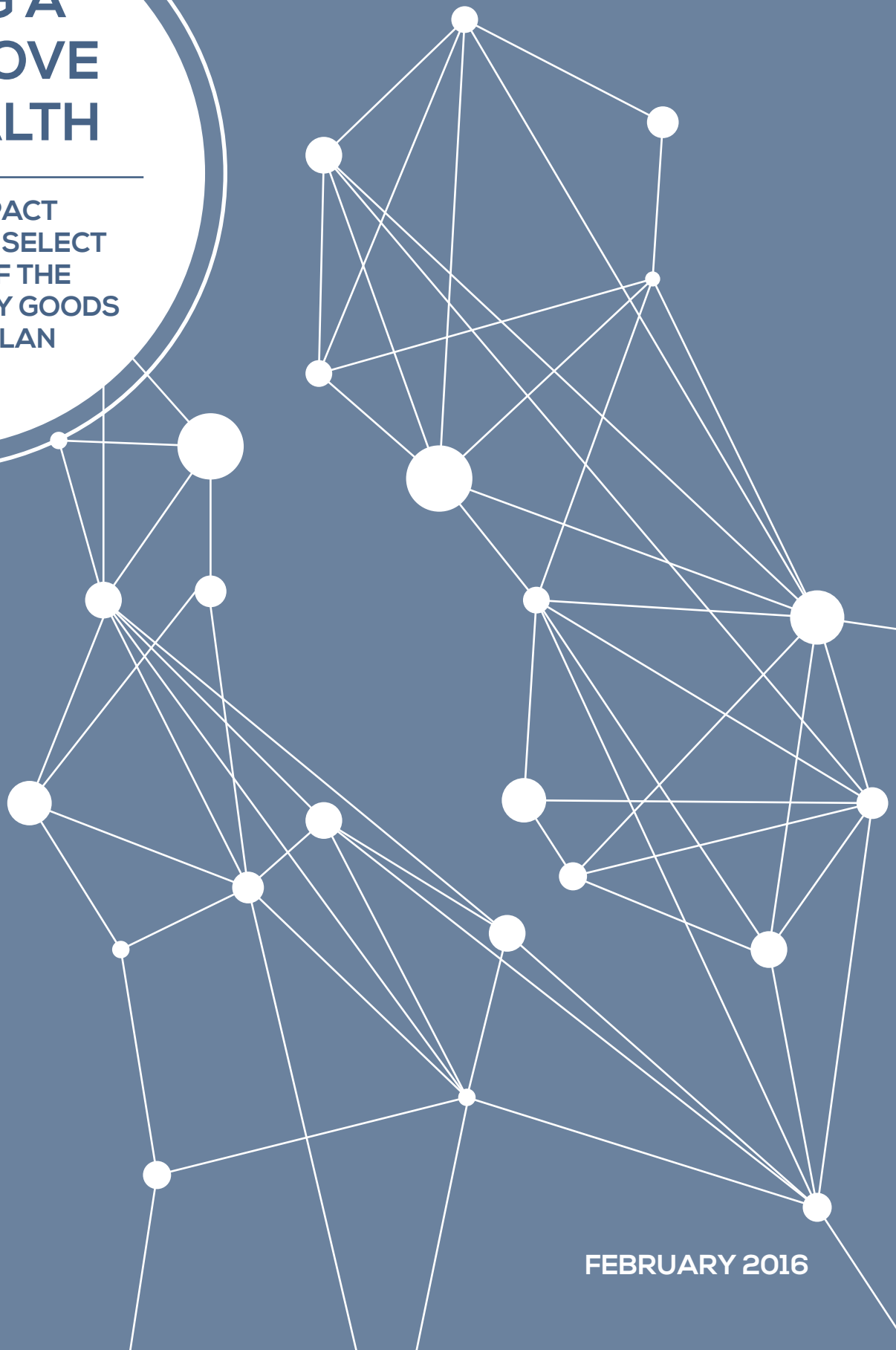
A DITCHING DIRTY DIESEL COLLABORATIVE REPORT

MAKING A GOOD MOVE FOR HEALTH

A HEALTH IMPACT ASSESSMENT OF SELECT STRATEGIES OF THE ALAMEDA COUNTY GOODS MOVEMENT PLAN



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FEBRUARY 2016

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LEAD AUTHOR

Catalina Garzón-Galvis, Ditching Dirty Diesel Collaborative

CONTRIBUTING AUTHORS

Logan Harris, Human Impact Partners
Zoë Levitt
Jill Ratner, Rose Foundation for Communities and the Environment

PROJECT ADVISORS

Ditching Dirty Diesel Collaborative - Freight Transport Committee:
Wendy Alfsen, California Walks
Bob Allen, Urban Habitat
Paul Cummings, Alameda County Public Health Department
Joel Ervice, Regional Asthma Management and Prevention Program
Frank Gallo, San Leandro Resident
Margaret Gordon, West Oakland Environmental Indicators Project
Richard Grow, US EPA Region 9 Air Division
Michael Kent, Contra Costa Health Services
Anna Yun Lee, Alameda County Public Health Department
Tammy Lee, Alameda County Public Health Department
Susan Levy, Alameda County Public Health Department
Marybelle Nzegwu, Public Advocates (formerly)
Jill Ratner, Rose Foundation for Communities and the Environment

OTHER PROJECT ADVISORS

Adenike Adeyeye, EarthJustice
Carlos Londono, Tiburcio Vasquez Health Center

GRAPHIC DESIGNER

Ariana de Leña

The Ditching Dirty Diesel Collaborative (DDD) is a Bay Area collaborative of over a dozen environmental justice and health organizations that work to reduce diesel pollution and improve health in environmental justice communities throughout the San Francisco Bay Area. The Freight Transport Committee of DDDC works to advance community health and social equity in freight transport planning and land use decision-making.

DITCHING DIRTY DIESEL

http://www.ditchingdirtydiesel.org/

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ABOUT THE AUTHORS

Catalina Garzón-Galvis, HIA Project Coordinator, has coordinated community-based planning, education, and research projects with environmental justice organizations and coalitions for over 15 years. Ms. Garzón-Galvis has co-authored several publications on freight transport planning and community health with the Ditching Dirty Diesel Collaborative, including Gearing Up for Action: A Curriculum Guide for Freight Transport Justice (2010) and At a Crossroads in Our Region's Health: Freight Transport and the Future of Community Health in the San Francisco Bay Area (2011). She has a Masters in City and Regional Planning from UC Berkeley.

Logan Harris, Research Associate at Human Impact Partners, has mixed methods research experience including statistical analysis, interviews, survey design, and spatial analysis. Her previous experience includes working on a project at Contra Costa Health Services to map population-level vulnerability to climate change and extreme heat. Ms. Harris has Masters degrees in Public Health and City Planning from UC Berkeley.

Zoë Levitt is an experienced qualitative researcher and policy analyst with expertise in health impact assessment methods and community-based participatory research approaches. She previously coordinated a Health Impact Assessment project on bus service access for the Alameda County Public Health Department with several community partners. Ms. Levitt has a Bachelors of Arts in Urban Studies from Stanford University.

Jill Ratner coordinated community/stakeholder engagement for this HIA project on behalf of the Ditching Dirty Diesel Collaborative. She directs the New Voices Are Rising program at the Rose Foundation for Communities and the Environment, a youth leadership development program delivering environmental justice and civics curricula to underserved East Bay high school students. Ms. Ratner is an attorney specializing in environmental and financial law.

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I. FOREWORD

DR. MUNTU DAVIS, ALAMEDA COUNTY HEALTH OFFICER AND PUBLIC HEALTH DEPARTMENT DIRECTOR

November 16, 2015

A great and comprehensive goods movement system equitably improves both the local economy and the local communities' quality of life. It does this by creating good jobs, reducing congestion and ensuring clean air and safe streets for all the communities it serves in a way that all are better off. The Alameda County Goods Movement Plan presents the opportunity to create such a goods movement system.

The vision of the Alameda County Goods Movement Plan is:

> 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.

As Alameda County Health Officer, I talk to people who live and work all over the County and to policy makers who represent the interests of the communities in their districts. Everyone wants us to have healthy communities that fulfill residents' basic needs for good health and well-being, and for a good quality of life for individuals and families. Those basic needs include clean air, safe streets, affordable and healthy housing and food, and good jobs that pay good wages. Unfortunately, not all communities are realizing that vision of a healthy community right now.

County health data shows that some communities have more health burdens than others, and some of these burdens are related to being near, or downwind of, the routes that goods travel. These communities visit the emergency department for asthma more often and have lower life expectancies relative to other communities. Diesel exhaust from the trucks, trains, and ships that move goods can have a number of environmental impacts that contribute to poor health, such as decreased lung function, increased asthma attacks and cardiovascular incidents. These health conditions often cause a higher number of missed days at school or work and a higher percentage of household income being spent on medication and/or medical bills.

This report, "Making a Good Move for Health: A Health Impact Assessment of Select Strategies in the Alameda County Goods Movement Plan" highlights that every County District has at least one "community of concern", a community that is vulnerable and heavily impacted by goods movement. The most heavily impacted of those are: East and West Oakland, Downtown Oakland and Chinatown, Ashland, Cherryland, and parts of San Leandro and Hayward, and Newark.

If we do not address the conditions leading to poor health and bolster and protect what is needed for good health, these populations will continue to end up in our emergency rooms, costing the County about $3500 per emergency room visit and over $16,500 per hospital stay.

Achieving "equity" means "closing the gaps", while making improvements for all.

An example of this is the Bay Area Air Quality Management District's Voucher Incentive Program (VIP) to help fleet owners of on-road diesel vehicles to retrofit or replace their trucks with newer, lower-emission equipment. This program improves air quality along transport routes, where air quality is worse in comparison to other areas. The positive health impact of this program, such as reduced emergency department visits and hospitalizations due to asthma, will be more readily be observed in the communities of concern, but improves the overall air quality for all in the region.

This report is a helpful guide for how government agencies can move toward achieving equity in health, environmental and economic goals. It suggests that in order to "close the gaps" we see in health outcomes, while improving health

for all, a goods movement system needs to holistically address congestion, reduce pollution, create jobs, spur economic development, and improve traffic safety overall, while paying special attention to preventing and reducing negative impacts in vulnerable communities. Ultimately, this protects and improves health and well-being for all.

Health Impact Assessments (HIA), the process used in this report, use data and analytical methods, consider input from stakeholders, determine potential—often overlooked or unintentional— health impacts of a proposed policy, program or project before it is built or implemented; and provide recommendations to monitor and address these impacts. HIAs are a useful way to a) ensure that health and health disparities are considered in decision-making and b) engage stakeholders in the process. They are used to inform policy-makers on decisions that are in the best interest of community health.

This report assesses a few, but different types, of projects in the proposed Goods Movement Plan. It is not an assessment of the entire plan or any actions already taken or in process by the Alameda County Transportation Commission (ACTC). Its findings and recommendations are simply presented for consideration when prioritizing and implementing projects in the Plan. Its focus is on increasing positive and minimizing adverse health outcomes for all.

As one would expect, the report suggests 1) that projects to minimize potential harm in communities of concern should be prioritized from the outset of a planning and development process; 2) that ongoing public health surveillance related to goods movement activities is needed to ensure we are adequately protecting public health; and 3) that it is important to engage and include community members who are impacted in the decision-making processes for projects and to do so at times and places that are more accessible to them. Including community members early in development processes would help to increase their understanding about what's happening and to incorporate their comments and concerns at the earliest stage of development processes that will affect their health and quality of life. The Ditching Dirty Diesel Collaborative modeled how this could be done in a community-friendly format in the process of developing this HIA report.

I believe that we all want to build a goods movement system that supports clean air, reduced congestion, and a healthy economy with healthy and good jobs for all communities. The Ditching Dirty Diesel Collaborative is a coalition of community-based, environmental justice, public health and environmental organizations and agencies that have been working to reduce the impact of diesel pollution in communities of concern using community education and engagement, research and policy advocacy. Their goals are aligned with the goals of the Goods Movement Plan and their report gives us valuable information and recommendations for ensuring a just and equitable goods movement system that will benefit the health and well-being of all communities in Alameda County.

II. EXECUTIVE SUMMARY

Our system of transporting raw materials and products from where they are made to where they are sold -- also known as goods movement or freight transport – benefits some communities more than others. As this Health Impact Assessment (HIA) shows, communities next to freight hubs and corridors like freeways, designated truck routes, ports, and rail lines bear the brunt of diesel pollution and other negative impacts of Alameda County's freight transport system. This HIA identifies the potential impacts of proposed changes to the county's freight transport system as detailed in the draft Alameda County Goods Movement Plan (hereafter, the draft Plan). The HIA then outlines ways that the implementation of this draft Plan can better protect and improve the health of all communities, including those most impacted by the county's freight transport system.

The draft Alameda County Goods Movement Plan outlines a long-range strategy for how to transport freight efficiently, reliably and sustainably within, to, from and through Alameda County by roads, rail, air and water. One of the draft Plan's five stated goals is to "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." To help make the draft Plan as successful as possible in advancing this goal, the Ditching Dirty Diesel Collaborative (DDD) – numerous environmental justice and health organizations working to reduce diesel pollution and improve health in the San Francisco Bay Area – commissioned this HIA of the draft Alameda County Goods Movement Plan. The HIA aims to advance this goal of improving health and quality of life by outlining ways that future changes to the county's freight system can be implemented to maximize benefits and minimize harms to health in impacted communities.

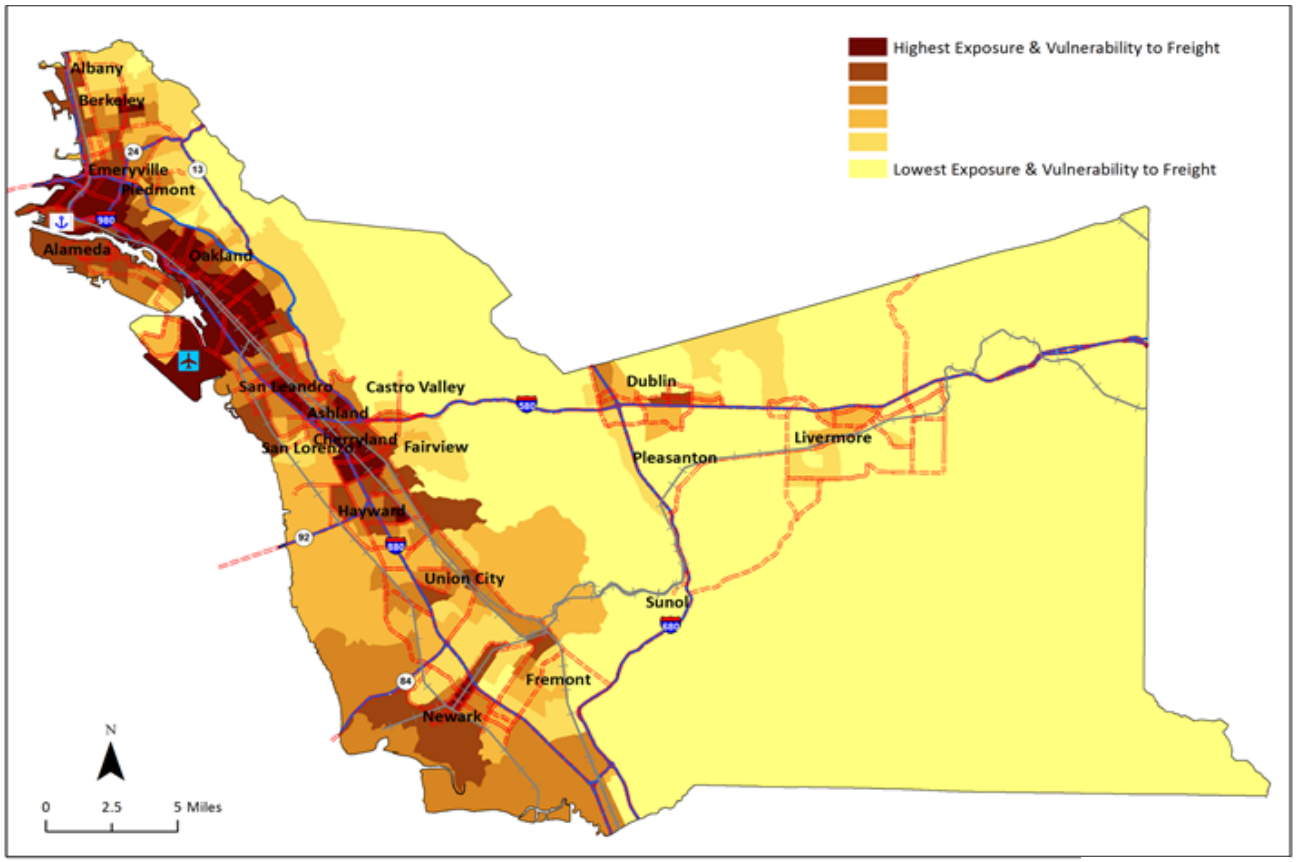
MAPPING EXISTING HEALTH CONDITIONS IN COMMUNITIES NEAR FREIGHT IN ALAMEDA COUNTY

To inform this HIA, the Alameda County Public Health Department (ACPHD) conducted an analysis of existing health, environmental, and economic conditions in communities near ports, freeways, rail lines and designated truck routes in Alameda County. ACPHD staff identified which areas of Alameda County are most to least impacted by freight transport based on three key factors - proximity to freight infrastructure, exposure to freight transport impacts such as air emissions, and vulnerability to health impacts of freight transport. This analysis revealed that the areas of the county that are most freight-impacted are in West Oakland and adjacent parts of downtown/ Chinatown, East Oakland, Ashland-Cherryland and parts of nearby San Leandro and Hayward, and part of Newark.

ACPHD's analysis found that these communities have levels of diesel particulate emissions that were over twice as high as the least freight-impacted areas in the county. The county's most freight-impacted areas also have more than three times higher rates of visits to the emergency department for asthma when compared to the least freight-impacted areas. For example, the rate of asthma visits to the emergency department from East Oakland residents – both for adults and children under five years of age - is over two times higher than the Alameda County rate and one of the highest in the county. Rates of pedestrian injuries and deaths are over seven times higher in the county's most freight-impacted areas. Unemployment rates in these areas are more than twice as high as the least freight-impacted areas in the county. Figure 1 below shows a map of exposure and vulnerability to freight transport by census tract in Alameda County, with the most freight-impacted areas shown in very dark red.

FIGURE 1

Exposure and Vulnerability to Freight Transport in Alameda County



Source: CAPE, 2015

ASSESSING POTENTIAL HEALTH IMPACTS OF PROPOSED CHANGES TO THE COUNTY FREIGHT SYSTEM

Ditching Dirty Diesel Collaborative members then prioritized a subset of strategies - proposed changes to the freight transport system - in the draft Alameda County Goods Movement Plan to analyze for potential impacts to health. Selected strategies include:

1) Oakland Army Base Phase 2 – Intermodal Rail Improvements
2) Other Proposed Rail Expansion Strategies
3) Develop/Support Workforce Training Programs
4) Near-Zero and Zero-Emission Goods Movement Technology Advancement Program
5) Freight Corridors Community Enhancement and Impact Reduction Initiative
6) Truck Route Coordination Planning/Guidance

Researchers working on this HIA then assessed the potential health impacts of each of these strategies for each of the factors that affect health outcomes being analyzed (air quality, traffic safety and employment). Due to the low level of detail provided in the descriptions of these strategies in the draft Plan, this HIA was largely qualitative and examined whether there was evidence to indicate whether these types of strategies would improve or worsen health outcomes. Table 1 below summarizes the results of this analysis for each the selected strategies in the draft Plan.

TABLE 1

Summary of Potential Health Impacts for Selected Strategies in the Draft Plan

	HEALTH DETERMINANT & DIRECTION OF CHANGE		
SELECTED STRATEGY	**AIR QUALITY**	**TRAFFIC SAFETY**	**EMPLOYMENT**
Oakland Army Base Redevelopment Phase 2 - Rail Improvements	⬇ in air quality in West Oakland; potential benefits to regional air quality	Possible ⬇ in pedestrian safety around Port entrances	⬆ in local hire jobs created in construction and operations for Oakland residents
Proposed Rail Expansions	⬇ in air quality along rail lines in Western Alameda County	Possible ⬆ in pedestrian safety at rail crossings with grade separations	Quality and quantity of local jobs created is unclear
Workforce Training Programs	N/A	N/A	Possible⬆ in middle-wage jobs with low barriers to entry
Zero- and Near-Zero Emissions Technology Advancement Program	Partial ⬆ in air quality by lowering diesel particulate matter emissions; use of alternative fuels could increase NOx and CO2 emissions	N/A	Quality and quantity of local jobs created is unclear
Freight Corridors Community Enhancement & Impact Reduction Program	Possible ⬆ in indoor air quality along freight corridors	Possible ⬆ in traffic safety along freight corridors	Quality and quantity of local jobs created is unclear
Truck Route Coordination Planning Guidance	Possible ⬇ in air quality along designated truck routes, with potential benefits to air quality on other streets	Possible ⬆ in traffic safety along truck routes	Quality and quantity of local jobs created is unclear

This HIA found that strategies to expand freight infrastructure and operations in Alameda County will likely increase negative outcomes associated with air quality and traffic safety in communities near existing freight routes and facilities. Strategies that would expand freight infrastructure and operations can reduce adverse impacts and maximize benefits to communities if adequate mitigation measures are incorporated into their design and implementation.

RECOMMENDATIONS FOR A HEALTHIER FREIGHT TRANSPORT SYSTEM THAT BENEFITS ALL RESIDENTS

While many of these promising measures are already listed as priority strategies in the draft Plan, the Alameda County Transportation Commission (ACTC) should prioritize the implementation of such mitigation strategies for funding and target freight-impacted communities for mitigations in order to address the health inequities caused by the existing and planned freight transport system. ACTC can also require that these strategies to reduce adverse impacts and maximize benefits be implemented alongside strategies to expand freight infrastructure and operations.

The HIA includes case studies detailing promising practices that have been applied in other communities to maximize benefits and minimize harms to health of these types of changes to the freight transport system. A case study of a community-led truck rerouting campaign in the Barrio Logan neighborhood adjacent to the Port of San Diego found that rerouting trucks reduced fine particulate matter emissions in the neighborhood after several mitigation measures were implemented by the City of San Diego and local freight transport facilities, such as relocating a polluting warehouse out of the community and installing a gateway sign preventing trucks from entering the neighborhood on a prohibited street. Another case study assessed the potential impacts to health of transporting more freight by rail instead of by truck, finding that optimal air quality benefits will likely result from a combination of measures including shifting freight onto trains instead of trucks for long-haul trips and strictly enforcing regulations to reduce emissions for locomotives and other rail equipment.

The HIA also provides recommendations for implementing the draft Plan to maximize benefits and minimize harms to health. These include:

- ACTC should meaningfully engage communities and residents impacted by the county's freight transport system in each stage of Plan implementation
- ACTC should immediately seek funding for strategies in the Plan to reduce environmental and community impacts from freight transport
- ACTC should work with the Alameda County Public Health Department and the Bay Area Air Quality Management District (BAAQMD) to assess the impacts that are likely to occur and need mitigation from proposed Plan strategies that increase the efficiency and capacity of the county's freight transport system
- ACTC should target impact reduction investments to benefit those communities most impacted by the county's freight transport system
- No strategies at the project, program or policy level should be implemented that increase health inequities for residents of impacted communities

To achieve its goal of reducing the adverse impacts of the freight transport system and improving quality of life for all residents, the draft Plan should include an analysis of whether proposed future changes to the county's freight system would reduce or exacerbate existing health disparities in already overburdened communities. The draft Plan should also prioritize existing freight-impacted communities for the implementation of strategies to maximize community benefits and minimize harms to health, such as emissions reduction and workforce development. Taking these steps will help ensure a more equitable freight system of the future.

III. INTRODUCTION: FREIGHT TRANSPORT AND HEALTH IN ALAMEDA COUNTY

Our system of transporting raw materials and products from where they are extracted or made to where they are sold, also known as goods movement or freight transport, does not benefit all communities equally. As this report shows, communities next to freight hubs and corridors like freeways, designated truck routes, ports, and rail lines bear the brunt of diesel pollution and other negative impacts of Alameda County's freight transport system. This report identifies the potential impacts of proposed changes to the county's freight transport system as detailed in the Alameda County Goods Movement Plan. The report then outlines ways that the implementation of this Plan can better protect and improve the health of those communities most impacted by the county's freight transport system.

In Alameda County, communities most impacted by freight transport include West Oakland next to the Port of Oakland and neighborhoods along the I-880 corridor like the Fruitvale District and East Oakland. Residents of the county's freight-impacted communities are predominantly low-income, African American and Latino. These communities contend with increased rates of cancer, asthma and other respiratory illness, cardiovascular disease, and pedestrian injuries. Despite hosting the freight routes that enable our economy to thrive, these communities also face social and economic challenges like high rates of poverty and unemployment.

The Alameda County Goods Movement Plan outlines a long-range strategy for how to transport freight efficiently, reliably and sustainably within, to, from and through Alameda County by road, rail, air and water. One of the Plan's five stated goals is to "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."[1] This Health Impact Assessment (HIA) of the Alameda County Goods Movement Plan (hereafter, the draft Plan) aims to advance this goal of improving health and quality of life by outlining ways that future changes to the county's freight system can be implemented to maximize benefits and minimize harms to health in impacted communities. An HIA assesses the potential impacts to health – both positive and negative – of a proposed decision, program, policy or project.

This HIA focuses on three aspects of the freight transport system that affect health, namely: 1) Air quality; 2) Traffic safety; and 3) Employment. The HIA identifies those communities in Alameda County that are currently most impacted by health outcomes related to these three aspects of the county's freight transport system, such as asthma, cardiovascular disease, and pedestrian injuries. The HIA then evaluates the potential impacts of proposed changes to the freight transport system in the draft Plan on air quality, traffic safety, employment, and their related health outcomes. This HIA also includes case studies detailing best practices that have been applied in other communities to maximize benefits and minimize harms to health of these types of changes to the freight transport system. Finally, the HIA includes recommendations for implementing the draft Plan to address health inequities of the county's current and future freight transport system.

IV. BACKGROUND ON THIS HEALTH IMPACT ASSESSMENT

This HIA of the Alameda County Goods Movement Plan was conducted by the Ditching Dirty Diesel Collaborative (DDD) in partnership with the Alameda County Public Health Department. DDD is an independent regional coalition of over a dozen community groups, environmental organizations, and public health departments working to reduce exposure to diesel pollution in the San Francisco Bay Area. The New Voices Are Rising Program at the Rose Foundation for Communities and the Environment, a DDD member, coordinated the stakeholder engagement activities for this HIA. Other DDD members, including Regional Asthma Management and Prevention and the West Oakland Environmental Indicators Project, provided guidance to the research team in developing and implementing this HIA at monthly DDD meetings.

In addition to DDD staff, members of the research team that conducted portions of this HIA included the Alameda County Public Health Department (ACPHD) and Human Impact Partners. ACPHD's Community Assessment, Planning and Evaluation (CAPE) Unit conducted the analysis of existing health conditions in communities most impacted by the county's freight transport system summarized in Part V of this report. Human Impact Partners (HIP), an independent consulting firm specializing in HIA methods, conducted a portion of the analysis of potential impacts of proposed changes to the freight transport system detailed in Part VI of this report. HIP also provided technical assistance to DDD in carrying out this HIA and led a training on HIA methods for DDD members.

DDD has been an active participant in the Alameda County Goods Movement Plan process since this process was launched by the Alameda County Transportation Commission (ACTC) in spring 2014. DDD members attended each of the community engagement meetings, or roundtables, hosted by convening agencies and consultants to inform the planning process. DDD members also provided written comments on the stakeholder engagement process for the draft Plan, the evaluation of proposed strategies – changes to the freight system – to be included in the draft Plan, and the draft Plan released in November 2015. DDD is a member of the Technical Advisory Committee for the Alameda County Goods Movement Plan and in this capacity has also provided feedback on technical documents informing the planning process.

In addition to participating in stakeholder engagement activities for the draft Plan, DDD hosted a series of four community workshops to discuss the draft Plan's potential impacts to health and quality of life. Over 50 community leaders, youth, environmental and health advocates, and residents of freight-impacted communities participated in these workshops. The workshops were timed to inform the methods used in this HIA to evaluate the draft Plan's potential health impacts and to share preliminary results of phases of the HIA with interested stakeholders. At the first community workshop, held in December 2014, participants discussed the overall goals and research questions for the HIA, including the aspects of the freight transport system that the HIA would focus on. At the second workshop, held in January 2015, participants discussed the scope of the HIA, or the existing and potential health impacts of the county's freight transport system that would be assessed. The final scope of this HIA, which focuses on air quality, traffic safety, and employment impacts, was determined by DDD members based on feedback received at the scoping workshop and is described in more detail in Appendix A of this report.

At a third workshop held in June 2015, DDD staff shared preliminary results of research on existing air quality, traffic safety, and employment impacts of the freight transport system in Alameda County. Workshop participants then discussed approaches to assessing the potential impacts of proposed changes to the freight transport system, or strategies, in the draft Alameda County Goods Movement Plan that could be included in the HIA. Finally, at a fourth workshop held in December 2015, ACPHD staff presented the results of research on existing health conditions in freight-impacted communities in Alameda County. The research team also shared preliminary results of research on potential health impacts of selected proposed changes to the freight transport system in the draft Plan. Participants then discussed recommendations for how to address existing and potential impacts of the county's freight transport system. The strategies and recommendations selected for inclusion in this HIA were determined by DDD members based on feedback received at these workshops.

To assess the potential impacts of proposed changes to the freight transport system, DDD members prioritized a subset of the more than 100 strategies included in the technical documents informing the draft Plan. During a series of meetings in spring 2015, DDD members developed a set of criteria for selecting the strategies to include in this HIA:

- Strategies should be countywide and/or applicable to a wide range of proposed projects and programs
- Strategies should address one or more of the factors that affect health, or health determinants, that this HIA focuses on (air quality, traffic safety and employment)
- Strategies should address multiple modes of freight transport (air, rail, road, and maritime)
- The impact analysis/assessment of such strategies should build on available data on existing health conditions in freight-impacted communities in Alameda County
- Strategies selected should include both strategies that could improve health outcomes and strategies that could result in negative health impacts

Based on these criteria as well as the three opportunity packages - sets of proposed strategies or changes to the county's freight transport system - included in the draft Plan, DDD members selected the following proposed strategies in the draft Plan as the focus of this HIA:

1) Oakland Army Base Phase 2 – Intermodal Rail Improvements
2) Other Proposed Rail Expansion Strategies
3) Develop/Support Workforce Training Programs
4) Near-Zero and Zero-Emission Goods Movement Technology Advancement Program
5) Freight Corridors Community Enhancement and Impact Reduction Initiative
6) Truck Route Coordination Planning/Guidance

For each of these strategies, this HIA discusses the potential health impacts for each of the health determinants being analyzed (air quality, traffic safety and employment). Due to the low level of detail provided in the strategy descriptions included in the draft Plan, the HIA is largely qualitative and focuses on assessing how, rather than to what extent, these strategies may impact these factors. The methods used to assess existing and potential health impacts of the county's freight transport system in this HIA are described further in Appendix A of this report.

Where applicable, this HIA also lists assumptions made to identify the potential health and equity impacts of each of these strategies. The HIA summarizes the description of these strategies included in the draft Plan and its appendices. Finally, this HIA includes recommendations for strategy implementation, such as mitigation measures needed to the address potential health impacts of the proposed strategies and opportunity packages, as well as policies to ensure effective implementation of these mitigations and a more equitable distribution of their burdens and benefits within Alameda County. The results of this HIA are detailed in Part VI of this report.

Along with organizing community workshops to inform the HIA, DDD members met with ACTC staff and consultants to share proposed methods and preliminary results of the HIA on the draft Alameda County Goods Movement Plan. DDD members also met with ACTC Commissioners to share recommendations based on the HIA results for how to incorporate existing and potential health impacts of the freight transport system into the draft Plan. These recommendations are summarized in Part VII of this report.

V. EXISTING IMPACTS OF THE FREIGHT TRANSPORT SYSTEM IN ALAMEDA COUNTY

A. IMPACTS OF THE FREIGHT TRANSPORT SYSTEM ON FACTORS THAT AFFECT HEALTH

1. AIR QUALITY

Over 40 toxic air contaminants are present in diesel exhaust. Studies have shown that a number of these contaminants have varied impacts on human health including cardiovascular disease, respiratory illness, and cancer. The California Air Resources Board (ARB) estimates that over 70% of airborne cancer risk in the state of California is attributable to exposure to diesel exhaust. The short-term (acute) health effects of exposure to diesel exhaust include irritation of the eyes, nose, throat, and lungs, nausea, headaches, and higher susceptibility to other allergens like dust and pollen. The long-term (chronic) health effects of exposure to diesel exhaust include respiratory illness like asthma and bronchitis, reduced lung function in children, high blood pressure, increased risk of stroke and heart disease, and premature mortality.[2]

One of the primary components of diesel exhaust is particulate matter (PM). Short-term (acute) exposure to coarse PM (size 10-2.5 micrograms) has been linked to health effects including increases in hospital admissions and emergency room visits for cardiovascular and respiratory causes. Long-term (chronic) exposure may be linked to heart disease, premature mortality and low birth weight. Short-term (acute) exposure to fine PM (2.5 or smaller) can cause reduced blood flow to the heart, stiffening of the blood vessels, and congestive heart failure. Short-term exposure to fine PM can also cause reduced lung function in children, chronic obstructive pulmonary disease, and premature mortality. Long-term exposure to fine PM can cause high blood pressure, hardening of the arteries, and increased risk of heart disease and stroke.[3] Chronic exposure to fine PM has also been linked to asthma, bronchitis, lung cancer, and premature mortality. Prenatal exposure to fine PM has been linked to maternal and child health outcomes such as low birth weight (which is in turn linked to an increased risk of infant mortality and diabetes)[4] as well as pre-term birth[5] and maternal health conditions associated with preterm birth, such as preeclampsia (high blood pressure during pregnancy).[6]

In addition to particulate matter, diesel exhaust contains a number of toxic air contaminants including nitrogen oxides, sulfur oxides, carbon monoxide, benzene, 1,3 butadiene, formaldehyde, and acetaldehyde. The health effects of exposure to nitrogen oxides include damaged lung tissue, increased susceptibility to respiratory diseases, and aggravation of asthma and other chronic lung diseases. Nitrogen oxides contribute to the creation of ground-level ozone, which is also a respiratory irritant. Sulfur dioxides and aldehydes (including formaldehyde and acetaldehyde) can irritate the respiratory tract and the eyes. Formaldehyde and benzene are also known carcinogenic compounds. Other symptoms associated with exposure to diesel exhaust can include chest pain, headaches, dizziness, laryngitis, memory loss, and insomnia.[7]

Air pollution from diesel trucks and other mobile sources is concentrated near major roadways such as highways. People who live, work or go to school near major roads have higher rates and more severe health conditions associated with air pollution from roadway traffic. Health conditions associated with near-roadway exposures to air pollution include the onset and aggravation of asthma, cardiovascular disease, reduced lung function in children, preterm and low birth weight infants, childhood leukemia, and premature death.[8] For example, a study of children enrolled at schools upwind and downwind from busy roads in the East San Francisco Bay Area found an association between exposure to traffic-related pollutants and asthma and bronchitis symptoms in study participants.[9] Other populations that are disproportionately exposed to diesel exhaust include workers in the freight transport industry, such as truck drivers and other operators of diesel-powered vehicles. Populations that are particularly sensitive to exposure to diesel exhaust include the elderly, children, those with chronic respiratory or heart conditions, and pregnant women.[10]

According to the Bay Area Air Quality Management District (BAAQMD), cancer risk-weighted emissions in the Bay Area are highest in areas in proximity to transportation infrastructure including freeways, seaports, and airports.[11] BAAQMD identified Western Alameda County, including portions of the cities of Oakland, Berkeley, San Leandro,

and Hayward along the I-880 corridor, as sites where levels of PM 2.5 periodically exceeded the federal maximum allowable concentration (35 mg per cubic meter) in the past three winters (2010-2012). BAAQMD also identified parts of Eastern Alameda County, including portions of the cities of San Ramon and Livermore, as sites where ozone levels periodically exceeded the federal maximum allowable concentration of 75 parts per billion (ppb) three or more times from 2011-2013.[12]

Through its Community Air Risk Evaluation (CARE) Program, BAAQMD assessed where air pollution is concentrated in the region and where residents most vulnerable to air pollution-related health impacts reside. Pollutants considered in identifying impacted communities included Toxic Air Contaminants (TACs), fine Particulate Matter (PM 2.5) and ozone. The analysis also considered the following air pollution-related health impacts: 1) Potential cancer risk from TACs; 2) Increased mortality rates from elevated PM 2.5 and ozone concentrations; and 3) Increased costs from emergency room visits and hospitalizations for respiratory and cardiovascular diseases associated with elevated PM 2.5 and ozone concentrations. The analysis applied the US EPA's BenMAP methodology to predict increases in adverse health outcomes associated with both air pollution levels from monitoring and modeling results as well as baseline health conditions as documented in health records.[13]

BAAQMD then generated a Pollution-Vulnerability Index (PVI) based on these air pollution levels and associated health outcomes to identify and map communities with the highest health risk from air pollution in the region.[14] Index scores range from 0 (least impacted) to 1000 (most impacted by health risks from air pollution in the region). This analysis identified western Alameda County along the I-880 corridor and portions of the cities of Berkeley, Alameda, Oakland and Hayward as an impacted community.

The BAAQMD analysis shows that 17 out of 44 (38%) of the zip codes in the Bay Area in the highest quintile of PVI scores (eg scores ranging from 80-100, or those areas with the highest health risks from air pollution in the region) are in Alameda County. These zip codes are: 94601,94603, 94606, 94607, 94609, 94612, 94613, and 94619 in Oakland; 94702 and 94710 in Berkeley; 94541 and 94545 in Hayward; 94501 in Alameda; 94578 in San Leandro; and 94608 in Emeryville.[15]

The BAAQMD analysis shows that half of the zip codes (11 out of 22) in the Bay Area with the most elevated cancer risk from toxic air contaminants (above 300 per million) are located in Alameda County. Cancer risk is defined as combined risk per million from lifetime exposure to current concentrations of benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and diesel exhaust. These zip codes are: 94601, 94606, 94607, 94609 and 94610 in Oakland; 94701 and 94710 in Berkeley; 94501 and 94502 in Alameda; and 94608 in Emeryville.[16]

The BAAQMD analysis found that, on average, residents in areas with the highest PVI scores live three years less than residents in the areas with the lowest PVI scores.[17] It also found that the average annual household income is more than $40,000 lower in the areas with the highest Pollution Vulnerability Index or PVI scores (80-100) than in the areas with the lowest PVI scores. Areas with the highest PVI scores are nearly 70 percent non-white. In contrast, areas with the lowest PVI scores are more than 70 percent white. The percentage of Latino residents in the areas with the highest PVI scores is double that in areas with the lowest PVI scores. The percentage of Black residents is more than five times higher in the areas with the highest PVI scores than areas with the lowest PVI scores. The analysis also found that, on average, residents in areas with the highest PVI scores have a year and a half less education than residents in areas with the lowest PVI scores.[18]

In 2006, the California Air Resource Board (CARB) issued guidelines that recommend that sensitive land uses not be sited within recommended health-protective distances from freight transport-related land uses. CARB-recommended buffer distances are 500 feet from freeways, 1000 feet from rail yards, and 1000 feet from warehouses and distribution centers. In 2011 the Ditching Dirty Diesel Collaborative and Pacific Institute conducted a study that applied these CARB-recommended distances around freight transport infrastructure around the region to assess how many sensitive receptors were located in close proximity to freight-related land uses. Sensitive receptors are defined as land uses where populations who are particularly sensitive to freight-related emissions, such as children, the elderly, and those with preexisting medical conditions, spend a lot of their time. In addition to applying the 1000 foot CARB-recommended buffers around rail yards, warehouses and distribution centers, the analysis applied a 1000 foot buffer around freeways and 2000 foot buffers around seaport and airport facilities based on available health risk assessments of specific freight transport

facilities in the area. The analysis found that, in Alameda County, there were 30 parks, 45 schools, 5 hospitals and 87 churches located within the health-protective buffers around freight-related land uses in the county.[19]

THIS DATA INDICATES THAT, BY MULTIPLE MEASURES, SPECIFIC AREAS IN ALAMEDA COUNTY HAVE HIGHER CONCENTRATIONS OF BOTH POOR AIR QUALITY ASSOCIATED WITH FREIGHT TRANSPORT AND VULNERABLE POPULATIONS. THESE AREAS INCLUDE PARTS OF OAKLAND, BERKELEY, HAYWARD, EMERYVILLE, AND SAN LEANDRO.

2. TRAFFIC SAFETY

Traffic collisions are the largest cause of death from unintentional injuries in the United States, with highway collisions accounting for over 95% of transportation fatality risk. In 2008, the fatality rate in truck-involved highway collisions was 50% higher than that for all motor vehicles at 1.87 versus 1.26 fatalities per 100 million vehicle miles. The majority (85%) of fatalities in truck-involved collisions are highway users other than truck occupants. Though truck-involved fatality rates on U.S. highways have decreased in the past decades, these improvements have largely been offset by the increase in the amount of truck traffic on highways.[20]

A review of the literature on interstate truck crashes found a number of causes and potential measures to reduce truck-involved collisions. Causes of interstate truck crashes include reduced visibility of other vehicles and road users, inadequate safe commercial vehicle parking on or near interstates, and inadequate training for truck drivers and other driver-related factors such as fatigue. Potential measures that have been employed to reduce the likelihood of interstate truck crashes include setting different speed limits for trucks and cars and instating truck traffic restrictions such as diverting trucks from congested corridors during peak times or restricting trucks to certain lanes and portions of routes. Other potential measures include increased education to the general population about how to share the road safely with large vehicles and increasing enforcement and safety advisory signs on corridors with a high number of truck collisions.[21]

In addition to general causes of truck crashes, there are a number of factors that contribute to truck-involved collisions resulting in pedestrian injuries. A summary study of U.S. truck collisions resulting in pedestrian injuries in the 1990s found that the three largest contributing factors for pedestrians to these crashes were pedestrians running into the road (15%), failing to yield to oncoming truck traffic (11.8%), and being alcohol-impaired (10.3%). The three largest contributing factors for truck drivers to these crashes were drivers failing to yield to the pedestrian (15%), exceeding the speed limit or safe driving speed (6.2%), and improper backing (5.6%).[22]

A number of potential measures can be instituted to change roadway behaviors and other factors contributing to truck crashes for both pedestrians and drivers. These measures include the use of Intelligent Transportation Systems (ITS) technology such as red light photo enforcement cameras, automated pedestrian detection, and countdown signals to change roadway behaviors.[23] Another type of measure that can be used is infrastructure enhancements such as reducing vehicle speeds, separation of pedestrians and vehicles, and measures to increase the visibility of pedestrians.[24]

About two-thirds of railroad fatalities (64%) are pedestrians and other non-motorized persons. The number of fatalities due to collisions between trains and vehicles at highway-rail crossings declined by 44% from 1994-2007.[25] The decline in highway-rail grade crossing collisions has been attributed to five major factors, namely improvements in commercial driver safety, increased visibility of trains, more reliable motor vehicles, removal of obstructions surrounding grade crossings to improve sight distance, and legislation to improve grade crossing maintenance.[26] The number of pedestrian and bicyclist fatalities at these crossings during that same time period remained relatively unchanged.[27]

Most of the estimated 3 to 4 billion tons of hazardous materials transported in the U.S. annually are moved by truck. Approximately 10% of hazmat volume is transported by rail, with most of this being in bulk shipments that can heighten the consequences of a release incident.[28] The rate of U.S. hazardous materials releases due to railroad collisions has declined by nearly 90% since 1980. This decline has been attributed to the use of improved safety measures such as infrastructure improvements, improved tank car design, better employee training, and technological advancements.[29]

An analysis of railroad derailment incidents from 1992 to 2001 found that speed of derailment and number of cars derailed are both highly correlated with hazardous materials releases. Several causes of these railroad derailment incidents were found to pose the greatest risk, namely broken rails or welds, buckled track, train handling (excluding use of brakes), and broken wheels.[30] Railway improvements to reduce the risk of railroad hazmat release incidents include enhancing packaging and tank car safety design, upgrading track infrastructure, changing routing for trains transporting hazardous materials, reducing train speed, and improving emergency response practices.[31]

The Safe Transportation Research and Education Center at the University of California-Berkeley maintains a Transportation Injury Mapping System (TIMS) based on traffic collisions data from the California Highway Patrol's Statewide Integrated Traffic Record System (SWITRS). In 2012, 241 truck-involved collisions and 3 collisions involving a train were reported in Alameda County.[32] 159 of the 241 (66%) truck-involved collisions occurred along state highways and connecting routes. Two of the three (66%) train-involved collisions occurred on rail lines along state highways and connecting routes. Of the 241 truck-involved collisions, eight involved pedestrians, eight involved bicyclists, three resulted in fatalities, 9 resulted in severe injuries, 71 (29.5%) resulted in visible injuries, and 158 (65.6%) resulted in complaints of pain.[33] One of the three train-involved collisions involved a bicyclist. Two of the three train-involved collisions resulted in visible injuries and one resulted in fatalities.

The California Governor's Office of Emergency Services (OES) collects data on reported significant or threatened releases of hazardous materials throughout the state. In 2014, there were a total of 299 reported incidents of hazardous materials releases in Alameda County. Together, these reported hazmat incidents resulted in 13 known injuries and 16 known fatalities. Of the 10 reported incidents involving known injuries, 6 occurred along a roadway and 1 occurred along a rail line. Seven of the 10 reported incidents involving known injuries were the result of collisions. Of the 16 reported incidents involving known fatalities, 2 occurred along a roadway and 13 occurred along a rail line. One of the 16 reported incidents involving fatalities was the result of a collision.[34]

The Needs Assessment informing the draft Alameda County Goods Movement Plan identified that collisions involving freight trucks comprise approximately 4% of total collisions involving injuries in the county. The Needs Assessment also found that truck-involved collisions comprise a higher percentage of collisions involving fatalities, indicating that these types of collisions tend to be more severe. Top truck crash locations in Alameda County include several in proximity to interstate highway on- and off-ramps connecting to major arterials.[35]

The Needs Assessment for the draft Plan also states that freight truck traffic can create conflicts with other street users, such as pedestrians or bicyclists. These mode conflicts can pose safety hazards, particularly when a designated truck route street also includes bike lanes and bus routes. The Needs Assessment found that many truck routes along major arterials in the county are also medium- and high-frequency bus routes. These include University Avenue in Berkeley (AC Transit Route 51B),

San Pablo Avenue (AC Transit Route 72, 72M and 72R), International Boulevard in Oakland (AC Transit Route 1 and 1R), and Hegenberger Road in Oakland (AC Transit Route 73).[36] Intersections along several of these streets are also on the map of top truck-involved collision locations in Alameda County included in the Needs Assessment, indicating that freight truck traffic affects walkability and bikeability on these streets.

THIS DATA INDICATES THAT TRUCK- AND TRAIN-RELATED COLLISIONS TEND TO RESULT IN MORE SERIOUS INJURIES THAN OTHER TYPES OF COLLISIONS. THE NEEDS ASSESSMENT FOR THE DRAFT PLAN INCLUDES A MAP OF WHERE PAST TRUCK- AND TRAIN-RELATED COLLISIONS IN THE COUNTY HAVE OCCURRED.

3. EMPLOYMENT

The California Employment Development Department (EDD) provides labor market information for the state including employment and occupations by industry sector based on the North American Industry Classification System (NAICS). Freight transport-related businesses or employers are classified under the transportation and warehousing industry. These include air transportation (NAICS 481000), rail transportation (NAICS 482000), water transportation (483000), truck transportation (NAICS 484000), support activities for transportation (NAICS 488000), couriers and messengers (NAICS 492000), and warehousing and storage (NAICS 493000).[37]

The EDD provides current industry employment data by Metropolitan Statistical Area (MSA) or Metropolitan Division (MD), not by county. Alameda County and Contra Costa County are in the Oakland-Fremont-Hayward Metropolitan Division (MD). In 2013, the Oakland-Fremont-Hayward MD had 1,120 businesses in the transportation and warehousing industry, which together employed 28,529 people.[38]

Freight-related occupations in the transportation and warehousing industry include: Aircraft pilots; ship captains; truck drivers; crane and tower operators; dispatchers; mechanics; maintenance and repair workers; freight, stock and material movers; stock clerks; cargo and freight agents; computer and information system managers; and transportation, distribution and storage managers. Annual salaries for these occupations range from an average of $24,000 for hand packers and $46,000 for truck drivers, to $106,000 for transportation, distribution and storage managers.[39]

According to the 2013 American Community Survey (ACS), the employed population in Alameda County (e.g., civilian employees 16 years or older) was 732,923. Of these employed persons, 32,603 (or 4.4 percent) were employed in the transportation and warehousing industry. Approximately three out of four people (73.8%) employed in the transportation and warehousing industry in Alameda County were male employees. The median annual earnings for employees in this industry in Alameda County was $44,241.[40]

The U.S. transportation and warehousing industry had the second highest fatal work injury rate of any U.S. industry in 2013 (13.1 injuries per 100,000 full-time equivalent workers). Of these fatal injuries in the transportation and warehousing industry, the majority (484 out of 687 total fatal injuries) occurred in truck transportation, and were primarily due to accidents and other transportation incidents.

By occupation in 2013, heavy and tractor-trailer truck drivers had the highest amount of occupational injuries in the U.S. transportation and warehousing industry, at 659 total fatal injuries. The majority of these fatal injuries (447 out of 659) were attributed to roadway incidents involving motorized land vehicles. In 2013 material moving workers had 222 total fatal injuries. The majority of these fatal injuries (113 out of 222) involved laborers and material movers by hand.

THIS DATA INDICATES THAT FREIGHT WORKERS ARE PARTICULARLY VULNERABLE TO OCCUPATIONAL INJURIES AND FATALITIES COMPARED TO OTHER OCCUPATIONS. IT IS NOT CLEAR WHETHER JOBS AVAILABLE IN THE FREIGHT TRANSPORT SECTOR IN ALAMEDA COUNTY BENEFIT RESIDENTS OF COMMUNITIES WHERE FREIGHT ROUTES AND FACILITIES ARE LOCATED, DUE TO A LACK OF READILY AVAILABLE DATA TO ASSESS WHERE FREIGHT WORKERS IN THE COUNTY LIVE.

A. EXISTING HEALTH CONDITIONS IN FREIGHT-IMPACTED COMMUNITIES

To inform this HIA, the Alameda County Public Health Department (ACPHD) conducted an analysis of existing health, environmental, and economic conditions in freight-impacted communities in Alameda County. ACPHD staff identified and prioritized which areas of Alameda County are most to least impacted by freight transportation based on three key factors - proximity to freight infrastructure, exposure to freight impacts such as air emissions, and vulnerability to health impacts of freight - to identify what parts of the county are most impacted by freight. In order to identify most- versus least freight-impacted communities, ACPHD staff calculated an index score that included the following:

1. Proximity to designated truck routes, rail lines, Port of Oakland, and Oakland airport
2. Freight exposure, as measured by diesel particulate matter emissions estimates along with amount and percentage of population living in proximity to freight; and
3. Vulnerable populations, with an emphasis on people in poverty, as well as young children, seniors, people of color, and freight workers - all of whom are especially vulnerable to freight exposure and health impacts.

FIGURE 4

Exposure and Vulnerability to Freight in Alameda County

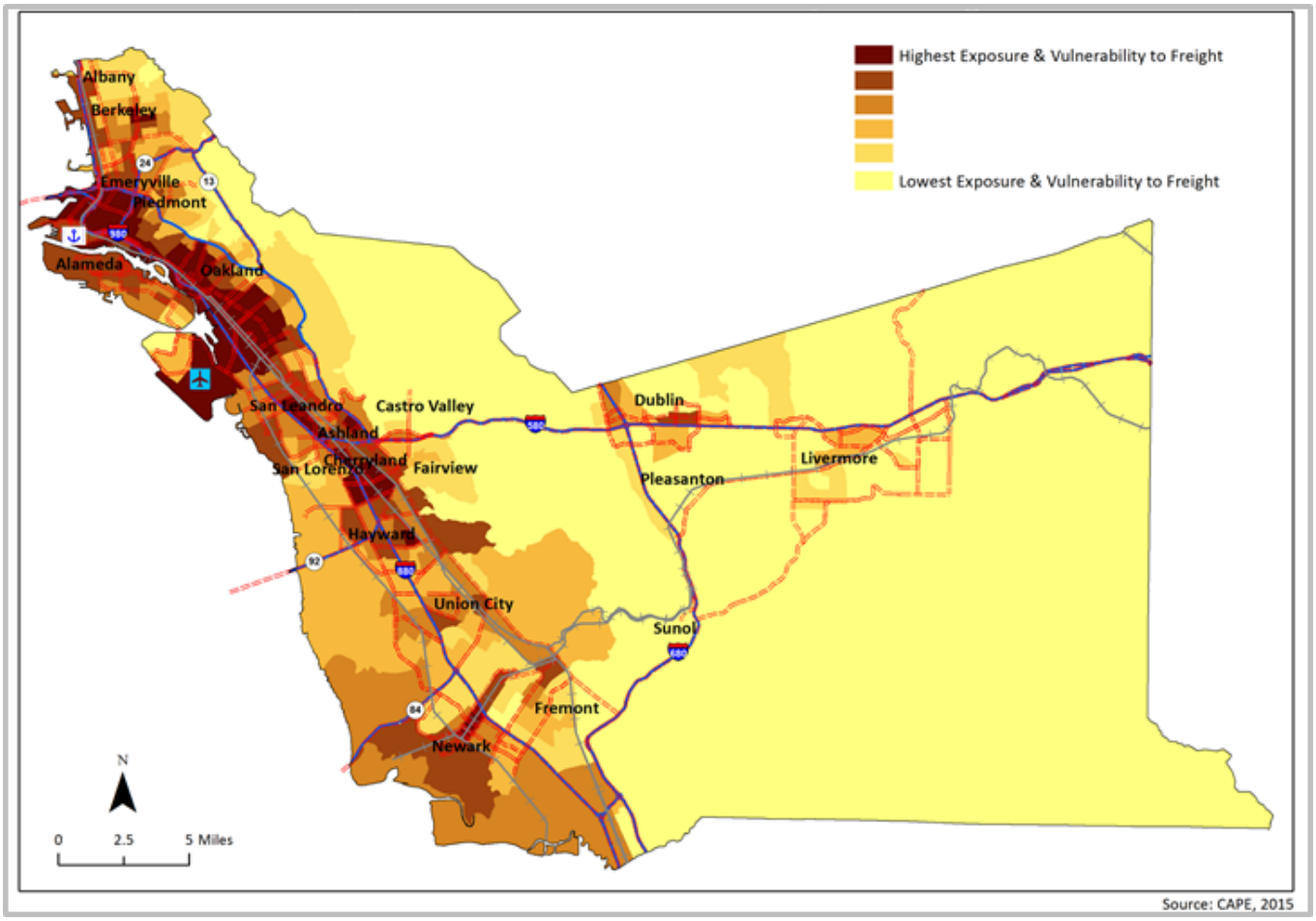


Figure 4 above shows a map of the calculated index scores of exposure and vulnerability to freight by census tract. Shown in very dark red, the areas of the county that are most freight-impacted are in West Oakland and adjacent parts of downtown/Chinatown; East Oakland; Ashland-Cherryland and parts of nearby San Leandro and Hayward; and part of Newark.

ACPHD's analysis found that these communities had levels of diesel particulate emissions that were over twice as high as the least freight-impacted areas in the county. The county's most freight-impacted areas also have more than three times higher rates of visits to the emergency department for asthma when compared to the least freight-impacted areas. For example, the rate of asthma visits to the Emergency Department (ED) from East Oakland residents – both adults and children under five years of age – is over two times higher than the Alameda County rate and one of the highest in the county. Rates of pedestrian injuries and deaths are over seven times higher in the county's most freight-impacted areas. These areas also have more than twice as high rates of unemployment when compared to the least freight-impacted areas in the county. The results of this analysis are summarized in Figures 5, 6 and 7 below.

FIGURE 5

Environmental Conditions in Most vs Least Freight-Impacted Areas in Alameda County

	Most Freight-Impacted (Top 60 CTs)	**Least Freight-Impacted** (Bottom 60 CTs)	**Rate Ratio** (Most vs. Least Freight-Impacted)
Average **Diesel PM Emissions** from on-road and non-road sources (kg/day)	41.26	15.83	2.61
Average Concentrations of **Toxic Chemical Releases to Air** from facilities	860.36	343.05	2.51
Sum of weighted **"Brownfield" Sites Undergoing Cleanup** due to presence of hazardous substances	36.56	4.91	7.44
Sum of weighted scores for **Sites Undergoing Cleanup due to Groundwater Contamination**	86.41	21.54	4.01
Summed number of pollutants across all **Water Bodies Designated as Impaired**	7.30	1.88	3.88
Average Percent of **Land Without Tree Cover**	99%	87%	1.14

Source: CAPE with data from CalEnviroscreen 2.0 based on CARB estimates, 2010 (diesel PM); US EPA RSEI model, 2010 (toxic chemical releases); DTSC EnviroStor, 2014 (brownfield sites); SWRCB GeoTracker Database, 2014 (impaired water bodies); National Land Cover Database, 2011 (tree cover)

FIGURE 6

Health Outcomes in Most- vs Least Freight-Impacted Areas in Alameda County

	Most Freight-Impacted (Top 60 CTs)	Least Freight-Impacted (Bottom 60 CTs)	Rate Ratio (Most vs. Least Freight-Impacted)
Average Asthma Emergency Department Visit Rate (per 100,000 persons)	1184.7	328.9	3.60
All-Cause Mortality Rate (per 100,000 persons)	769.1	506.3	1.52
Cancer Mortality Rate (per 100,000 persons)	171.0	140.8	1.21
Coronary Heart Disease Mortality Rate (per 100,000 persons)	105.6	72.2	1.46
Chronic Lower Respiratory Disease Mortality Rate (per 100,000 persons)	40.5	28.3	1.43
Average Low Birth Weight Rate (per 100 births)	5.33%	5.08%	1.05
Pedestrian Injury & Death Rate (per 100,000 persons)	92.9	12.9	7.21

Source: CAPE with data from CalEnviroscreen 2.0 based on OSHPD, 2007-2009 (asthma ED) and CDPH, 2006-2009 (LBW) and SWITRS, 2006-2010 (ped injury/death); CAPE with data from Alameda County Vital Statistics, 2011-2013 (all other indicators)

FIGURE 7

Economic Conditions in Most- vs Least Freight-Impacted Areas in Alameda County

	Most Freight-Impacted (Top 60 CTs)	Least Freight-Impacted (Bottom 60 CTs)	Rate Ratio (Most vs. Least Freight-Impacted)
Poverty Rate (% of Pop Living at Poverty)	29.3%	4.1%	7.2
2X Poverty Rate (% of Pop Living at 2X Poverty)	56.0%	10.9%	5.1
Child Poverty Rate (% of Youth under age 18 Living at Poverty)	38.6%	3.8%	10.2
Unemployment Rate (Average % of Adults ages 16+ who are Unemployed)	14.8%	6.5%	2.3
Median Earnings (Average Median Earnings in past 12 months)	$25,588	$63,665	0.4
Education Level Less than High School Degree (Average % of Adults ages 25+ <HS graduate)	30.3%	5.1%	6.0

Source: CAPE with data from American Community Survey, 2009-2013 (poverty); CAPE with data from American Community Survey, 2010-2014 (unemployment, earnings, education)

VI. POTENTIAL IMPACTS OF PROPOSED CHANGES TO THE FREIGHT TRANSPORT SYSTEM

A. OVERVIEW

This HIA of the Alameda County Goods Movement Plan assesses the potential negative and positive impacts to health of proposed changes to freight transport infrastructure and operations in Alameda County (e.g., strategies), particularly for vulnerable populations living in close proximity to freeways, designated truck routes, rail lines, seaports and airports. The HIA also aims to assess ways that potential impacts to health, particularly for populations living in close proximity to freight infrastructure and operations, could be better incorporated into the implementation of proposed strategies in the draft Plan.

As described in part IV of this report, this HIA assessed the potential impacts of six proposed strategies in the draft Plan. The results of this analysis are summarized in Table 1 below.

TABLE 1

Summary of Potential Health Impacts for Selected Strategies in the Draft Plan

	HEALTH DETERMINANT & POTENTIAL DIRECTION OF CHANGE		
SELECTED STRATEGY	**AIR QUALITY**	**TRAFFIC SAFETY**	**EMPLOYMENT**
Oakland Army Base Redevelopment Phase 2 - Rail Improvements	⬇ in air quality in West Oakland; potential benefits to regional air quality by shifting freight from trucks to trains	Possible ⬇ in pedestrian safety around Port entrances	⬆ in local hire jobs created in construction and operations for Oakland residents
Proposed Rail Expansions	⬇ in air quality along rail lines in Western Alameda County	Possible ⬆ in pedestrian safety at rail crossings with grade separations	Quality and quantity of local jobs created is unclear
Workforce Training Programs	N/A	N/A	Possible ⬆ in middle-wage jobs with low barriers to entry
Zero- and Near-Zero Emissions Technology Advancement Program	Partial ⬆ in air quality by lowering diesel particulate matter emissions; use of alternative fuels could increase NOx and CO2 emissions	N/A	Quality and quantity of local jobs created is unclear
Freight Corridors Community Enhancement & Impact Reduction Program	Possible ⬆ in indoor air quality along freight corridors	Possible ⬆ in traffic safety along freight corridors	Quality and quantity of local jobs created is unclear
Truck Route Coordination Planning Guidance	Possible ⬇ in air quality along designated truck routes, with potential benefits to air quality on other streets	Possible ⬆ in traffic safety along truck routes	Quality and quantity of local jobs created is unclear

B. RESULTS OF IMPACT ANALYSIS FOR SELECTED STRATEGIES IN THE DRAFT PLAN

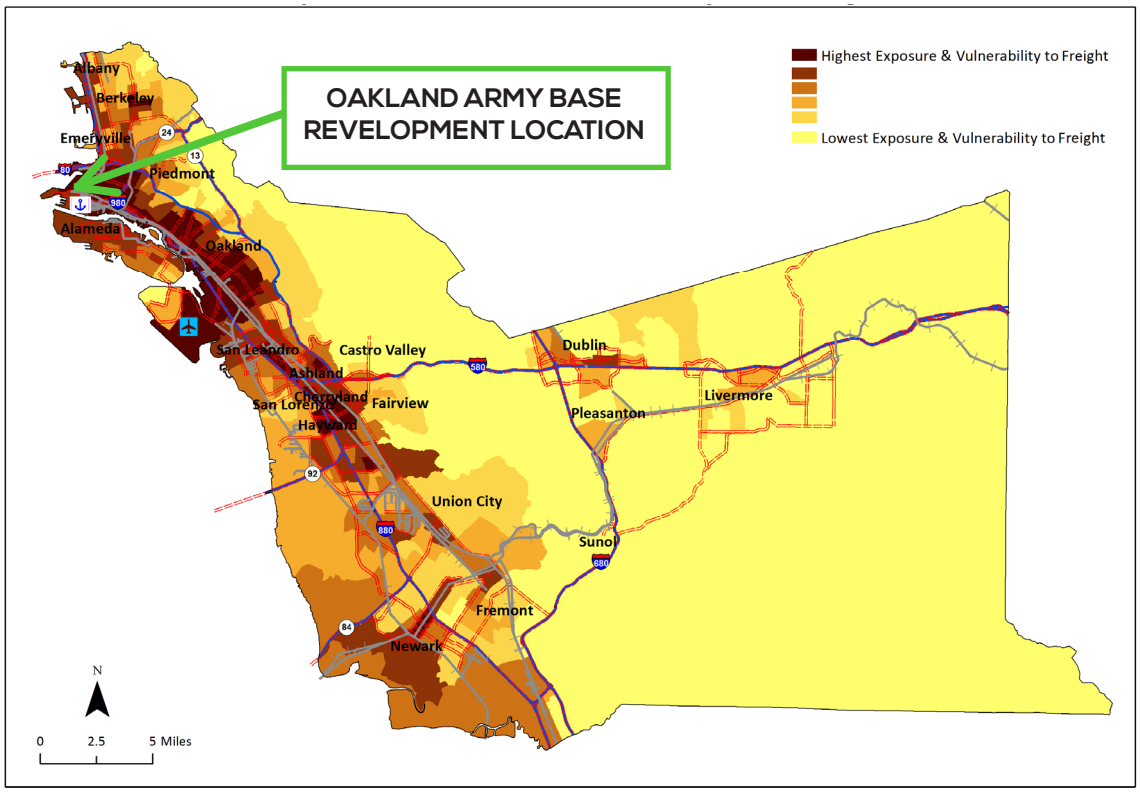
1. OAKLAND ARMY BASE PHASE 2 INTERMODAL RAIL IMPROVEMENTS

A. Brief Overview of Strategy

This strategy is part of the redevelopment of the former Oakland Army Base (OAB), now officially known as the Oakland Trade & Logistics Center.[41] It is included in Opportunity Package 1 ("Sustainable Global Competitiveness"), of the draft Alameda County Goods Movement Plan. The OAB redevelopment's approximate location in West Oakland is shown in Figure 8 below.

FIGURE 8

Location of OAB Redevelopment with Exposure and Vulnerability to Freight in Alameda County



Source: CAPE, 2015

The draft Plan refers to the strategies related to the Oakland Trade & Logistics Center as OAB Phase 2, and so the term OAB is also used in this HIA for consistency. Phase 1 of the OAB redevelopment is currently underway, and includes construction of a rail storage and classification yard (where railway cars are divided onto different tracks) on the eastern portion of the former army base.[42]

The OAB Phase 2 Intermodal Rail Improvements strategy significantly expands capacity for intermodal rail traffic at the Port of Oakland. Intermodal traffic refers to long-haul movement of goods in shipping containers on trips that combine and truck and rail movement.[43] A large new intermodal yard would include new cranes, six working rail tracks, a truck interchange, and an internal circulation road.[44] When completed, it would have capacity for 900,000 TEUs (a TEU is a twenty foot equivalent unit, or intermodal container), but the goal is to complete the project in stages, creating capacity for 300,000 TEUs by 2021. By way of comparison, the Port's activity in 2014 was 2.39 million TEUs.[45] Combined with additional intermodal and transfer facilities detailed in a separate strategy[46], and the planned expansion of rail infrastructure in other parts of the county, this strategy is designed both to increase the amount of freight passing through the Port and to help shift some growth in freight movement to rail rather than truck traffic.[47]

B. Assumptions for Impact Assessment

Impacts of air emissions for the OAB Redevelopment are described in the 2002 Environmental Impact Report (EIR), and 2012 Addendum to the EIR.[48] While the draft Plan separates the OAB project into multiple strategies, the EIR looks at the impact of the project as a whole, and therefore this HIA refers to this analysis. In discussing the impacts we assume that closely related strategies would also be adopted, since analysis is not available for each strategy in isolation.

C. Summary of Impacts

I. AIR QUALITY

a. Emissions Impacts

The draft Plan states, citing the OAB EIR, that the project as a whole will have significant and unavoidable air quality impacts.[49] The impacts would be concentrated at the location of the former OAB, in West Oakland. Emissions would come from ship and rail operations, passenger and transport trucks, and space and water heating.[50]

TABLE 2

Emissions in Tons per Year for Oakland Army Base Redevelopment Operations

POLLUTANT	MAXIMUM TONS/ YEAR FROM OAB	BAY AREA AIR QUALITY MANAGEMENT DISTRICT (BAAQMD) THRESHOLD, TONS/YEAR
Reactive organic compounds	No net increase	10
NOx	146.5	10
PM10	0.8	10
PM2.5	0.7	N/A

*The EIR discusses two different scenarios for land use within the former OAB. This table includes the higher reported emissions, in order to be conservative.

According to the EIR analysis in Table 2, the increase in nitrous oxides greatly exceeds the threshold of significant impact BAAQMD has established, within a potential increase in over 145 tons per year, compared to the threshold of 10 tons per year. NOx is a toxic pollutant that causes respiratory health problems, and can also lead to the formation of ground level ozone when combined with heat and light. There would be no net increase in reactive organic compounds or particulate matter.

TRANSLOADING :

As defined in the draft Plan, "[t]ransloading is a logistics practice where the contents of international containers (usually forty feet in length) are unpacked and repacked into larger domestic containers before being loaded on trains for inland movement. During the transloading process, other value-added services can be performed on the goods and these value-added activities create jobs in the transload warehouses."

The EIR also states that the project would result in a substantial increase in diesel emissions from the use of a variety of new diesel equipment, increasing nearby residents' exposure to toxic air contaminants.[51] While this strategy increases emissions in West Oakland, in combination with other strategies designed to expand goods movement by rail and shift growth away from truck transport, it could have some regional benefits for air quality.

The OAB strategies are meant to grow freight transport overall, and to help rail transport grow more quickly than truck transport. The draft Plan states a goal of increasing the share of rail movement at the Port from 21% currently to 40% in 2020.[52] The increase in rail capacity at the OAB redevelopment, along with the construction of transloading facilities, are designed to make it possible for imported cargo to be handled in Oakland, and be placed directly onto trains for transport to other places within the United States. This is an alternative to trucking the cargo on I-580 to the Central Valley where it is then put onto trains. The draft Plan estimates that about 730 truck trips per day would be reduced on I-580 if these plans were implemented, although it does not quantify projected reductions in emissions.[53, 54] The draft Plan states that trucks also use I-880 to connect to I-580 and access the Central Valley, but does not quantify reductions in truck trips or pollutant emissions. It is unclear whether this is because the overall growth in freight transport associated with the OAB redevelopment will outweigh any reduction from eliminating trips to the Central Valley.

Broadly, there are environmental benefits associated with shifting goods movement away from trucks to rail, but the infrastructure that supports this shift can results in negative impacts at the local level. This is discussed in greater detail in the case study on shifting from truck to rail transport in Appendix B of this report. Furthermore, this strategy is part of a general expansion of goods movement, designed to increase the amount of rail transport more quickly than the increase in truck transport, rather than just shift existing levels of freight transport from truck to rail. The burden of this increase will occur in West Oakland, which has many of the most freight-impacted census tracts in Alameda County, according to the analysis conducted by the Alameda County Public Health Department (ACPHD) summarized in Part V of this report. The BAAQMD has also designated the neighborhoods in western Alameda County as one of the most impacted and vulnerable communities in the Bay Area as part of their CARE program (Community Air Risk Evaluation). [5556] The draft Plan notes that West Oakland is currently exposed to diesel particulate matter (DPM) ambient concentrations about three times as high as average concentrations within the Bay Area.[57] Despite major strides in decreasing diesel emissions regionally (discussed further below), West Oakland remains a hotspot of DPM and other toxic air emissions, and the planned expansion of the former OAB will continue to lead to disproportionate pollution in the neighborhood.

The 2012 OAB EIR quantifies the increase in cancer risk associated with the projected increase in diesel emissions and toxic air contaminants resulting from the OAB redevelopment. The EIR conducted a Health Risk Assessment that determined that maximum cancer risk from the operation of the project was 96 cases per million. As discussed in the existing conditions section of this report, West Oakland zip code 94607 currently has the highest cancer risk associated with toxic air contaminants in the County, at 689.2 cases per million. Census tracts within West Oakland also have some of the highest rates of emergency department visits for asthma in the County, according to the ACPHD's analysis summarized in Part V of this report.

There are likely to be air quality benefits along I-580 in the Eastern portions of the County, where truck traffic to the Central Valley will be reduced – or grow less quickly than it would otherwise. These areas are not for the most part highly impacted and/or vulnerable to freight activity,

although there are a small number of census tracts along this corridor in the second or third most highly impacted tiers according to the ACPHD's analysis as summarized in this report. However, Eastern Alameda County has the highest ozone levels in the Bay Area, owing to high temperatures that contribute to ozone formation.[58] A reduction in truck traffic and related emissions would help mitigate this problem.

As discussed above, potential reduction in traffic and emissions, and associated health benefits are less clear along the I-880 corridor between the Port of Oakland and I-580. This freeway passes through many highly impacted communities, including East Oakland and San Leandro. There are several census tracts in these communities that experience very high rates of emergency department visits for asthma. Reductions in truck traffic on I-880 would have positive impacts on health equity.

b. Existing Mitigations

The major mitigations provided in the EIR regarding air quality are that the Port of Oakland should implement a criteria pollution reduction plan, that the City of Oakland and the Port should jointly create a truck diesel emission reduction program, and that the City and Port should jointly lobby for, and participate in, emission reduction demonstration projects.

The Port of Oakland does have a criteria emissions reduction program, the Maritime Air Quality Improvement Program (MAQIP.) MAQIP has been in place since 2009, and set an 85% target for DPM health risk reduction from 2005 to 2012 in the West Oakland neighborhood, which it is expected to achieve.[59] These reductions will be achieved in large part because of a change in California requirements mandating low sulfur fuel in ocean going vessels, which also resulted in major decreases in DPM.[60] The Port has also seen large reductions in DPM and other toxic emissions from trucks, primarily as a result of the California Air Resources Board's (CARB) Diesel Air Toxic Control Measures that have been put in place over the last decade. CARB's truck regulations require that by the year 2023, all truck engines meet 2010 standards.[61]

Many other mitigations that could help minimize the negative impacts of this strategy are already mentioned within the draft Plan, but could be explicitly tied to the OAB rail expansion strategy, and specifically directed to the West Oakland area where the impacts of this strategy will be felt.

II. TRAFFIC SAFETY

a. Freight Traffic Impacts

This strategy could have mixed impacts on traffic safety, and many potential traffic impacts are not evaluated explicitly within the Draft Plan. A West Oakland Case Study has been developed as part of the draft Plan, and is intended to more specifically address issues including mode conflicts (e.g. between bicyclists, pedestrians and trucks,) and pavement conditions.[62] In general, the evaluation of strategies within the draft Plan acknowledges that increased traffic would have negative local impacts in West Oakland, including congestion and reduced pedestrian safety.

Within West Oakland, the increase in truck traffic associated with overall growth in freight transport would be likely to increase risk of collisions, and pedestrian and bicyclist death or injury, while further degrading pavement and road conditions. The draft Plan shows a cluster of truck-related injury crashes on local roads in West Oakland between 2008 and 2012, and an increase in truck traffic in the neighborhood could lead to an increase in these crashes.[63] Higher truck volumes are associated with lower safety – both real and perceived – for bicyclists in particular.[64,65] Truck parking, and especially truck parking in bike lanes, can interrupt the connectivity of bike routes and is a common source of conflict between cyclists and trucks.[66]

While the draft Plan notes that poor pavement conditions are not generally associated with truck volumes and freight transport countywide, the West Oakland neighborhood is an outlier with several truck routes in very poor condition.[67] The West Oakland case study in the draft Plan notes that several roads, including West Grand Ave. and other streets around the intersection of Grand and Mandela have degraded conditions.[68]

While impacts in West Oakland would be primarily negative, this strategy would help reduce congestion – or at least slow the growth of congestion – along I-580 corridor, as is discussed above in the Air Quality section. Portions of I-580 have some of the worst truck delays in the county, while the westbound I-580 interchange with I-680 is the single worst crash spot in the county, with 29 truck related crashes from 2008 to 2012.[69]

b. Employment

This strategy, as a part of the Oakland Army Base Redevelopment, is covered by a Cooperation Agreement, similar to a Community Benefits Agreement, signed in 2012. This is intended to direct jobs created to Oakland residents.

The Cooperation Agreement includes[70]:

- 50% of construction jobs by each trade for Oakland residents, and all new apprentices to be Oakland residents
- 50% of operations jobs for Oakland residents
- Creation of a job resource center in West Oakland
- Limitations on the use of temporary employees for the warehouse industry
- Living wages for all workers on site
- A Community Jobs Oversight Commission

The agreement also places first priority on hiring residents from zip codes that are more highly impacted by freight transport, namely zip codes 94607, 94612, 94608 and 94609.[71] Phase 1 of the project is currently under construction, and so only construction jobs have been generated thus far. According to the latest Jobs Oversight Commission Report, 49.9% of construction hours have been completed by Oakland residents, although not all trades are meeting the 50% target. However, according to report provided to the Community Jobs Oversight Commission, just 3.5% of these hours were completed by West Oakland residents.[72]

The OAB EIR estimates approximately 2,600 jobs associated with operations of new facilities, and according to the Cooperation Agreement this should lead to at least 1,300 jobs for Oakland residents. Based on the average wages for the most common freight transport-related jobs discussed in Part V of this report, non-supervisory positions with lower educational barriers to entry currently have annual wages ranging from about $26,000 (for hand packers) to $46,000 (for maintenance workers.) The draft Plan states a goal to specifically to increase employment in value added logistics services which would occur at transloading facilities within the development, and possibly providing higher wage jobs than more traditional warehouse employment.

The Cooperation Agreement is likely to provide employment benefits, and associated health benefits, to Oakland residents. However it is also important to note that the extremely high (and rising) costs of housing in Oakland, mean that even middle wage jobs may not provide financial stability for residents.[73]

2. STRATEGIES REGARDING IMPROVEMENT AND EXPANSION OF RAILWAYS

A. Brief Overview of Strategy

This section does not concern one strategy specifically, but rather focuses on multiple strategies within Opportunity Package 1 that are designed to expand rail capacity on the Niles and Oakland Subdivisions within the county, referred to as "the southern route." These would accommodate the planned expansion in rail traffic that will result from the OAB redevelopment, and the focus is on the southern route because the northern train routes are already congested and the rights-of-way along these routes are constrained.[74]

The prioritized strategies include:

- A Variety of Rail Crossing Improvements
- Hayward Double Track
- Niles Junction Bypass
- Improvement on the Oakland Subdivision East of Niles Canyon

B. Assumptions for Impact Assessment

The draft Plan lists several additional rail expansion projects that are not prioritized and thus not included as part of the opportunity packages in the draft Plan (e.g. additional tracks at Jack London, and the Alviso Wetlands Double Track.) These strategies are listed as lower priorities because it is not clear that additional capacity is needed in these areas, and because they would have negative impacts on surrounding communities.[75] Since these strategies are not recommended by the draft Plan at this time, we do not include them in our analysis.

C. Summary of Impacts

I. AIR QUALITY

Generally, adding train traffic along the southern route would increase exposure to emissions from locomotives, through areas with significant residential population and in some cases in already highly impacted areas.

According to the strategy evaluation in the draft Plan, 25% of the land within 1500 feet of the Niles Junction Bypass is residential, while 25% is a public park. New trains along this route will expose residents and park users to increased

emissions.[76] The Hayward Double Track project is surrounded by significantly more residential land, with 75% residential uses within 1500 feet of the tracks, and is located within the Western Alameda BAAQMD CARE Area, and so would be increasing emissions in an already burdened area.[77]

The third prioritized strategy, improvements on the Oakland Subdivision in the Eastern part of the county, is not evaluated by the draft Plan because it is currently undergoing official environmental review.

Because these strategies are elements of the overall goal to shift the growth in goods movement towards rail and away from truck travel, they would help reduce emissions regionally, while the negative impacts would be felt locally.

Community residents have also raised concerns about coal being shipped through Oakland on existing and new rail lines, and the potential for coal dust to add a new source of harmful emissions adjacent to rail lines. A previous HIA on coal transport by train found that there was substantial evidence on the negative impacts of inhaling coal dust in occupational settings, but slim independent scientific literature is available on the amount of dust emitted during train transport.[78]

II. TRAFFIC SAFETY

The grade separation strategies would be likely to have traffic safety benefits, and should fully eliminate the risk of collision between trains and on-road traffic. Three grade separations are recommended for crossings along the Niles subdivision in Oakland and San Leandro that have seen a combined total of 11 accidents in the past decade, including 4 fatal accidents in San Leandro.[79] The two other grade separations prioritized for the southern route are also on the Niles subdivision, at Tennyson Road in Hayward and Decoto Road in Union City. These locations have had no crashes in the past decade, but the separations would eliminate the possibility of collisions.

It is, however, possible that an expansion in train activity and the addition of new tracks generally could create traffic hazards elsewhere along the routes, owing to the increase in train volume, although this is not discussed in the draft Plan.

III. EMPLOYMENT

To the extent that these strategies are a key part of the larger "Sustainable Global Competitiveness" opportunity package, they should have some employment benefits associated with the increase in transloading and goods movement. However the draft Plan does not evaluate employment associated with these specific rail strategies, and their individual impact on jobs is unclear.

CASE STUDY SUMMARY

The Health Equity Considerations of Shifting from Truck to Rail Transport

Scientific evidence suggests that freight rail transport is more environmentally sustainable than freight truck transport, due to higher fuel efficiency and lower emissions per mile. However, the local impacts of rail activity, rail yards, and intermodal rail facilities – both existing and new – are significant and often discounted from discussions of shifting from truck to rail freight transport. These local impacts must be evaluated and mitigated alongside the potential regional air quality benefits, in order to ensure that the burden of freight-related health impacts is reduced rather than exacerbated for communities living close to freight corridors. This study summarizes available evidence from the California Air Resources Board (CARB), academic studies, and health impact assessments about the health impacts of rail corridors, rail yards, and intermodal rail facilities, the impacts of shifting cargo from truck to rail, and potential mitigations to offset rail pollution. A set of health equity considerations are offered to inform a healthy and equitable shift from truck to rail transport, or mode shift, in Alameda County.

Key Findings

- Rail yards are a significant source of diesel particulate matter (DPM) and diesel cancer risk in California, generating more than 250 tons of DPM emissions annually. In addition to diesel-related health risks (including cancer, asthma, cardiovascular disease, and reduced lung and cognitive function), rail yards have numerous negative impacts on local communities – including noise-related impacts on stress, concentration, and sleep; traffic congestion and safety concerns; delayed emergency response times; and constrained home values and tax revenues.
- Many rail yards utilize old and highly polluting equipment – some of which may be 30 years old or more, and are out of compliance with current state emissions requirements. According to CARB, many communities (including West Oakland) already face "unacceptable" cancer risk levels, even after state rail yard emissions regulations have taken effect.
- Locomotives (trains), trucks, and cargo handling equipment are the largest sources of pollution at rail yards, with switcher locomotives and trucks serving and operating inside rail yards generating significant diesel PM (DPM) emissions. A number of zero and near-zero emissions technologies are available for application at rail yards; however replacement of locomotives is costly.
- Many communities adjacent to rail yards, including West Oakland, are exposed to multiple sources of diesel pollution, which exacerbate the health impacts of rail yards. West Oakland in particular faces a diesel cancer risk level that is three times that of the greater Bay Area, due to the presence of the Union Pacific rail yard, the surrounding highways, and the Port of Oakland within close proximity.
- Rail yards disproportionately impact communities of color. In 17 out of 18 rail yards in California, a significantly higher proportion of people of color reside within high-risk cancer zones near rail yards than within other areas of the county. In Oakland, 64% of residents within the highest risk cancer zone surrounding the Union Pacific rail yard are African American, compared with 14% of residents in Alameda County as a whole.
- One study found that transporting freight by rail may expose a greater number of people and census tracts designated as "environmental justice communities" than transporting freight by truck between the same origin and destination. Another study estimates that, in California, population growth among Latinos and African Americans will be greater near rail corridors than truck routes over the next 20 years.
- Several modeling-based studies in the U.S., Europe, and Asia have estimated significant benefits from shifting freight from truck to rail transport, resulting in decreased emissions of PM2.5, PM10, and NOX and health benefits in terms of reduced mortality risk, asthma, and respiratory problems. These studies focus primarily on vehicle operations-related emissions and do not take into account the impacts from developing and expanding infrastructure needed to

support this mode shift, as well as new truck activity that may be generated at and near rail yards.

- The case study findings suggest that perhaps the most optimal air quality benefits will result from a combination of: truck to rail mode shift for long-haul trips, the widespread adoption of zero emissions vehicles and equipment in and adjacent to rail yards, the utilization of existing infrastructure over new rail facilities, strict enforcement of emissions standards for locomotives and other rail equipment, and strong mitigations at and near rail yards.

Considerations for a Healthy and Equitable Mode Shift

Below are a series of additional considerations for decision-makers to take into account in assessing the relative benefits of rail versus truck transport, as well as a set of recommended health equity mitigations for rail yards and rail corridors in Alameda County.

- **Mode shift or expansion?** If shifting freight from truck to rail will require or involve new infrastructure, the impacts of new rail yards, tracks, and facilities must be considered alongside the emissions benefits of transporting cargo by rail instead of truck. In addition, if the overall freight system is expanded in terms of the volume of cargo throughput, the relative benefits of rail must be weighed against the increase in emissions that will result from greater cargo activity and freight traffic.
- **Weighing local with long-haul impacts** – Fuel efficiency and emissions benefits are greater for rail trips beyond 500 miles, making rail more environmentally beneficial for long distance transport. In addition, the local impacts of rail transport are greatest for communities adjacent to rail yards, due to the near-constant activity at rail yards. The potential increase in emissions at and near rail yards as a result of expanded activity along rail corridors needs to be taken into account in air quality modeling studies of mode shift. In addition, strong mitigations must be implemented to offset the burden of pollution for communities near rail yards, many of which already face hazardous health conditions and high levels of cancer risk.
- **Emissions exposure by population size, demographics, distance, and route** – Nuanced analysis should be conducted that takes into account the potential exposure size and population of proposed shifts in freight transport routes along truck versus rail corridors, in order to assess and minimize harm for communities of color and low-income communities.
- **Clean technology and compliance with emissions standards** - Age of equipment and fuel type greatly affect the amount of air quality benefits generated by switching from truck to rail. Because many rail yards are currently out of compliance with state emissions standards, cleanup and strengthening and enforcement of emissions requirements at rail yards will be necessary to ensure health benefits from shifting from truck to rail transport.
- **Mitigations and zero emissions at the yard** – A number of mitigations can and should be implemented insideand adjacent to rail yards in order to minimize the burden of pollution for freight-impacted communities before any rail expansion is allowed. These include:
  - ❖ Enforce and go beyond state emissions standards for trucks and locomotives as a condition for operating inside rail yards, including accelerated adoption of Tier 4 locomotives.
  - ❖ Minimize short-haul truck trips through "on-dock rail."
  - ❖ Electrify rail lines in urban areas and prioritize electrification of vehicles and equipment that operate inside and adjacent to rail yards – including locomotives, trucks, cargo handling equipment, and TRUs.
  - ❖ Locate highest polluting activities furthest from residential areas – including maintenance facilities, testing sites, spur tracks, fueling stations, idling locomotives, and load testing.
  - ❖ Implement air filters, vegetative barriers, and other community mitigation strategies adjacent to rail yards.
  - ❖ Adopt zero emissions technology to the widest extent possible before any expansion of rail facilities are permitted, including intermodal freight facilities.

3. WORKFORCE TRAINING PROGRAMS

A. Brief Overview of Strategy

This strategy is included in both Opportunity Package 1 ("Sustainable Global Competitiveness") and Opportunity Package 3 ("Modernized Infrastructure") in the draft Plan. However, it offers almost no detail about how the strategy would be designed or implemented. The draft Plan states that it is "a program to support workforce training for goods movement related jobs, including for residents of areas most affected by goods movement projects."[80] Any programs or jobs related to this strategy would be in addition to those already covered by the Cooperation Agreement for the Oakland Army Base redevelopment (discussed above) as well as the Maritime and Aviation Project Labor Agreement, which covers labor at the Port of Oakland.

This strategy does specifically reference a shortage of truck drivers as one issue that Workforce Training Programs would be designed to address. The current shortage of truck drivers is attributed in part to the overall strengthening economy, as more people choose jobs as truck drivers when there are few other options for work.[81]

B. Assumptions for Impact Assessment

Because this strategy explicitly focuses on workforce development, we assume that it will not have significant impacts on air quality or traffic safety, and only evaluate the impacts on employment.

C. Summary of Impacts

I. EMPLOYMENT

It is not possible to make clear predictions about how this strategy could impact employment in the county because of the lack of detail. The strategy would not be expected to create new jobs, but would rather provide training and connect residents in communities impacted by freight transport to jobs.

Part of the purpose of the strategy is to meet the need for truck drivers. Average annual wages for truck drivers in the Alameda County area was about $46,000 in 2014, according to Employment Development Department data as summarized in Part IV of this report. This is higher than the $40,174 in median earnings for workers in Alameda County, and significantly higher than the $31,034 in median earnings for people with only a high school degree.[82] Truck drivers are generally required to have a high school diploma, to complete training at a private truck-driving school or through a community college, and to obtain a commercial driver license.[83] Pre-job training requires about 160 hours of instruction, according to private schools in Oakland, and costs between $3,000 and $5,000. Trucking is an inherently challenging job for many people, because it can require long periods of time away from home. Trucking also has relatively high rates of occupational injury and fatal occupational injury, as discussed in Part IV of this report.

The other freight-related jobs that currently employ significant numbers of people tend to have lower mean annual wages, ranging from $25,000 for material packers to $46,000 for maintenance workers. Introduction of new technology, such as alternative fuels and engines, could create positions for maintenance workers with new skills that could require additional training.[84]

An increase in warehouse jobs, and specifically transloading warehouse jobs, has primarily been discussed as part of the Oakland Army Base Redevelopment, which is already covered by the jobs Cooperation Agreement on jobs. While this agreement requires a living wage and limits the use of temporary labor, in other parts of California the warehouse employment has been associated with very low wages and job insecurity.[85] If an increase in freight transport does lead to increase in warehousing employment in other areas of the County, these could be low quality jobs unless safeguards are put in place.

Overall, this strategy would be expected to lead to employment benefits within freight-impacted communities, and to have associated equity benefits.

4. ZERO AND NEAR-ZERO EMISSIONS TECHNOLOGY ADVANCEMENT PROGRAM

A. Overview of Strategy

The Zero Emissions (ZE) and Near-Zero Emissions (NZE) Technology Advancement Program (the Program) will provide funding for research and development (R&D) activities that test and develop "pre-commercial" emerging zero and near-zero emissions goods movement technology. This program may also include funding, incentives, and demonstration projects to advance the use of zero emissions (electric) and near-zero emissions (hybrid electric, alternative fuels, and low-emission fuels and engines) technology throughout Alameda County's freight transport system. According to the draft Plan[86], this program will

draw funding from the Regional Transportation Plan and will be coordinated with CARB's Sustainable Freight Strategy and BAAQMD programs. The program could include incentives for engine retrofits to install diesel particulate filters on old trucks and replacement of old trucks with newer, cleaner engine trucks. According to the draft Plan, the program may also include funding to compensate small, independent truckers who might otherwise struggle to afford retrofits and upgrades, and it will be targeted to freight corridors and facilities in communities with the greatest adverse impacts from freight emissions. Very limited information is provided regarding the amount of funding for the program, the types of technology funded, or the location and nature of demonstration projects, making it difficult to predict exact impacts.

According to the draft strategy evaluation document for the Alameda County Goods Movement Plan, this strategy would have the following impact on air quality, employment, and equity[87]:

- Air quality/emissions – "Zero Emission and Near-Zero Emission Trucks can nearly eliminate particulate emissions, and some technologies (e.g., electric) can substantially reduce Greenhouse Gas Emissions."
- Employment – "This strategy is focused on demonstration projects and identification of promising new technologies, rather than widespread deployment of a proven approach, so a significant benefit to jobs and output would not be a direct result of the program."
- Equity – "This strategy is focused on demonstration projects and identification of promising new technologies, rather than widespread deployment of a proven approach, so the scale of equity benefits may not be very large."

B. Assumptions for Impact Assessment

Overall, this strategy is likely to have positive but limited impacts on air quality by encouraging and directly funding the adoption of zero emission technology at select sites throughout Alameda County's freight transport system. An overview of potential impacts on air quality and employment, including assumptions and a review of available literature, is below.

This strategy will not directly result in widespread adoption of zero or near-zero emissions technology throughout Alameda County, as it is primarily focused on supporting research and development activities and a few site-specific demonstration projects. Research and Development activities may result in indirect impacts on air quality by improving the availability and effectiveness (and possibly reducing cost) of Zero Emission (ZE) technology in the longer term.

Demonstration projects will have direct but limited impacts on air quality by replacing old with cleaner technology and/or reducing emissions of existing vehicles and equipment. Incentives and funding for adoption of ZE technology, including retrofits of heavy-duty diesel trucks, will result in direct but limited impacts on air quality.

For the purposes of this assessment, zero emissions technology includes any vehicle or equipment that results in zero on-site (tailpipe) emissions and limited upstream emissions. Near-zero emissions technology includes any vehicle or equipment that can travel a considerable distance with zero on-site emissions (including hybrid electric vehicles) as well as technology that significantly reduces emissions for existing (conventional) vehicles and equipment.

C. Summary of Impacts

I. AIR QUALITY

a. Emissions Impacts

A review of different types of zero and near-zero emissions technology applications suggests that the below potential impacts on air quality could result, both directly and indirectly, from projects and activities funded by this program:

i. Electric Powered Vehicles and Equipment

Trucks are the most frequently used freight mode, moving 82% of all goods by weight in CA. Twenty percent of CA's 100,000 drayage trucks operate at and service ports and rail yards, which trucks in these locations an important target for transition to zero-emissions technology.[88] In addition, cargo handling equipment, including Transport Refrigeration Units (TRUs), run almost constantly, producing significant emissions at rail yards. For example, CARB estimates that cargo handling equipment contributes to a quarter of all DPM emissions at four major California rail yards, making them a powerful candidate for electrification.[89]

Against that polluting backdrop, electric vehicles represent the cutting edge of zero emissions technology, as they result

in zero or very low on-site (tailpipe) emissions and limited upstream emissions. All-electric vehicles run entirely on electricity and may be powered by rechargeable batteries, which require external charging stations, or hydrogen fuel cells, which operate inside the vehicle and produce electricity through a chemical reaction of hydrogen and oxygen.[90] Catenary and electric freight shuttle vehicles are powered by electric wires. Hybrid-electric vehicles use a mix of conventional (diesel or natural gas) fuel and electric power sources, including an internal battery pack and "regenerative braking," which captures kinetic energy in the form of electricity during acceleration and deceleration.[91] Specific applications of electric technology include trucks (plug-in hybrid electric, battery powered, hydrogen fuel cell powered, catenary electric, and electrified freight shuttle); trains (hybrid electric locomotives, both on-rail and switch locomotives, which transport cargo and rail cars within rail yards); cranes, TRUs, forklifts, and other cargo handling equipment (battery-powered, fuel cell, and rail-mounted); tugboats and other harbor craft (hybrid electric).[92]

Electric technology has significant emissions reductions benefits in terms of diesel particulate matter (DPM) and nitrogen dioxide (NOX) – with the greatest reductions for all-electric vehicles. Within this category, battery electric technology has the greatest benefits, with zero on-site and very limited upstream emissions.[93] While hydrogen fuel cell powered vehicles have zero tailpipe emissions, they do generate PM2.5 and C02 in the upstream hydrogen production process.[94] Even taking upstream emissions caused by power generation into account, electric technologies would reduce total emissions, including NOX, C02, and PM2.5, by 90%, compared with conventional 2010 diesel trucks.[95] Hybrid electric locomotives can reduce DPM and NOX emissions by 85%.[96]

Electrifying rail lines would bring tailpipe emissions of locomotives to zero, with 99% reduction in NOX and 97% reduction of PM, compared with Tier 2 locomotives.[97] Battery-powered and rail-mounted gantry cranes have also been implemented successfully in several rail yards and ports, and they result in zero on-site emissions, reduced noise, and reduced truck trips due to wider size.[98]

While electric technology is costly, particularly for locomotives, it offers the greatest emissions benefits for freight-impacted communities and several commercial electric vehicles are already available.[99] Electric technology should be a priority for research and demonstration projects funded through this strategy, with the goal of developing lower cost electric vehicles and equipment that can operate over long distances and utilize limited to no conventional fuel.

ii. Shoreside Power and Auxiliary Power Units for Trucks, Trains, and Ships

Generally speaking, ships are important targets for emissions reductions. At most ports, marine vessels contribute the vast majority of diesel particulate matter by tons, and emissions from ships are estimated to contribute to 60,000 premature deaths globally each year.[100] Similarly, trucks that idle in residential neighborhoods while drivers stop to rest are a significant source of DPM emissions and noise for communities adjacent to freight corridors and facilities.[101] Idling trucks may burn up to a gallon of fuel per hour.[102]

Because pollution from ships represent one of the largest sources of port-related diesel emissions, shoreside power (also known as "cold ironing") is considered a powerful way to reduce emissions at ports and for communities adjacent to ports. Shoreside power provides a clean (electric) source of power that allows ships to maintain electricity and other comforts without using their engines while docked at ports. Similarly, truck stop electrification is a strategy that provides electric power hook-ups at designated truck stops so that truckers can rest with the comforts of their cab without having to leave the engines on.[103] Locomotives can also be plugged into electric power sources to eliminate emissions from engines while locomotives are idling at rail yards.

Electric power hook-ups at rail yards, ports, and truck stops have significant emission reductions potential for NOX, sulfur dioxide, and DPM. At the Port of Long Beach, for example, shoreside power has been estimated to remove the equivalent of 33,000 cars from the road each day.[104] In Gothenberg, Sweden, shoreside power eliminates up to 97% of criteria pollutants, including 80 tons of NOX, 60 tons of sulfur dioxide, and 2 tons of PM emissions annually.[105] A recent Port of LA emissions inventory found that diesel particulate matter from ships decreased dramatically between 2005 and 2014, in part due to the use of cold ironing, in addition to use of lower sulfur fuel and reduced speed in harbors. [106] In Oregon, where the governor funded the electrification of 600 official truck parking spaces along the I-5 highway, one year of use reduced nitrogen oxides by nearly 30 tons, volatile organic compounds by 1.5 tons, and DPM emissions by 0.8 tons.[107]

Each of these technologies is somewhat costly and capital-intensive as it requires the installation of power units at freight facilities and the retrofitting of vehicles to enable hookup to auxiliary power units. In addition to cost, differences in voltage at various ports make shoreside power complicated to implement initially. However, auxiliary

power units have the potential to bring great emissions benefits to freight-impacted communities. The highest-impact locations for electric power stations should be identified and prioritized for demonstration projects as part of this strategy.

iii. Idling Control Technologies

At the Union Pacific Oakland rail yard, service and maintenance of locomotives, which often involve substantial idling time, contribute 12% of locomotive-related diesel emissions annually.[108] For this reason alone, idling control technologies are worth exploring; they can be installed on locomotives to automatically shut off engines that are left idling for 15 minutes or more. Locomotives and trucks can also be equipped with ventilation hoods that capture and filter emissions while vehicles are at rest. Automatic truck entry gates can also reduce idling at rail yards, which BNSF has estimated reduces idling by 50%. Anti-idling devices on locomotives work best in warm climates, making them a limited option globally but potentially a good option for California's rail yards.[109]

Idling control devices offer important emissions reductions benefits at lower cost than replacing vehicles, thus offering a relatively "low-hanging fruit" for this strategy. While this technology would not offer the same level of emissions reduction benefits as replacing conventional vehicles with zero emissions vehicles, it can and should be prioritized for trucks and trains that operate and idle within freight-impacted communities.

iv. Retrofitting Old Vehicles with Cleaner Fuels and Lower Emission Engines

Retrofitting and updating vehicles with lower emission engines and models can reduce DPM, NOX, and SOX emissions but this approach does not reduce on-site DPM as much as zero emission (electric technology) would.

Retrofitting or replacing engines with lower emission engines and/or the lower sulfur fuels are relatively low-cost ways to reduce emissions using existing equipment and vehicles. For example, port drayage trucks can be retrofitted with new engines or diesel particulate filters that capture and limit emissions. Locomotives can also be retrofitted to ensure lower emissions. Installing diesel particulate filters on trucks can reduce emissions by more than 90% and is a cost-effective way to reduce emissions. The Port of Oakland's accelerated retrofit and replacement program in 2010 resulted in a 54% reduction in black carbon before and after implementation, in part due to diesel particular matter filters and engine replacement.[110] On older locomotives, filters and "selective catalytic reduction" technology can reduce NOX emissions.[111]

Alternatively, vehicles can be replaced entirely with newer models that have cleaner and more fuel-efficient engines. New diesel trucks, for example, are 98% less polluting than trucks built before 1999, and sulfur emissions have been reduced 97% since 1999.[112] Replacing old locomotives with newer locomotives is costly but has significant emissions reductions impacts. New Tier 4 locomotives create 80% less PM and NOX emissions compared with 2008 engines, for example, and emit significantly lower PM and NOX emissions than new 2010 diesel trucks.[113] Requiring lower sulfur fuels is also a strategy to reduce emissions for trucks, trains, and ships. Marine fuel regulations requiring lower sulfur fuels by 2020 are expected to reduce PM emissions by 86% and NOX by 23% and SOX by 74%.[114]

Retrofitting and replacing existing vehicles with lower emission (conventional) engines and fuels are an important near-term step to reduce emissions until a zero-emissions freight system is possible. Because there are existing state regulations and incentives to encourage adoption of the latest and cleanest technology vehicles, however, this strategy should seek a balance between supporting faster vehicle upgrades (such as Tier 4 locomotives) and prioritizing funding for truly zero emissions technology.

v. Alternative Fuels

Biodiesel and natural gas are both considered alternative fuels for diesel powered freight transport, though they are not considered to be near-zero emissions technology unless they are used in hybrid electric vehicles. Both of these fuels have potential benefits for PM but may increase NOX or CO2 emissions.[115] Biodiesel may increase NOX emissions.[116] While natural gas can reduce PM emissions by 90-100%, it may increase CO2 emissions.[117] Furthermore, a recent air quality monitoring study near the Ports of LA/Long Beach found that while DPM emissions were significantly reduced by the truck replacement program, NOX and ammonia increased due to the use of natural gas powered trucks.[118]

Because these fuels generate emissions in the production process and may raise new health hazards (in the case of natural gas production), they should be a lower priority for this strategy. Instead, resources from the Program should be invested in the identification, development, and application of locally generated, verifiably clean sources of renewable fuel for the freight transport industry.

vi. Emissions-Related Health Impacts

Zero emissions technology has the potential to benefit health by reducing diesel related cancer risk for freight-impacted communities, reducing incidents of asthma emergency department visits and other respiratory problems, decreasing risk of cardiovascular disease, and reducing premature mortality rates caused by prolonged exposure to high levels of diesel particulate matter. Wide adoption of zero emissions technology throughout Alameda County's freight transport system would have important and considerable benefits for health; however, this particular program may have limited impacts as it focuses on individual demonstration projects and development of new technology rather than adoption of technology throughout the system. In the long term, if significant funding is invested into this program and if projects are targeted to benefit the most freight-impacted communities, this strategy could contribute to improved health outcomes, but the magnitude and distribution are unclear, given lack of program detail.

Based on this review, the greatest potential health benefits in terms of reduced diesel PM and NOX emissions and limited new risks would come from replacing conventional diesel with all-electric vehicles and equipment, adopting hybrid electric vehicles that utilize a mix of electric and renewable power sources, and installing idling control devices and auxiliary power units that cut down on emissions from conventional equipment. Electric locomotives and trucks have the potential to significantly impact diesel cancer risk in communities adjacent to rail yards. For example, cleaning up switch locomotives and trucks was a key factor in reducing diesel cancer risk at the San Bernardino rail yard.[119] Electric technology is also quieter than diesel powered vehicles, offering quality of life benefits for communities adjacent to freight corridors and facilities. While retrofitting and replacing conventional vehicles with cleaner (conventional) engines will be critical to reducing emissions in the near term, this strategy should prioritize resources for technology that is not already commercially available or otherwise supported by existing programs (and is therefore less likely to happen without new technology and demonstration). Furthermore, the Program should focus primarily on zero emissions technology in order to ensure that the technologies with the greatest health benefits are more affordable and available in the near future.

Because limited program detail is provided, it is unclear how this strategy will impact freight-impacted communities; however, the Program includes a focus on "disadvantaged communities," suggesting that projects and incentives may be targeted towards communities that currently struggle with the greatest freight-related health impacts.

The greatest health equity benefits would result from concentrating the resources of this program (including demonstration projects and incentives) in West Oakland, which currently faces numerous sources of DPM emissions and the highest levels of diesel cancer risk in the region. This could include focusing on electrification of equipment and vehicles that primarily operate inside the Port of Oakland and UP rail yard, along with electrification of drayage and local delivery trucks that serve both facilities. According to CARB's Health Risk Assessments of California's 18 major rail yards, locomotives, trucks, and cargo handling equipment contribute the majority of the local community's diesel cancer risk.[120] In particular, a Health Risk Assessment of the West Oakland community estimated that cleaning up trucks and locomotives would have the greatest impact on emissions reductions,[121] making trucks and locomotives operating inside and near the Union Pacific rail yard and the Port of Oakland a high priority target for zero emissions technology. Since electrification of rail lines is costly, electrifying urban portions of rail lines adjacent to West Oakland and other highly freight-impacted communities would bring important health equity benefits.[122]

II. TRAFFIC SAFETY

This review did not uncover any potential impacts on traffic safety as a result of zero emissions technology development and demonstration.

III. EMPLOYMENT

Because of lack of program detail, potential impacts on employment are unclear. Because the program description includes a stated goal of working with local technology companies, it is likely that any new jobs created would go to workers who are already employed within or trained for jobs in the regional clean technology sector. Because funding will be limited to individual R&D and demonstration projects, jobs related to zero emissions technology development and adoption may be limited; however, incentives and stricter requirements regarding new and retrofitted vehicles and equipment may have wider employment impacts, as more individual vehicles may be replaced or retrofitted than the number of new zero emissions vehicles that are adopted. For example,

one estimate of jobs created by the Port of LA's Clean Air Action plan suggests that 37 one-year equivalent jobs were created as part of the technology advancement component of the program, and that diesel retrofits and replacements provided 52 one-year equivalent jobs.[123]

CASE STUDY SUMMARY

Port of Rotterdam: Sustainable Freight in Action

The Port of Rotterdam, Netherlands, is one of the world's largest ports, transporting 444 million metric tons of cargo as of 2014.[124] Through a combination of zero emission technology, smart design, and emissions regulations and incentives, the port is also becoming a model of sustainable freight transport. Some examples of the Port's most promising and high impact strategies for reducing freight-related diesel pollution and other greenhouse gases are below.

Electric Power

- Maasvlakte 2, a recent addition to the Port of Rotterdam, uses all electric equipment and vehicles – including 62 battery-powered automated guided vehicles and 54 rail-mounted electric gantry cranes.[125] Battery-powered automated guided vehicles (AGV's) can operate for 12 hours on a single battery and are easily recharged on site.[126]
- The port has installed shoreside power, or electric power units, that provide a clean source of power and minimize emissions from ships while they are docked at berth. To ensure their use, inland vessels docked at the port are not allowed to use generators.[127]
- Electric locomotives were introduced to the Port in 2009, providing a zero-emissions alternative to conventional diesel locomotives.[128]

Shifting Away from Truck Exports

- At Maasvlakte 2, the port has set a goal of limiting truck transport to 35% of container transport, ensuring that at least 20% of cargo is transported by rail and 45% by inland (short distance) shipping by 2033.[129] This facility also uses on-dock rail, which minimizes truck transport of containers between ships and trains, thus reducing emissions.[130]
- The port encourages shippers to shift their cargo transport from truck to ship wherever possible. One company recently shifted 10% of its cargo from truck to barge by shipping containers to a smaller facility located near their final destination, limiting the total amount of miles to be traveled by trucks and reducing CO2 emissions by an estimated 14%.[131]

Smart Shipping

- The Port has partnered with company K-tainer to encourage reuse of empty freight containers by developing technology that helps shippers identify available containers and deliver them for use by other shippers at the final destination. This reduces unnecessary transport of empty containers, which is also an unnecessary source of pollution.[132]
- Technology to help shippers coordinate their arrival to the port will limit unnecessary idling and circling of ships outside the port, limiting unnecessary emissions by 3-4%.[133]

Renewable Energy

- Wind turbines installed throughout the Port and surrounding areas now generate 10% of the Netherlands' total wind energy. The Port of Rotterdam has committed to producing 300+ MW of wind energy by 2020.[134]
- Maasvlakte 2 is now fully powered by wind energy generated on site.[135]

Efficient Port Layout

- A compact port layout at the Shortsea Terminal in Rotterdam has container stacks (or storage areas for containers) located next to where ships dock, which limits the amount of horizontal transport that needs to happen inside the Port. This layout limits emissions from cargo handling equipment and drayage trucks. A recent study estimates that this approach reduces CO2 emissions by 65%.[136]

Emissions Requirements and Incentives for Shippers

- As a result of the Sustainable Maasvlakte Accord with Friends of the Earth Netherlands, companies sited at the port are required to limit truck transport and use the cleanest engines available. As of 2016, only trucks with Euro VI engines will be allowed to operate inside and service the port.
- At Maasvlakte 2, companies are required to meet standards related to air quality, noise, and energy use, and they are also required to reuse other companies' waste heat and waste products to minimize negative environmental impacts.[137]
- The Port Authority uses an Environmental Shipping Index to score and reward ships based on their adherence to emissions standards. Shippers receiving a high score get discounts on the port tariff required to operate at the port. In addition, inland ships (ships that travel shorter distances between European destinations) that do not meet CCR II emissions requirements will not be allowed to enter the port as of 2025, and those that go beyond existing requirements also get a discount on port tariffs.[138]

5. FREIGHT CORRIDORS COMMUNITY ENHANCEMENT AND IMPACT REDUCTION INITIATIVE

A. Overview of Strategy

The proposed Freight Corridors Community Enhancement and Impact Reduction Initiative would help to fund impact reduction in neighborhoods next to freight facilities where buffers and relocation of freight-attracting land uses are not possible. These proposed impact reduction projects would be independently designed and funded to address overall impacts on sensitive land uses, instead of being tied to a particular source of pollution or treated as mitigation measures for the projected impacts of specific development projects. Examples of eligible projects listed in the strategy evaluation document for the draft Plan include air filtration systems for schools and senior centers and double-paned windows to reduce noise exposure and impacts.[139] The strategy evaluation document states that such a program could be focused on reducing impacts from existing freight activities rather than new freight activities generated by proposed expansions included in the draft Plan.

The Freight Corridors Community Enhancement and Impact Reduction Initiative is listed as one of the strategies comprising Opportunity Package 1 ("Sustainable Global Competitiveness") in the draft Alameda County Goods Movement Plan. The stated objective of this opportunity package is to "support environmentally sustainable investments at key global gateways that create local jobs, protect the community, and attract international commerce."[140] The initiative is one of several strategies included in this opportunity package to reduce existing impacts on communities to a healthful level as well as to reduce additional impacts that can result from freight industry growth in Alameda County, such as a Rail Quiet Zone program and a Rail and Terminal Emissions Reduction Program. Types of community impacts of freight traffic listed include diesel pollution; noise from trucks, trains, and port activities; and nuisance and safety impacts of spillover truck traffic in residential neighborhoods.

The strategy evaluation in the draft Plan of the proposed Freight Corridors Community Enhancement and Impact Reduction Initiative assigns a high rating to this strategy for reducing land use conflicts associated with freight traffic. The strategy evaluation also ranks this initiative highly in terms of advancing equity by providing for mitigations that would help address the inequitable distribution of freight-related environmental and community impacts across the county. The initiative is premised on the assumption that "the physical location of most goods movement activities is unlikely to change, and so the adjacent communities are likely to continue to experience some level of environmental burden from their relative proximity to freight facilities."[141]

B. Summary of Impacts

I. AIR QUALITY

This strategy has a potential positive impact on air quality since it focuses on funding impact reduction along existing freight corridors. Various impact reduction or mitigation measures have been demonstrated to reduce the impacts of heavy traffic on neighborhood air quality. It should be noted that reducing pollution at its source through the use of cleaner engines is among the most effective measures; for example installing diesel particulate filters in freight vehicles can remove up to 95% of harmful particulate matter from exhaust before it is emitted into the air.[142] However, certain measures can be put in place within new and existing housing units to reduce exposure to outdoor air pollutants once they are emitted, such as indoor air filtration systems and sealed or double-paned windows. Yet other measures, such as soundwalls and vegetative barriers, can be integrated into the built environment along freight corridors to reduce the impacts of outdoor air pollutants on surrounding neighborhoods.

A 2012 California Air Resources Board report on air quality mitigation measures found that indoor air filtration systems work best in older buildings without mechanical ventilation (such as bathroom exhaust fans) which also have sealed windows and other measures to limit intrusion by polluted outdoor air. The report estimated that built-in filtration systems can cost from $200 to $2800 (not including installation labor costs), while portable filtration units can cost from $200 to $1250 (two or more may be needed per housing unit). According to the report, ongoing system maintenance like filter replacement is key to effectiveness in reducing exposure to air pollutants and costs $25-$255 per year.[143]

A 2012 assessment of the effectiveness of windows as a mitigation measure for airport impacts found that ventilated dual-paned windows may both reduce noise pollution and improve indoor air quality.[144] The 2012 ARB report on air quality mitigation measures stated that sealed windows are questionably effective in reducing exposure to outdoor air pollutants since they also trap other pollutants inside the home and increase condensation, contributing to mold and other indoor air quality issues.[145]

Installing physical barriers such as soundwalls and vegetation along freight corridors can also be used to

help reduce exposure to outdoor air pollutants. The 2012 ARB report on air quality mitigation measures found that combining soundwalls and vegetative barriers can reduce pollutants by 50 to 60%. The report also found that soundwalls can reduce pollutant concentrations downwind, but may increase concentrations on the roadway by trapping pollutants. The report stated that vegetation can restrict dispersion of pollutants, though density and gaps in vegetation affect effectiveness. However, vegetation can also produce pollen and other allergens which can somewhat offset positive impacts on dispersion of pollutants. [146]

Site re-design measures are also promising in terms of their potential to reduce exposure to outdoor air pollutants in new housing developments. The 2012 ARB report found that locating air intakes away from roadways and building housing in taller buildings may reduce exposure, but more research is needed to assess how effective these are compared to other measures.[147]

II. TRAFFIC SAFETY

Due to its focus on funding impact reduction measures, this strategy has the potential to have a positive impact on traffic safety along existing freight corridors. Mitigation measures to improve traffic safety can be put in place to reduce the impacts of heavy truck and train traffic on pedestrians, bicyclists, and other roadway users. A Federal Highway Administration (FHWA) handbook on freight and air quality states that many of these measures also have air quality co-benefits. Such measures include grade separations, other mode separations like dedicated truck-only lanes, and driver training.[148]

The FWHA handbook states that grade separations, such as overpasses to separate trains from vehicular traffic, can reduce the risk of collisions between different types of roadway users while reducing emissions by curbing idling at intersections. Other mode separations, such as dedicated pedestrian and bike lanes or truck-only lanes, can contribute to improving traffic safety while reducing emissions by improving traffic flow. However, the FWHA handbook states that such lanes are only viable if there is a sufficient volume of a certain type of roadway user to dedicate the lanes to one type of traffic. Currently, a minimum of 30% of roadway users being trucks is the threshold for truck-only lanes in Southern California. Driver training can help reduce speeds, thereby improving traffic safety by reducing likelihood of collisions involving other roadway users like cars and bicyclists, while lowering air emissions by saving fuel.[149]

III. EMPLOYMENT

The potential impact of the proposed Freight Corridors Community Enhancement and Impact Reduction Initiative on employment is unclear and is thus not analyzed in this HIA. The installation of the impact reduction or mitigation measures outlined above as part of this strategy could generate jobs. However, it is unclear whether these jobs would benefit residents of communities along existing freight corridors.

6. TRUCK ROUTE COORDINATION PLANNING/ GUIDANCE

A. Overview of Strategy

The proposed Truck Route Coordination Planning/ Guidance aims to guide the Alameda County Transportation Commission in providing planning and technical assistance to cities on truck route planning based on principles of connectivity and separation of truck activity from sensitive receptors, as described in the Needs Assessment report for the Alameda County Goods Movement Plan. The guidance would also support the Commission in facilitating discussion and actions by cities to adopt routes that address truck route system gaps, as well as possible consideration for removing restrictions on truck traffic on particular streets. The proposed guidance would include model truck route ordinances and policies for cities and make available online truck route information including a countywide truck route map, city contacts for oversize/overweight truck permits, and links to city truck services. [150]

The Truck Route Coordination Planning/Guidance is listed as one of the strategies comprising Opportunity Package 3 ("Modernizing Infrastructure") in the draft Plan. The stated objective of this opportunity package is to "support Alameda County's industry and job diversity by modernizing the road network in industrial corridors, improving safe access to industrial corridors and facilities, reducing land use conflicts along freight corridors, and improving last-mile truck routes and rail connections to existing and emerging industries."[151] The guidance is among several strategies listed within this opportunity package that aim to improve the safety and efficiency of truck traffic along the county's industrial corridors, such as a countywide freight signage program and developing additional truck parking and truck services facilities near major industrial centers.

B. Summary of Impacts

I. AIR QUALITY

The strategy evaluation conducted for the proposed Truck Route Coordination Planning Guidance in the draft Plan assigns a neutral rating to this strategy for its impact on air emissions "because the net effect (of this strategy) is difficult to determine in advance."[152] The evaluation states that "the Needs Assessment (for the Alameda County Goods Movement Plan) does not identify specific emissions issues related to truck routes in Alameda County." However the strategy evaluation indicates that the strategy could have a negative impact on air quality and pavement conditions along truck routes by redirecting additional truck traffic onto designated streets. However, the strategy could also have a positive impact on air quality on other streets by curtailing truck traffic on non-designated truck route streets, as illustrated in the case study on the impacts of truck re-routing in the Barrio Logan neighborhood in San Diego CA in Appendix B of this report.

a. Emissions Impacts

Neighborhood studies indicate that increasing freight traffic along existing truck routes could have a negative impact on air quality. Several studies in Alameda County have found diesel truck traffic along the county's industrial corridors to be a significant source of exposure to toxic air emissions. A 2003 diesel study in West Oakland conducted by the Pacific Institute found that neighborhood residents were exposed to five times more diesel exhaust than those in other parts of Oakland.[153] An air monitoring study in West Oakland conducted for the Bay Area Air Quality Management District found that black carbon concentrations (an indicator for particulate matter) were highest along major truck routes within the Port and along major arterials like 7th Street and Mandela Parkway.[154] A 2010 air monitoring study in East Oakland conducted by Communities for a Better Environment found elevated fine particulate matter (PM 2.5) levels along high diesel truck traffic corridors in the neighborhood.[155] A 2010 diesel study in East Oakland conducted by Communities for a Better Environment concluded that agency estimates of truck traffic volumes based on modeling were underestimating the amount of truck traffic on local streets when compared to estimates based on actual truck counts at key intersections.[156]

Rerouting diesel trucks away from residential areas has been recommended as a strategy to reduce exposure to air emissions in several local studies conducted in partnership with community groups.[157] A 2010 East Oakland truck route assessment conducted for the City of Oakland was developed by a Technical Advisory Group (TAG) comprised of city staff, community groups and other stakeholders. The assessment recommended posting adequate route signage as well as "no idling" signage along designated truck route streets, along with education and outreach to truckers and community members about the location of designated truck routes. The assessment also recommended that the City and Port of Oakland identify areas where excessive idling is taking place to target for outreach to truck drivers, as well as to inform them of the availability of incentive funds from the Bay Area Air Quality Management District for truck engine retrofits and upgrades. Installing vegetative barriers along neighborhood truck routes was also recommended in the assessment as a measure to mitigate air quality impacts.[158]

b. Emissions-Related Health Impacts

Several studies also indicate that health and quality of life impacts associated with exposure to diesel exhaust are higher in neighborhoods harboring heavy diesel truck traffic. A 2008 Health Risk Assessment for West Oakland conducted by the California Air Resources Board found that 71% of cancer risk from diesel sources in West Oakland was attributable to truck traffic on nearby freeways and local streets. The assessment also showed that Port-related activities could potentially result in an additional 18 premature deaths (out of a total population of three million age 30 and older), 290 asthma-related attacks, 2,600 days of work loss, and 15,000 minor restricted activity days each year. [159]

c. Mitigations to Address Impacts

The City of Oakland has adopted several revised neighborhood truck route ordinances developed in collaboration with impacted communities which could serve as the basis for a model ordinance and process for inclusive truck route planning.[160] The West Oakland truck route ordinance, adopted in 2005, aimed to reduce truck traffic in the West Oakland neighborhood in order to reduce exposure to diesel emissions and improve traffic safety and quality of life. The ordinance was developed by the West Oakland Environmental Indicators Project Truck Route Committee through a collaborative process among city staff, community groups, trucking businesses, and other stakeholders. As a result of this process and extensive community outreach, the ordinance removed portions of 7th Street and Mandela Parkway from the designated truck route in order to re-direct trucks away from residential neighborhoods while still providing route access for local businesses. [161]

The 2005 West Oakland truck route ordinance estimated the fiscal impact of installing and removing signage to conform to the revised truck route to be $9200, with enforcement to be provided by the Police Agency Commercial Vehicles Unit with two officers paid for by the Port of Oakland.[162] Since the ordinance was adopted, the Port of Oakland has also distributed outreach materials about the revised truck route to truck drivers.[163] However, subsequent research has indicated that adequate enforcement of the revised truck route in West Oakland remains a significant issue on neighborhood streets, underscoring the need to proactively address and identify funding for enforcement within truck route planning and ordinance development.[164]

II. TRAFFIC SAFETY

The strategy evaluation states that the proposed Guidance could have a moderate positive impact on traffic safety along designated truck routes by reducing the risk of truck-involved crashes on these streets and reducing conflicts between freight and passenger uses like bike lanes and bus routes.[165] The Needs Assessment for the draft Plan found that many of the county's truck-involved collisions have occurred along interstate highway on- and off-ramps, suggesting that designated truck routes along major arterials connecting to such ramps could be prioritized for safety improvements to reduce incidences of collisions involving trucks. However, increases in freight traffic along designated truck routes may offset the potential benefits of the proposed Guidance on traffic safety.

a. Mitigations to Address Impacts

Various mitigation measures have been instituted as part of local truck rerouting projects to improve traffic safety. The 2010 East Oakland truck route assessment conducted for the City of Oakland recommended various changes to the existing truck route to separate truck traffic from residential areas, including restricting truck traffic on streets whose design was not appropriate for accommodating heavy truck traffic. The recommendations in the assessment include proposed measures to reduce future land use and mode conflicts, such as requiring proposed truck-generating developments to assess the potential impacts of additional truck traffic in their environmental review. Lastly, the assessment recommended that the City's Complete Streets policy include specific guidelines for roadways that carry truck traffic, especially through residential and mixed use (residential/commercial) areas, such as traffic calming measures to address safety concerns.[166]

Multi-modal assessments and truck routing plans in other areas have identified a number of roadway design considerations and measures that can be put in place to improve traffic safety. Where possible, the physical separation of pedestrian and bicycle traffic from truck traffic is recommended to improve safety, for example by building pedestrian overpasses at key intersections or installing physical barriers to separate bike lanes from lanes with truck traffic. In cases where this is not feasible, engaging a range of roadway users including bicyclists, truck drivers and pedestrians in the planning process can help identify solutions that address specific safety concerns and user considerations.[167] A multi-modal assessment carried out in Seattle's SoDo neighborhood by the US Department of Transportation as part of its Safer People, Safer Streets Initiative also identified the following safety solutions: High-quality road surfaces, intersections that promote high visibility, logical "way-finding" signage for both bicyclists and truck drivers to follow, and infrastructure design that improves predictability by all roadway users.[168]

The Atlanta Strategic Regional Thoroughfare Plan recommends the following safety-related thoroughfare design features on roadways with heavy truck traffic: 1) Adequate lane widths of 11-12 feet where feasible; 2) Wider sidewalk widths with more vertical clearance for truck routes; 3) Grade separations between rail lines and truck routes where possible; where not, train-activated warning devices should be used; 4) Clear zones of 7-10 feet around local roads with curbs along truck routes; 5) Minimum right-turning radius of 15 feet in residential areas, 35 feet in commercial areas, and 75 feet where an intersection is designed for trucks; 6) Longer crosswalks and crossing times at intersections with heavy pedestrian and truck traffic; 7) Median refuge islands and curb extensions in areas with heavy pedestrian and truck traffic; 8) Appropriate signage, particularly where bike lanes may also be used by trucks to make right turns; 9) Removing on-street parking in areas where trucks need the extra clearance to access destinations or make turns.[169]

III. EMPLOYMENT

The potential impact of the proposed Truck Route Coordination Planning Guidance on employment is unclear and is thus not analyzed in this HIA.

CASE STUDY SUMMARY

Redistributing the Burden of Diesel Pollution in Barrio Logan, San Diego

Barrio Logan is a waterfront neighborhood adjacent to the Port of San Diego that is considered an "environmental justice community" by the US EPA, due to the high proportion of residents who are low-income people of color and its proximity to multiple sources of freight pollution. Historically, heavy-duty trucks have used Cesar Chavez parkway and other Barrio Logan neighborhood streets to travel between the Port and the I-5 highway. As a result of port-related activity, local industrial activity, and the BNSF rail yard to the north, residents in Barrio Logan face high levels of diesel particulate matter exposure and asthma emergency department visit rates that are more than two times that of San Diego County. Between 2004 and 2012, local residents and members of the Environmental Health Coalition (EHC) initiated several mitigations to mitigate and redistribute diesel pollution out of their community. This case study synthesizes results and lessons learned from those mitigations based on an air quality modeling study, local air quality monitoring data, and an interview with EHC staff member Joy Williams.

Key Findings and Statistics

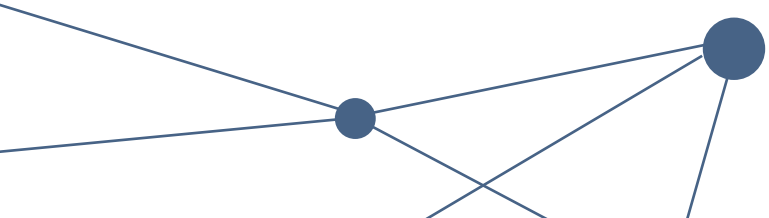
Starting in 2004, several mitigations were implemented in the community – including a permanent re-routing of heavy-duty diesel trucks off of neighborhood streets, repainting of parking spaces to prevent truck idling, relocation of a polluting warehouse out of the community, adoption of a port truck rule that prohibits entrance of trucks that are out of compliance with state emissions regulations, and the installation of a gateway sign preventing trucks from entering the neighborhood on Cesar Chavez. Results of the mitigations include:

- A 2009 air quality modeling study predicted that the truck route changes, if effectively implemented, could reduce DPM pollution by 98% for local residents in Barrio Logan, while slightly but insignificantly increasing DPM pollution levels in other parts of the region.
- Despite the new truck route ordinance that was adopted in 2006, trucks routinely ignored the ban and continued to use Cesar Chavez and other neighborhood streets. It wasn't until the City paid for the installation of a gateway sign that prevented trucks above a certain height from entering the neighborhood in 2012 that the new route was actually followed.
- A local air quality monitoring station in Barrio Logan reveals that PM2.5 levels decreased between 2006 and 2013 -- from over 60 $\mu g/m^3$ to 40 $\mu g/^{m3}$. However, these levels are still higher than state and federal standards, and concentrations of Elemental Carbon remain higher in Barrio Logan than other neighborhoods of San Diego.
- Children's asthma hospitalization rates in Barrio Logan remain the highest in the region.

Lessons for Alameda County

1. Aggressive enforcement by local government agencies is necessary for regulations and policies (including new truck routes and vehicle emissions standards) to translate into real emissions benefits for freight-impacted communities. Too often, community residents bear the brunt of unenforced regulations and have to take enforcement into their own hands.
2. Multiple strategies are necessary to achieve emissions reductions - including those that minimize exposure, reduce freight volume and emissions, and redistribute emissions.

3. Mitigations may not be enough to improve health, without reduction in freight volume and/or significant adoption of zero emissions technology. Even when mitigations are successful, diesel particulate matter exposure may remain at hazardous levels, resulting in persistently high asthma rates and other air pollution related health outcomes. As long as freight volume and activity expands, health improvements will be difficult to attain without aggressive adoption of zero emissions technology, strict enforcement of emissions regulations, and implementation of multiple mitigation strategies at the community level.
4. Redistribution is necessary for equity. Until a completely zero emissions freight transport system is possible, reducing emissions for vulnerable populations will require redistributing some of the burdens of pollution towards less historically burdened areas.
5. Air quality studies may overestimate or oversimplify emissions reductions benefits because they rely on multiple assumptions, including compliance with regulations. While they are an invaluable source of information for decision-makers, they should be supplemented with data from community residents and local air quality monitoring stations.
6. Local authorities (including ports) can and should help enforce state emissions requirements as a condition for entering freight facilities.
7. Proximity matters when it comes to pollution and mitigation. Mitigations to minimize diesel pollution exposure should be prioritized for locations closest to freight operations where vulnerable populations are present.
8. In heavily freight-impacted communities, relocate the heaviest sources of pollution (both mobile and stationary) away from sensitive receptors and avoid locating any new freight facilities in proximity to vulnerable communities.
9. Some mitigations can be simple and relatively cheap, including design features like gateway signs and parking spaces that make it difficult for trucks to idle on residential streets.
10. Make it easy and safe for truck drivers to comply with regulations by ensuring that official truck routes are clearly signed and establishing designated truck stops where drivers can rest without polluting residential neighborhoods.



VII. RECOMMENDATIONS: TOWARDS A HEALTHIER FREIGHT SYSTEM IN ALAMEDA COUNTY

A. OVERALL RECOMMENDATIONS TO ADDRESS HEALTH IMPACTS AND ADVANCE HEALTH EQUITY

The benefits and burdens of goods movement are not equally distributed throughout Alameda County. Even though regional pollution levels are improving, data compiled by the Alameda County Public Health Department show that certain areas of the county are still disproportionately exposed to diesel particulate matter, a toxic air contaminant found in exhaust from freight trains, ships and trucks, as discussed in Part V of this report. ACPHD data also show that residents in those areas are more likely to be hospitalized for illnesses including asthma. Those neighborhoods most impacted by freight in the County are largely low-income communities of color.

Recognizing these unequal burdens, the Alameda County Transportation Commission (ACTC) set the following goal in its vision and goals for this goods movement plan:

> *"Goal: 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."*

However, the draft Alameda County Goods Movement Plan (hereafter, the draft Plan) did not collect and analyze the data necessary to determine current health inequities caused by the existing goods movement system, project potential future health impacts that will be caused by changes proposed in the draft Plan, and evaluate the impact that these changes will have on the distribution of health impacts between already overburdened communities and the rest of the County. As a result of not collecting and analyzing this vital data, the draft Plan also does not demonstrate that the mitigation measures proposed by the draft Plan adequately meet the goal of improving health and quality of life for those communities most impacted by goods movement in Alameda County.

Therefore DDD recommends that the following general measures be incorporated into the implementation strategy for this draft Plan:

1. ACTC should immediately seek funding for and implement strategies in the draft Plan to reduce environmental and community impacts from goods movement. These proposed strategies include:
    a. Demonstration projects using zero emission and near-zero emission technologies
    b. A proposed rail and terminal emission reduction program
    c. A proposed freight corridors community enhancement and impact reduction initiative
    d. Land use guidance to reduce conflicts between goods movement and residential development, schools, childcare centers and other projects that put sensitive people near freight operations

    While implementing these strategies, ACTC should also evaluate their effectiveness to see what additional actions are needed to reduce adverse impacts of goods movement.
2. ACTC should work with the Alameda County Public Health Department and the Bay Area Air Quality Management District to assess the environmental, health, and community impacts that are likely to occur from proposed Plan strategies that increase the efficiency and capacity of the county's goods movement system. That assessment will help ACTC understand what level of impact reduction is needed to counter any negative impacts of proposed changes to the county's freight system.
3. ACTC should target impact reduction investments to benefit those communities most impacted by the County's freight system. In turn, assessing the likely effectiveness of those measures will help ACTC evaluate whether

proposed strategies in the draft Plan will reduce or increase inequities. That knowledge is critical to informed implementation planning. Additionally, no strategies at the program or policy level should be implemented that increase health inequities for residents of impacted communities. This assessment should be carried out in collaboration with BAAQMD, which is already identified as a key partner in section 7 of the proposed draft Plan, and with ACPHD.

The draft Alameda County Goods Movement Plan proposes three Opportunity Packages to guide the County's future freight system: 1) Sustainable Global Competitiveness; 2) Smart Operations and Deliveries; and 3) Modernizing Infrastructure. Since many strategies listed in Opportunity Package 1 would expand freight infrastructure and operations in already overburdened communities, the implementation of strategies listed in Opportunity Packages 1, 2 and 3 that would address the adverse impacts of these expansions should be prioritized in freight-impacted areas. For example, emissions reduction programs and traffic safety improvements should target areas where proposed strategies to expand freight infrastructure and operations will take place. In order to do this most effectively, the Implementation Plan should include a detailed analysis of which areas in the county stand to be most impacted by proposed changes to the county's freight system as detailed in the opportunity packages.

B. RECOMMENDATIONS ON SELECTED STRATEGIES IN THE DRAFT PLAN

1. OAKLAND ARMY BASE REDEVELOPMENT PHASE II – RAIL IMPROVEMENTS

Because the proposed rail expansion at the former Oakland Army Base entails increasing freight activity specifically at the Port of Oakland, it does not offer opportunities to redistribute impacts to other, less-burdened areas of the county. Therefore the following recommendations focus on mitigating the negative impacts of this strategy within West Oakland. Many mitigations that could help minimize the negative impacts of this strategy are already mentioned within the draft Plan, but could be implemented before or concurrently with rail expansions at the former Oakland Army Base, and specifically directed to the West Oakland area where the impacts of this strategy will be felt.

1. Target demonstration and adoption of zero emission technologies to vehicles and equipment within the Port of Oakland.
    a. Yard trucks and other equipment that stays entirely within the Port would be especially good targets for electrification since they could remain in close distance to charging stations. Zero and near-zero emission equipment should also be prioritized at rail terminals within the Port.
    b. Include details about how truck conversions to zero-emissions technology can be funded so that the burden of upgrading technology is not placed on individual truck drivers working as independent contractors.
    c. Include specific goals on adoption of zero and near-zero emission technology in updates to the Maritime Air Quality Improvement Plan for the Port of Oakland, and commit to emission reductions even if Port activities grow.
2. Reduce air emissions related to the implementation of proposed rail improvements at the former Oakland Army Base, and clarify projected impacts on emissions.
    a. Clarify in the Final Plan to what extent this strategy is expected to lead to freight transport mode shift from truck to rail, and to what extent it is expected to grow freight transport volume overall.
    b. Clarify in the Final Plan how this strategy is expected to impact truck traffic and emissions on I-880.
    c. Require that the Port of Oakland adopt a new iteration of MAQIP after the 2020 planning horizon, with clear and ambitious goals to further reduce emissions, even as Port activity increases.
    d. Move forward with the Clean Truck Policy and Program Collaborative Strategy for the Port of Oakland before or concurrently with OAB buildout.

e. Ensure that the Rail and Terminal Emission Reduction Plan incentivizes transition to Tier 4 locomotives.

f. Maximize use of renewable energy at the Port of Oakland through its Utilities Office. This should incorporate identifying potential for renewable power generation at the Port itself, and should be included in the Freight Emissions Reduction Action Plan.

g. Implement Intelligent Transportation Systems (ITS) at the Port to reduce queuing and congestion.

h. Pursue analysis of nighttime Port operations, which could reduce emissions by reducing truck idling and congestion. However, this should include careful analysis of the potential negative impacts to local residents from nighttime noise and light pollution.

3. Institute measures to address traffic safety impacts as part of the proposed rail improvements at the former Oakland Army Base. These recommendations will require collaboration with the City of Oakland, and the Goods Movement Plan should specify which the City must implement and which can be implemented by ACTC.

a. Integrate recommendations in the West Oakland Specific Plan for improving signage and enforce truck-parking rules, including truck parking in bike lanes.

b. Enforce the dedicated space for truck parking that is being provided as part of the Oakland Army Base redevelopment so that parking on local streets is reduced.

c. Provide Complete Streets guidance for West Oakland neighborhoods with high volumes of freight traffic.

d. Identify specific locations within West Oakland where conflicts between truck traffic and bicyclists and/or pedestrians could lead to heightened risk of injury, and prioritize infrastructure improvement at these locations.

e. Work with the City of Oakland to prioritize repairing local roads in poor condition within West Oakland with heavy freight traffic.

4. Increase recruitment and job training for West Oakland residents for jobs created during and after the rail improvements are made at the former Oakland Army Base. See the recommendations regarding the Workforce Training Programs strategy below for further details.

5. Refer to this strategy as the Oakland Global Trade and Logistics Center, instead of as the "Oakland Army Base Phase II," to ensure consistency with other nomenclature being used for this development.

2. OTHER PROPOSED RAIL EXPANSION STRATEGIES

This section does not concern one strategy specifically, but rather focuses on multiple strategies within Opportunity Package 1 that are designed to expand rail capacity on the Niles and Oakland Subdivisions within the County, referred to as "the southern route." These would accommodate the planned expansion in rail traffic that would result from the former Oakland Army Base redevelopment, and the focus is on the southern route because the northern train routes are already highly impacted and the rights-of-way along these routes are constrained. These strategies include:

- A variety of rail crossing improvements
- Hayward double track
- Niles Junction bypass
- Improvement on the Oakland subdivision east of Niles Canyon

These strategies are elements in the overall goal to shift the growth in goods movement towards rail and away from truck transport. As such, they should help reduce emissions regionally; however, negative impacts would be experienced locally. The recommendations below aim to address the potential negative impacts of these proposed strategies for the county's freight-impacted communities, particularly those near rail lines.

1. Design the Rail and Terminal Emission Reduction Program to mandate adoption of low emission and Tier 4 locomotives, rather than including only voluntary programs.
2. Support CARB's petition to the EPA to adopt stricter standards for the turnover of existing locomotives engines. If the EPA fails to strengthen requirements, request that CARB establish stricter state level requirements.
3. Do not ship coal through Alameda County until such projects undergo a comprehensive review of their potential environmental and health impacts.
4. Analyze the potential for an increase in train traffic along this route to increase collisions along other parts of the route.
5. Grade separations should be made before or as a condition of adding new track.
6. Establish local hiring policies for construction projects associated with rail expansions.

3. WORKFORCE TRAINING PROGRAMS

In the current draft of the Plan, the Workforce Training Programs strategy offers almost no detail about how the strategy would be designed or implemented. The strategy description does specifically reference a shortage of truck drivers as one issue that the Workforce Training Programs would be designed to address. In general, the strategy would not be expected to create new jobs, but would rather provide training and connect residents in communities impacted by freight transport to jobs. Overall, this strategy would be expected to lead to employment benefits within freight-impacted communities, and to have associated equity benefits, but again, the lack of details makes it difficult to evaluate. The recommendations below suggest ways that this strategy could be developed and implemented to maximize benefits to the county's freight-impacted communities which have unemployment rates that are over twice as high as those in other parts of the county, as detailed in Part V of this report.

1. Identify clear, enforceable targets for hiring in freight-impacted areas, for example using ACPHD's analysis described in Part V of this report, and/or the Bay Area Air Quality Management District's CARE program.
    a. For freight expansion projects that have local impacts, identify workforce training and hiring goals specifically for local residents of impacted communities, e.g., by zip code rather than city or countywide.
    b. Work with Revive Oakland, the coalition of community based organizations that helped establish the Cooperation Agreement for the former Oakland Army Base redevelopment, to identify further opportunities for labor agreements that direct jobs to impacted residents.
    c. Continue to evaluate the Cooperation Agreement with the Port of Oakland in terms of its ability to create jobs for West Oakland residents specifically, and apply lessons learned to new workforce development programs.
2. Limit the use of temporary labor in warehouses across the County, not only in the Port of Oakland, whenever possible.
3. Establish partnerships between employers and community colleges for low cost training programs, as recommended in the Partner Roles for the Opportunity Packages in the draft Plan.

4. ZERO- AND NEAR-ZERO EMISSIONS TECHNOLOGY ADVANCEMENT PROGRAM

The proposed Zero- and Near-Zero Emissions Technology Advancement Program includes a focus on disadvantaged communities, suggesting that projects and incentives could be targeted towards communities that currently contend with the greatest freight-related health impacts. According to ACPHD's analysis as described in Part V of this report, the county's most freight-impacted communities include West and East Oakland, Ashland-Cherryland, parts of San

Leandro, and Newark. According to this analysis, communities in West and East Oakland face the highest levels of diesel particulate matter and the highest rates of asthma emergency department visits, making these locations the highest priority for zero emissions projects and incentives. To maximize its health equity benefits for the West Oakland community, the program could focus on electrification of equipment and vehicles that primarily operate inside the Port and UP rail yard, along with electrification of drayage and local delivery trucks that serve the Port of Oakland.

In order to maximize employment and emissions-related health impacts and minimize adverse impacts for freight-impacted communities, we suggest the recommendations below to guide the design and implementation of this program.

1. Engage Freight-Impacted Communities.

    a. Ensure that affected community residents in West Oakland and other freight-impacted communities are involved in identifying and prioritizing needed demonstration projects.

2. Require the Reduction of Emissions before Freight Expansion.

    a. Create a funding source to support the replacement of conventional diesel with zero emissions technology that is tied to expansion of freight activity via a container or cargo tariff fee.

    b. Require retrofitting of all existing port and rail yard equipment that is not feasible to electrify before new freight facilities are allowed to be built.

    c. Require that all new freight facilities utilize zero or near-zero emissions technology for vehicles and equipment that operate inside or serve the facility.

    d. Adopt and enforce emissions standards for diesel equipment that go beyond state requirements, and enforce standards as a condition to entering and operating within the Port and rail yard.

3.Focus on Electric Technology in Freight-Impacted Communities.

    c. Focus resources (including demonstration projects and incentives) on the development and adoption of electric technology and other truly zero emissions vehicles and equipment.

    d. Prioritize electric technology for trucks, trains, and cargo handling equipment that primarily operate inside the Port and UP rail yard, in order to maximize benefits for West Oakland, including funding and incentives to electrify delivery and drayage trucks that operate in and near West Oakland.

    e. Implement electric, auxiliary power units at the UP rail yard and shoreside power hook-ups at the port.

    f. Fund the electrification of designated truck stops within freight-impacted communities throughout the county to minimize idling in residential communities.

4. Invest in Verifiably Clean, Renewable Energy.

    a. Invest in the development of locally generated, clean and renewable energy sources that reduce health risks associated with electricity generation and increase local employment development opportunities

5. Support the Economic Well-being of Truck Drivers and Freight Workers.

    a. Prioritize funding for retrofitting of trucks for independent contractors.

    b. Adopt specific local hiring targets to ensure that residents from freight-impacted communities are able to access new jobs created by the program, and ensure that new jobs pay a living wage.

v. Freight Corridors Community Enhancement and Impact Reduction Program

The proposed Freight Corridors Community Enhancement and Impact Reduction Program would target communities already impacted by freight where buffers and relocation of freight facilities are not possible. In order to do so, the program should be based on an analysis to identify those places and populations in the county most heavily impacted by freight, such as the ACPHD analysis summarized in Part V of this report. Furthermore, program implementation should be prioritized in existing freight-impacted areas where proposed changes in the freight system described in the draft Plan could further exacerbate negative impacts. The recommendations below aim to maximize benefits of this program to the county's freight- impacted areas.

1. Build on ACPHD analysis to identify freight-impacted areas to prioritize for funding and program implementation.
2. Include an analysis of both current and projected impacts of proposed changes to the county's freight system in program design.
3. Create an implementation oversight committee comprised of disproportionately impacted communities that prioritizes impacts that the program will address and selecting mitigation measures to address them. Community members know best which combination of proven, effective mitigation measures best suit community needs Demonstrated mitigation measures are available for many negative impacts of freight operations[170]:
    a. Indoor air filtration can reduce exposure to toxic air contaminants by up to 98%
    b. Physical barriers (soundwalls or vegetation) can reduce exposure by 15-60%
    c. Reducing congestion can reduce exposure by ~80%
    d. Grade separations can reduce emissions by curbing idling, while improving traffic safety

    The above are examples of measures that community members should consider.
4. Tie program funding and requirements to other proposed strategies in the draft Plan, such as freight expansion projects that could worsen impacts in communities along existing freight routes.
5. Incorporate interventions to prevent, as well as reduce, negative impacts of future freight expansions into program implementation in communities already overburdened by freight operations.
    a. Many negative impacts of proposed changes to the county's freight system can be reduced through proactive planning interventions, such as incorporating buffer zones between freight-related and sensitive land uses into proposed expansion projects.

5. TRUCK ROUTE COORDINATION PLANNING GUIDANCE

The proposed Truck Route Coordination Planning Guidance could alleviate some negative impacts of freight traffic on local communities by addressing current gaps in truck routes across jurisdictional lines. However, the strategy could also potentially lead to further concentrating negative impacts like air emissions and street wear-and-tear along designated truck routes by further consolidating truck traffic along these routes. If adequate mitigation measures are included in strategy implementation, the strategy could lead to improved traffic safety along truck routes by reducing mode conflicts between freight and passenger users such as bicyclists and pedestrians. The strategy could also lead to addressing land use conflicts if the guidance leads to re-routing trucks away from residential areas.

Since this strategy will most impact communities along designated truck routes, the recommendations below aim to maximize benefits of this strategy to these communities:

1. Include model ordinance language in guidance based on community-based truck rerouting projects in West and East Oakland.[171]
    a. Ensure that enforcement of designated truck routes is adequately addressed in the guidance, such as installing adequate signage and educating truck drivers about revisions to the previous truck route.

2. Prioritize zero- and near-zero emissions technology demonstration projects for trucks on designated truck routes to mitigate the potential adverse impacts on air quality of further consolidating truck traffic onto designated truck routes.

3. Prioritize traffic safety improvements for designated truck routes, particularly at intersections with high incidences of truck-involved collisions as identified in the Needs Assessment for the draft Plan, to mitigate the potential adverse impacts on traffic safety of further consolidating truck traffic onto designated truck routes.

4. Create an implementation oversight committee comprised of impacted communities along designated truck routes to work with ACTC staff on guidance design and implementation.

    a. Include the multi-stakeholder collaborative processes used for revising neighborhood truck route ordinances in East and West Oakland as best practices for truck routing and identifying mitigation measures to reduce adverse impacts on local residents.[172]

    b. Recommendations for Plan implementation

The Moving Forward section of the draft Plan, Section 7.1.1, recognizes the need to implement impact reduction strategies simultaneously with capacity expansion:

> "Strategies included in this package that address community impacts... would need to be implemented as separate programs/projects whose execution would need to be timed to come on-line as the Port and Army Base projects are delivered. The zero and near-zero emission demonstration program would likely be coordinated by the BAAQMD (with cooperation from the Port) and could be funded with Air Resources Board Cap-and-Trade programs under the incentives to purchase low-carbon vehicles program. Thus, there will need to be a high level of coordination of these two sets of strategies."

It is vital that this need is addressed in an adequately vetted, effective, and binding fashion. Projects which have the potential to increase impacts in an already impacted community, similar to the Port and Army Base project, should not move forward until adequate funding is available for related impact reduction measures. In addition, impact reduction strategies in the draft Plan, such as the Freight Corridors Impact Reduction Initiative and the Zero-Emissions Technology Advancement Program, should be implemented prior to strategies that could increase adverse impacts such as proposed infrastructure expansion projects.

It also is imperative that, as part of implementation planning, ACTC assess the likely impacts of capacity expansion projects and implement strategies that reduce those impacts to a level such that, rather than increasing impacts in already impacted communities or maintaining an unequal and unfair status quo, Plan implementation will genuinely improve health and quality of life in impacted areas and decrease the gap between these communities and other more affluent communities throughout the county.

The same section of the draft Plan, section 7.1.1, seems to assume that public funds will be used to pay for rail line improvements that will facilitate goods movement by rail:

> "Coordinating the rail mainline improvements creates additional challenges. Most of these improvements have been identified as projects in the plans for the commuter rail service providers, and some currently are under environmental review. Thus, they could be implemented by the commuter rail service providers. Alternatively, they could be funded and implemented by Caltrans, or other partner agencies, as part of a new Trade Corridor Improvement Fund (TCIF) program (or the Cap-and-Trade program). Regardless, agreements will need to be negotiated with the UP as the owner of most of the track."

No public funds should be committed to any rail improvements that benefit Union Pacific, Southern Pacific, or any other investor owned rail line, unless that funding is based on an agreement with the carrier that commits the company to using the cleanest engines available.

On a more fundamental level, the Moving Forward section of the draft Plan (Section 7.1) outlines partnerships key to successful implementation of the Goods Movement Plan. Community members have tremendous knowledge about impacts of goods movement operations and infrastructure in their neighborhoods. Community members and community-

based organizations in freight impacted communities should be identified as partners in the discussion of each of the Opportunity Packages presented, but they are not mentioned. Thus far, the Goods Movement Planning process has not been particularly accessible to many residents of freight impacted communities. Four of the five Stakeholder Roundtables were held during the regular work-day at times that made it difficult or impossible for students or working people to participate. Only one Roundtable -- the only one held in a freight impacted community -- was held during a weekend.

As implementation planning moves forward, ACTC should directly engage impacted communities, in community-friendly forums, ideally hosted by organizations with strong community ties. Community members should be invited and encouraged to prioritize strategies for implementation, and to provide input on how to best implement impact reduction strategies in their communities. In addition, residents of impacted communities should be given decision-making authority in the implementation of the Plan, for example through the creation of an implementation oversight committee that works with ACTC staff to design and implement strategies and opportunity packages in the Plan.

In addition, strong community representation is needed in any institutional framework created to coordinate and implement these strategies, in order to provide for community oversight to ensure that disparities in the distribution of adverse impacts of these and future freight transport projects are minimized and adequately mitigated.

VIII. CONCLUSION

As this report shows, freight-impacted communities in Alameda County are already disproportionately impacted by adverse health outcomes associated with heavy freight traffic, such as high asthma hospitalization and pedestrian injury rates. Yet these communities reap few of the economic benefits of hosting freight routes, contending with high poverty and unemployment rates. In order to address these disparities, future changes to the freight transport system must account for the health impacts of the existing freight transport system as well as potential impacts of proposed projects, programs, and policies that affect this system.

In order to address the existing health inequities created by the county's freight system, the implementation of the Alameda County Goods Movement Plan must take into account the environmental, health, and economic conditions that make freight-impacted communities vulnerable to severe and cumulative impacts on health. To do so, the Plan can build on the analysis of existing health conditions in freight-impacted communities summarized in this report by including a detailed assessment of which communities stand to be most impacted by proposed freight infrastructure expansions and other changes to the county's freight system detailed in the draft Plan's opportunity packages and strategies.

The Plan should also include an analysis of whether these proposed future changes to the county's freight system could reduce or exacerbate existing health disparities in already overburdened communities. No strategies at the policy, program or project level should be implemented that increase health inequities for residents of impacted communities. Furthermore, the Plan should prioritize existing freight-impacted communities for the implementation of strategies to reduce adverse impacts and maximize community benefits, such as emissions reduction and workforce development. Only then will the Plan truly achieve its goal of reducing the adverse impacts of the freight transport system and improving quality of life for all residents.

IX. ENDNOTES

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X. APPENDICES

A. HIA RESEARCH SCOPE AND METHODS

1. METHODS USED TO ASSESS POTENTIAL HEALTH IMPACTS OF THE DRAFT PLAN

This HIA engaged Ditching Dirty Diesel Collaborative (DDD) members and community stakeholders in each phase of the research process. These phases included developing the scope or range of health impacts to be studied, informing the methods used to study existing and potential impacts to health of proposed changes to the freight transport system, and prioritizing the strategies in the Alameda County Goods Movement Plan to be analyzed. DDD members were engaged primarily via monthly Collaborative meetings in planning the HIA and its stakeholder engagement activities, as well as in reviewing research results as these became available. In addition, DDD members identified project advisors to lend their expertise to inform specific aspects of the Assessment. Community stakeholders were engaged via the series of community workshops described in the previous section of this report, and included impacted residents, youth, environmental and public health advocates.

During initial planning discussions, DDD members identified the following objectives for this HIA of the Alameda County Goods Movement Plan:

1) To assess the potential impacts to health – both positive and negative -- of the current and planned freight transport system in Alameda County, particularly for vulnerable populations living in close proximity to freight routes;

2) To assess ways that impacts to health, particularly for vulnerable populations, could be better incorporated into the development and implementation of the Alameda County Goods Movement Plan, and to advance recommendations for maximizing benefits and minimizing risks to health of the Plan

DDD staff conducted a literature review to identify health determinants, or social and environmental conditions that contribute to health outcomes, affected by the freight transport system. The following health determinants were selected as the focus of this HIA based on feedback from DDD members and community stakeholders: 1) Air Quality; 2) Traffic safety; and 3) Employment.

Other health determinants identified as of interest by DDD members and community stakeholders, but not included in the scope of the assessment, were noise and vibrations and access to goods and services. These determinants were not selected due to capacity and resource constraints as well as a lack of readily available data at the county level.

DDD staff then conducted a literature review to identify the health outcomes associated with the health determinants included in the assessment, namely air quality, traffic safety and employment. These health outcomes include respiratory disease, cardiovascular disease, cancer, diabetes, obesity, maternal health outcomes, pedestrian injuries and fatalities, and premature mortality. Lastly, DDD staff worked with DDD members to identify populations likely to be affected by these health outcomes and determinants associated with the freight transport system. These sensitive or vulnerable populations include:

- Those living close to freight corridors and infrastructure
- Those with preexisting medical conditions (e.g., asthma, cardiovascular disease, cancer, etc.)
- Those with occupations in the freight transport sector (e.g., truck drivers, longshoremen, warehouse workers, etc.)
- Children (young children ages 0-5 and school-aged children 6-17)
- The elderly (adults ages 65+)
- Low-income individuals
- People of color

DDD members and staff then worked with Alameda County Public Health Department (ACPHD) staff to develop a methodology for assessing the existing health impacts of the county's freight transport system and identifying those communities most impacted by this system. ACPHD's analysis focused on how current health, environmental, and economic conditions in the most freight-impacted communities compare to conditions in the least freight-impacted communities across Alameda County. This existing conditions analysis covered 360 census tracks within the county and was based on the following three factors: 1) Proximity to freight; 2) Exposure to freight; and 3) Vulnerability to freight and health impacts.

To calculate proximity to freight, buffer distances of 500 feet were applied around designated truck routes, rail lines, and freeways in Alameda County, as recommended by the California Air Resources Board.[1] Buffer distances of 1500 feet and 2000 feet were also applied around seaports and airports, respectively, based on previous health risk assessments conducted at the Port of Oakland.[2] Exposure to freight was measured based on Diesel Particulate Matter emissions estimates, percentage of the population living in proximity to freight, and number of people living in proximity to freight. Lastly, vulnerability to freight and health impacts was measured based on percentage of the population living in poverty, young children, seniors, people of color, and freight workers, since these populations are particularly sensitive to exposure to air quality, traffic safety, and employment impacts of freight transport.

ACPHD staff then created an overall index score based on these three factors that was used to rank Census tracts in the county to identify most- versus least-freight impacted areas. The analysis then compared health outcomes associated with freight transport operations in the most- versus least-freight impacted areas based on surveillance data collected by ACPHD. These health outcomes included asthma emergency department visit rates, chronic lower respiratory disease mortality rates, cancer mortality rates, heart disease mortality rates, low birth weight rates, and all-cause mortality rates. The analysis also compared economic indicators like poverty rates and unemployment rates in the most- versus least freight-impacted areas in the county. The results of this existing conditions analysis are summarized in Part VI of this report.

To assess the potential impacts of proposed changes to the freight transport system, DDD members prioritized a subset of the more than 100 strategies included in the technical documents informing the draft Plan. During a series of meetings in spring 2015, DDD members developed a set of criteria for selecting the strategies to include in this assessment:

- Strategies should be countywide and/or applicable to a wide range of proposed projects and programs
- Strategies should address one or more of the factors that affect health, or health determinants, that this HIA focuses on (air quality, traffic safety and employment)
- Strategies should address multiple modes of freight transport (air, rail, road, and maritime)
- The impact analysis/assessment of such strategies should build on available data on existing health conditions in freight-impacted communities in Alameda County
- Strategies selected should include both strategies that could improve health outcomes and strategies that could result in negative health impacts

Based on these criteria as well as the three opportunity packages, or sets of proposed changes to the freight transport system, included in the draft Plan, Collaborative members selected the following proposed strategies in the draft Plan as the focus of this HIA:

1) Oakland Army Base Phase 2 – Intermodal Rail Improvements
2) Other Proposed Rail Expansion Strategies
3) Develop/Support Workforce Training Programs
4) Near-Zero and Zero-Emission Goods Movement Technology Advancement Program
5) Freight Corridors Community Enhancement and Impact Reduction Initiative
6) Truck Route Coordination Planning/Guidance

For each of these strategies, this HIA discusses the potential health impacts for each of the health determinants being analyzed (air quality, traffic safety and employment). Due to the low level of detail provided in the strategy descriptions included in the draft Plan, the HIA is largely qualitative and focuses on assessing how, rather than to what extent, these strategies may impact these factors.

Where applicable, this HIA also lists assumptions made to identify the potential health and equity impacts of each of these strategies. The HIA summarizes the description of these strategies included in the draft Plan and its appendices. Finally, this HIA includes recommendations for strategy implementation, such as mitigation measures needed to the address potential health impacts of the proposed strategies and opportunity packages, as well as policies to ensure effective implementation of these mitigations and a more equitable distribution of their burdens and benefits within Alameda County. The results of this HIA are summarized in Part VI of this report.

2. FACTORS THAT AFFECT HEALTH INCLUDED IN THIS ASSESSMENT

The pathway diagrams below were developed by DDD staff and members to inform the research questions for this HIA for each of the health determinants being studied. These diagrams illustrate the relationships between potential changes to freight transport, their impacts on the three factors that affect health being analyzed, and health outcomes related to these impacts.

Figure 1 shows the potential relationships between air quality and health outcomes studied in this HIA that may be impacted by the implementation of the Alameda

County Goods Movement Plan. The HIA focused on toxic air emissions generated by freight traffic, such as Particulate Matter and Volatile Organic Compounds, as the primary indicators of air quality impacts of the freight transport system. Health outcomes related to toxic air emissions assessed include rates of respiratory disease, cardiovascular disease, and cancer, as well as low birth weight and overall premature mortality.

FIGURE 1

Air Quality Pathway Diagram

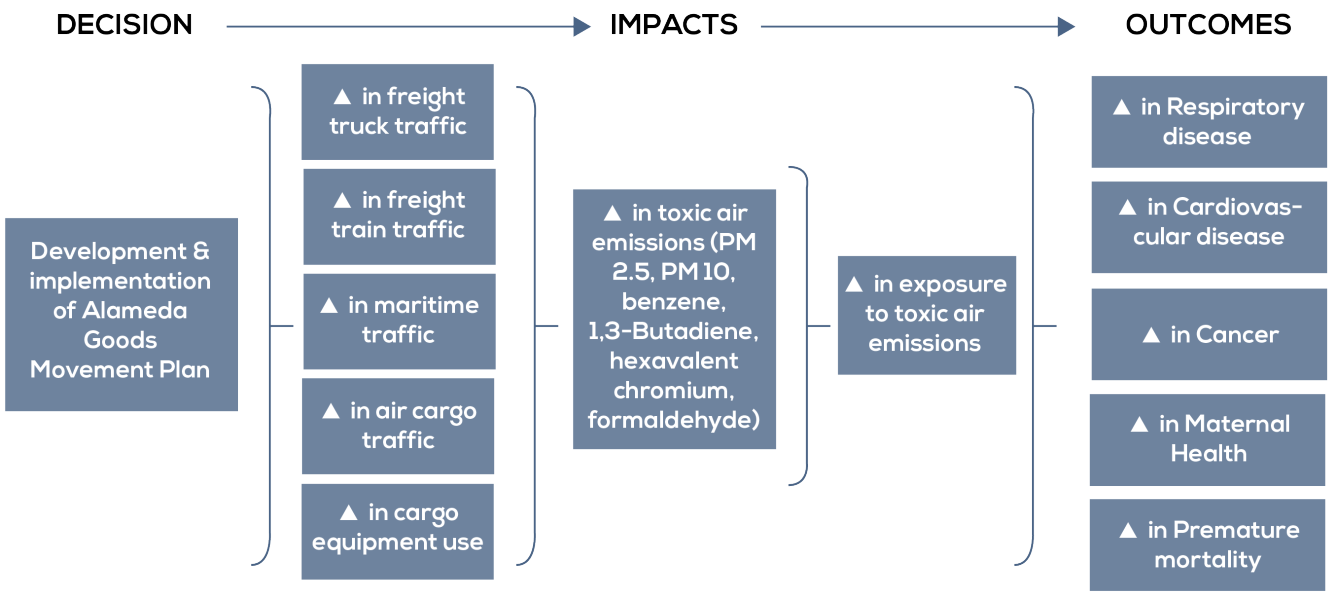


Figure 2 shows the potential relationships between traffic safety and health outcomes studied in this HIA that may be impacted by the implementation of the Alameda County Goods Movement Plan. This HIA focuses primarily on five traffic safety impacts of the freight transport system, namely traffic congestion, pavement conditions, truck- and train-involved collisions, bikeability and walkability of local streets, and hazardous materials incidents. Health outcomes related to traffic safety assessed included pedestrian injuries and fatalities and rates of chronic conditions like obesity and diabetes.

FIGURE 2

Traffic Safety Pathway Diagram

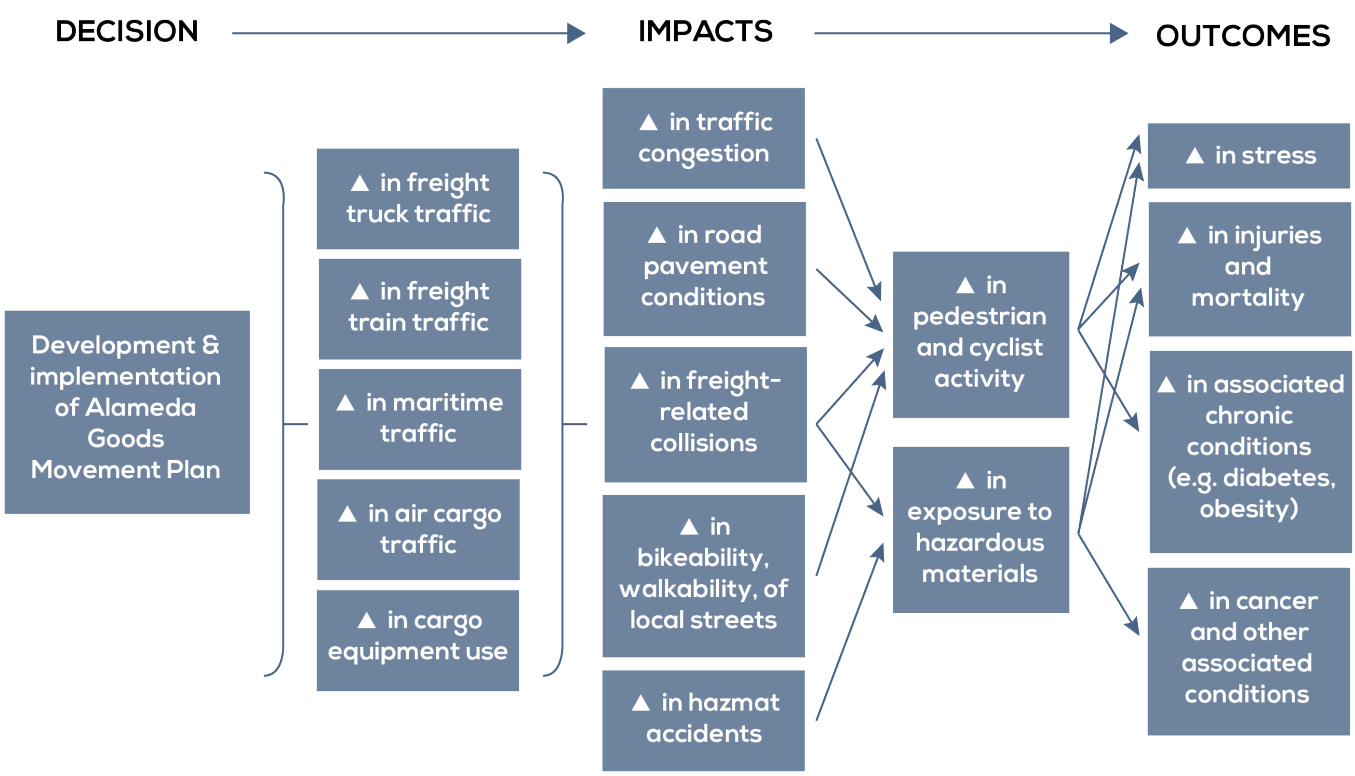
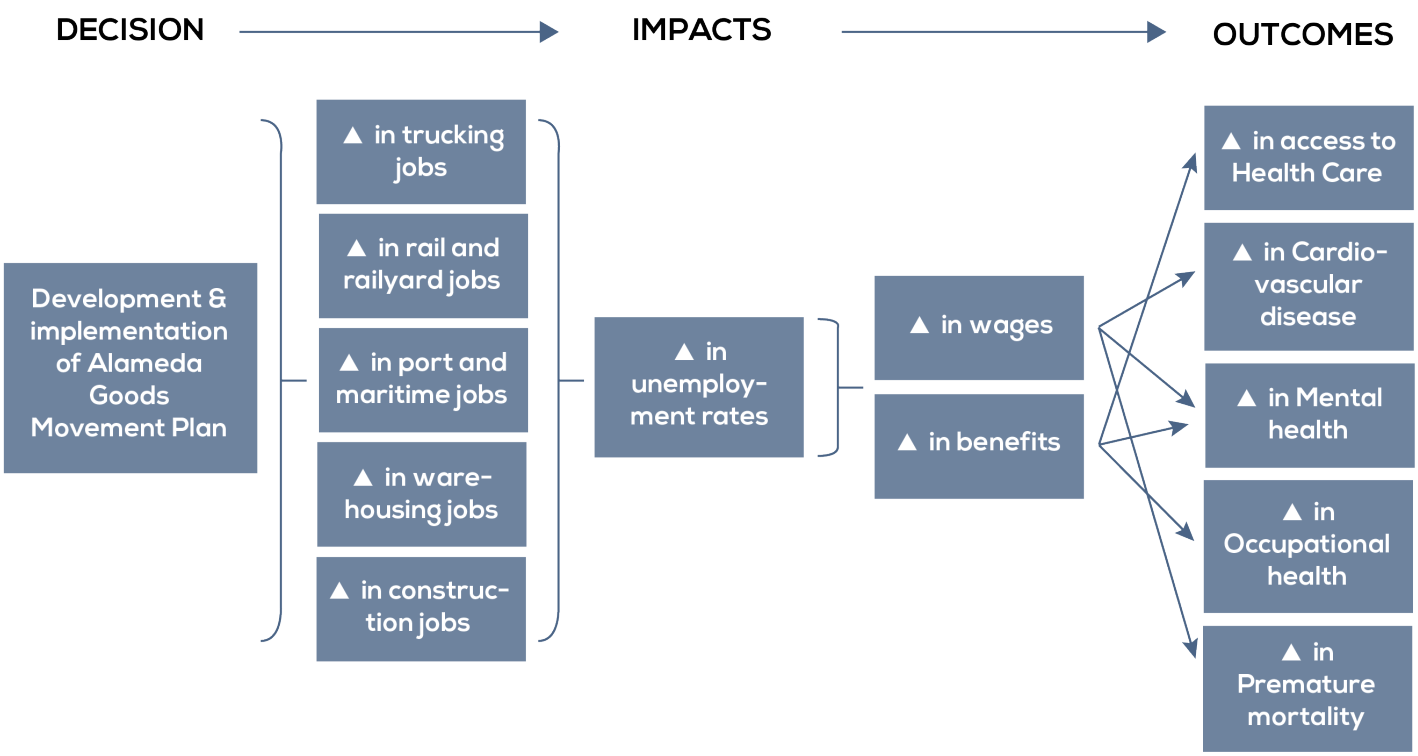


Figure 3 shows the relationships between employment and health outcomes studied in this HIA that may be impacted by the implementation of the Alameda County Goods Movement Plan. The HIA focused on freight transport sector occupations and jobs, as well as unemployment rates in freight-impacted communities, as the primary indicator of impacts of the freight transport system on employment. Health outcomes related to employment assessed included occupational injuries and fatalities for freight industry jobs and overall premature mortality.

FIGURE 3

Employment Pathway Diagram



B. CASE STUDIES

1. THE HEALTH EQUITY CONSIDERATIONS OF SHIFTING CARGO FROM TRUCK TO RAIL

A. Overview

Scientific consensus suggests that freight rail transport is more environmentally sustainable than freight truck transport, due to higher fuel efficiency and lower emissions per mile.[3] However, the local impacts of rail activity, rail yards, and intermodal rail facilities – both existing and new – are significant and often discounted from discussions of shifting cargo from truck to rail, or mode shift.[4] These local impacts must be evaluated and mitigated alongside the potential regional air quality benefits, in order to ensure that the burden of freight-related health impacts is reduced rather than exacerbated for communities living close to freight corridors. This study summarizes available evidence regarding health impacts of rail corridors, rail yards, and intermodal rail facilities, the predicted and documented impacts of shifting cargo from truck to rail, and potential mitigations to offset rail-related air pollution, along with a set of health equity considerations to ensure a healthy and equitable mode shift in Alameda County.

Case study findings suggest that perhaps the most optimal air quality benefits will result from a combination of: truck to rail mode shift for long-haul trips, the widespread adoption of zero emissions (electric) vehicles and equipment in and adjacent to rail yards, the utilization of existing infrastructure over new rail facilities, strict enforcement of the latest emissions standards for locomotives and other rail equipment, and strong mitigations at and near rail yards.

B. Health Impacts

Recent research conducted by both government and academic sources has illuminated the significant health risks faced by residents living in close proximity to rail yards, many of which were built over 30 years ago and utilize old and highly polluting equipment. Diesel particulate matter (DPM) emissions are the dominant toxic air contaminant found within and nearby rail yards, according to the Air Resources Board (ARB). Other toxic air contaminants found in and near rail yards include black carbon[5], sulfur dioxide, metals, and polycyclic aromatic hydrocarbons.[6] Taken together, California's 18 major rail yards generate more than *250 tons* of diesel (PM) emissions annually.[7] Diesel PM emissions are responsible for numerous health problems, including asthma, increased risk of cardiovascular and respiratory disease, cognitive decline in older adults, reduced lung function in children, cancer, and premature death. Diesel PM emissions are responsible for more than 80% of cancer risk within the San Francisco Bay Area[8] and more than 70% of cancer risk within the state.[9]

I. RAIL YARDS AND DIESEL PM CANCER RISK

In 2005, the California Air Resources Board (CARB), in response to community pressure and concern about the health risks associated with diesel particulate matter emissions from rail activity, created guidelines for siting decisions regarding sensitive receptors and proximity to rail yards.[10] Between 2005 and 2008, CARB conducted Health Risk Assessments (HRAs) for each of California's 18 major rail yards as a means to assess the sources, magnitude, and distribution of diesel-related cancer risk for residents living in close proximity to rail yards and draft a mitigation plan for each rail yard in order to reduce emissions and exposure for local residents.

These Health Risk Assessments highlight the numerous sources of diesel PM pollution within and just outside of rail yards – including locomotives, switch engines, yard equipment, and trucks – as well as the populations affected by high cancer risk due to proximity to the rail yards. While diesel PM emissions contribute to health problems beyond cancer, CARB concluded that "from a risk management perspective…it is reasonable to focus on diesel PM cancer risk because it is the predominant risk driver and the most effective parameter to evaluate risk reduction actions. Further, actions to reduce diesel PM will also reduce non-cancer risks."

The highest level of exposure by population for a single rail yard was found in San Bernardino, where more than 3,700 residents were estimated to be exposed to a cancer risk greater than 980 chances in a million, and 41 separate sensitive receptor sites (schools, homes, and hospitals) were located within one mile of the rail yard.[11]

II. RAIL YARD SOURCES OF DIESEL PM EMISSIONS

Rail yards utilize several types of stationary and mobile diesel-powered equipment which are responsible for the high levels of diesel PM emissions generated by rail yards. These fall into four major source categories – locomotives, on-road trucks, cargo handling equipment (including cranes and yard hostlers), and other equipment – including refrigerated rail cars and other stationary sources. Health

Risk Assessments for rail yards have estimated the share of diesel PM emissions generated by different sources. In the vast majority of cases, locomotives were found to be the highest contributor to the rail yards' diesel PM emissions, followed by cargo handling equipment, on-road trucks, and other equipment. In the four rail yards with the highest diesel PM emissions levels in California, locomotives accounted for 25% to 97% of total emissions.[12]

Within the category of locomotive emissions, switcher locomotives (or trains that solely operate inside rail yards and carry cargo back and forth between line-haul locomotives) generate a substantial portion of emissions, which are concentrated inside and directly adjacent to rail yards. In San Bernardino, for example, switcher locomotives generate 38% of the rail yard's locomotive-related diesel pollution.[13] In Oakland's Union Pacific rail yard, switcher locomotives generate 49% of all locomotive-related diesel PM emissions, even more than line-haul locomotives, suggesting the importance of ensuring that on-site locomotives meet the latest emissions standards and/or the cleanest technology available.[14]

Container and Fleet Trucks Are Significant Emissions Contributors at Intermodal Rail Facilities

Trucks are a significant source of diesel pollution for intermodal rail yards but are often underestimated in environmental impact analyses. In a few Health Risk Assessments of rail yards in California, trucks were found to be equally significant if not greater contributors to total rail yard diesel PM emissions. In the City of Commerce, for example, trucks and locomotives were found to contribute a roughly equal share of emissions to the overall rail yard impacts.[15] This is most likely because Commerce has four separate rail yards within its city limits, and thus CARB conducted a HRA for all four rail yards combined, using a wider buffer zone of 2 miles versus 1 mile to assess emission sources and cancer risk. In this HRA, CARB found that locomotives accounted for 33% of emissions and trucks accounted for 32%.[16] At the BNSF Hobart intermodal rail facility, which is one of the four rail yards in Commerce, on-road trucks were found to be responsible for a greater share of the rail yard's PM emissions than locomotives, with trucks contributing 43% of emissions versus 24% for locomotives, or 9.36 tons a year. The majority of truck-related emissions in the Hobart facility were generated by container trucks, which transport containers between the main rail line and outlying areas of the yard. CARB estimates that container trucks at the Hobart facility make roughly 3,590 trips per day.[17]

A Health Impact Assessment of a new intermodal rail facility in Baltimore MD found that the truck trips generated by this new facility could worsen air quality and lead to an excess mortality risk of 10 deaths per 100,000 as a result of PM 2.5 exposure.[18] An equity analysis conducted on the proposed Southern California International Gateway (SCIG) project, a new intermodal rail facility in Los Angeles, revealed that the Environmental Impact Report (EIR) for this project significantly underestimated the negative environmental and health impacts on local communities that would be generated by the increase in truck activity between the new facility and surrounding freight facilities.[19]

The Intermodal Container Transfer Facility (ICTF) in Long Beach/Carson was created in 1982, providing an example of the impacts that a new intermodal facility can have. While the final EIR for this facility in 1982 stated that primary benefits of the facility would be to reduce truck miles traveled and air emissions in the L.A. region, a more recent CARB Health Risk Assessment shows that this facility is now among the most polluting rail yards in the state, generating 27.1 tons of diesel PM emissions annually, 32% of which come from on-road heavy duty diesel trucks that serve and operate within the facility.[20]

III. NON-CANCER HEALTH IMPACTS

In addition to elevated risk of cancer, communities directly adjacent to rail yards and intermodal rail facilities experience a number of other health and quality of life impacts related to diesel traffic congestion and air and noise pollution – including asthma, cardiovascular disease, reduced lung and cognitive function, constrained opportunities for physical activity, stress, hearing loss, sleep disturbance, difficulty concentrating at school, premature death, increased incidence of stroke and other heart incidents, increased traffic congestion and safety concerns at freight crossings, constrained home values and tax revenues, and delayed emergency response times.[21]

One study focused on community perspectives of a nearby rail yard found that residents living adjacent to the rail yard not only struggled with high rates of chronic illness, including asthma and cardiovascular disease, but many residents living near the rail yard also did not have enough money or insurance to access high quality health care, making them particularly vulnerable to the health impacts of constant air pollution.[22] Other recent research studies suggest that residents who face chronic stress due to daily experiences of financial instability, unemployment, violence, and discrimination are more susceptible to the negative health impacts of air pollution, further exacerbating disproportionate burdens for low-income people and families residing near rail yards.[23]

IV. CUMULATIVE IMPACTS FOR FREIGHT-BURDENED COMMUNITIES

Many communities adjacent to rail yards are impacted by multiple modes of freight and sources of pollution, contributing to severe health risks. In West Oakland, for example, CARB conducted a Health Risk Assessment of diesel PM cancer risk due to multiple sources of diesel pollution, including the rail yard, the Port of Oakland, and highway truck traffic. Residents in West Oakland were found to face cancer risk levels that are three times that of the rest of the Bay Area, at 1,200 chances per million. Trucks were found to be the most significant contributor to diesel PM cancer risk, with non-Port and non-rail yard sources of emission being responsible for the majority of risk, followed by the Port of Oakland and the Union Pacific rail yard. Given the significant role that trucks play in contributing to diesel PM emissions and cancer risk, CARB found that reducing emissions from truck activity would have the greatest impact on cancer risk in West Oakland, followed by train locomotives.

Because of cumulative impacts, the actual impacts of new rail facilities may be greater than estimated by official environmental impact or health risk assessments – given that local communities may already be facing unhealthy levels of diesel PM cancer risk. In regard to West Oakland, CARB stated that "even with the benefits from [CARB's] regulatory programs, the residual risks [in West Oakland] are unacceptable and much more needs to be done to ensure that the potential cancer risks are reduced quickly and that programs are developed to offset the expected growth in emissions as global trade expands."[24]

In San Bernardino, part of the "Inland Empire" in southern California, air pollution levels are found to be the highest in the nation – reflecting the multiple modes of freight and sources of freight activity within a single air basin, including a large intermodal rail yard, multiple warehousing and distribution centers, rail corridors, and highways. CARB found that the point of maximum impact (PMI) (or the highest level of cancer risk faced by a resident living in close proximity to a rail yard) near the San Bernardino rail yard was the highest of all rail yards in the state – at 3,300 chances per million.[25] When risk levels are already extremely high, even the utilization of clean technology and low emitting vehicles is not enough to counteract the growing levels of emissions caused by new freight facilities. A Specific Air Quality Study conducted for a new warehousing facility in Mira Loma within the Inland Empire, for example, found that even if all new trucks brought into the area for the facility were new or used cleaner fuels, the diesel PM pollution levels would still remain at dangerous levels for local residents.[26]

In Los Angeles, a proposed new intermodal rail facility that would expand capacity at the Ports of L.A. and Long Beach by transferring containers between trains and trucks has been the subject of a lawsuit by environmental, community, and labor organizations. Plaintiffs argued that the proposed facility violates the California Environmental Quality Act and that it would create more Port-related truck traffic and diesel PM pollution for the already over-burdened communities of West Long Beach, Wilmington, and Carson.[27] One 2009 study of pregnant women in this freight-impacted community found that nitrogen oxides and particulate matter increase risk of premature delivery (prior to 30 weeks) for local women by 128% and 91%, respectively.[28]

V. DISPROPORTIONATE IMPACTS FOR LOW-INCOME COMMUNITIES OF COLOR

A recent study analyzing the demographic characteristics of CARB's estimated high cancer risk zones surrounding rail yards found disproportionate representation of low-income residents and people of color within communities directly surrounding rail yards, in comparison to the respective county in which the rail yard was located. The authors found that 17 of 18 rail yards in California have a significantly higher population of people of color living within high risk cancer zones near rail yards, with Latinos being particularly over-represented in 15 out of 18 rail yards. Low-income residents are also disproportionately exposed to high cancer risk from rail yards. A few rail yards disproportionately expose African Americans to diesel PM cancer risk. Union Pacific Oakland is one of these rail yards, with 64% of exposed residents adjacent to the UP rail yard being African American, compared with 14% of residents in Alameda County as a whole.[29]

The study authors discuss discrimination in siting decisions as a root cause of present day inequities in diesel cancer risk exposure, and they use the 1980 siting decision for an Intermodal Container Transport Facility (ICTF) rail yard in Los Angeles as an example of this. Because the communities directly surrounding the proposed rail yard site were already disproportionately comprised of low-income residents and people of color compared to L.A. County at the time of the decision, it appears to be a discriminatory decision that was bolstered by inadequate environment impact reporting. In 1986, the final EIR for the ICTF rail yard found that "insignificant air pollution impacts" would be created by the new yard, while CARB now considers this to be one of the four most polluting rail yards in the whole state of California, exposing more than

30,000 residents to a diesel cancer risk of more than 100 chances per million.[30]

Other studies have indicated that low-income communities and communities of color are disproportionately represented in close proximity to rail corridors. One study of environmental justice population exposure near freight truck and rail corridors in Southern California found that the proportion of Latino and Black residents are higher within communities adjacent to truck and rail corridors, in comparison to the region. For example 56% of communities adjacent to rail corridors were found to be Latino, compared to 45% of the region's population.[31]

The authors also found that projected growth of environmental justice communities (measured as the percentage of Black, Latino, Asian, and low-income populations) would be higher along rail corridors than highway corridors by 2035, indicating that expanded rail activity could have even greater environmental justice (EJ) implications in the future. For example, Latinos living along rail corridors are estimated to grow in population by 57% compared with 42% for Latinos living along truck corridors, while the projected population growth for African American residents is estimated to be 48% along rail corridors versus 7% along truck corridors.[32]

Similarly, another study found that rail corridors in two counties of Delaware and Maryland expose greater numbers of low-income people and people of color – both in terms of population and number of "environmental justice" (EJ) designated census blocks – than highway corridors. The authors find that even as rail activity generates lower overall emissions per mile compared with truck activity, it may exposure greater numbers of vulnerable populations throughout the county. For example, rail corridors in the two counties studied were found to expose more than 300 EJ designated census blocks, compared with less than 200 that are impacted by truck corridors.

These studies suggest that decisions about where to site new rail facilities as well as shifting freight transport from truck to rail have important environmental justice implications that should be considered alongside the potential regional benefits of emissions reductions.

C. Truck VS. Rail Transport

Several modeling-based studies have been conducted to assess the potential air quality impacts of shifting freight transport from truck to rail. Most of these studies find that shifting freight from truck to rail will yield substantial air quality benefits due to the lower emissions generated per mile and the higher level of fuel efficiency for locomotives compared with trucks.

A 2013 study evaluating the potential benefits of shifting both intra-regional freight transport within the Midwestern U.S. and freight transport passing through the Midwestern U.S. from truck to rail found that PM 2.5, NOX, NO2, and O3 could all be decreased by this mode shift.[33] This is similar to the findings of other studies, including a 2009 study by You et al which evaluated the potential air quality benefits of shifting from truck to rail transport at and surrounding the San Pedro Bay Ports in Los Angeles.[34] This study also found that emissions of NOX and PM 2.5 could be significantly reduced by switching from drayage trucks to trains, and that heavy duty truck emissions (NOX and PM 2.5) could be significantly reduced by taking port trucks off the road. The authors conclude that system-wide emissions reductions were achieved because train emissions are lower than trucks, but that emission reductions would be even greater if mode shift were accompanied by more stringent emissions regulations for locomotives.

A 2012 dissertation published by the University of Wisconsin-Madison found that shifting long-haul (more than 400 miles) freight trips passing through the Midwest from trucks to rail has the potential to generate substantial public health benefits. For example, the author found that this mode shift could prevent 231 premature deaths, 10,000 cases of asthma exacerbation, and 150,000 other respiratory problems each year. The author used the U.S. Environmental Protection Agency's Benefits Mapping Analysis Program (BenMAP) to estimate health impacts, concluding that the annual estimated economic benefit to society of this shift would be $2.11 billion dollars.[35]

A few studies in Europe have also found air quality benefits related to transitioning freight cargo from truck to trains.[36]

While the majority of these studies have found environmental benefits from truck to rail mode shift, these studies rely on many assumptions in order to develop their models, including compliance with emissions regulations. They also focus on the relative environmental impacts of rail and truck transport over a certain distance traveled and do not always take into account the impacts of local emissions due to new or expanded rail facilities that may be needed to accommodate a mode shift. Below is a set of additional health equity impacts and considerations that should be included in discussions of shifting from truck to rail transport.

D. Health Equity Considerations for Shifting from Truck to Rail Transport

I. MODE SHIFT OR EXPANSION?

While the above studies find that a truck to rail mode shift would yield substantial air quality benefits, most do not consider the potential impacts of new infrastructure needed to support expanded rail activity – including both the construction and operation of new rail yard and intermodal rail facilities. Because rail capacity is often cited as a limiting factor to substantial mode shift, expanding rail infrastructure – including building new rail lines and yards – should be part of the equation for assessing potential air quality impacts of this shift.

Often, the creation of infrastructure associated with shifting from truck to rail transport can lead to or accompany an increase in overall freight system capacity and volume (both in terms of truck and rail activity). This diminishes the environmental benefits of mode shift - particularly for communities residing adjacent to freight facilities where rail trips originate.[37] One study of European "dry ports" or inland intermodal rail facilities found that they have potential benefits in terms of reducing long-haul truck trips, but they can also facilitate an increase in overall cargo volume, including local truck trips and local emissions.[38]

In CARB's analysis of four high-priority rail yards in 2010, for example, the emissions reductions for the UP Commerce rail yard were lower than projected, even after rail yard vehicles were transitioned to cleaner engine technologies in compliance with ARB regulations, because of an increase in cargo activity between 2005 and 2010. Thus, even when the latest model vehicles are utilized, expansion of freight activity can offset the projected environmental benefits.[39]

As mentioned previously, the air quality and other impacts of new rail yards and intermodal facilities are substantial, including increase in local truck trips and diesel PM emissions, noise issues, and other quality of life concerns for communities who may already be overly burdened by air pollution impacts of existing freight activity.[40]

II. WEIGHING LOCAL WITH LONG-HAUL BENEFITS

Even if existing infrastructure can be utilized to shift cargo from truck to rail, air quality impacts near the origin of rail trips and in communities adjacent to rail yards are greater than impacts for communities alongside rail lines, given the constant operation of rail yards and the multiple sources of diesel pollution. Furthermore, fuel efficiency for rail transport is greatest beyond 500 miles of the trip origin, minimizing the environmental benefits of rail for short-haul trips. These impacts should be considered and studied as part of transportation planning efforts in order to carefully plan for an optimal freight transport system that minimizes and reduces environmental burden on vulnerable communities.

III. EMISSIONS EXPOSURE BY POPULATION SIZE, DEMOGRAPHICS, DISTANCE, AND ROUTE

While rail transport is less polluting than truck transport on a per mile basis, rail lines are often less direct than truck routes and involve long distances,[41] affecting, the distribution and population size of exposure areas.

As mentioned in the study of rail and freight corridors in Delaware and Maryland, freight rail lines may expose a greater number of people who are low-income and/or people of color than freight truck routes, given routes and distances traveled by rail vs. truck.[42] This should be weighed against the concentration of exposure for similar populations, even if population size is smaller, as a result of truck transport.

Nuanced analysis should be conducted that takes into account the potential changes in population size and distribution of exposure areas, along with an assessment of concentration of pollution for already freight-burdened communities, in order to assess and minimize harm for freight-impacted communities as a result of mode shift.

IV. CLEAN TECHNOLOGY AND COMPLIANCE WITH EMISSIONS STANDARDS

Many rail yards and rail corridors utilize old and highly polluting equipment.[43] Age of equipment and fuel type greatly affect the amount of air quality benefits generated by switching from truck to rail. For example, transporting cargo by locomotives meeting Tier 4 standards over trucks would reduce NOX and PM emissions by more than half. However, utilizing Tier 2 locomotives would generate more PM and NOX than 2010 trucks.[44] A 2008 study focused on the impacts of shifting freight from truck to rail along the I-710 corridor in Los Angeles concluded that replacing heavy-duty port truck fleets with zero or low-emission trucks may be even better for air quality than shifting container transport from truck to conventional rail locomotives.[45] Electrifying rail lines, locomotives, drayage trucks, and other yard and cargo handling equipment

would lead to even greater emissions reductions.

Many rail yards are currently out of compliance with state emissions standards, according to CARB's Health Risk Assessments of California's 18 major rail yards, making cleanup and compliance a key factor in assessing the emissions benefits of rail transport. While many zero emissions technologies are available for rail transport-related equipment – including electric and hybrid-electric locomotives, cranes, yard hostlers, Transport Refrigeration Units (TRUs), and other cargo handling equipment, locomotives are particularly costly to replace.

V. MITIGATIONS AT THE YARD: THE IMPORTANCE OF PROXIMITY AND CONCENTRATION OF POLLUTION

Because rail yards operate 24 hours a day, 7 days a week, they operate as somewhat "stationary sources" of pollution and create high concentrations of diesel exhaust for local communities.[46] Thus, concentrating mitigations inside and adjacent to rail yards will most effectively curb emissions at the source of pollution and protect communities who need it most.

Communities and government agencies have demanded a number of mitigations at and near rail yards that can substantially offset the burden of diesel PM emissions. Taken together, these mitigations and conditions could help to make rail an equitable and healthier alternative to truck transport. These include:

- Enforce and go beyond state emissions standards for trucks and locomotives as a condition for operating inside rail yards, including accelerated adoption of Tier 4 locomotives.
- Minimize short-haul truck trips through "on-dock rail."
- Electrify rail lines in urban areas and prioritize zero emissions technology (electrification, auxiliary power units, and idling control devices) for vehicles and equipment that operate inside and adjacent to rail yards – including locomotives, trucks, cargo handling equipment, and TRUs.
- Locate highest polluting activities furthest from residential areas – including maintenance facilities, testing sites, spur tracks, fueling stations, idling locomotives, and load testing.
- Implement air filters, vegetative barriers, and other community mitigation strategies adjacent to rail yards.
- Adopt zero emissions technology to the widest extent possible before any expansion of rail facilities are permitted, including intermodal freight facilities.

2. COMMUNITY-LED MITIGATIONS TO REDISTRIBUTE THE BURDENS OF DIESEL POLLUTION IN BARRIO LOGAN, SAN DIEGO

A. Background

Barrio Logan, San Diego is recognized by the U.S Environmental Protection Agency as an "Environmental Justice community," due to the high proportion of low-income Latino residents and the disproportionate share of environmental hazards and industrial land uses in this small residential community. Barrio Logan face numerous sources of freight pollution – including activity related to the Tenth Avenue Marine Terminal (TAMT) of the Port of San Diego, a BNSF rail yard to the north, and the I-5 highway. Taken together, these sources emit 3 million tons of toxic air pollution into the Barrio Logan community each year.[47] In response to chronically high levels of diesel truck pollution to and from the port and mounting health concerns for residents and school children in the neighborhood, residents, staff, and members of the Environmental Health Coalition (EHC), a community-based environmental justice organization founded in 1980, initiated a number of strategies to reduce and redistribute pollution out of Barrio Logan. This case study presents the outcomes, challenges, and lessons learned from several community-initiated mitigations implemented between 2005 and 2015 and is based on an interview with Environmental Health Coalition (EHC) staff member Joy Williams, local air quality data, and an air quality study on the Barrio Logan truck route mitigations published in 2009.[48] While the air quality study provided extensive data on the impact of the mitigations, the results were based on modeling and thus may have missed some of the nuanced impacts and challenges regarding implementation of the mitigations. This case study builds on the findings of the air quality study using more recent data and information from EHC staff.

B. Impacts of Freight Transport in Barrio Logan

Barrio Logan faces disproportionately high levels of diesel particulate matter exposure and a number of diesel-related health concerns. For example, asthma related Emergency Department (ED) visit rates for Barrio Logan residents are more than 2.5 times that of the county average, indicating

that this community experiences a disproportionate health burden from freight-related air pollution.[49] Other freight-related problems experienced by Barrio Logan residents include traffic congestion, pedestrian safety concerns, emergency vehicle delays, and noise.

One of the primary sources of diesel pollution in Barrio Logan has been truck traffic along Cesar Chavez Parkway and other neighborhood streets – including trucks going to and from the port as well as trucks serving businesses in the neighborhood. Cesar Chavez Parkway was a particular route of concern for residents, as it has been a heavily used truck route into and out of the port as well as a common crossing for children walking to Perkins elementary school, the only elementary school in the neighborhood.[50] Illegal parking and idling of trucks throughout the neighborhood has been another major concern for residents. In addition, one warehouse managed by Dole Inc. was identified as a problem site, as trucks queuing outside the warehouse were causing pollution, blocking traffic, and delaying emergency vehicles and buses.[51]

C. Mitigations to Address Impacts

EHC was involved in identifying and advocating for several mitigations that were implemented between 2004 and 2012.[52]

In 2004, residents and EHC members successfully advocated for the repainting of diagonal parking spaces throughout the neighborhood to prevent trucks from easily parking on residential streets.

In 2005, the first truck route change was officially adopted via a city ordinance, banning trucks weighing more than 5 tons from using Cesar Chavez Parkway and other surface streets within the neighborhood, unless they were destined for a local business. This truck route change was implemented by the City of San Diego as a result of requests from EHC and community residents, and following a truck traffic study that was funded by the U.S. Environmental Protection Agency through an Environmental Justice grant.

In 2012, EHC successfully negotiated with the Port of San Diego to relocate the Dole warehouse out of the community. This was accomplished through the addition of language into Dole's lease renewal that required Dole to perform truck staging and off-terminal operations in industrial zones and no closer than 500 feet to the nearest residential area. This had the effect of shutting down the Dole warehouse in Barrio Logan; Dole subsequently leased land on the National City Marine Terminal, a location further from residential uses and vulnerable populations.

In 2012, EHC advocated for a Port truck rule that prohibited drayage trucks that were out of compliance with state emissions regulations from entering the Port of San Diego, thus helping to enforce an already existing state regulation. Simultaneously, the state's low sulfur fuel requirement for marine vessels took effect in 2012.

In 2015, partially in response to non-compliance with the city's truck ban on Cesar Chavez Parkway, the Port of San Diego paid for the design and installation of a gateway sign over Cesar Chavez Parkway to serve as both a sign honoring the community's identity and a barrier to prevent trucks over the height of the sign from entering the neighborhood on this street.

Finally, an important factor affecting emissions was the economic recession between 2008 and 2013, which reduced overall cargo volume in the San Diego freight transport system.

D. Outcomes of Implementing Mitigation Measures

In 2009, Karner et al conducted an air quality study examining the air quality impacts of the proposed truck route changes in Barrio Logan. This study used actual neighborhood truck count data for 2004, combined with emissions factor data from CARB and regional traffic demand data to predict emissions levels and distribution for the proposed truck route changes in comparison to the baseline (no mitigation) scenario.[53] The results of the analysis showed that diesel particulate matter (DPM) emissions would be reduced on Cesar Chavez Parkway by 98% as a result of the re-routing measures, while overall DPM emissions for the whole neighborhood would increase slightly as a result of longer distances traveled on the new routes. The authors conclude that, since the study area was small and only streets within Barrio Logan were taken into consideration, and because emissions factors would be improved by the time the truck routes took effect, the increase in regional emissions would be relatively small in context of the county. The authors conclude that the new truck routes achieve their stated goal of reducing emissions where it matters most – for sensitive receptors residing near Cesar Chavez Parkway.[54]

While the truck route changes would certainly benefit residents of Barrio Logan, an interview with EHC staff member Joy Williams adds information that somewhat complicates the results of this study. According to the interview, trucks routinely ignored the truck ban ordinance

on Cesar Chavez Parkway until the summer of 2015, minimizing the emissions benefits of the route change. While the Port has conducted educational efforts to encourage truck drivers to comply with the truck ban, Williams described how the largest factor has been the location of the port entrance, which opens directly onto Cesar Chavez Parkway. The Port is considering using as the primary Tenth Avenue Terminal entrance an alternate, already existing port entrance and exit that feeds directly onto Harbor Boulevard farther from the community. Several intersection improvements are also under consideration that would make it easier for trucks to turn onto Harbor Boulevard and proceed to 28th and 32nd streets as routes to I-5, rather than using Cesar Chavez Parkway.

While lack of compliance with the truck ban has been a major issue, the combination of community-initiated mitigations that EHC has supported over the last 10 years has contributed to reduced DPM emissions in Barrio Logan. Local air monitoring data shared by EHC staff reveals that average daily PM 2.5 levels have steadily decreased in the neighborhood, from over 60 $\mu g/m^3$ in 2006 to 40 $\mu g/^{m3}$ in 2013.[55] Similarly, the local air quality monitoring station in Barrio Logan shows that levels of Organic Carbon (OC) and Elemental Carbon (EC) decreased between 2008 and 2012, with EC levels decreasing from 1.5 to 0.9 $\mu g/m^3$.

Despite the overall decrease in DPM emission levels, data from local air quality monitoring stations show that Barrio Logan continues to face higher concentrations of diesel exhaust than other communities in the region. As of 2013, the average concentration of Elemental Carbon in Barrio Logan's air was 22% compared with 14% for El Cajon and 15% in Escondido, other freight-impacted communities in the region.[56] Additionally, children's asthma hospitalization rates remain the highest in the region and DPM emissions remain above the federal 24-hour PM 2.5 standard and the state annual average PM 10 standard.[57] This data indicates that current emission levels, while reduced, are still too high to be safe. The high concentration of diesel present in Barrio Logan's air presents a continued health risk for residents in terms of cancer, asthma and other respiratory problems, cardiovascular disease, and other cognitive problems that have been linked to diesel exposure.[58] When communities face multiple sources of pollution and high concentrations of diesel pollution, multiple mitigation strategies may be necessary to have an effect on air quality and health outcomes.

E. Lessons Learned for Alameda County

The section below synthesizes some of the lessons learned from this case study that apply to Alameda County regarding the benefits and challenges of implementing community-level mitigations to offset diesel truck pollution.

1. **Enforcement is necessary for policies and regulations to translate into real emissions benefits.** Too often, vulnerable communities bear the burden of unenforced regulations. In the case of Barrio Logan, residents and community members took enforcement into their own hands using creative methods like the gateway sign on Cesar Chavez Parkway. Enforcement should not be the responsibility of the community that is burdened by freight pollution but rather the government agencies responsible for regulating the freight transport industry.
2. **Multiple mitigations and strategies are necessary to achieve emissions reductions**. In the case of Barrio Logan, the DPM emissions reductions were likely the result of several mitigations focused on redistributing high-impact sources of diesel pollution and implementing creative design features to enforce truck bans and prevent idling. Even after mitigations were implemented, diesel particulate matter emissions remain at levels that are hazardous to health. This data suggests that in order to effectively reduce DPM emissions in heavily freight-impacted communities with numerous sources of pollution, multiple mitigations strategies must be undertaken and combined with emissions reductions measures – including zero emissions technology. Mitigation strategies should only buffer exposure for vulnerable populations but also reduce freight volume and emissions, redistribute the burden of pollution, and support the enforcement of existing emissions regulations and truck traffic ordinances.
3. **Freight volume matters**. Until all freight operations are conducted using zero emissions technology, expansion of freight operations and growth in cargo throughput will pose a health threat to communities adjacent to ports and freight facilities. Even when mitigations are successful, diesel particulate matter exposure may remain at hazardous levels, resulting in persistently high asthma rates and other air pollution related health outcomes. In the case of Barrio Logan, a decrease in overall cargo throughput due to the economic recession was a key contributing factor to reduced emissions. If emissions reduction is a goal of the Alameda County Goods Movement Plan, significant resources should be invested into zero emissions technology before any expansion of freight

activity is approved.

4. **Redistribution is necessary for equity.** Moving pollution away from freight-impacted communities may require a slight increase in pollution levels in other parts of the region. Until a completely zero emissions freight transport system is possible, reducing emissions for vulnerable populations will require redistributing some of the burdens of pollution towards less historically burdened areas. In the case of Barrio Logan, the approved alternative truck route goes along the industrial waterfront adjacent to San Diego Bay, avoiding residential areas altogether and protecting health for those who need it most.
5. **Air quality studies may overestimate or oversimplify emissions reductions benefits,** because they assume perfect compliance with new routes and emissions regulations. While air quality studies are an important source of information for decision-makers regarding the trade-offs of different freight transport scenarios, they should be supplemented with actual data collected at monitoring stations on the ground. Additionally, decision-makers should consider compliance as a limiting factor in the success of proposed mitigations and invest substantial resources into enforcement to ensure maximum positive impact.
6. **Local authorities can help enforce state laws regarding emissions reductions regulations.** In the case of Barrio Logan, the Port of San Diego implemented a truck ban for any vehicles out of compliance with state level emissions requirements – thus strengthening the local impact of state level policies. Without local enforcement, state level emissions requirements are less impactful and meaningful. Furthermore, local authorities can and should require emissions standards that go beyond what states require.
7. **Proximity matters when it comes to pollution and mitigation.** Mitigations to minimize diesel pollution exposure should be prioritized for locations closest to freight operations where vulnerable populations are present. In the case of Barrio Logan, routing trucks off of surface streets and around the community reduces the community's exposure to the high concentrations of traffic pollutants that occur in the immediate vicinity of roadways.
8. **Relocate heavy sources of pollution instead of sensitive receptors**. In many freight-impacted communities, residential uses existed before freight facilities were located in the same area. Regulations about sensitive receptors are often ineffective at mitigating pollution as they tend to focus on the siting of new schools and housing rather than siting of new industrial activities. To the extent possible, all efforts should be made to relocate the heaviest sources of pollution away from sensitive communities – including the most polluting factories, warehouses, trucks, and other mobile sources of pollution. In cases where it is not feasible to relocate an entire facility, implement design features that create distance, barriers, and filters between the most polluting activities and sensitive residents. Avoid locating any new freight facilities in proximity to vulnerable communities.
9. **Some mitigations can be simple and relatively cheap**. A number of cost-effective design strategies can be employed to shift truck traffic activity and reduce idling, including repainting parking spaces to be diagonal so trucks can't park on residential streets, hanging a sign that's too low for trucks to pass, providing clear signage and changing official port entry and exit routes so they feed onto a road that does not expose sensitive receptors.
10. **Make it easy and safe for truck drivers to comply with regulations**. Supporting the economic and physical wellbeing of truck drivers can help them comply with regulations and support the wellbeing of freight-impacted communities. For example, EHC is working to establish designated places for truck drivers to rest and recharge that are outside of residential neighborhoods. These places will provide a safe and comfortable place for truck drivers to rest and can also provide electric truck outlets so drivers can maintain the comforts of their cab without needing to idle their engines. Similarly, improving intersections to make it easier for large trucks to turn onto established routes will make truck drivers more likely to comply with bans on residential streets.

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