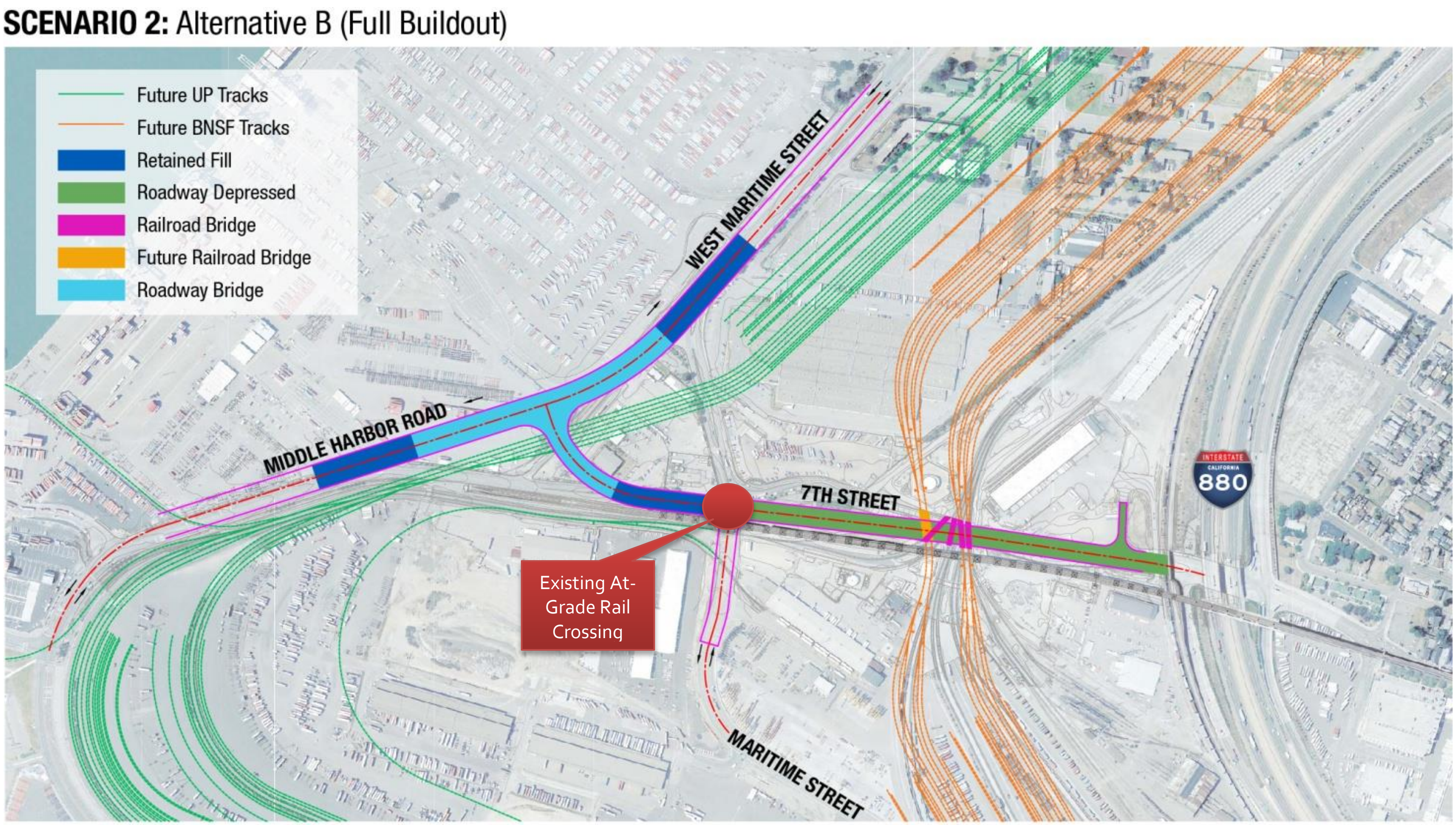
4.1.3 Port of Oakland Connectivity

To evaluate port connectivity, the last-mile roadway connectors and rail connections into the rail yards and terminals at the Port of Oakland were examined for constraints to growth in the landside transportation connections. The most significant constraint, aside from long wait times at the gates, is the impact of at-grade crossings in the Port, specifically on Maritime Street where both at-grade crossings (one near 7th Street and the other near Middle Harbor Road) can simultaneously be blocked by one train. One train blocking both crossings temporarily eliminates access to the Joint Intermodal Terminal (JIT)/Oakland Intermodal Gateway (OIG) rail yard and several other uses along this segment of Maritime Street. A blockage of the at-grade crossing of Maritime Street near 7th Street also results in significant truck queues that can extend

[25] Danish Ship Finance, http://www.shipfinance.dk/en/SHIPPING-RESEARCH/~/media/Shipping-Market-Review/Shipping-Market-Review---April-2013.ashx.

as far back as I-880. The proposed grade separation and roadway reconfiguration of 7th Street from Maritime Street to Navy Roadway, planned as part of the Oakland Army Base Redevelopment Project, would eliminate the at-grade crossing of Maritime Street near 7th Street. The preferred alternative is shown in Figure 4.1.It should be noted that the increase in domestic intermodal traffic as mentioned in previous sections will likely decrease traffic on I-580 as some truck traffic will shift to rail. However, diversion from truck traffic to trains for other types of commodities around the Bay Area will not likely happen, as most of these other commodities require long haul movements that would not be conducive to be moved on trucks. Thus, congestion at the port which can affect efficient movement of these commodities can cause these commodities to be diverted to other ports.

Figure 4.1 Preferred OHIT 7th Street Grade Separation Alternative



Source: Port of Oakland, prepared by URS.

Another bottleneck, the 7th Street Union Pacific Railroad underpass, restricts travel flow due to narrow travel lanes and inadequate height clearance for some truck loads. Improvement of this underpass would not increase capacity, but would improve traffic flow, truck operations, and safety (also reflected in the figure above).

The MDAS also identified a bottleneck on Adeline Street and 5th Street. Capacity constraints could be resolved by braiding the ramps at Adeline Street and 5th Street. This is illustrated in Figure 4.2.

Figure 4.2 Adeline Street/5th Street Braided Ramp

Source: MDAS.

Overall, improvements in truck traffic operations within the Port through traffic management could help with managing queues, reducing intersection delay, and improving safety (i.e., eliminate blinking red signals that drivers regularly ignore).

Bicycle and Pedestrian Access

Community interests to provide bicycle and pedestrian access to the Middle Harbor Shoreline Park is reflected in the OAB Redevelopment Project, which identified several bicycle and pedestrian projects to improve access to the park:

- Improve bike/ped access along 7th Street to Shoreline Park, specifically, there is a gap in bicycle access from just west of I-880 to Peralta Street; and
- Provide sidewalks along Maritime Street between I-880 and 7th Street.

Providing bicycle and pedestrian access within an extremely truck intensive environment poses hazards to bicyclists, pedestrians and truckers. Visibility restrictions of trucks pose threats to smaller vehicles, especially nonmotorized, slower moving vehicles and pedestrians. Extreme care is needed to ensure proper signage and adequate separations between trucks and slower, nonmotorized port users provide the safest operating environment for all.

4.2 Air Cargo Issues

California is home to 11 of the top 100 air cargo airports in North America. The Oakland International Airport (OAK) is one of the U.S.'s busiest cargo airports, ranked as #13 in North America by the Airports Council International in 2011. Along with the San Francisco International Airport (SFO; ranked as #17), the Bay Area airports provide the majority of air cargo services for the region. A small amount of air cargo also flows through the Norman Y. Mineta San Jose (SJC) airport, and through the Sacramento International and Sacramento Mather airports.[26]

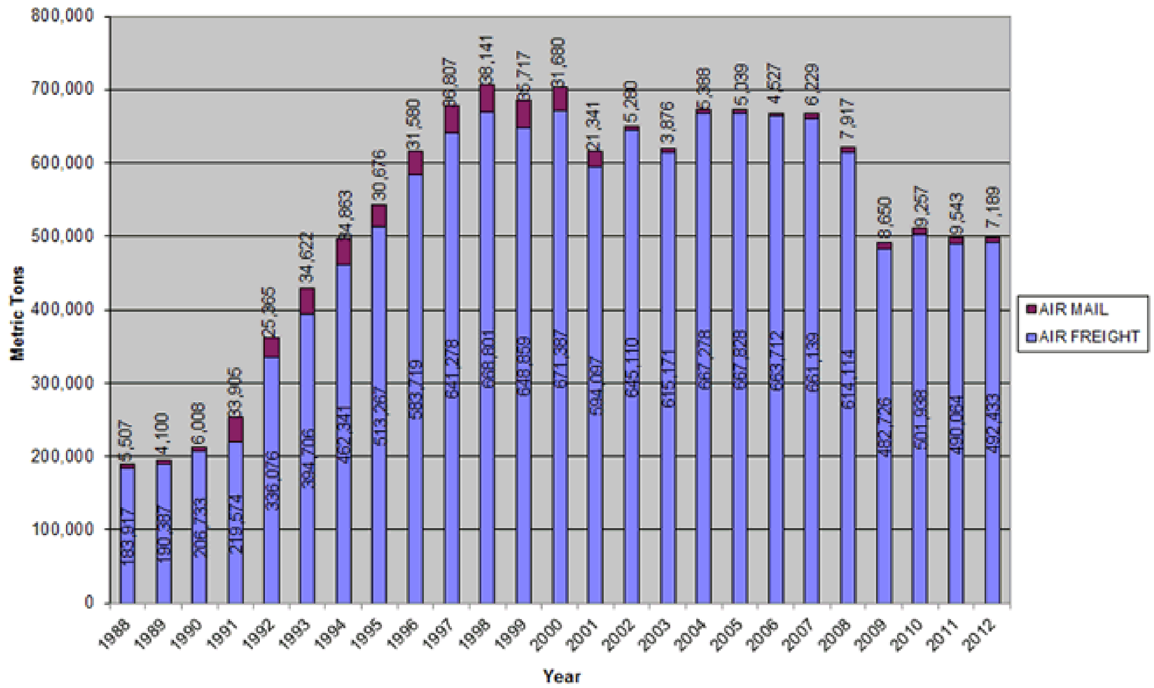
Located just nine miles from the Port of Oakland, Oakland International Airport is located near many of Alameda County's main freight routes. The airport has a Foreign Trade Zone (FTZ) located within 1.5 miles of its boundaries, consisting of 500,000 square feet of modern high-cube buildings, including dock-high truck capability and direct interstate highway access. U.S. Customs personnel are available at Oakland International on a scheduled basis to expedite the clearance process. The largest on-site carrier, FedEx, operates its own import clearance center at Oakland, processing up to 100,000 pounds of freight daily from the Pacific Rim.[27]

Primary air freight destinations from OAK are domestic, serving the West Coast as well as national cargo hubs such as Memphis (FedEx) and Louisville (UPS). The airport also handles significant international service to Pacific Rim nations. Air cargo volumes have overall been decreasing since the peak in the late 1990s, with a significant drop in 2009 due to the global recession. Since the recession OAK has not seen air cargo volumes return to pre-recession levels (Figure 4.3).

[26] Caltrans, *Freight Planning Fact Sheet. California Air Cargo.* http://www.dot.ca.gov/hq/tpp/offices/ogm/air_cargo.html.

[27] Oakland International Airport, 2014 http://www.oaklandairport.com/cargo_services.shtml.

Figure 4.3 Oakland International Airport Air Cargo Volumes



Source: Oakland International Airport, 2014.

4.2.1 Changing Demand for Air Cargo and Uncertain Growth

Over the past decades, air cargo has seen significant swings in both volumes and types of service offered. The 1980s and 1990s saw rapid growth in air cargo, particularly driven by increases in integrated express carriers (i.e., FedEx, UPS). However, the air cargo market has since matured and other modes have begun offering additional competitive services, particularly trucking for domestic cargo and maritime for international cargo. Hence, since 2000 there has been consistent declines in overall air cargo tons. The growth of email and decline of traditional mail delivery and changing management practices have also contributed to the decline. From 2000-2007, air cargo shipments in the Bay Area declined even faster than the national average at a decrease of 1.2% annually (OAK) and 6.1% annually (SFO).[28]

Although the trends leading to the decline in air tonnage will likely continue over the foreseeable future, the shift to high-value goods is leading to a resurging demand for air cargo for high value shipments. Air is the fastest growing mode, in terms of value, for importing goods into

[28] Regional Airport Planning Committee (Metropolitan Transportation Commission; Bay Conservation and Development Commission; Association of Bay Area Governments), *Regional Airport System Planning Analysis (RASPA), 2011 Update*.

California. In 2012, over $50 billion in shipments traveled by air to the Bay Area airports. The value of international cargo – both imports and exports – is expected to triple between 2012 and 2040.[29]

In 2014, the market for air cargo in the North American / Asian markets, the primary markets for Alameda County and the Bay Area air cargo, appear to be cautiously optimistic. Growth in air freight for North American carriers grew 2.6 percent in April, at a relatively slow but increasing pace after a weak first quarter impacted by severe weather conditions. The International Air Transport Association (IATA) market reports indicate that the latest data shows a rebound in trade volumes and positive underlying growth trends, supporting stronger growth in overall trade and air freight demand in North America. However, the market for Asia Pacific carriers is mixed. After a strong year of growth in 2013, export volumes declined through early 2014, and the latest monthly growth rates, although relatively strong at 5.2 percent, are slower than in 2013. This slowing of growth is potentially caused by the continuing weakness in Chinese manufacturing, impacting regional economic performance and ultimately trade growth and air freight demand. These trade patterns have implications for the imports and exports moving through Alameda County and the Bay Area, as shifting economies in the Pacific Rim will change the demand for consumer goods and other products, as well as impact the sourcing for goods and manufactured products traveling to Alameda County.[30]

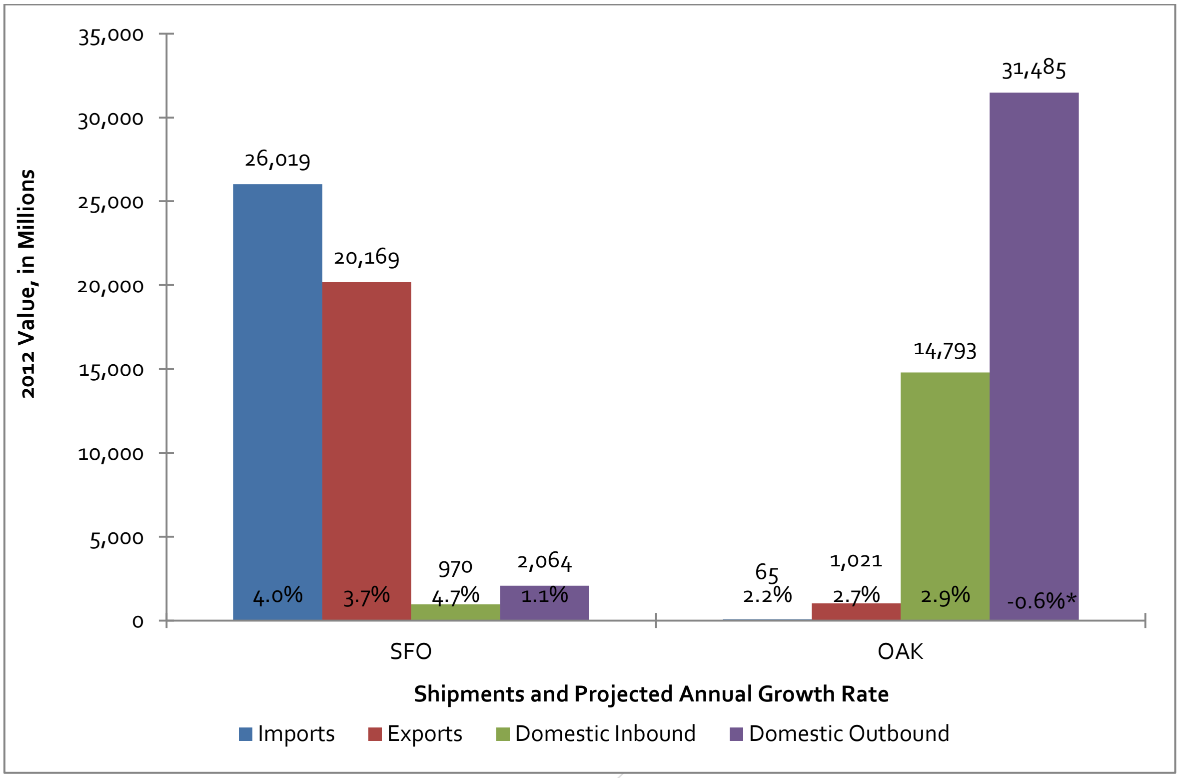
4.2.2 Imbalances in Air Cargo

There is a significant imbalance in the air cargo markets between SFO and OAK in terms of inbound versus outbound traffic, and domestic versus international traffic. SFO retains the majority of international shipments, both inbound and outbound, while OAK primarily serves domestic traffic (Figure 4.4).

[29] FHWA FAF3, analysis by Cambridge Systematics.

[30] International Air Transport Association (IATA) Air Freight Market Analysis, April 2014.

Figure 4.4 2012 Value of Air Cargo Shipments and Projected Growth Rates at Bay Area Airports, by Type and Direction



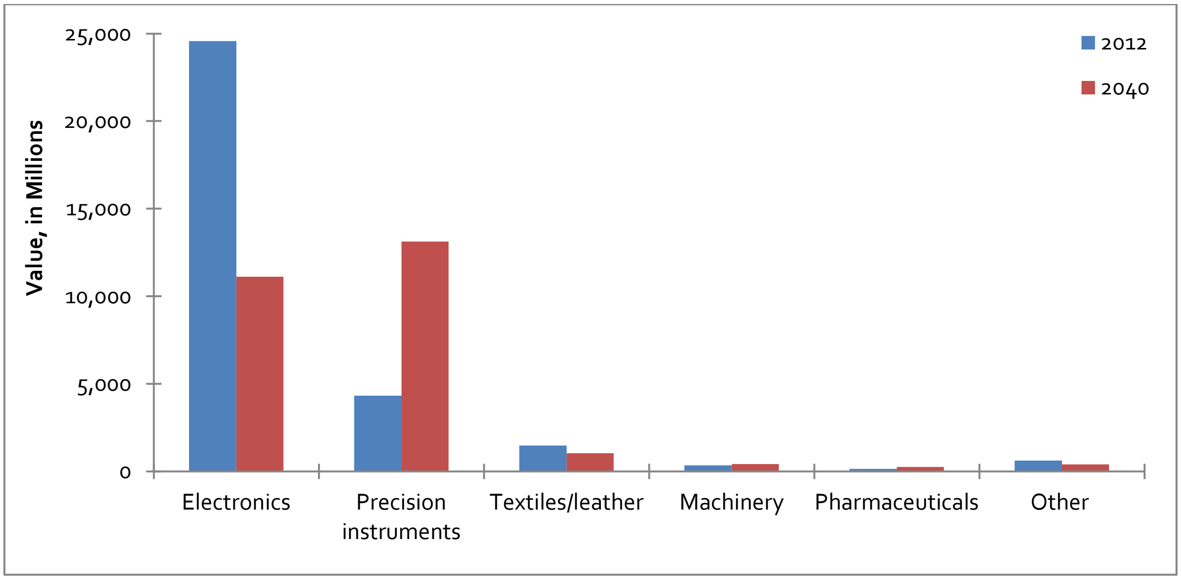
Source FAF 3.4, analysis by Cambridge Systematics *Without Electronics, OAK domestic outbound cargo is forecast to grow at 2.9 percent annually.

The Pacific region of the U.S. (including California) accounts for about 11 percent of Oakland's inbound shipments and 23 percent of outbound domestic shipments, by value. The West South Central U.S. is the source of about 40 percent of domestic outbound shipments; whereas, the East North Central and Mountain regions are sources of about one-third of inbound goods. In terms of international traffic, Oakland's primary markets are eastern Asia, resulting in 72 percent of imports and 63 percent of exports. While some exports are traded with Mexico and Canada, the majority of the remainder of Oakland's international trade is with Europe and Southeast Asia and Oceania.

The primary sources of growth in air cargo in the Bay Area are projected to be in international shipments to SFO, although international shipments to Oakland are expected to grow at a moderate rate as well. Domestic shipments from OAK are expected to drop slightly, yet almost the entirety of this decrease can be explained by the decrease in electronics shipments value at 2.8 percent annually (Figure 4.5). Disregarding these shipments, overall domestic outbound air cargo from OAK is expected to grow at 2.9 percent annually. The highest growth in outbound shipments is precision instruments, expected to grow at 4 percent annually from $4 billion in

2012 to over $13 billion in 2040. Exports of precision instruments from the Bay Area are expected to grow at over 4 percent annually, although most of this growth will be through SFO.

Figure 4.5 Oakland International Airport Top 5 Air Cargo Domestic Outbound Commodities, by Value, 2012 and 2040

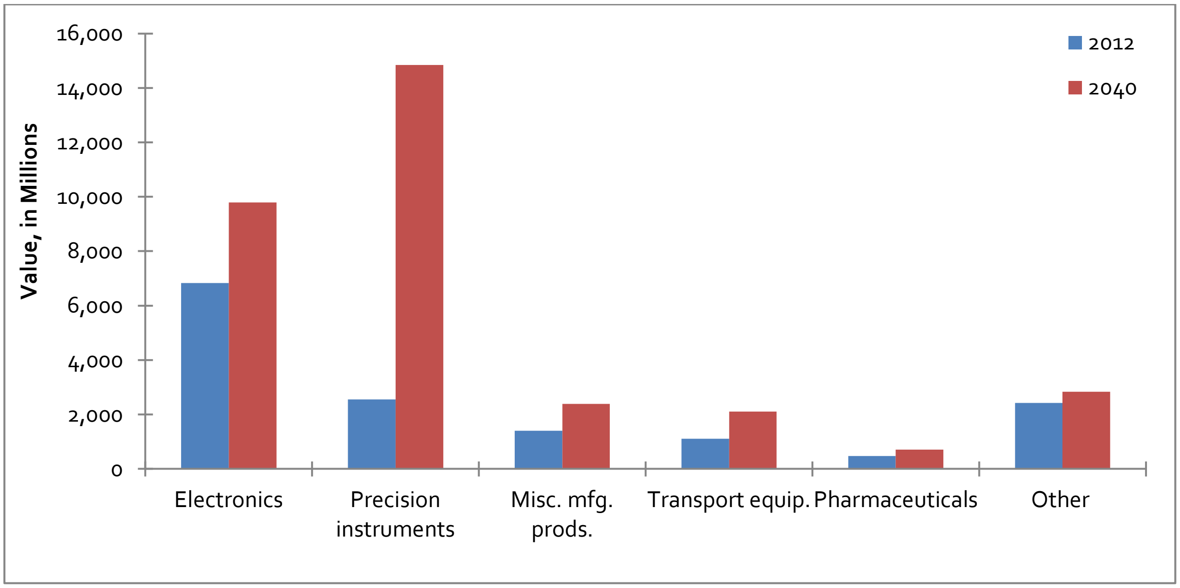


Source: FAF 3.4, analysis by Cambridge Systematics.

The dramatic decline of electronics outbound shipments is primarily due to the changing computer market, with less goods being manufactured in the Bay Area and California in general. Shipments of electronics from OAK are projected to decrease from $24.5 billion (78 percent of outbound shipments, by value) in 2012 to 11 billion (42 percent) in 2040.

Inbound domestic traffic at Oakland is projected to grow at 2.9 percent annually through 2040. Inbound shipments of precision instruments in particular are expected to increase at over 6 percent annually. Air shipments of electronics, manufactured goods, and other commodities will also add to increasing domestic traffic at OAK (Figure 4.6). Other inbound commodities of note are basic chemicals, projected to grow at 5.5 percent annually to a value of 1.2 billion dollars by 2040.

Figure 4.6 Oakland International Airport Top 5 Air Cargo Domestic Inbound Commodities, by Value, 2012 and 2040



Source FAF 3.4, analysis by Cambridge Systematics.

4.2.3 Airport Capacity and Congestion Challenges

The deficiencies of the region's air cargo system are tied to a lack of expansion potential and a runway configuration that is not optimal for boosting total throughput. However, construction of new runways at either SFO or OAK are not identified as priority projects in the 2011 *Regional Airport System Planning Analysis*, in part due to the large expense and constrained geography of the airfields. The focus instead is on serving future aviation demand using alternative options, including a redistribution of air passenger traffic from SFO to other regional airports to mitigate issues from growing passenger and air cargo traffic.[31]

At SFO, the effective capacity is limited both by closely spaced runways and by the frequency of inclement weather, principally fog, which leads to periodic delays and flight cancellations. In 2013, SFO airport ranked 28th respectively out of major airports for on time arrivals.[32] Ranked as 27th for on-time departures in 2012, San Francisco increased to 6th in 2013, increasing its on-time

[31] Regional Airport Planning Committee (Metropolitan Transportation Commission; Bay Conservation and Development Commission; Association of Bay Area Governments), *Regional Airport System Planning Analysis (RASPA), 2011 Update.*

[32] U.S. Department of Transportation Bureau of Transportation Statistics Ranking of Major Airport On-Time Arrival Performance Year-to-date through December 2013, http://www.rita.dot.gov/bts/subject_areas/airline_information/airline_ontime_tables/2013_12/table_04.

performance from 69 percent to 77 percent (OAK was not included in the ranking).[33] Accounting for the different weather conditions and runway use configurations, it is estimated that SFO's runways can handle between 460,000 and 485,000 annual aircraft takeoffs and landings, or about 61-100 arrivals and departures an hour. Although not as constrained as SFO, OAK also has challenges to growth. The airport's hourly capacity has been estimated between 54-85 takeoffs and landings an hour, about 420,000 to 450,000 annually. However, the airport has significant challenges to meeting these projections, including airspace conflicts with SFO. Significant capacity issues at OAK occur with easterly winds and during inclement weather conditions. [34]

Almost all commercial operations at OAK are conducted in the South Field, and OAK's main runway, 30, is used for nearly all passenger and air cargo flights. OAK's North Field is primarily used by General Aviation and Air Taxi operators. This is in part due to a noise policy that discourages North Field jet departures to the west and arrivals from the west. In addition to these noise abatement procedures, home sound insulation programs are in place to mitigate impacts to area residents.

4.2.4 Last-mile Connections to OAK

The Oakland International Airport is proximate to many of Alameda County's main freight routes, which is a major benefit to air freight traffic, but also provides challenges in terms of roadway condition and congestion. The airport is located just east of I-880, and can be accessed by the Hegenberger Road, 98th Avenue exits, or via Route 61/(Doolittle Drive). The primary access in and out of the airport is via Bessie Coleman Drive/ Airport Drive or via the Harbor Bay Parkway/Ron Cowan Parkway to Airport Drive. However, these local roads and highways leading into and out of the airport are often highly congested, leading to delays and other related problems. Freight traffic to and from the airport contributes to roadway congestion, safety, environmental, and air quality issues, and particularly impacts surrounding communities. Interstate and state routes in the region are also some of the worst hotspots for congestion in Alameda County. Just southeast of the airport on I-880 access to I-580 is provided by I-238, and access to the East Bay is provided via the San Mateo Bridge (Route 92). North of the airport I-880 intersects with I-580 via I-980, Route 24, and I-80 via the Bay Bridge. The Federal Highway

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[33] U.S. Department of Transportation Bureau of Transportation Statistics Ranking of Major Airport On-Time Departure Performance Year-to-date through December 2013, http://www.rita.dot.gov/bts/subject_areas/airline_information/airline_ontime_tables/2013_12/table_05.

[34] Regional Airport Planning Committee (Metropolitan Transportation Commission; Bay Conservation and Development Commission; Association of Bay Area Governments), *Regional Airport System Planning Analysis (RASPA), 2011 Update*.

Administration has identified I-80 at I-580/I-880 (Bay Bridge approach) among the worst freight bottlenecks in California's supply chain.[35]

[35] Caltrans *Freight Planning Fact Sheet: Oakland International Airport.* http://www.dot.ca.gov/hq/tpp/offices/ogm/air_cargo.html.

5.0 Crossing-Cutting Issues

Looking at issues within each functional element allows for an in-depth analysis of the deficiencies of that function. This must also be complemented with looking at issues that are across the function elements, in order to provide a holistic view of the issues and their impacts across functions. Cross-cutting issues are those issues that not only cross modal boundaries, but also may apply to any or several of the goods movement system functions of goods movement on local streets and roads, inter- and intraregional corridors, and global gateways. These are different types of issues that fall within a spectrum that includes:

- **Issue is a result of goods movement activity.** As example, one of the most pressing cross-cutting issues in the Bay Area, as well as in California and the U.S., is that of air quality. This is a cross-cutting issue as all modes of freight release emissions (whether truck, rail, air or barge), and while each of these modes may contribute to the issue, they may each also have a role in the solution.

- **Issue is an external factor that influences goods movement activity.** As example, industrial land in and around Alameda County is under threat due to a combination of high land costs and a shifting economic base, leading to conversions of historically industrial land to alternative uses. If existing land development trends continue, jobs in goods movement-dependent industries that would otherwise have been available in cities along key Alameda County corridors will move to outlying locations. This will increase truck trip length, VMT and consumer cost (as well as other impacts).

- **Issue is related to decision-making that does not consider goods movement and freight activity needs.** As example, time-of-day or noise ordinances prevent the overnight delivery of goods. The intent of these policies is to preserve community quality of life, but often the result includes negative impacts on community quality of life; such as trucks traveling during congested AM and PM peak periods along with commuters to arrive during daytime delivery windows.

This section provides a high-level overview of several of the most pressing cross-cutting issues in Alameda County, including the air quality and public health impacts of freight, climate change effects, truck driver shortage, and industrial land shortage. These issues are identified to be the most significant cross cutting issues by stakeholders as well as through the analysis conducted for this report. The summary of the cross-cutting issues "status" today and expected future is shown in Table 5.1.

Table 5.1 Summary of Countywide Crossing Cutting Needs

Goals	Measures	Metrics	Report Section	Current Rating	Current and Future Rating Explanation	Gaps and Opportunities
Reduce and mitigate impacts from goods movement operations	Emissions/ Air Quality/ Public Health	Tons of $PM_{2.5}$ emissions	5.1	●	$PM_{2.5}$ emission from freight levels have been decreasing steadily, though disproportionate impacts existing in certain communities. Continued efforts in the future to address existing concerns will reduce emission levels overall and on specific communities	Opportunity to work with communities, air quality districts and federal and state agencies to address freight emissions issues from the source, which include emissions from Port of Oakland, emissions from local trucks and other freight generators.
	Equity	Freight impacts, such as light, noise pollution, safety, air pollution and encroachment on specific, adjacent communities most affected	5.1	●	Freight operations contribute significantly to pollution in specific neighborhoods, and create other health risks.	Need and opportunity to collaborate between stakeholders to reduce freight impacts that addresses the root of the problem, including providing adequate parking, better vehicle technologies etc.
Promote innovative technology and policy strategies	Use of Innovative Technologies	Use of ITS and innovative technologies, such as zero-emission technologies	5.1	●	Currently, emerging technologies such as shore power are helping to reduce emissions significantly, though some areas are still at high risk. In the future, new technologies are expected to further reduce emissions at an accelerated rate.	Opportunity to accelerate deployment of zero-emission vehicles, as well as adopting operational concepts such as FRATIS.

Goals	Measures	Metrics	Report Section	Current Rating	Current and Future Rating Explanation	Gaps and Opportunities
Provide safe, reliable, efficient, resilient, and well-maintained goods movement facilities and corridors.	Freight Resiliency	Addresses freight system vulnerability to major service disruptions due to major natural or other events	5.2	High (green)	There is moderate risk of vulnerability to freight infrastructure, especially I-80, I-880 and the Port of Oakland. Given the risk of the 16 inch sea level rise is for 2050, this is along term issue.	Better preparedness for such events and opportunities to better manage land use to avoid potential loss from sea level rise.
Preserve and strengthen an integrated and connected, multimodal goods movement system.	Compatibility with Land Use Decisions	Locations and corridors with significant freight activities in proximity to noncompatible land uses currently and in the future	5.3	Medium (yellow)	Existing shortage of industrial land will only be exacerbated in the future and create outward push of freight activities.	Need more balanced approach to smart growth. Opportunity to involve freight in smart growth discussions
Increase jobs and economic opportunities that support residents and businesses.	Economic Contribution	Jobs and output generated (including co-benefits of public health strategies)	5.4	Low (red)	A chronic lack of drivers, and also misconception of good paying jobs in freight is leading to a significant shortage of drivers, which may continue to be exacerbated in the future	Opportunities to engage with workforce development programs to attract new workforces; increase retention and attractiveness of truck driving jobs.

High – (green circle); Medium – (yellow circle) yellow; and Low – (red circle) red.

Source: Cambridge Systematics.

5.1 Air Quality and Public Health Impacts from Freight Pollution

While Alameda County residents and businesses rely on goods movement to provide their day-to-day needs, this freight activity sometimes leads to unintended impacts that should be mitigated. Perhaps the most critical air quality and public health issues surrounding goods movement in the Bay Area are related to impacts of goods movement-related emissions on the health and safety of communities directly adjacent to major goods movement facilities and connecting infrastructure. These communities experience some of the highest exposure levels to pollution that causes asthma and other respiratory ailments, heart disease, and other health problems. Populations sensitive to these health outcomes associates with freight movements include children, the elderly, pregnant women, people with physical disabilities, freight workers and people who live close by freight activities centers.

Recent reports have shown significant decreases in air pollutants in some communities as a result of Port of Oakland (e.g. Maritime Air Quality Improvement Plan) and regulatory activities. Understanding air quality issues that arise from freight vehicle emissions and the resultant public health impacts is a critical step in determining appropriate mitigation activities, and is a component of this goods movement plan. This section explores the trends in emissions from freight sources in Alameda County, and also the effect of these emissions on local communities. A significant portion of the discussion from this section is drawn from the recently completed report, Community Air Risk Evaluation Program Retrospective and Path Forward (2003 to 2013).[36]

In addition to emissions impacts, proximity to freight infrastructure and operations also cause other adverse effects on health from noise, vibration, and light. This can lead to discomfort, lack of sleep, anxiety and a variety of other stress-induced health problems. This section also looks at localized health impacts in Bay Area Communities based on their proximity to freight sources.

5.1.1 Emissions from Freight

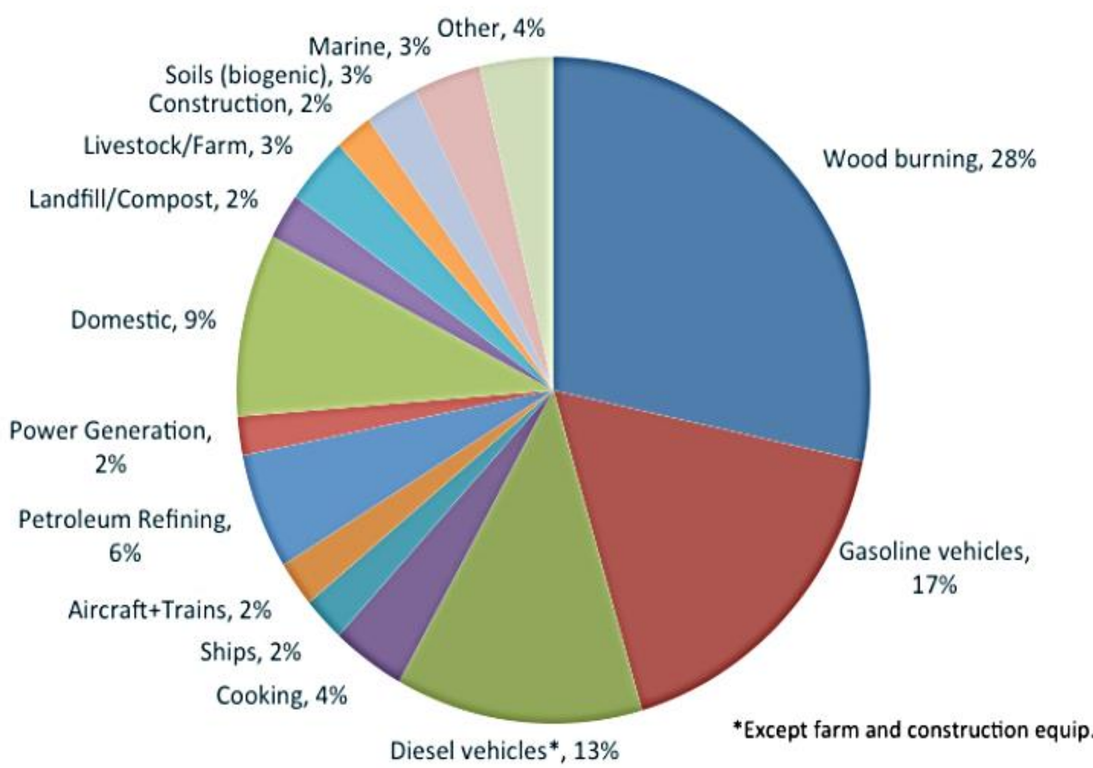
California's air quality standards are the most stringent and health-protective in the nation, and are designed to provide additional protection for those segments of the population who are most sensitive to the effects of air pollution. Although the Bay Area does not yet attain all national and state standards for pollutants that cause health impacts, specifically particulate matter (PM), the Bay Area Air Quality Management District (BAAQMD) and the California Air Resources Board

[36] Improving Air Quality & Health in Bay Area Communities, Community Air Risk Evaluation Program Retrospective & Path Forward (2004 – 2013), BAAQMD, April 2014.

(CARB) are actively seeking to reduce emissions from key sources and significant achievements have been made in reducing these pollutants.[37]

Particulate Matter pollution is of utmost concern from a freight perspective because a significant portion of the PM pollution, especially $PM_{2.5}$[38] pollution, comes from freight. From July 2009 to December 2011 (as shown in Figure 5.1), during the peak $PM_{2.5}$ concentration period, freight transportation contributed to 17 percent of total $PM_{2.5}$ pollution in the Bay Area (13 percent from diesel vehicles, 2 percent from ships, 2 percent from aircraft/trains). Given that Alameda County houses a significant portion of these freight activities, it likely contributes an equally significant share of $PM_{2.5}$ pollution.

Figure 5.1 Estimated Source Contributions to Peak $PM_{2.5}$ Concentrations
July 2009 through December 2011



Source: http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/Plans/PM%20Planning/ParticulatesMatter_Nov%207.ashx.

[37] Bay Area Air Quality Management District (BAAQMD), http://www.baaqmd.gov/Divisions/Planning-and-Research/Particulate-Matter.aspx#dpm.

[38] $PM_{2.5}$ is fine particular matter and is believed to cause more significant health risk than PM_{10} (larger).

PM from diesel is also a significant contributor to cancer risk. BAAQMD staff estimated incremental cancer risk due to measured toxic air contaminants (TAC) in the Bay Area. According to the most recent analysis (2012), the average regional cancer risk was about 300 per million. That is, for every million residents exposed for 70 years to current levels of TAC, 300 would be expected to develop cancer as a result of the exposure. Figure 5.2 shows a fourfold reduction in cancer risk due to air toxics over time: from 1,300 per million in 1990 to 300 per million in 2012. It also shows the relative contribution of certain specific air toxics to cancer risk. According to the analysis, more than 70 percent of the cancer risk related to air pollution in the Bay Area are due to diesel PM, and 90 percent of the total risk are due to three compounds: diesel PM, benzene, and 1,3-butadiene. All three of these compounds are emitted via fuel combustion.[39]

Proximity to roadways, particularly those with high volumes of truck traffic, is an important factor in evaluating health impacts. Adverse health effects from $PM_{2.5}$ have been documented within 1,000 feet of high-volume roadways, with the strongest effects within 300 feet.[40] Noise, light and vibration impacts also increases with proximity to freight sources. Thus, local impacts can be much higher and fluctuate based on proximity, as discussed in Section 5.1.2.

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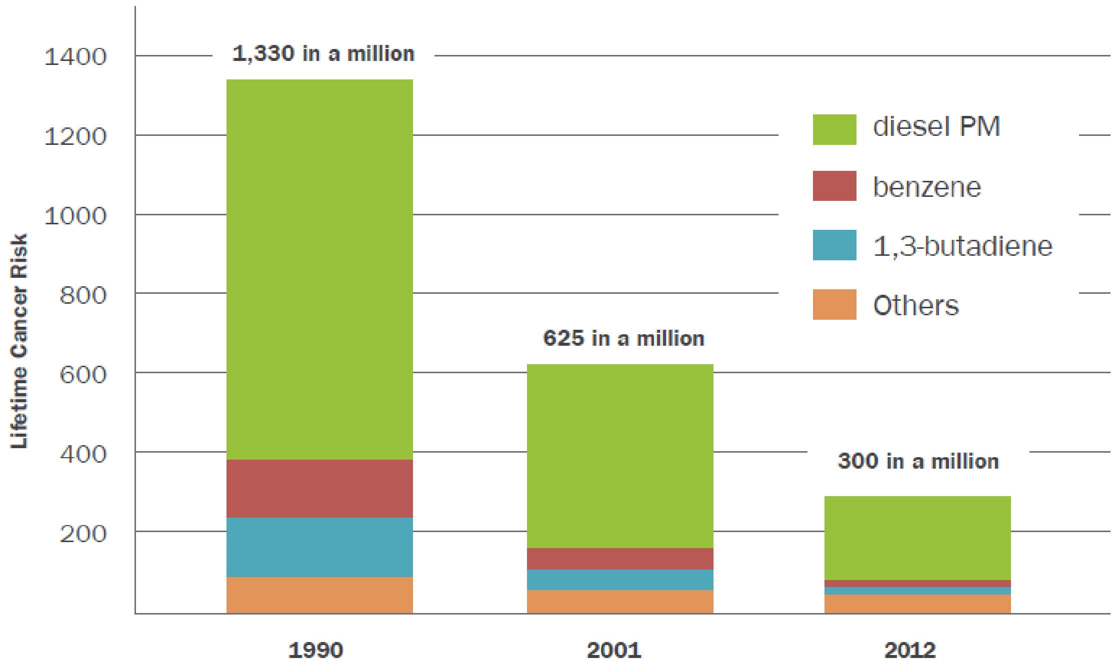
39 Improving Air Quality & Health in Bay Area Communities, Community Air Risk Evaluation Program Retrospective & Path Forward (2004 – 2013), BAAQMD, April 2014.

40 http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/Plans/PM%20Planning/ParticulatesMatter_Nov%207.ashx.

Figure 5.2 Estimated Bay Area Lifetime Cancer Risk from Toxic Air Contaminants, Based on Air Pollution Measures



Source: Improving Air Quality & Health in Bay Area Communities, Community Air Risk Evaluation Program Retrospective and Path Forward (2004 – 2013), BAAQMD, April 2014.

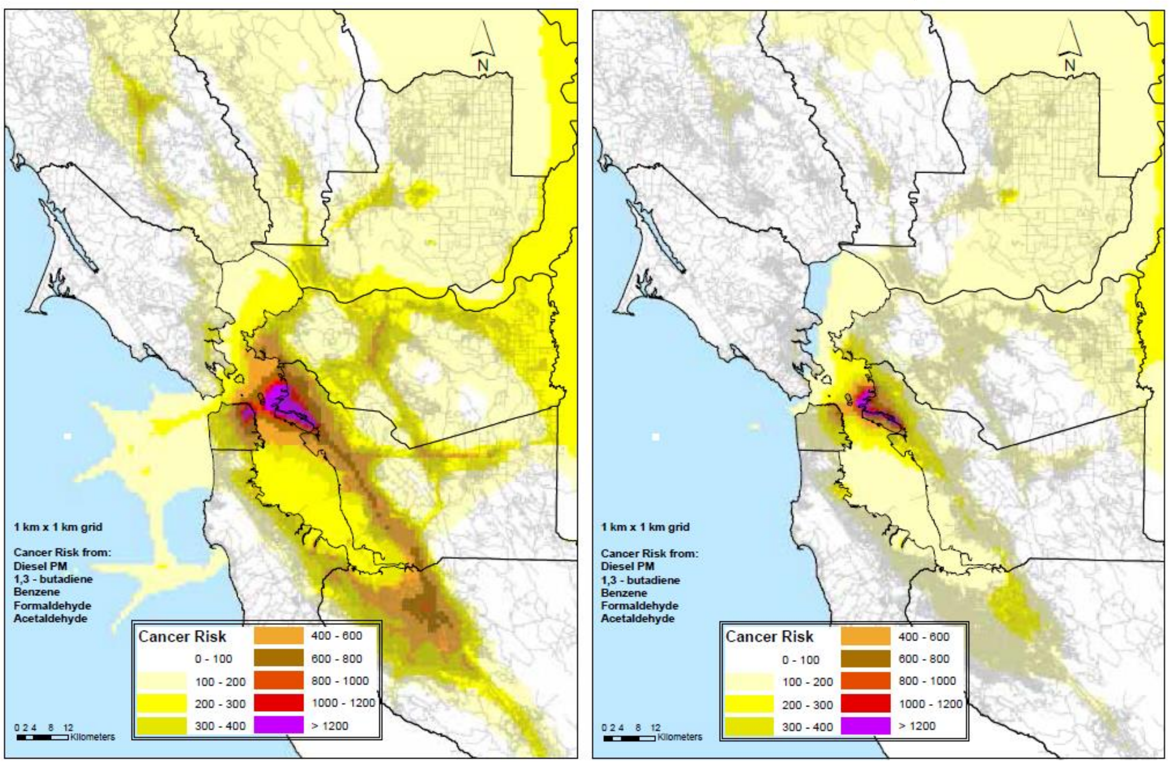
Predicting future trends of emissions is challenging, as many factors come into play such as changes in technology, emission standards, and land use decisions. Considering current regulations, and assuming no additional regulations or policies will be adopted, $PM_{2.5}$ emissions from on- and off-road motor vehicles are expected to decline until 2020 due to aggressive regulations on diesel engines. These key regulations include regulations to reduce tailpipe emissions, regulations for cleaner fuels, restrictions on vehicle use, as well as grants and incentives to encourage emission reductions above regulatory requirements. A full list of current emissions regulations are discussed in a later section of this report. After 2020, vehicle emissions are expected to increase by less than one percent annually until 2030. This is in large part due to the lack of current regulations for the 2030 timeframe and uncertainty surrounding new technologies when looking out to 2030.

5.1.2 Localized Health Effects on Communities

Despite tremendous strides in air pollution reduction, some communities in the Bay Area experience higher pollution levels, and more adverse health effects, compared to their counterparts in other parts of the region. The underlying causes of this disparity are complex.

In 2004, BAAQMD launched the Community Air Risk Evaluation (CARE) program, a critical step toward reducing and eliminating health disparities linked to air quality. In 2006, emissions inventories for years 2005 and 2015 were input to a regional air quality model to predict concentrations of key toxic compounds and cancer risk associated with them. Some of the key findings from this work were that the simulated potential cancer risk from TAC is highest near major diesel PM sources, as shown in Figure 5.3. Another key finding is that cancer risk from TAC is dropping; modeled risk values were projected to drop by more than 50% between 2005 and 2015, when emissions are reduced by state diesel regulations and other reductions.[41] However, after review of the figure it is evident that West and East Oakland continue, to have a higher risk than other parts of the Bay Area and Alameda County.

Figure 5.3 Potential Cancer Risk from Toxic Air Contaminants for the Bay Area in 2005 (Left) and 2015 (Right)

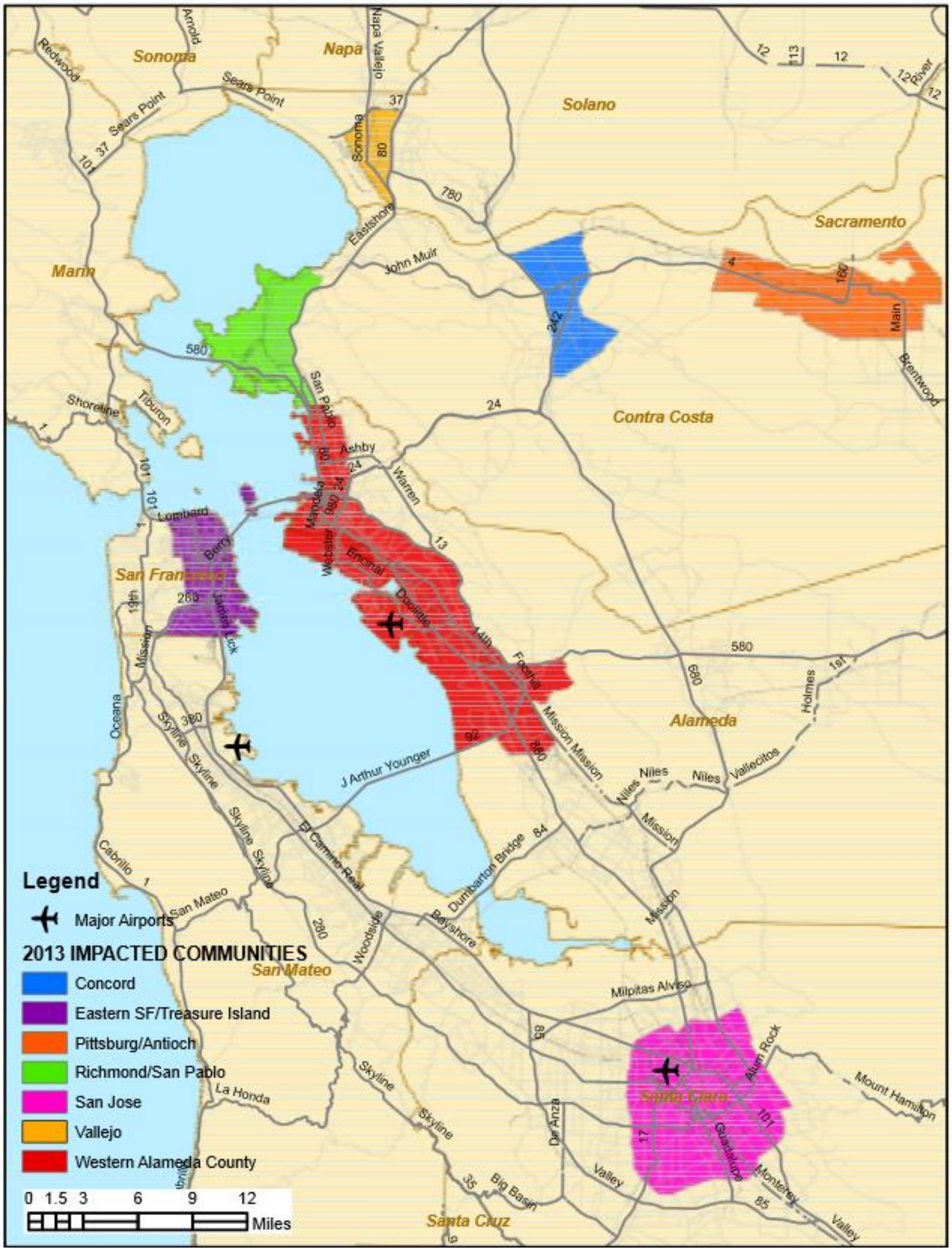


Source: Improving Air Quality & Health in Bay Area Communities, Community Air Risk Evaluation Program Retrospective and Path Forward (2004 – 2013), BAAQMD, April 2014.

[41] Improving Air Quality & Health in Bay Area Communities, Community Air Risk Evaluation Program Retrospective and Path Forward (2004 – 2013), BAAQMD, April 2014.

In 2009, for the first time, the BAAQMD mapped areas with relatively high levels of toxic air pollution and with people who are relatively more vulnerable to health impacts of air pollution. In 2014, the Air District updated its methodologies to include a wider range of pollutants with health effects and by directly estimating health effects on vulnerable populations. The impacted communities based on the 2014 updated methodology are shown in Figure 5.4. These areas have the highest pollution vulnerability index, where combined health impacts are predicted to be the greatest, which includes cancer risk, mortality rates, and health costs from air pollution.

Figure 5.4 Impacted Communities Based on the Updated Method



Source: Bay Area Air Quality Management District, 2014.

The Impacted areas included:

- Western Alameda County along the I-880 corridor,
- Eastern San Francisco/Treasure Island,
- San Jose,
- West Contra Costa County,
- Concord,
- Pittsburg and Antioch, and
- Vallejo.

These communities are located along major truck corridors, industrial areas and in some cases, nearby major freight hubs. These communities also have high concentrations of lower income residents. It should be noted that many of these communities also have other sources of air pollution that contribute to health risks and more analysis may be necessary to determine the degree to which goods movement is a major cause of health risks in these communities.

Looking at the two sets of maps does make clear that West Oakland is one part of the Bay Area that currently experiences high levels of health risk associated with diesel pollutants and even with significant reductions in these pollutants regionally, West Oakland will continue to experience relatively high levels of health risk. To a large degree, the health risks experienced in West Oakland can be traced to its proximity to the Port of Oakland, near-dock rail terminals, and the I-880 freeway. In 2006, CARB, in partnership with BAAQMD and the Port of Oakland, conducted a health risk assessment (HRA) for West Oakland[42] to estimate the public health risks from exposure to diesel PM. Three sources were considered including the Port of Oakland (maritime), UP rail yard and other sources around the West Oakland community. Emissions from each source were analyzed to evaluate the impacts of each on residents. The findings of the study were updated in 2008 and 2009 in partnership with the West Oakland Environmental Indicators project by using a truck survey (West Oakland Truck Survey, December 2009).[43] Key results from this study are shown in Table 5.2 and Figure 5.5. The updated data that came from the truck survey indicated that overall health risk in West Oakland was lower than previously estimated but that the Port's contribution was greater than initially estimated.

[42] http://www.arb.ca.gov/ch/communities/ra/westoakland/westoakland.htm.

[43] http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/CARE%20Program/Documents/CARE_Retrospective_April2014.ashx.

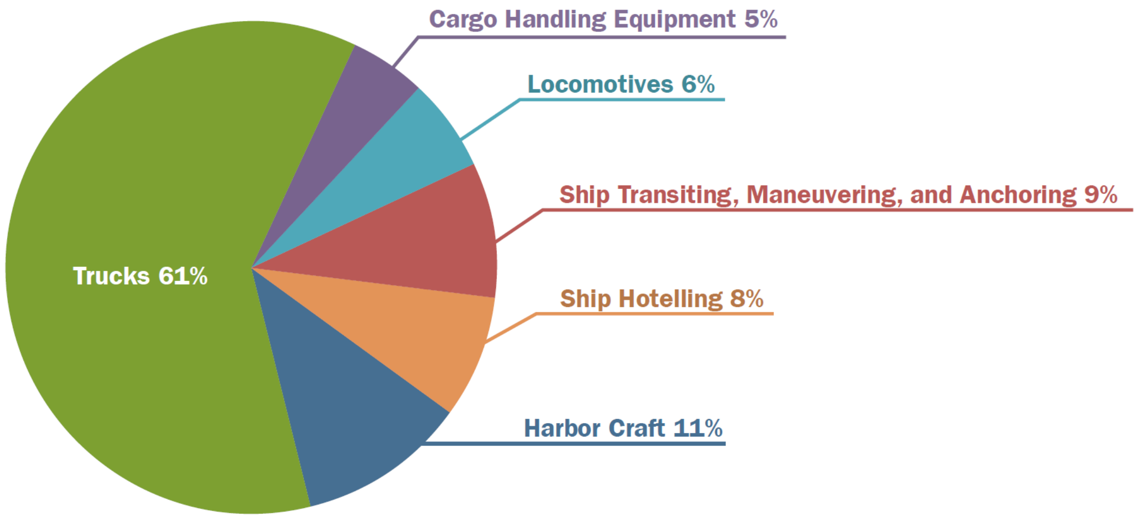
The Port's contribution to cancer risk is 29 percent according to the revised numbers in Table 5.2, with the vast majority of the rest contributed by other sources in and around West Oakland. This indicates that solutions that address local sources of pollution around West Oakland are important. More detailed discussions on this issue is included in the West Oakland Case Study of the Alameda County Goods Movement Plan as part of this project. On the other hand, there will continue to be a high level of focus on port-related emissions because the port is such a concentrated source of activity, which creates certain opportunities to demonstrate and implement solutions like zero-emission truck technologies. But solutions to this problem that place a disproportionate cost on the international trade industries could have impacts on the port's competitiveness without addressing the larger impact on the West Oakland community for nonport trucking on I-880. While CARB's upcoming in-use trucking rule will reduce emissions from all trucks, there is still likely to be a need to find ways to incentivize lower emission trucking technologies, improve operations to reduce truck VMT, and spread trucking activity to other roadways to reduce overall health risks.

Table 5.2 Average Potential Cancer Risk (per million) in West Oakland by Source Areas in 2005, with Revisions Based on Truck Survey

Source of Diesel Particulate Matter Emissions	Average Potential Cancer Risk (per million) in West Oakland—Revised based on truck survey	Average Potential Cancer Risk (per million) in West Oakland—Based on HRA
Port of Oakland	250 (29%)	190 (16%)
Union Pacific Rail Yard	40 (5%)	40 (4%)
Other sources in and around West Oakland	570 (66%)	950 (80%)
Total	**860 (100%)**	**1180 (100%)**

Source: Improving Air Quality & Health in Bay Area Communities, Community Air Risk Evaluation Program Retrospective & Path Forward (2004 – 2013), BAAQMD, April 2014.

Figure 5.5 Revised Based on Truck Survey: Apportionment of Total Cancer Risk in 2005 (in Percent) by Source Category from All Source Areas in West Oakland



Source: Improving Air Quality & Health in Bay Area Communities, Community Air Risk Evaluation Program Retrospective and Path Forward (2004 – 2013), BAAQMD, April 2014. Includes both Port and Non-Port related emissions sources.

5.1.3 Current Programs and Regulations to Reduce Air Quality Impacts of Goods Movement

Air quality is regulated at the Federal, state, regional and local levels. In the case of transportation emission regulation, all vehicle emission standards and most fuel regulations are established at the Federal and state levels. Regional agencies, such as BAAQMD, are mainly responsible for distributing Federal and state air quality funds, as well as carrying out programs and adopting transportation control measures to comply with Federal and state regulations.

While there are many regulations that affect emissions from trucks, the one that will have the greatest impact is the 'CARB's On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation, which will be the main cause for the drop in NO_x and PM emissions in the immediate future. The regulation calls for phase-in of best available control technology for PM and NO_x between 2011 and 2023. By 2023, nearly all trucks and buses will need to have 2010 model-year engines or equivalent.

Table 5.3 provides a summary of all applicable regulations in California that control emissions from heavy-duty vehicles, locomotives, and ships. Some regulations will have significant impacts on truck emissions over time and cause a much faster turnover of trucks on the road than would otherwise occur in their absence. Locomotive regulations also are established by the U.S. EPA, and apply to both new and remanufactured locomotives. In addition to enforcing regulations, the California Air Resources Board (CARB) also helps develop voluntary agreement and funding programs (such as those for railroads) to further reach emission reduction goals.

Table 5.3 CARB Diesel Air Toxic Control Measures for Heavy-Duty Vehicles, Equipment and Ships

Pollutant	Impacts to Public Health/the Environment
Trucks and Buses	Since 2008, idling limited to 5 minutes
	By 2016, all trucks meet equivalent of 2007/2010 PM standard
	By 2023, all trucks meet equivalent of 2010 NO_x standard
Drayage Trucks	By 2010, pre-MY 1994 trucks banned
	By 2010, MY 1994-2003 trucks meet 2007/2010 PM standard
	By 2014, all trucks meet 2007/2010 PM and 2007 NO_x standard
	By 2023, all trucks meet 2010 NO_x standard
Public Fleet Vehicles	By 2012, all trucks meet equivalent of 2007/2010 PM standard
Garbage Trucks	By 2011, all vehicles have installed Best Available Control Technology (BACT)
Transit Buses	By 2003, met an NO_x fleet average of 4.8 g/bhp-hr
	By 2007, PM emissions reduced by 85% from 2002 baseline
	For fleets in the Bay Area with 200+ buses, 15% of new buses purchased from 2011-2026 must be zero emissions. (May be amended in 2012.)
Truck Refrigeration Units	By 2020, engines must meet Ultra-Low Emission standard
Locomotives	In 2007, begin using 15 ppm Sulfur fuel in California-based locomotives
	By 2008, conduct health risk assessments for major rail yards
	By 2009, install idling reduction devices on California-based locomotives
Construction Equipment	Since June 2008, idling limited to 5 minutes
	Between 2014 and 2023, fleets with more than 5,000 total hp must meet fleet average NO_x targets or turnover/replace 4.6-10% of fleet hp
	Between 2017 and 2023, fleets with 2,501 to 5,000 total hp must meet fleet average NO_x targets or turnover/replace 4.6-10% of fleet hp
	Between 2019 and 2029, fleets with less than 2,501 total hp must meet fleet average NO_x targets or turnover/replace 4.6-10% of fleet hp
Cargo Handling Equipment	By 2007, new equipment meets equivalent of Tier 4 off-road engine standards or 2007 PM/NO_x on-road engine standards
	By 2015, pre-2007 yard trucks meet equivalent of Tier 4 off-road engine standards or 2007 PM/NO_x on-road engine standards
	By 2017, all other pre-2007 equipment must meet equivalent of Tier 4 off-road engine standards or 2007 PM/NO_x on-road engine standards
Harbor Craft	Beginning in 2009, engines for new vessels or repowers meet Tier 2 or Tier 3 off-road standards; new ferries must be 85% below Tier 2 standards

Pollutant	Impacts to Public Health/the Environment
	By 2016, pre-2000 engines meet Tier 2, 3, or 4 off-road standards
	By 2022, all engines must meet Tier 2, 3, or 4 off-road standards
Ships	In 2009, ships began using Marine Diesel Oil (MDO) with 0.5% sulfur or Marine Gas Oil (MGO) with 1.5% sulfur. By august 2014, ships begin using MDO or MGO with 0.1% sulfur
	In 2014, 50% reduction in auxiliary engine use during 50% of visits by cruise and container ships (shore power)
	In 2017, 70% reduction in auxiliary engine use during 70% of visits by cruise and container ships (shore power)
	In 2020, 80% reduction in auxiliary engine use during 80% of visits by cruise and container ships (shore power)
Back-up Generators (BUG)	By 2008, PM emissions for BUGs reduced by 85% in new engines

Source: http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/Plans/PM%20Planning/ParticulatesMatter_Nov%207.ashx.

Plans, Programs, and Incentives

To help reach air quality goals in a comprehensive manner, plans, programs and incentives have been adopted by the BAAQMD, MTC, and the Port of Oakland. These programs and plans are described below.

Bay Area 2010 Clean Air Plan

The Bay Area 2010 Clean Air Plan (CAP) provides a comprehensive plan to improve Bay Area air quality and protect public health, through implementation strategies that involve all pollutants. Specific measures pertinent to freight listed in the CAP under the three relevant control measure categories are presented below. The 2015 CAP is in development and is expected to be released and adopted in 2015.

5.1.3.1.1 Mobile Source Measures (MSM)[44]

MSM are measures that reduce emissions by accelerating the replacement of older, dirtier vehicles and equipment through programs such as the Air District's Vehicle Buy-Back and Smoking Vehicle Programs, and promoting advanced technology vehicles that reduce emissions of criteria pollutants and/or greenhouse gases. Specific measures that are most applicable to freight include:

- **MSM B-1 – Fleet Modernization for Medium and Heavy-Duty On-Road Vehicles.** This measure is designed to provide and encourage other organizations to provide incentives for

[44] http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/Plans/2010%20Clean%20Air%20Plan/Draft%202010%20CAP/Vol2_SectionB_MSMs.ashx.

the purchase of new trucks to meet CARB's 2010 emission standards for heavy-duty engines. Between 2010 and 2015, the BAAQMD will directly provide and/or work with other entities to provide incentives to accelerate the replacement of up to 5,000 heavy-duty on-road diesel engines in advance of requirements for the CARB in-use heavy-duty truck regulation (mentioned before).

Currently, this measure is partially being addressed by the Carl Moyer program, a state-level program that provides grant funding for cleaner-than-required engines and equipment administered by the BAAQMD.[45] Stakeholder interviews have indicated that many private sector entities in marine, trucking, and railroading businesses have benefitted from this program. For example, in 2010, Richmond Pacific Railroad and California Northern Railroad received Carl Moyer funds for purchasing locomotives. In year 2014 of the program (2013) alone, a total of 85 projects, or 112 engines are funded in the Bay Area at a cost of $5.4 million.[46]

- **MSM B-2 – Low NO_x Retrofits in Heavy-Duty On-Road Vehicles.** This measure is designed to reduce NO_x emissions from on-road heavy-duty vehicles. Between 2010 and 2015, the BAAQMD will provide incentives to install CARB-verified abatement equipment to reduce NO_x emissions from existing on-road heavy-duty truck engines. Emphasis is placed on bringing existing engines into early compliance with CARB's in-use truck regulation. The retrofit of heavy-duty diesel engines with NO_x abatement equipment is estimated to cost $30,000 per engine. BAAQMD staff anticipates that about 75 percent of the retrofits will occur between 2013 and 2015 as fleets prepare to comply with NO_x requirements in the CARB in-use truck engine regulation. It is anticipated that BAAQMD will make available up to $3 million to 5 million per year in incentives for the retrofit of existing trucks between 2010 and 2015. However, currently there is no identified dedicated funding for this program according to BAAQMD staff.

[45] http://www.arb.ca.gov/msprog/moyer/moyer.htm (last accessed on September 19, 2013).

[46] http://www.baaqmd.gov/~/media/Files/Strategic%20Incentives/Carl%20Moyer/CMP%20Year%2014%20Projects.ashx.

5.1.3.1.2 Transportation Control Measures (TCM)[47]

These are measures to reduce vehicle trips, vehicle use, vehicle miles traveled, vehicle idling, or traffic congestion for the purpose of reducing motor vehicle emissions. Specific measures that are applicable to freight include:

- **TCM B-4 – Goods Movement Improvements and Emission Reduction Strategies.** This measure has reduced emissions associated with goods movement by investing in the Bay Area's trade corridors and by providing incentive funding for diesel equipment owners to purchase cleaner-than-required vehicles and equipment. This measure is funded by Proposition 1B, a $19.9 billion transportation infrastructure bond for California. Proposition 1B included a $2 billion Trade Corridors Improvement Fund (TCIF) to improve goods movement infrastructure statewide. In 2008, the State augmented the program to nearly $2.5 billion and programmed just more than $3 billion for high-priority goods movement projects. Proposition 1B also included $1 billion for a Goods Movement Emissions Reduction program. Nearly all of these funds have been expended with small amounts of savings from completed projects still being programmed.

- **Land Use and Local Impacts Measures (LUM)**. This is a new category of measures built on the Community Air Risk Evaluation (CARE) Program. It is designed to: 1) promote mixed-use, compact development to reduce motor vehicle travel and emissions, and 2) ensure that we plan for focused growth in a way that protects people from exposure to air pollution from stationary and mobile sources of emissions. Measures relevant for goods movement include LUM 1- Goods Movement, and LUM 5 – Reduce Health Risk in Impacted Communities.

5.1.3.1.3 Maritime Air Quality Improvement Program

The Port of Oakland's commitment to reducing air pollution can be seen from the development of the Maritime Air Quality Improvement Plan (MAQIP) in 2009, which set to achieve the emission reduction goals in Table 5.3. Based on the 2012 Port of Oakland Seaport Emissions Inventory[48], the Port has made major strides towards emissions reduction. In a more recent MAQIP Outcomes memo, it was noted that although TEU volumes have increased by a total of 3 percent between 2005 and 2012, overall diesel particulate matter (DPM) emissions have decreased by 70 percent for that same period. With continued progress and follow-through on MAQIP strategies, the Port should be able to fully achieve its air quality targets by 2020. Table 5.4, shows the progress made by the Port in terms of emissions reductions between 2005 and 2012.

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[47] http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/Plans/2010%20Clean%20Air%20Plan/Draft%202010%20CAP/Vol2_SectionC_TCMs.ashx.

[48] http://www.portofoakland.com/pdf/environment/maqip_emissions_results.pdf.

Table 5.4 Emission Changes for Port of Oakland, 2005 to 2012

Emission	Ocean-Going Vessels	Cargo-Handling Equipment	Harborcraft	Locomotives	Trucks	Overall Percentage Change 2005-2012	2020 Target
DPM	-72%	-63%	-30%	-77%	-88%	-70%	-85%
CO	-1%	-49%	14%	-81%	-67%	-33%	N/A
NO_x	4%	-46%	-32%	-75%	-60%	-15%	-34% (on, near shore)
SO_x	-80%	-92%	-94%	-100%	-90%	-80%	-85% (on, near shore); -94% (off-shore)
ROG	50%	-33%	11%	-83%	-74%	1%	N/A

Source: http://www.portofoakland.com/pdf/environment/maqip_postcard.pdf; http://www.portofoakland.com/pdf/environment/maqip090515.pdf.

In an even more recently study, done by UC Berkeley's Lawrence Berkeley National Laboratory, it was determined that between 2009 and 2013[49]:

- The median emission rate from diesel trucks operating at the Port declined 76 percent for black carbon, a major portion of diesel particulate matter.
- The average emission rate for nitrogen oxides, which leads to the creation of ozone and particulate matter, went down 53 percent.

These findings are inline with the finding above, and based on the Port's future projections, on and near-shore DPM emissions are expected to decrease from the 2005 baseline by 78 percent in 2015 and by 86 percent in 2020. These projected reductions are a direct result of the combined effect of regulatory deadlines seen in TABLE 5.3, shore power implementation, slow steaming, and the use of cleaner ocean-going vessel fuel.[50] Since all of the heavy duty trucks are required to have a 2010 model year engine or equivalent by 2023, we can expect that the complete fleet turnover will help reduce emissions significantly. Beyond 2023, there is opportunity to determine what additional regulations CARB will enact.

For locomotives, the most stringent standards currently in place, the Tier 4 standards will not take place until 2015. There also is no requirement for existing locomotive engines to be

[49] http://www.portofoakland.com/newsroom/pressReleases/2014/pr_359.aspx

[50] Ibid.

replaced to meet newer standards. Thus, there is more of an opportunity to tighten up the standards for locomotives as a way to further reduce emissions.

There have been some concerns raised about how continued growth in Port activity after 2020 and the activities at the Oakland Army Base will affect future health risk. As noted above, almost all of the emissions reductions from existing truck regulations will have been achieved by the time the full fleet has turned over in 2023, and port cargo growth is expected to continue beyond that point. Truck activity will grow more slowly if the Port is successful in expanding its rail transport share from 21% today to its target of 40% by 2035. But there may be a need to consider other alternatives to keep truck-related emissions down through adoption of new technology to manage truck activities or reducing truck activity. There also may be opportunities working with both Class I railroads to introduce low-emission technologies to the intermodal terminals and switching yards, as well as to accelerate the introduction of Tier 4 locomotives to service in Northern California.

5.2 Climate Change Effects

Climate change is expected to have very significant impacts in California and is predicted to impact temperature, precipitation, wildfire, sea-level rise, and coastal marine upwelling and currents.[51] In Alameda County, sea-level rise and changes in precipitation trends (including downpour and flooding) have the potential to damage critical infrastructure and severely disrupt goods movement. Sea-level rise (SLR) is expected to cause permanent inundation in some areas, and cause more frequent inundation in others when combined with storm effects such as precipitation, storm surge, and wind waves. Changes to precipitation will impact rainfall experienced locally at goods movement asset sites—in the form of direct rainfall on the assets, and localized flooding in the area—and will impact regional riverine flooding.

In recent years, the San Francisco Bay Conservation and Development Commission (BCDC) has partnered with the National Oceanic and Atmospheric Administration Coastal Services Center to work with San Francisco Bay Area shoreline communities on planning for SLR and other climate change-related impacts. The overall goal of the project, called Adapting to Rising Tides (ART), is to increase the preparedness and resilience of Bay Area communities to SLR and other climate change-related impacts while protecting ecosystem and community services. It involves evaluating potential shoreline impacts, vulnerabilities, and risks; identifying effective adaptation strategies; and developing and refining adaptation planning tools and resources that will be useful to communities throughout the Bay Area.

[51] Ekstrom, Julia A., and Susanne C. Moser. 2012. Climate Change Impacts, Vulnerabilities, and Adaptation in the San Francisco Bay Area: A Synthesis of PIER Program Reports and Other Relevant Research. California Energy Commission, CEC-500-2012-071.

According to current projections, climate change will cause the Bay to rise 16 inches by midcentury and 55 inches by the end of the century.[52] This means that today's floods will be the future's high tides, and areas that currently flood every 10–20 years will flood much more frequently. Neighborhoods, businesses, and entire industries that currently exist on the shoreline will be subject to this flooding and the many other direct impacts that will result from it.

Aside from the obvious unacceptable effect on transportation assets from inundation, the seismic vulnerability of and potential failure risk to transportation assets associated with SLR-caused groundwater-level increase revolves around liquefaction potential and the associated resultant adverse conditions it creates. The bay margins within the SLR area of the Alameda County shoreline, which contain materials most susceptible to liquefaction, often have the shallowest groundwater conditions. The transportation assets that have been evaluated that fall within both the SLR area and the high to very high liquefaction susceptibility mapped areas would generally be considered the most vulnerable to increased seismic impact associated with the indirect groundwater rise effect. Thus, most vulnerable would be structures in the SLR areas of the Emeryville, Oakland, and Alameda waterfront and Oakland International Airport fill areas.

The ART project developed risk profiles for selected assets of transportation infrastructure in Alameda County, which include all of the major goods movement facilities along the shoreline of the County:

- Highway: Interstate 80, including the San Francisco Oakland Bay Bridge Approach; Interstate 880; and State Route 92, including the San Mateo Bridge Approach;

- Railroad: Union Pacific Martinez Subdivision and Union Pacific Niles Subdivision, including the BNSF International Gateway Intermodal Yard;

- Port: Port of Oakland, including West Grand Avenue and Burma Road, which connect the Port to the highway network; and

- Air: Oakland International Airport, including Hegenberger Road and Airport Drive, which connect the Airport to the highway network. Though SFO is not in Alameda County, it will also be impacted by SLR thus limiting the alternatives for air travel in and out of the County.

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[52] Sea-Level Rise Task Force of the Coastal and Ocean Resources Working Group for the Climate Action Team (CO-CAT). 2010 (October). State of California Sea-Level Rise Interim Guidance Document. Developed with science support provided by the Ocean Protection Council's Science Advisory Team and the California Ocean Science Trust. Available: http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20100911/14.%20SLR/1011_COPC_SLR_Interim_Guidance.pdf.

Table 5.5 summarizes key elements presented in the risk profiles of the assets, and Figures 5.6 and 5.7 show the infrastructure that will be vulnerable with a 16 and 55 inch sea level rise. Ratings are given for the following elements of the risk assessment, with definitions used by the Intergovernmental Panel on Climate Change[53]:

- **Sensitivity** "is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli."
- **Exposure** "is the nature and degree to which a system is exposed to significant climatic variations."
- **Vulnerability** "is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes."

The ART Project team used a matrix provided by the FHWA conceptual model that evaluates both the likelihood of an asset to be affected by SLR impacts and the consequence of SLR impacts on an asset to allocate an overall risk rating for each asset.

Table 5.5 SLR Risk Profile of Goods Movement Assets

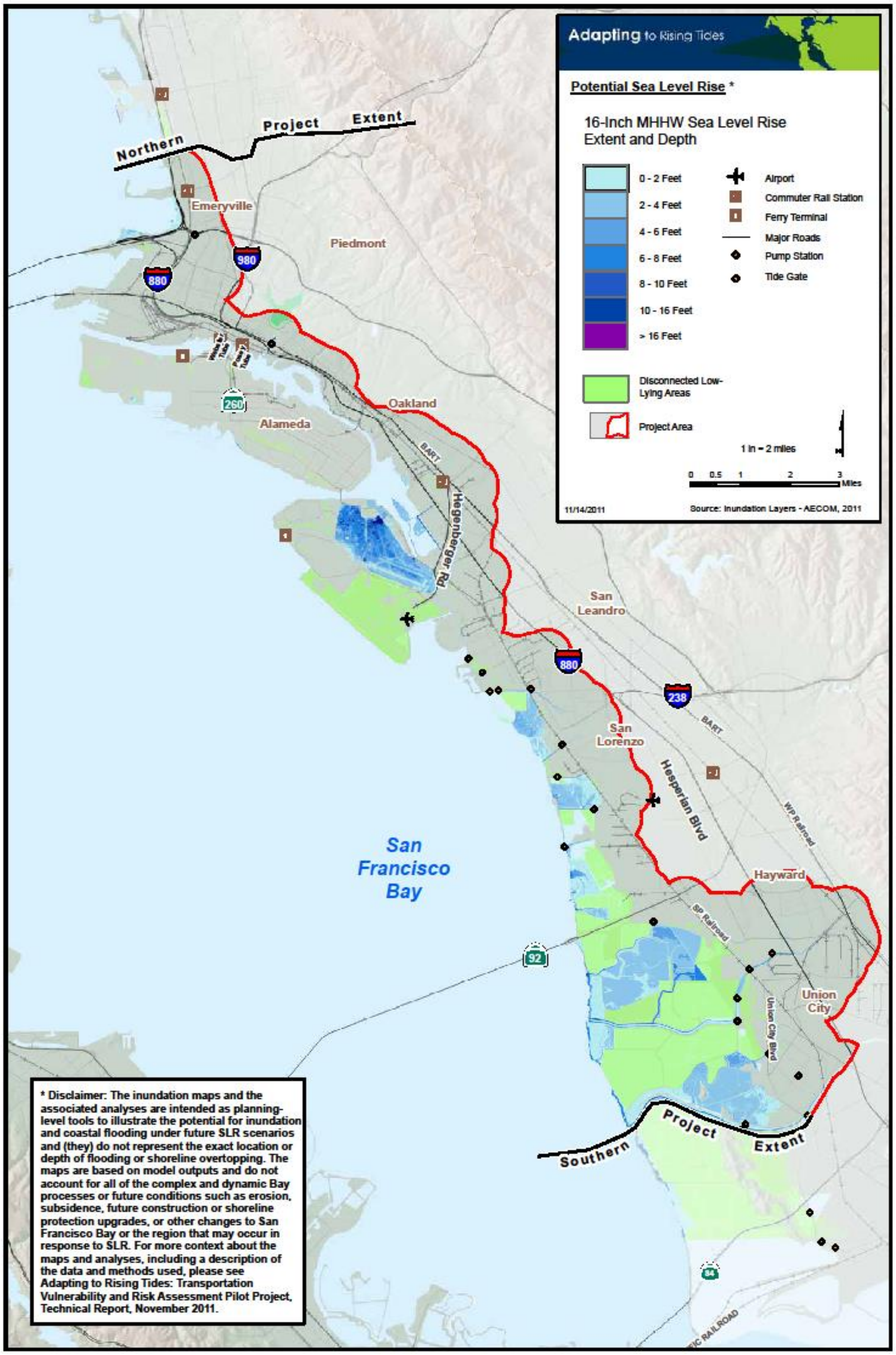
Asset	Sensitivity	Exposure	Vulnerability	Risk
Highway				
I-80 and San Francisco Bay Bridge Approach	Red	Yellow	Red	Red
I-880	Red	Yellow	Yellow	Red
SR 92 and San Mateo Bridge Approach	Yellow	Yellow	Yellow	Yellow
Railroad				
UP Martinez Subdivision	–	Yellow	Yellow / Red	Yellow
UP Niles Subdivision	–	Yellow	Yellow / Red	Yellow
BNSF International Gateway Intermodal Yard	–	Green	Yellow	Yellow
Port of Oakland and Related Assets				
West Grand Avenue	Red	Yellow	Yellow	Yellow
Burma Road	Red	Yellow	Yellow / Red	Green
Oakland International Airport and Related Assets				

[53] IPCC Fourth Assessment Report: Climate Change 2007 (AR4) IPCC 2007.

Hegenberger Road and Airport Drive	🟡	🟡	🟡🔴	🟡

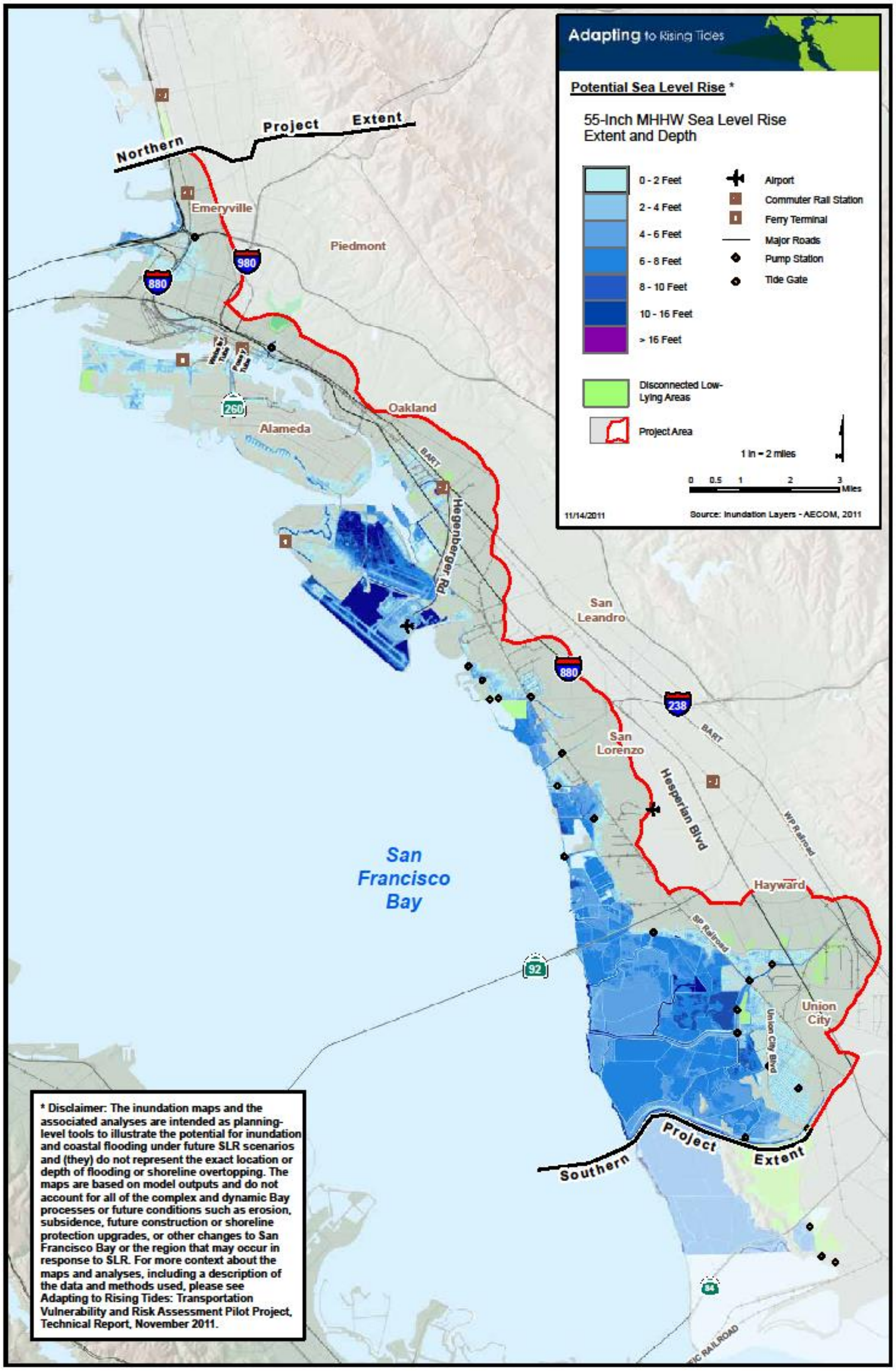
High – 🔴; Medium – 🟡; and Low - 🟢.

Figure 5.6 The Impact of 16-Inch Sea Level Rise around Alameda County



Source: Adapting to Rising Tides.

Figure 5.7 The Impact of 55-Inch Sea Level Rise around Alameda County



Source: Adapting to Rising Tides.

Interstate 80 (I-80). Sensitivity is high (due primarily to the high level of use and very high liquefaction potential), while exposure is medium (due to inundation under the 16" + 100-year stillwater elevation (SWEL) and 55" + mean higher high water (MHHW) SLR scenarios). When combined with the lack of adequate alternate routes, this results in a high vulnerability rating. Overall, a high level of risk was determined for this asset.

Focused analysis conducted subsequent to the ART project has determined key vulnerabilities at the San Francisco Oakland Bay Bridge Touchdown of I-80: inundation of the westbound highway lanes first occurs at the 36-inch SLR scenario with inundation depths of 0 to 3 feet; limited inundation occurs near the toll plaza as early as at the 12-inch scenario; and access road and buildings are partially inundated first at the 36-inch scenario with inundation depths of zero to 3 feet.

Interstate 880 (I-880). Sensitivity is high (due primarily to the high level of use and very high liquefaction potential), while exposure is medium (due to inundation under the 16" + 100-year SWEL and 55" + MHHW SLR scenarios). When combined with the availability of adequate alternate routes, this results in a medium vulnerability rating. Overall, a high level of risk was determined for this asset.

Focused analysis conducted subsequent to the ART project has determined key vulnerabilities at the I-880 bridge over Damon Slough in Oakland: potential scour at abutments from increasing wind, wave, or tidal energy; potential increase in channel erosion; and overtopping of roadway. The capacity of the Damon Slough Bridge to contain future extreme water levels is unknown and further studies are needed to understand how the facility may or may not be of adequate capacity as sea level and groundwater rises. Further refinements are needed to estimate the asset's pressure flow scour and, if necessary, evaluate structural integrity to determine if the bridge is vulnerable to scour.

State Route (SR) 92. Sensitivity is medium (due to its relatively moderate level of use and very high liquefaction potential), while exposure is medium (due to inundation under the 55" + 100-year SWEL SLR scenario). When combined with the lack of adequate alternate routes, this results in a medium vulnerability rating. Overall, a medium level of risk was determined for this asset.

Focused analysis conducted subsequent to the ART project notes that work along the SR 92 corridor requires coordination with a number of regulatory agencies including BCDC, California Department of Fish and Wildlife, Regional Water Quality Control Board, and U.S. Army Corps of Engineers because of its location between tidal marshes and managed ponds. As determined through the ART project, the amount of coordination necessary could delay necessary maintenance or improvements to address future storm events and SLR impacts.

The *Martinez Subdivision*'s exposure is rated medium, due to inundation under the 55" + MHHW SLR scenario. No adequate rail-based alternative exists for this asset, resulting in a medium-high vulnerability rating. Overall, a medium level of risk was determined for this asset.

The *Niles Subdivision*'s exposure is rated medium, due to inundation under both the 16" + 100-year SWEL and 55" + MHHW SLR scenarios. No adequate rail-based alternative exists for this asset, resulting in a medium-high vulnerability rating. Overall, a medium level of risk was determined for this asset. Focused analysis conducted subsequent to the ART project has determined key vulnerabilities along the Niles Subdivision in the vicinity of the Oakland Coliseum Amtrak Station: in the absence of storm surge, the rail corridor is vulnerable to flooding beginning at a 50-year peak flow event. During coastal storm surge, flooding can also occur with a 100-year extreme tide combined with a 25-year peak flow event. The rail crossings over Arroyo Viejo and Lion Creek are especially vulnerable to flooding during all scenarios.

BNSF Railway operates an intermodal shipping facility at the Port of Oakland, adjoining the Union Pacific Niles Subdivision. Exposure is rated low, due to inundation under only 100-year SWEL + wind waves for both the 16" and 55" SLR scenarios. When considering that no adequate alternative is available for this asset, vulnerability is rated medium. Overall, a medium level of risk was determined for this asset.

The *Port of Oakland*'s maritime facilities include berth terminals, railway terminals, 20 deep water berths, and 35 container cranes, and the site is served by local roads, interstates, warehouses and intermodal rail yards. While most Port facilities themselves are not particularly vulnerable to climate impacts, SLR and storm events will affect rail and interstate access to and from the seaport in the near term. Temporary or permanent disruption of rail and interstate access to the seaport will result in economic impacts to the city, region, and state, including disrupting jobs that are both directly and indirectly related to the seaport. Disruption of rail access at the seaport would result in more trucks being necessary to move cargo, which would have impacts on the surrounding neighborhoods, local roadways, and interstates, as well as on air quality. The ART project profiled two assets related to the Port, West Grand Avenue and Burma Road, both of which connect the Port to the regional highway network.

West Grand Avenue is an arterial that connects between Broadway and I-80 in Oakland. Sensitivity is high (due to the high level of use and very high liquefaction potential), while exposure to inundation is medium (due to inundation under the 55" + MHHW SLR scenario). Maritime Street/7th Street could provide an alternate route, resulting in a medium rating of overall vulnerability. Overall, a medium level of risk was determined for this asset.

Burma Road is a local street that parallels I-80 within the Port of Oakland. Sensitivity is high (due to very high liquefaction potential), while inundation exposure is medium (due to inundation under the 55" + MHHW SLR scenario). When combined with the lack of adequate alternate routes, this results in a medium-high vulnerability rating. Overall, a low level of risk was determined for this asset.

The climate impacts that were considered in the ART project will have relatively early impacts on *Oakland International Airport*. Both the commercial runway at South Field Airfield and the general aviation runway at North Field Airfield are exposed to the high tide or storm events with 16 inches of sea level rise. Additionally, the access roads are exposed to the high tide or storm events with 16 inches of sea level rise. Further complicating the issue, the inundation of the airfields and the roadways has different sources, so improving the flood protection at South Field would not likely reduce the exposure of either North Field or the access ways to the airport. The airport is surrounded by a variety of adjacent land uses and conditions that could contribute to flooding or be affected by adaptation measures, including the residential development on Bay Farm Island to the West, Martin Luther King Jr. Regional Shoreline to the northeast and a number of marshes surrounding and on airport property. The region's airfield capacity could not accommodate the loss of the commercial runway at OAK, and it would be difficult to compensate, at the regional level, for the loss of the general aviation and goods movement capacity at OAK. The temporary or permanent disruption of OAK due to flooding would likely result in serious consequences for the region's economic health, as well as public health and safety. The ART project profiled the combined assets of Hegenberger Road and Airport Drive related to Oakland International Airport, which connect the facility to the regional highway network.

Hegenberger Road and *Airport Drive* are arterials that connect between Oakland International Airport, State Route 61, and I-880 in Oakland. Both assets have medium sensitivity (due primarily to very high liquefaction potential) and exposure (due to inundation under the 16" + 100-year SWEL and 55" + MHHW SLR scenarios). 98th Avenue is an alternate route to Hegenberger Road, which rates medium for vulnerability; however, no adequate alternative exists for Airport Drive, making its vulnerability medium-high. Overall, a medium level of risk was determined for this combined asset.

5.3 Industrial Land Shortage

Whether to support existing or emerging industry growth, changes in logistics patterns or macro-level growth in international and domestic trade, industrial land uses are needed to carry out freight and logistic activities. This is especially important as cities consider joint development needs and plan for an industrial corridor along I-880 and alike. A 2008 Goods Movement/Land Use Study was carried out to further understand goods movement/land use issues and implications and to identify the effects of land use decisions on the efficiency and cost of regional goods movement. The study determined that at that time goods movement industries with demand for industrial land along the corridors were growing, and at the same time, industrial land use supply was declining.

Anecdotal evidence as of the writing of this technical memorandum suggests that warehousing/industrial real estate markets have low vacancy rates and many cities are continuing to adopt specific plans and take other discretionary land use actions that involve conversion of industrial land to other uses.

Currently UC-Berkeley, ABAG, and MTC are collaborating on an Industrial Land and Job Study to complement the 2015 MTC Goods Movement Needs Assessment. This study will analyze the demand for and supply of industrially zoned land in the nine-county Bay Area region, both now and in the future. Results of the study can allow us better understand industrial land needs and better allow agencies to integrate land use planning with goods movement planning.

5.4 Truck Driver Shortage

As freight volumes and demand continue to grow, all modes of freight will be required to convey goods. As a result, a variety of labor skills, including truck drivers, will be needed. Currently (and historically) the trucking industry faces challenges to hiring and keeping drivers, and the American Trucking Associations (ATA) predicts that a driver shortage is "looming." This is particularly challenging because industry revenue and average revenue per mile are increasing, but the industry is having difficulty adding trucks on the road due to lack of labor.

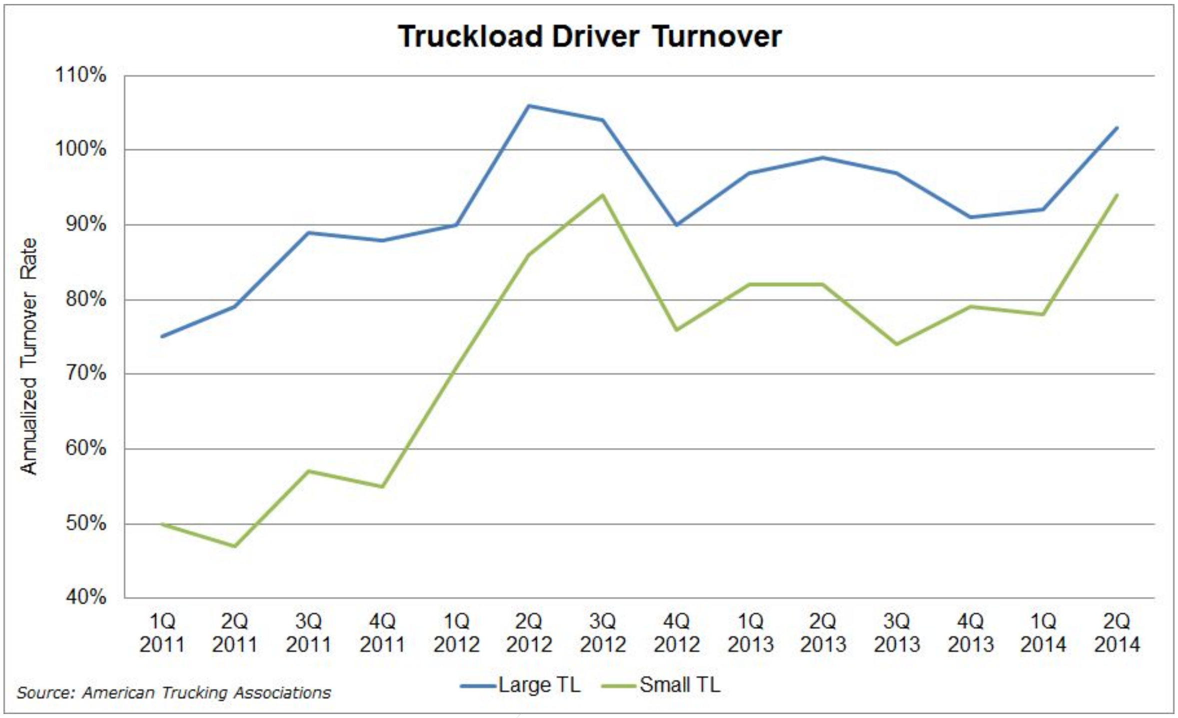
As shown in Figure 5.8, driver turnover at large truckload companies rose in the second quarter of 2014 to its highest point since 2012, putting pressure on trucking companies struggling to hire and keep truck drivers. The national average driver turnover rate at large truckload carriers rose 11 percent to 103 percent, meaning those carriers, on average, are losing more drivers than they are keeping. Turnover at small truckload fleets — those with less than $30 million in annual revenue — rose 16 percent to 94 percent.

When the economy is not doing well, and there is a high unemployment rate, more people opt to drive trucks for a living. However, that is not the case today, and the result is higher driver turnover, increased recruiting costs and increased driver pay. These factors all contribute to higher rates for shippers and increased cost to consumers. In the ATA's annual survey of important industry issues the driver shortage was identified by trucking executives as the second most critical issue facing trucking (the top issues was truck driver hours of service rules).[54]

[54] *Drivers, regulations top list of critical trucking issues*, Journal of Commerce, October 6, 2014.

Prolonged driver shortage will cause companies to adjust distribution patterns, relying more on intermodal transportation and shipping larger quantities at a time. While this may not seem bad from a regional perspective, the consumers will likely suffer as drivers are still needed to make critical last-mile deliveries of goods, at least in the foreseeable future.

Figure 5.8 Truckload Driver Turnover



Source: Journal of Commerce.

Based on ATA survey comments, several steps have been recommended to address the difficulty of finding, hiring and keeping truck drivers, including convincing Federal and state authorities to consider a graduated commercial drivers license program to qualify younger drivers for CDLs. Another recommendation includes recruitment strategies and encouraging carriers to hire more U.S. military veterans as drivers. Some carriers are raising driver pay — which truck drivers have said is the biggest issue convincing them to either switch carriers—and offering bonuses. On the shipper side, 52 percent say they planned to pay peak surcharges to move truckload freight.

In Alameda County this issue arose during stakeholder interviews; FedEx noted a lack of reliable delivery persons. And a slightly different labor issue arose related labor at the Port, specifically the need to work with ILWU on labor rules, hours of operation and worker willingness to work night shifts. The Alameda County Workforce Investment Board has studied industry clusters that are facing new trends related to the workforce, and in their recent Industry Data Briefing (June 2014) drivers and truckers that support the transportation logistics industry were studied. That report reviewed demand for drivers and truckers in the region by the number of online advertisements received by the occupations. During the fourth quarter of 2013, the Bay Area received 1,045 on-line advertisements for driver-related occupations. Tractor and trailer drivers received 639 advertisements alone, representing 61 percent of all advertisements received in the driver occupation class. It is clear in the future that a combination of strategies must be adopted to fill the driver shortage gap.