

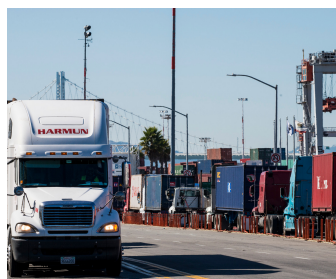
OWNING OUR AIR

DRAFT

THE WEST OAKLAND COMMUNITY ACTION PLAN

Volume 2: *Appendices*

JULY 2019



BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT



**West Oakland
Environmental
Indicators Project**
Know which way the wind blows

A joint plan by Bay Area Air Quality Management District
and West Oakland Environmental Indicators Project

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Appendix A – Technical Support Document

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**AB 617 West Oakland Community Action Plan
Technical Support Document**

**Appendix A Part I:
Base Year Emissions Inventory and Air Pollutant Dispersion Modeling**

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Notation

Acronyms

AADT	annual average daily traffic
AB	Assembly Bill
ABAG	Association of Bay Area Governments
AERMAP	American Meteorological Society/Environmental Protection Agency Regulatory Model terrain pre-processor
AERMET	American Meteorological Society/Environmental Protection Agency Regulatory Model Meteorological Processor
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
agl	above ground level
APCS	automated pavement condition survey
ASF	age sensitivity factor
asl	above sea level
AQS	Air Quality System
BAAQMD	Bay Area Air Quality Management District
BAU	business-as-usual
CalEPA	California Environmental Protection Agency
CAPCOA	California Air Pollution Control Officers Association
CAPP	Community Air Protection Program
CARB	California Air Resources Board
CARE	Community Air Risk Evaluation
CAS	Chemical Abstract Service
CEIDARS	California Emissions Inventory Development and Reporting System
CHC	commercial harbor craft
CHE	cargo handling equipment
CHEI	Cargo Handling Equipment Inventory (model)
CMAQ	Community Multi-scale Air Quality (model)
CPF	cancer potency factor
CT-EMFAC	Caltrans-EMissions FACtors (model)
DBR	daily breathing rate
DPM	diesel particulate matter
EBMUD	East Bay Municipal Utility District
EC	elemental carbon
ED	exposure duration
EDF	Environmental Defense Fund
EMFAC	EMission FACtors (model)
EPA	Environmental Protection Agency
EZ	exclusion zone
FAH	fraction of time at home
FHWA	U.S. Federal Highway Administration
GVWR	gross vehicle weight rating
HDV	heavy-duty vehicle

HHDT	heavy heavy-duty truck
HRA	health risk assessment
IDW	inverse distance weighting
LDV	light-duty vehicle
LHDT	light heavy-duty truck
LST	local standard time
MSAT	mobile source air toxic
MDV	medium-duty vehicle
MHDT	medium heavy-duty truck
NAD83	North American Datum of 1983
NEI	National Emissions Inventory
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NT	Non-Truck
OEHHA	Office of Environmental Health Hazard Assessment
OGV	ocean-going vessel
O&M	operation and maintenance
O-D	origin-destination
PeMS	Performance Measurement System
PM	particulate matter
PM ₁₀	particulate matter 10 micrometers or less in diameter
PM _{2.5}	particulate matter 2.5 micrometers or less in diameter
POM	polycyclic organic matter
POAK	Port of Oakland
PSD	prevention of significant deterioration
QA	quality assure/assurance
SIC	Standard Industrial Classification
SMOKE	Sparse Matrix Operator Kernel Emissions (model)
SRTM	Shuttle Radar Topography Mission
TAC	toxic air contaminants
TIGER	Topographically Integrated Geographic Encoding and Referencing
TOG	total organic gases
T1	Truck 1
T2	Truck 2
UP	Union Pacific
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
VHT	vehicle hours traveled
VMT	vehicle miles traveled
WD	weekday
WE	weekend
WETA	Water Emergency Transportation Authority
WOEIP	West Oakland Environmental Indicators Project
WRF	Weather Research and Forecasting (model)

Units

g	gram
kg	kilogram
lb	pound
mg	milligram
ton	U.S. ton (2,000 lb)
tpy	tons per year (U.S. ton/y)
µg	microgram
L	liter
gal	gallon
ft	feet
nmi	nautical mile
m	meter
mi	mile
h	hour
min	minute
s	second
mph	miles per hour (mi/h)
kt	knot (1.15078 mph)
°C	degrees Celsius
°F	degrees Fahrenheit
K	Kelvin
ppm	parts per million
bhp	brake horsepower
hp	horsepower
kW	kilowatt

1. Introduction

The California State Assembly adopted Assembly Bill (AB) 617 in 2017 (C. Garcia, Chapter 136, Statutes of 2017). The bill established the Community Air Protection Program (CAPP), which focuses on reducing exposure in communities most impacted by air pollution. Local air districts are tasked with partnering with community groups, environmental organizations, regulated communities, and other stakeholders to develop a new community-focused action framework for community protection.

1.1 Context

The Bay Area Air Quality Management District (BAAQMD, “the District”) identified West Oakland as its first-year community under the CAPP. West Oakland is bounded by three major freeways (I-580, I-880, I-980), is adjacent to large industrial sources and the Port of Oakland (“the Port”), and is the location of a major U.S. Postal Service Distribution Center (Figure 1-1). Based on modeling and field studies conducted under the District’s Community Air Risk Evaluation Program (CARE), the District identified West Oakland as a community impacted by poor air quality (elevated fine particulate matter), where residence have poor health outcomes and are subjected to elevated cancer risk.¹

The technical work performed to support the West Oakland Community Action Plan (“Action Plan”) pursuant to AB 617 is described in this document. The objective of this technical work was to spatially map the contribution of emissions from major emissions sources to pollutant concentrations within the community that may potentially impact current and future residents in West Oakland. To identify areas with elevated air pollutant concentrations and higher population exposure, a bottom-up air pollutant *emissions inventory* was developed, and *air pollution dispersion modeling* was performed to support a *source apportionment* analysis. This document therefore describes how emissions from major source categories were estimated, how the dispersion model was selected and configured, and how output from the dispersion model was used.

Emissions inventories contain information on the quantity of air pollutants that are emitted from specific sources or source categories over a specific period. In this analysis, emissions inventories of fine particulate matter (particulate matter 2.5 micrometers or less in diameter [PM_{2.5}]) and toxic air contaminants (TACs) that have documented cancer toxicities (see Attachment 1) were developed. The emissions inventory accounts for *primary pollutants* only.²

¹ Previous analyses (Bay Area Air Quality Management District 2014) identified impacted areas based on elevated fine particulate matter concentrations and high rates of cancer, incidences of mortality, hospitalization rates, and respiratory illnesses.

² Primary pollutants are those compounds emitted directly into the atmosphere. In dispersion modeling, primary pollutants are also assumed to be nonreactive. *Secondary pollutants* (compounds formed in the atmosphere as a result of chemical reactions) were not included in this analysis because (1) their formation involves complex chemical reactions that cannot be accounted for in the dispersion models, and (2) near-source exposures tend to be driven by emissions of primary pollutants; secondary pollutants form downwind of sources and tend to be distributed at a regional scale.

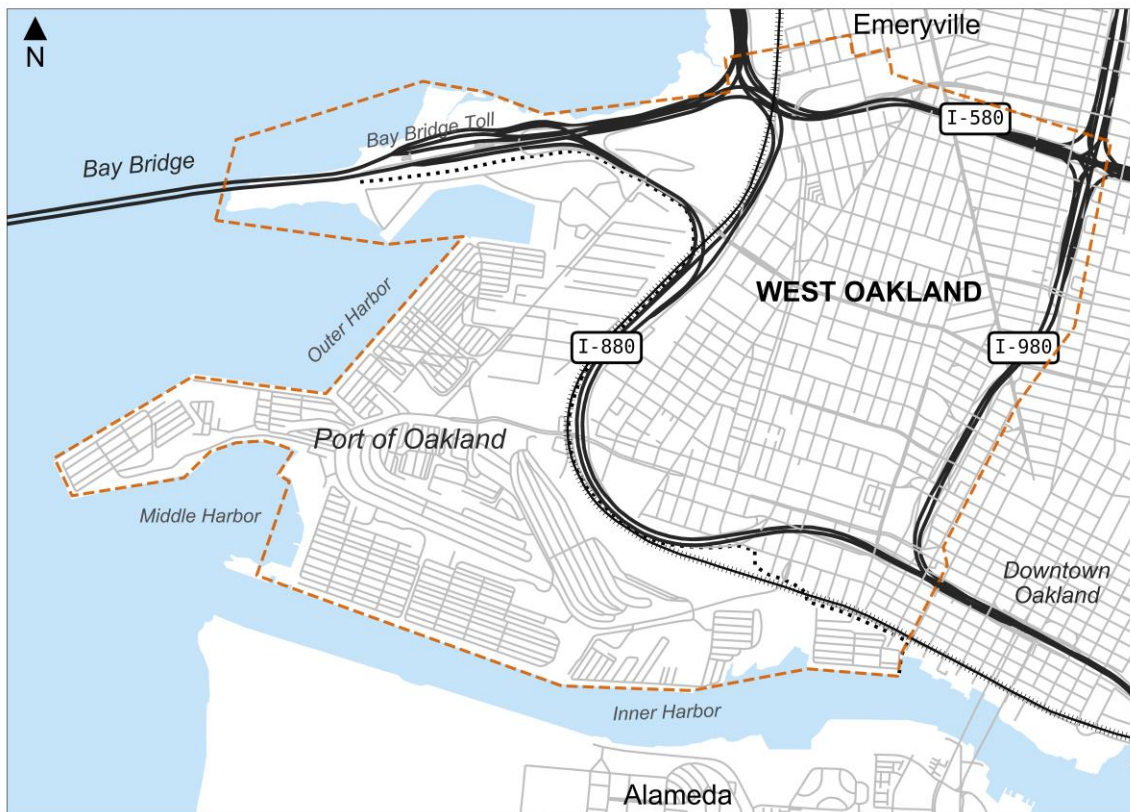


Figure 1-1. Map of the West Oakland community. The extents of West Oakland (dashed red line) and the Port of Oakland (dotted black line), roadways (solid black and grey lines) and rail lines (hatched black lines) are denoted.

The inventory includes emissions from: permitted stationary sources (small and large complex facilities regulated by the District), on-road mobile sources (vehicles on all surface streets and freeways, and extended idling from trucks operating at certain large businesses), marine operations and railyard activity at the Port, locomotives, and commuter ferries and excursion vessels. PM_{2.5} and TACs are the primary air pollutants which pose the greatest risk to the health of residents in West Oakland and are further described below.

Toxic Air Contaminants (TACs): The California Air Resources Board (CARB) is responsible for identifying TACs, which are defined as pollutants that “may cause or contribute to an increase in deaths or in serious illness, or which may pose a present or potential hazard to human health.”³ Exposure to TACs can cause serious health effects, including cancer and birth defects. Other adverse health effects can include damage to the immune, neurological, reproductive (reduced fertility), developmental, and respiratory systems. TACs are emitted from many sources in the Bay Area, including from: diesel engines, vehicles (e.g., cars, trucks), industrial processes, and gas stations. Types of TACs include diesel particulate matter (DPM), lead, benzene, formaldehyde, and hexavalent

³ <https://ww2.arb.ca.gov/about/glossary> (accessed January 2019).

chromium (a complete list of TACs examined in this analysis is provided in Attachment 1). DPM is the most significant TAC in the Bay Area, accounting for ~85% of the cancer risk.

Fine Particulate Matter (PM_{2.5}): PM_{2.5} originates from a variety of sources, including fossil fuel combustion, residential wood burning and cooking, and natural sources (such as wildfires and re-entrained road dust). Epidemiological studies have established that exposure to PM_{2.5} has serious adverse health impacts (e.g., Cohen and Pope 1995, Krewski *et al.* 2009, Health Effects Institute 2010). PM_{2.5} can enter deep into lungs and the bloodstream. Exposure to PM_{2.5} has negative effects on the respiratory system (such as triggering asthma attacks, aggravating bronchitis, and diminishing lung function), cardiovascular system (and may cause atherosclerosis [hardening of the arteries], ischemic strokes [cause by an obstruction of the blood supply to the brain], and heart attacks). Because of the serious cardiovascular effects of exposure to PM_{2.5}, studies have found a clear correlation between exposure to elevated PM_{2.5} levels and mortality. Studies also indicate that exposure to PM_{2.5} may be related to other negative health effects, including impacts on the brain, such as reduced cognitive function, as well as increased risk of diabetes. Exposure to PM_{2.5} remains the leading public health risk and contributor to premature death from air pollution in the Bay Area. More information on fine PM and associated health effects can be found in the report *Understanding Particulate Matter: Protecting public health in the San Francisco Bay Area*, prepared by the District (Bay Area Air Quality Management District 2012).

Emissions inventories were developed for three years: a base (“current”) year (effective 2017), and a forecasted near-term future year (2024), and a far-term future year (2029). The base year is used to establish initial concentrations where mitigation strategies may be developed to reduce future-year exposures. The future-year emissions inventories include anticipated reductions from existing regulations and known changes in source activity (*business-as-usual*; BAU); additional anticipated reductions from presumed implementation of proposed mitigation measures under this Action Plan were also included (within the Action Plan) to show where high levels of air pollution may persist, and additional actions may be warranted. The base-year emissions inventory is further described in this document (Section 2); forecasted future-year emissions inventories are described in Part II of this documentation.

Air pollutant concentrations at a *receptor* (a location where concentrations are measured) represent the sum of all concentration contributions from many emissions *sources*; that is, the total concentrations at a receptor can be *apportioned* to different sources. From a spatiotemporal perspective, concentrations at a receptor also represent the sum of concentrations due to local sources and those of regional sources. Accordingly, two modeling analyses were performed:

- (1) “Regional-scale modeling” was used to provide an estimate of the “background” pollutant concentrations, i.e., the air pollutant concentrations in West Oakland in the absence of any local emission sources in West Oakland. Concentrations were simulated pollutant concentrations within 1 km grid cells over the entire Bay Area. This was performed using a modeling framework consisting of a numerical meteorological model (Weather Research and Forecasting [WRF] model), an emissions inventory model (Sparse Matrix Operator Kerner Emissions [SMOKE] modeling system), and a chemical transport model (Community Multiscale Air Quality [CMAQ] modeling system), where

emissions sources within West Oakland were excluded. The regional-scale modeling was also evaluated using the concentrations from local air quality monitors.

- (2) “Community-scale modeling” was used to quantify the local impacts from emissions sources on air pollutant concentrations in West Oakland at a finer spatial scale. Dispersion factors were generated using the American Meteorological Society/ Environmental Protection Agency Regulatory Model (AERMOD) system with a single year of representative meteorological data (2014). Dispersion models use a time-averaged, simplified representation of turbulent atmospheric dispersion to approximate how pollutants are transported and diluted. Critical inputs to the dispersion models are estimates of emissions from major air pollution sources and source characteristics. Year-specific emissions inventories were then convolved with the dispersion factors to obtain year-specific air pollutant concentrations for the West Oakland community.

The approach is that the results of the AERMOD dispersion modeling, which only accounts for local emissions sources, when added to the background concentration from the regional modeling, will result in a concentration that approaches the total concentration (Figure 1-2).⁴ The results from the dispersion modeling can also be thought of as the “additional burden” caused by the emissions in West Oakland alone. The community-scale modeling using AERMOD is further described in this document (Section 3); the regional-scale modeling is briefly described herein (Section 3.6), and fully documented elsewhere (Tanrikulu *et al.* 2019a, Tanrikulu *et al.* 2019b).

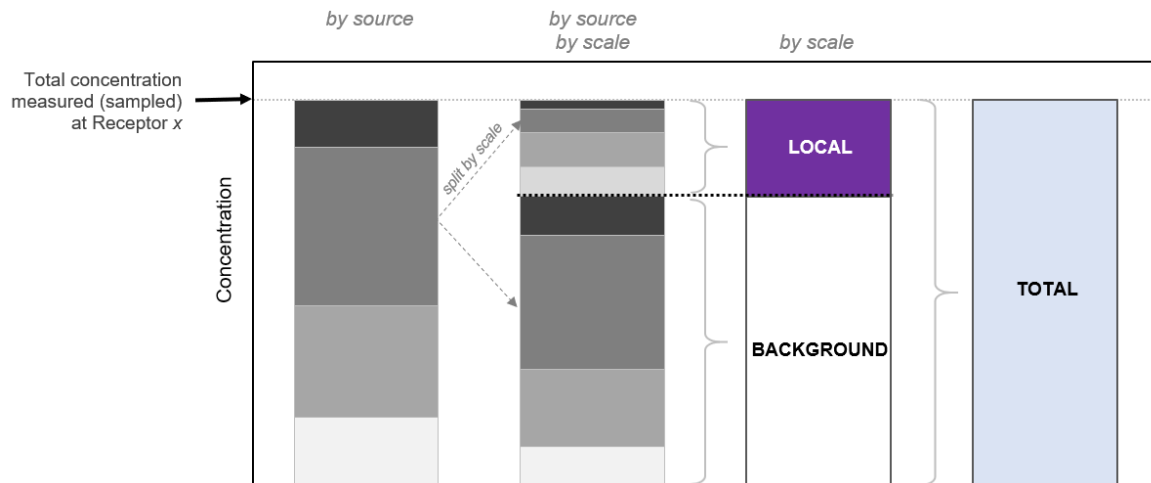


Figure 1-2. Schematic representation of how concentration contributions are disaggregated in a source apportionment analysis. Grey bar sections represent the concentration contributions from different arbitrary source categories.

⁴ A model evaluation can be performed by comparing the total concentration to those observed at monitoring locations within the same domain. This analysis is not discussed in this document.

1.2 Objectives

The District, in partnership with the West Oakland Environmental Indicators Project (WOEIP), developed an Action Plan for West Oakland to promote innovative policies to improve air quality. The objective of this technical work was to understand the spatial distribution of pollutant concentrations in West Oakland due to local emissions sources. Collaboration with WOEIP helped the District identify specific goals and action-oriented strategies for West Oakland that will focus on reducing exposure to PM_{2.5}, DPM, and TACs. To assist with this effort, the District initiated a community-scale modeling analysis to:

- Develop a base year emissions inventory and risk assessment for all major emissions sources impacting West Oakland residents;
- Provide source apportionment of concentrations at receptors by source category (i.e., trucks, ships, rail, etc.) or source origin (e.g., Port of Oakland, Union Pacific rail, etc.);
- Establish a baseline to track the benefits of future emission reductions on the burden of future new emissions sources.
- Develop a framework for modifying and expanding the emissions inventory for local emissions sources.

In this analysis, an emissions inventory was developed (Section 2), air dispersion modeling was performed (Section 3), and pollutant concentrations and cancer risk estimates were generated (Section 4). A brief overview of the results (Section 5), and a discussion of sources of uncertainty in the methods (Section 6) are also presented.

2. Emissions Inventory

The District developed bottom-up emissions inventories for PM_{2.5} and TACs from all significant emissions sources in West Oakland. A summary of the emissions inventory developed for the Action Plan for the base year (effective 2017) is described in this section by source category, including: permitted stationary sources, on-road mobile sources, truck-related businesses, sources due to activity in the Port of Oakland (ocean-going vessels, commercial harbor crafts, cargo handling equipment, Port Trucks at terminals, railyards), locomotives, railyards, commuter ferries and excursion vessels, and ferry berths. Emissions inventories from Port-related sources were largely based largely on the Port of Oakland 2017 Seaport Air Emissions Inventory (Ramboll 2018). Specific temporal and spatial allocation information for emissions source categories are discussed in Section 3, as they pertain to the emissions and dispersion modeling.

2.1 Development and Overview

2.1.1 Pollutants

AB 617 focuses on evaluating local community risk impacts associated with PM_{2.5} and TACs (which includes DPM), which are the primary air pollutants that pose the greatest risk to the health of residents in West Oakland. A full list of TACs compounds included in this analysis is provided in Attachment 1. In the following emissions inventories and modeling results, DPM is presented separately from PM_{2.5} and TACs. Only PM_{2.5} concentrations and potential health impacts (cancer risk) from directly emitted PM_{2.5} and TACs emissions were evaluated; secondary PM_{2.5} and TACs were not included.

2.1.2 Domain

All sources in this analysis were located within the “Source Domain”, which encompassed the entire West Oakland community and Port of Oakland, as well as part of downtown Oakland (Figure 2-1). For comparison purposes, the extents of the Source Domain were defined such that they correspond to a subset of the two-dimensional grid cells used in the regional-scale modeling analysis (see Section 3.6). The Source Domain is 7 km × 5 km. All emission sources discussed in this section are located within the Source Domain; if an emissions source’s extents were beyond those of the Source Domain, only the emissions associated with the area within the Source Domain were included in the inventory.

2.1.3 Emissions Sources and Base Year

The emissions inventory consists of emissions from various source categories, as shown in Figure 2-2 and Table 2-1. These sources include stationary and mobile (on-road, off-road) sources of emissions. Annual emissions estimates were developed for a base year, effective 2017 (i.e., the emissions data from the year closest to 2017 was used for each source category).⁵

⁵ Forecasted inventories for 2024 and 2029 are presented in Part II.



Figure 2-1. Extents of the Source Domain (red dotted lines) used to develop the emissions inventories. The extents of the map represent the extents of the Source Domain. The inner tiles represent the 1 km × 1 km grid cells of the regional-scale modeling.

In West Oakland, a large number of emissions source types are attributed to activity from the Port of Oakland. The Port is the fifth busiest port in the U.S. and serves as a gateway for intermodal cargo transport. In 2017, the Port consisted of four active marine terminals (TraPac, Nutter (STS/Everport), Oakland International Container Terminal [OICT], and Matson), and two railyards (Burlington Northern Santa Fe [BNSF], and Oakland Global Rail Enterprise [OGRE]). A fifth terminal (the Charles P. Howard terminal, located on the southeastern corner of the Port), has been vacant since the tenant filed for bankruptcy in 2010. Presently, the American Baseball League the Oakland Athletics (the A's) is investigating the possibility of building a baseball stadium on the site that is currently being used for long term Port (drayage) Truck parking.

Maritime emissions developed for the West Oakland Action Plan were based largely on the *Port of Oakland 2017 Seaport Air Emissions Inventory* developed by Ramboll (2018), herein referred to as the 2017 Port Inventory. The District contracted Ramboll (with prior approval from the Port) to assist in developing further spatial and temporal allocations of emissions associated with Port activities. Most of the emissions inventory information for Port-related sources discussed herein are partially excerpted from Ramboll (2018), including information for: ocean-going vessels (OGVs) (Section 2.5), commercial harbor crafts (CHCs) (Section 2.6), cargo handling equipment (CHE) (Section 2.7), on-road heavy-duty vehicles (Section 2.8), locomotives (Section 2.9), and railyards (Section 2.10).

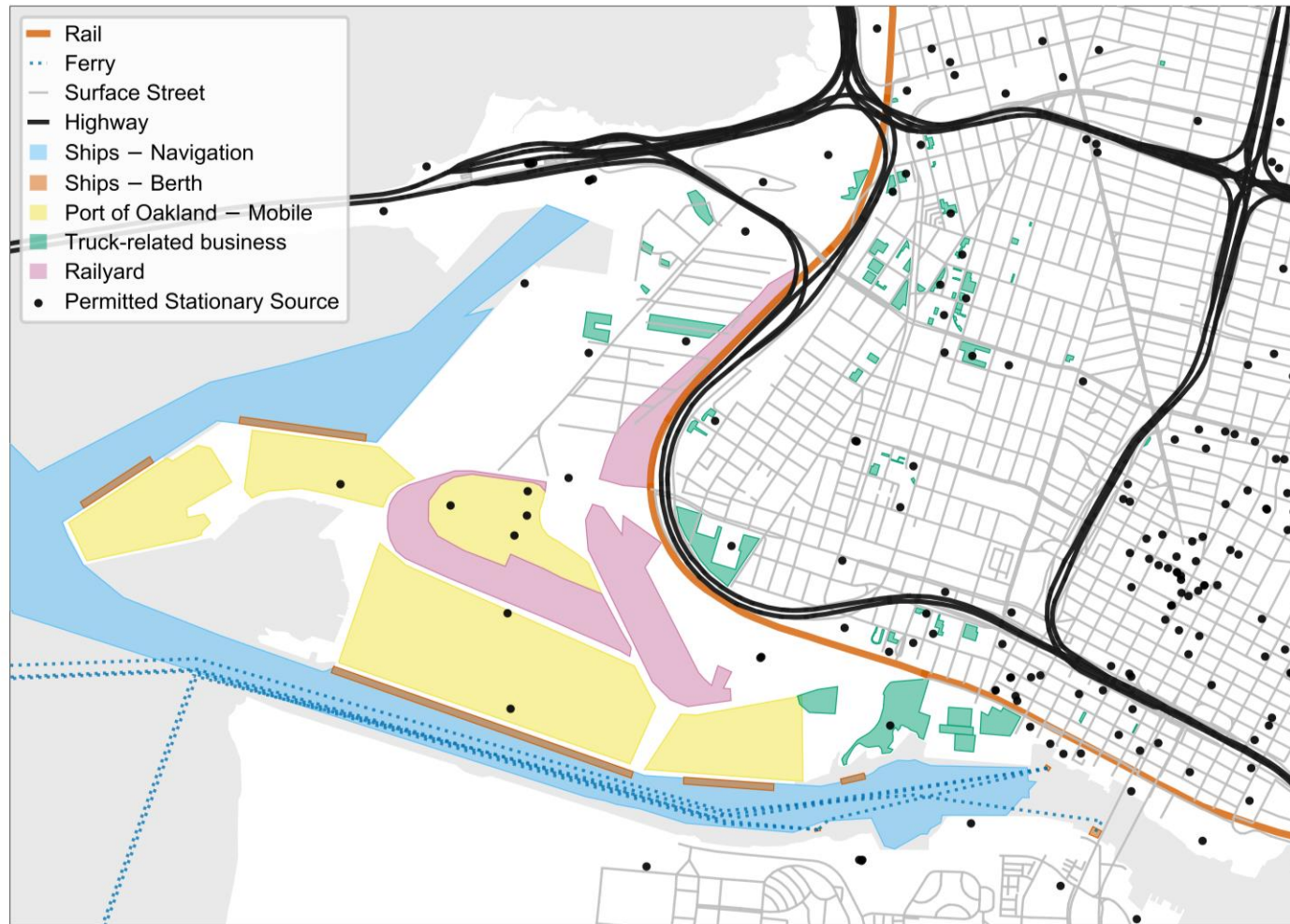


Figure 2-2. Composite of emissions source categories locations for the emissions inventory and community-scale modeling in West Oakland. Ships –Navigation encompasses the areas of emissions from ocean-going vessels (maneuvering) and commercial harbor crafts (assist tugs, dredgers, and bunkering tugs and pumps) at the Port, as well as ships transiting to Schnitzer Steel; Ships – Berth includes berthing areas for ships at the Port, Schnitzer Steel, commuter ferries, and excursion vessels. Port of Oakland – Mobile encompasses the areas of emissions from Port Truck activity (idling and transiting) and cargo-handling equipment; Surface Street may include on- and off-ramps. Only permitted stationary sources that were modeled are included.

Table 2-1. Emission source categories in West Oakland and year of data used to create the base year emissions inventory, effective 2017. The reference or data sources of the activity data and/or emissions data are indicated.

Section	Source Category	Year	Reference/Data Source
2.2	Permitted stationary sources	2015–2018	District (based on 2017 CEIDARS report)
2.3	On-road mobile sources	2017	Citilabs, StreetLight, Caltrans Truck Volumes, Caltrans PeMS, EMFAC2017, CT-EMFAC2017, Bay Area Air Quality Management District (2009)
2.4	Truck-related businesses	2018	Bay Area Air Quality Management District (2009), District survey (2018)
2.5	Ocean-going vessels	2017	Ramboll (2018), Port of Oakland
2.6	Commercial harbor crafts	2017	Ramboll (2018), Port of Oakland
2.7	Cargo handling equipment	2017	Ramboll (2018), Port of Oakland
2.8	Port Trucks at Terminals	2017	Ramboll (2018), District
2.9	Locomotives	2017–2018	District (passenger), UP and BNSF (freight)
2.10	Railyards	2017	Environ International Corporation (2008), UP
2.11	Commuter ferries and excursion vessels	2018	CARB, WETA, District survey (2018)

While there are some privately owned terminals and non-maritime activity on Port property, emissions from these sources are not included in the Port source categories. For example, emissions from activities at Schnitzer Steel and from truck fleets operating on Port property were accounted for separately.

Finally, emissions sources and categories that were not included in the community-scale emissions inventory include:

- residential wood burning (from fireplaces and wood stoves);
- commercial and residential cooking;
- construction activities;
- personal power boats;
- transportation refrigeration units (TRUs);
- law and home gardening equipment;
- portable combustion engines;
- small artisans or businesses that do not require District permits; and
- the Amtrak Oakland maintenance facility (located near 3rd Street/Adeline Street).

While emissions from these categories are potentially important sources of PM_{2.5} and TACs on a community scale, they are either (a) difficult to analyze (e.g., for wood burning and cooking, the spatial and temporal distribution of emissions are poorly understood), or (b) deemed to be less important than similar sources that are included in the emissions inventory (e.g., emissions from lawn equipment, an off-road mobile source, are many times smaller than emissions from on-road mobile sources; emissions from personal power boats are many times smaller compared to those from ocean-going vessels). The emissions from some of these categories were estimated using top-down approaches (see Table 2-3), but were not further included in the analysis or risk assessment.

2.1.4 Approach

A bottom-up emissions inventory involves estimating emissions using (1) emission factors (mass of pollutant emitted per unit of activity), and (2) local activity information of the emission processes (e.g., number of events, duration of activity). Emission factors vary by source type and/or emissions process, and can depend on other factors, such as the source age, model year, control technology, load, fuel type, speed, and ambient conditions, where applicable. Local activity information varies by source and by year (and by season and/or hour, depending on the source). In this analysis, activity data from 2017 (or nearest year available; Table 2-1) by source type was used, and then convolved with corresponding emission factors to estimate emissions.

2.1.5 Emissions by Category

Based on the bottom-up emissions inventory, there were 86.32 tpy of PM_{2.5} and 25.49 tpy of DPM emitted in 2017 in West Oakland (Figure 2-3). These values represent the total emissions from numerous source categories, as described in the remaining sections and in Table 2-2, and are used to perform the community-scale dispersion modeling (using AERMOD) and risk assessment (Section 4). The largest portion of PM_{2.5} emissions in West Oakland arises from on-road mobile sources (~51%, including Port Trucks and operations at truck-related businesses); the Port and

permitted stationary sources contribute nearly equal amounts (~26% and ~21%, respectively). In contrast, most DPM emissions in West Oakland are from activity related to the Port (~69%).

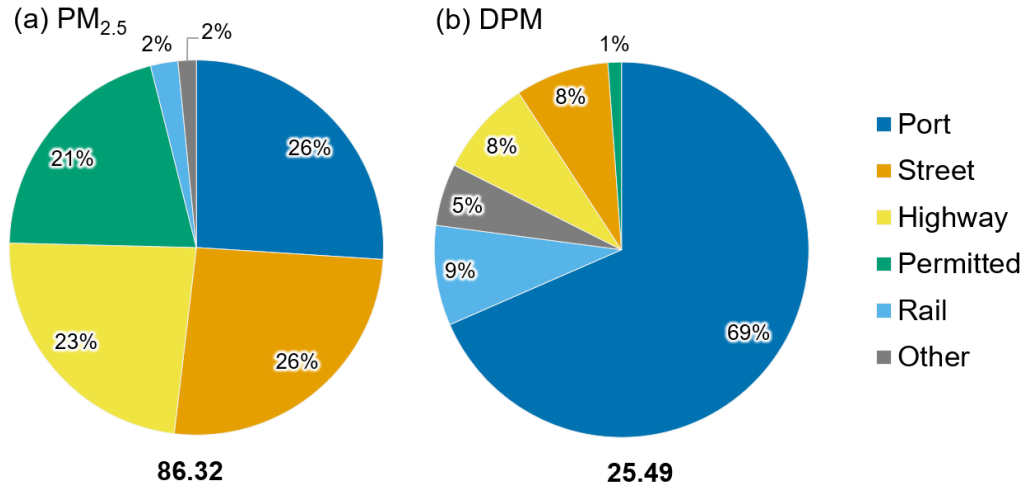


Figure 2-3. Emissions of (a) PM_{2.5} and (b) DPM by source category included in the 2017 community-scale (bottom-up) West Oakland emissions inventory within the Source Domain. Emissions from Highway and Street are composed of emissions from all on-road mobile sources except Port Trucks, which are attributed to the Port category. The total emissions (tpy) of each pollutant is displayed below their respective pie chart. Source categories are further described in Table 2-2.

As discussed in Section 2.1.3, there are several emission sources in West Oakland that were not accounted for in the bottom-up community-scale emissions inventory. These emissions sources were namely fuel combustion and commercial area sources, and non-road mobile sources (Table 2-3). Emissions from these sources were derived from regional-scale modeling (using SMOKE), but were not included in the subsequent analyses or risk calculations. Of these emissions sources, only non-road mobile sources emit DPM.

The grand total emissions in West Oakland can be estimated by summing the results from the bottom-up emissions inventory and the top-down emissions inventory. Therefore, the total emissions of PM_{2.5} in West Oakland were estimated as 129.72 tpy, where the community-scale analysis accounts for 67% of these total emissions. Similarly, 86% of total DPM emissions (29.61 tpy) are accounted for in the community-scale analysis.

Table 2-2. Emissions by Source Category within the Source Domain. Percentage (%) of emissions are reported as a total of the entire inventory (“Total” row) and within categories. The Port Trucks category includes emissions from all Port Trucks, regardless of location (i.e., within the Port and operating on Highways and Surface Streets).

Source Category	PM _{2.5}			DPM		
	tpy	% of total	% within	tpy	% of total	% within
Highway	20.28	23.5	100.0	2.12	8.3	100.0
Non-Trucks	12.22	14.1	60.3	0.19	0.7	9.0
LHDT	0.41	0.5	2.0	0.09	0.3	4.0
MHDT/HHDT	2.48	2.9	12.2	1.84	7.2	87.0
Road dust	5.17	6.0	25.5	-	-	-
Surface Streets	22.34	25.9	100.0	2.06	8.1	100.0
Non-Trucks	4.82	5.6	21.6	0.09	0.4	4.5
LHDT	0.35	0.4	1.6	0.09	0.4	4.5
MHDT/HHDT	2.43	2.8	10.9	1.88	7.4	91.0
Road dust	14.74	17.1	66.0	-	-	-
Port	22.46	26.0	100.0	17.45	68.5	100.0
OGV – maneuvering	3.94	4.6	17.6	3.84	15.1	22.0
OGV – berthing	8.59	10.0	38.3	6.20	24.3	35.5
Dredging	1.12	1.3	5.0	1.16	4.6	6.6
Assist Tugs	3.64	4.2	16.2	3.75	14.7	21.5
Bunkering (tugs, pumps)	0.16	0.2	0.7	0.17	0.7	1.0
CHE	1.59	1.8	7.1	1.58	6.2	9.1
Port Trucks	0.93	1.1	4.1	0.50	2.0	2.9
Road dust	2.25	2.6	10.0	-	-	-
Railyard – OGRE	0.07	0.1	0.3	0.08	0.3	0.4
Railyard – BNSF	0.17	0.2	0.7	0.18	0.7	1.0
Rail	2.04	2.4	100.0	2.20	8.6	100.0
Locomotives	1.02	1.2	50.0	1.09	4.3	49.5
Railyard – UP	1.02	1.2	50.0	1.11	4.4	50.5
Permitted	17.84	20.7	100.0	0.30	1.2	100.0
CA Waste (10th Street)	0.46	0.5	2.6	0.00	0.0	0.0
California Cereal	0.58	0.7	3.2	0.00	0.0	0.0
CASS	0.72	0.8	4.0	0.00	0.0	0.0
Dynergy	1.96	2.3	11.0	< 0.01	< 0.1	0.1
EBMUD	3.99	4.6	22.4	0.09	0.4	30.0
Pinnacle Ag Services	1.48	1.7	8.3	0.00	0.0	0.0
Schnitzer Steel – stationary	5.20	6.0	29.2	0.00	0.0	0.0
Sierra Pacific	0.91	1.1	5.1	0.00	0.0	0.0
Other	2.53	2.9	14.2	0.21	0.8	69.9
Other	1.36	1.6	100.0	1.36	5.4	100.0
Ferry/Excursion vessels	0.91	1.1	66.7	0.93	3.7	68.4
Schnitzer Steel – OGV	0.30	0.4	22.2	0.30	1.2	22.2
Schnitzer Steel – trucks	0.04	< 0.1	2.8	0.01	< 0.1	0.8
Truck-related businesses	0.11	0.1	8.2	0.12	0.5	8.6
Total	86.32	100.0		25.59	100.0	

Table 2-3. Total emissions by Source Category within the Source Domain based on regional-scale emissions inventory (not included in community-scale bottom-up emissions inventory). Percentage (%) of emissions are reported as a total of the entire inventory (“Total” row) and within categories.

Source Category	PM _{2.5}			DPM		
	tpy	% of total	% within	tpy	% of total	% within
Area	30.40	70.0	100.0	0.00	0.0	
Commercial cooking	20.63	47.5	67.9	0.00	0.0	–
Food and agriculture	0.00	0.0	0.0	0.00	0.0	–
Fuel combustion – residential	6.93	16.0	22.8	0.00	0.0	–
Fuel combustion – Commercial/industrial	2.30	5.3	7.6	0.00	0.0	–
Industrial processes	0.03	0.1	0.1	0.00	0.0	–
Solvent use	0.00	0.0	0.0	0.00	0.0	–
Consumer products	0.00	0.0	0.0	0.00	0.0	–
Other	0.50	1.2	1.6	0.00	0.0	–
Non-road	13.00	30.0	100.0	4.12	100.0	100.0
Construction – equipment	4.10	9.5	31.6	3.33	80.8	80.8
Construction – dust	6.74	15.5	51.9	0.00	0.0	0.0
Commercial/industrial equipment	1.17	2.7	9.0	0.51	12.5	12.5
Lawn and garden equipment	0.12	0.3	0.9	0.02	0.5	0.5
TRUs	0.24	0.5	1.8	0.26	6.2	6.2
Other	0.63	1.4	4.8	0.00	0.0	0.0
Total	43.40	100.0		4.12	100.0	

2.2 Permitted Stationary Sources

Stationary sources of air pollution are regulated and subject to permitted conditions established by the District. These include complex sources such as metal smelting, wastewater treatment plants, and Port activities, and smaller facilities, such as diesel generators, gasoline dispensing facilities (GDFs, or gas stations), and boilers. The District maintains a database of its permitted sources and their associated characteristics and emissions. These emissions are determined either through direct measurement (via source tests) or by engineering calculation (based on process throughput and industry emission factors). Emission values are updated annually or bi-annually, depending on their permit cycle. Emissions from all permitted facilities are reported annually to CARB under the California Emissions Inventory Development and Reporting System (CEIDARS)⁶ and, subsequently, reported to the U.S. Environmental Protection Agency (EPA) to supplement the National Emissions Inventory (NEI) database.⁷ The 2017 CEIDARS report was used as the basis to assemble emissions for permitted facilities located in West Oakland and surrounding areas (encompassing zip codes 94607, 94608, 94609, 94612, 94615, and 94501). The inventory was developed for PM_{2.5} and TACs, including DPM.

⁶ CEIDARS 2.5 Database Structure can be found at: <https://www.arb.ca.gov/ei/drei/maintain/dbstruct.htm>.

⁷ EPA NEI web page can be found at: <https://www.epa.gov/air-emissions-inventories>.

Quality assurance (QA) was performed and updates were made to the report to include newly permitted facilities and removed facilities that closed after 2017. Another important improvement was the addition of GDFs to the point-source inventory. Historically, emissions from GDFs have been aggregated and reported as part of county-level area totals in CEIDARS. The emissions inventory for West Oakland includes 32 GDFs geolocated with actual or permitted throughputs, which were used to individually estimate their emissions.

The District made other updates to the emissions estimates in the 2017 CEIDARS report, mainly to ensure that the latest emissions factors, source test results, and methods used to estimate emissions were incorporated. In most of these cases, the individual facility's emissions were revised by specific facility source (e.g., Custom Alloy Scrap Sales [CASS], East Bay Municipal Utility District [EBMUD], and Schnitzer Steel; Table 2-4). Otherwise, source specifications and associated emissions from entire source categories were updated (Table 2-4). Certain categories of permitted stationary sources were excluded from the emissions inventory, such as portable engines, other portable equipment, and most registered restaurants,⁸ since their operations are intermittent and their emissions are generally not well characterized. Dry cleaners⁹ were also excluded since pollutants currently emitted from these sources do not contribute to cancer risk. Other permitted stationary sources were excluded from this analysis for one of the following reasons:

- There were no associated PM_{2.5} emissions and/or TAC emissions available, or these emissions could be estimated based on data available;
- There were no PM_{2.5} emissions and TAC emissions were non-cancerous; and/or
- The source had emissions from solvents only.

While the permitted stationary source database originally contained 430 individual sources among 205 unique facilities, only 322 sources had associated emissions of PM_{2.5} or cancerous TACs among 170 unique facilities. These 322 sources were modeled in this analysis (Table 2-5). The final list of permitted stationary sources included in this analysis is provided in Attachment 2. Less than half (~42%) of these sources had known release heights (required for dispersion modeling; see Section 3.1), and only ~34% had complete dispersion modeling parameters.¹⁰

The majority of permitted stationary sources in West Oakland are located on the eastern side of the modeling domain (Figure 2-4). GDFs are the most evenly spatially distributed. Back-up generators are clustered in the downtown Oakland area, reflecting the fact that many multi-story buildings (such as hotels or offices) have emergency generators. Coffee roasters are mainly located in the industrial area south of I-880, whereas cement-related facilities are located in the northwest quadrant of the West Oakland community. Other sources are associated with industrial activities and tend to be located near main arterial roadways such as 7th Street, West Grand Avenue, and Peralta Street.

⁸ One restaurant with charbroiling operations was included since emissions information was available.

⁹ All dry cleaners in the Source Domain used petroleum-based solvents, and therefore did not have associated TAC emissions.

¹⁰ A complete set of release parameters for point sources includes: stack height, stack diameter, gas exit temperature, and gas exit flow rate. A complete set of release parameters for volume sources includes: stack height, and initial lateral dispersion coefficient (which can be estimated from the stack diameter).

Table 2-4. Updates performed to permitted stationary sources in the 2017 CEIDARS report. The name of the facility or category of the source is provided, with the plant number (P), source ID (S), and information regarding updates to the emission factors (EF) and/or emissions.

Name/Category	P	S	Source Description	Updates
CASS	146	1	furnace	Emissions increased to reflect source test results.
		2	furnace	Emissions were decreased by using updated EFs.
		7	material handling	Emissions increased.
Schnitzer Steel	208	6	shredder	Emissions increased based on source test results (reported for Stack 15, identified as Source 6).
		–	–	Fugitive emissions included.
EBMUD	591	100	wet treatment process	Emissions decreased based on influent testing.
		37 – 39	standby generator	Emissions for DPM increased by using default EFs.
		52	portable emergency electric generator	Source removed from the inventory since it is no longer in use.
		–	–	Other carcinogenic pollutants associated with diesel fuel were excluded since DPM is a surrogate for all toxic compounds collectively emitted during diesel oil combustion.
Central Concrete	1253	1	aggregate piles	Emissions were decreased by using updated EFs.
		2	cement silo	Emissions were decreased by using updated EFs.
		3	conveyors	Emissions were decreased by using updated EFs.
		4	cement batcher	Emissions were decreased by using updated EFs.
Dynergy	11887	1 – 6	gas turbine	Emissions were decreased by using updated EFs.
Sierra Pacific	18268	1, 2	aggregate handling	Emissions were decreased by using updated EFs.
		3	silo	Emissions were decreased by using updated EFs.
		4	truck loading	Emissions were decreased by using updated EFs.
		5	conveyor	Emissions were decreased by using updated EFs.
standby generators and fire pumps	–	–	–	DPM was used as a surrogate to represent all carcinogenic compounds that may be emitted from combustion of diesel fuel. However, other toxic compounds were included in the analysis if the generators burned natural gas or digester gas.

Table 2-5. Summary of data completeness for permitted stationary sources in West Oakland. The final inventory reflects the number of sources modeled in this analysis that had associated emissions of PM_{2.5} and/or TACs that contribute to cancer risk.

Inventory	Record type	Number of records
Original	Number of permitted stationary sources	430
	Number of unique facilities	205
Final	Number of permitted stationary sources	322
	Number of unique facilities	170
	Sources with known release heights	134
	Sources with complete dispersion modeling parameters	110

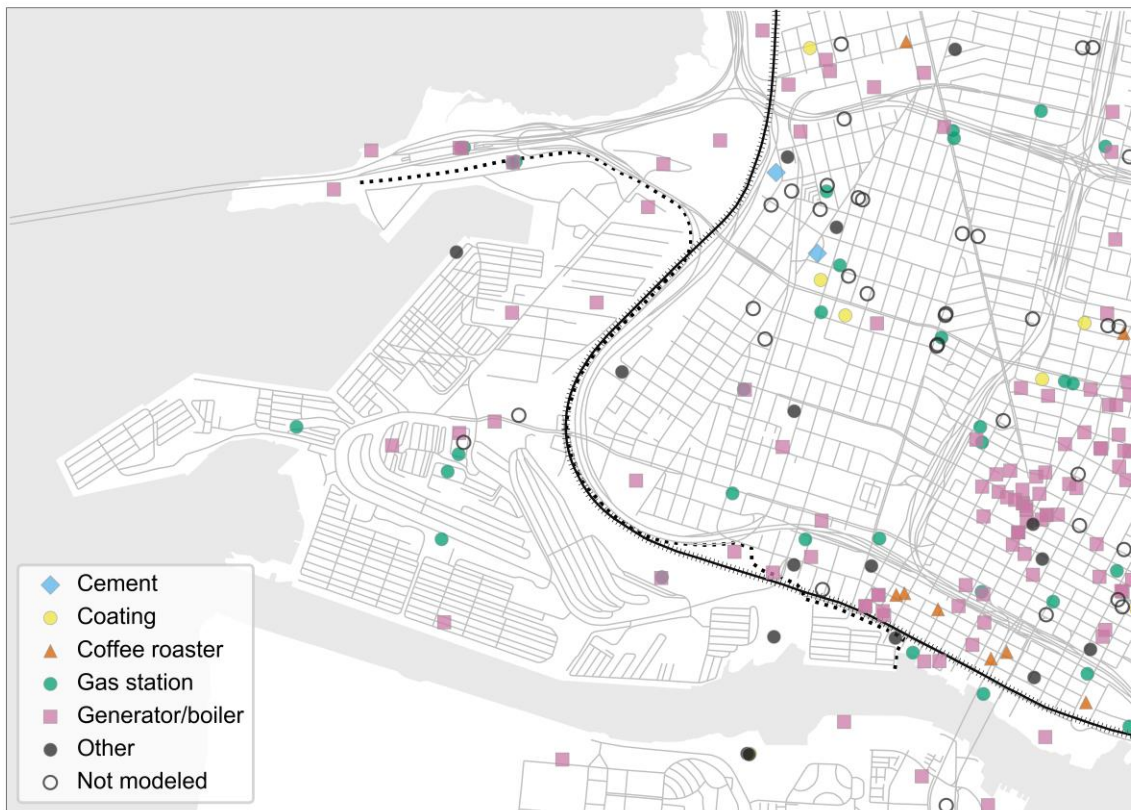


Figure 2-4. Location of permitted stationary sources in West Oakland. “Generator/boiler” indicates either a generator (primary or standby), boiler, generator and boiler, or generator and fire pump. “Other” sources include: charbroilers, cremators, electric shredders, furnaces, grain systems, microturbines, printing presses, recycling, sandblasting, smoke houses, soil vapor extraction, and turbines. Sources that were “Not modeled” were excluded because either PM_{2.5} emissions were not available, or because the TACs that are emitted do not contribute to cancer risk.

2.3 On-Road Mobile Sources

The approach for developing an emissions inventory from on-road mobile sources depended on location: due to data availability, those from roadways within terminals at the Port were developed separately (by Ramboll (2018); see Section 2.8) from those within the rest of the Port area and West Oakland community. In this section, the process for developing a bottom-up emissions inventory for the remaining roadways is presented.

Emissions from vehicles travelling on roadways in urban environments tend to occur near *sensitive receptors*,¹¹ and have been shown to have a high intake fractions (ratio of inhaled to emitted pollutants; Marshall *et al.* 2005). For this analysis, a bottom-up emissions inventory of PM_{2.5} and TAC pollutants was developed using annual average daily emission profiles for each roadway segment (or roadway “link”¹²) within the West Oakland Source Domain. Annual average daily emission profiles were developed by vehicle category and for weekday (WD) (Monday–Friday) and weekend (WE) (Saturday–Sunday) days separately since traffic activity varies significantly by day of week (typically, total daily traffic is higher on weekdays, with slower fleet average speeds; peak traffic periods may also vary due to commuting).

Pollutants are emitted from on-road mobile sources due to the following processes:

- *Operational* emissions result from the consumption and combustion of fuel or from wear of vehicle-related materials. The emissions processes include:
 - Running exhaust, when pollutants are emitted from the tailpipe of the vehicle as the fuel is combusted;
 - Running loss, when fuel vapors escape from the fuel system during operation;
 - Tire wear, when PM is emitted as a result of a vehicle’s tires wearing on the road surface; and
 - Brake wear, when PM is emitted as a result of wearing of brake discs as the vehicle’s brakes are applied.

In California, emission factors from these processes are typically estimated by using the Emission FACTors (EMFAC) model, which is developed and maintained by CARB. In this analysis, operational on-road mobile source emission included the four processes listed above, as defined¹³ in the latest version of EMFAC, EMFAC2017 (v1.0.2) (California Air Resources Board 2017b).

- *Re-entrained road dust* emissions are particulate matter from resuspended road surface material (dust) that is entrained by vehicles traveling on roads. Currently, road dust emission factors are estimated following CARB’s method for paved road dust (California Air Resources Board 2016), which is based on the EPA Air Pollution (AP) report *AP-42*

¹¹ Sensitive receptors are locations where occupants are more susceptible to adverse health effects of air pollution exposure, including schools, hospitals, daycare facilities, elderly housing, etc.

¹² A link is a section of roadway where either roadway attributes or travel activity are constant along the length of the section.

¹³ EMFAC2017 is a trip-based mobile source emissions model. As such, running exhaust emission factors also account for idling events (and other processes, such as crankcase exhaust) during normal vehicle operation (California Air Resources Board 2015), such as a vehicle idling while queuing at an intersection for a limited amount of time. Therefore, idling exhaust emissions were not explicitly calculated for on-road mobile sources. Extended idling events of heavy-duty vehicles were accounted for separately (see Section 2.4).

Compilation of Air Pollutant Emissions Factors, Volume I (or simply “AP-42”) Chapter 13.2.1 Paved Roads (U.S. Environmental Protection Agency 2011). Entrained road dust on paved roadways can be significant source of PM_{2.5}, especially as the relative proportion of emissions from other vehicle processes decreases over time (Reid *et al.* 2016).

Bottom-up emissions inventories from on-road mobile sources can be calculated at different levels of aggregation. For example, emissions may be calculated by individual vehicle types (e.g., passenger car, motorcycles), or by vehicle categories (e.g., Non-Trucks, which includes passenger cars and motorcycles; Table 2-6). EMFAC2017 groups all vehicle classes into three vehicle categories: Non-Truck (NT), Truck 1 (T1), and Truck 2 (T2). In this analysis, operational emissions were namely estimated by vehicle category (Table 2-6) based on the vehicle categorization EMFAC2017, as well as analysis needs (so that potential mitigation measures can be applied to specific source categories within the source apportionment). The EMFAC2017 default Non-Truck and Truck 1 results were used, but the default Truck 2 category was further divided into two categories: Port drayage trucks (POAK), and the remaining EMFAC2017 Truck 2 vehicles (Non-POAK-Truck 2, or NPT2). This was done because Port Trucks have historically been significant source of DPM in West Oakland (California Air Resources Board 2008a); however, POAK emission factors in EMFAC2017 suggest a much cleaner Port Truck fleet because of CARB’s Drayage Truck Regulation (California Air Resources Board 2011b). Therefore, designating Port Trucks to a single category could help evaluate the emissions contribution and the effectiveness of regulations. Finally, the total of all truck-related categories – Truck 1, POAK, and Non-POAK-Truck 2 – may be referred to collectively as “Trucks”.

Table 2-6. Emission source and vehicle categories from on-road mobile sources. Vehicle categories are generally based on gross vehicle weight rating (GVWR) and based on EMFAC2017 (see California Air Resources Board 2017a).

Emissions Category	Vehicle Category	Description/Vehicle Types
Operational	NT	Passenger cars, passenger trucks, medium-duty trucks (GVWR ≤ 8,500 lb), buses, motorcycles, motor homes, motor coaches.
	T1	Light-Heavy Duty Trucks (LHDT) (GVWR 8,501–14,000 lbs)
	POAK	Heavy-Heavy Duty Diesel Drayage Truck in Bay Area (GVWR > 33,000 lb) (referred to as “Port Trucks” or “drayage trucks” in this analysis).
	NPT2	Medium-Heavy Duty Trucks (MHDT) (GVWR 14,001–33,000 lb) and Heavy-Heavy Duty Trucks (HHDT) (GVWR > 33,000 lb), excluding Port Trucks.
Road dust	All	Entrained road dust (PM ₁₀ and PM _{2.5}) on paved roads.

To develop a bottom-up link-level emissions inventory for on-road mobile sources, the data needed are (1) roadway attributes, (2) vehicle travel activity, and (3) corresponding emissions factors (by vehicle emissions process and category). In this analysis, the majority of the roadway attributes and travel activity data were purchased from Citilabs (Streetlytics platform).¹⁴ A set of shapefiles containing the geographic location, travel activity (volume and speed), and roadways

¹⁴ <http://www.citilabs.com/>.

attributes of roadway segments in Alameda County was obtained for 2016 by hour of day for four seasons and four day types (Monday–Thursday, Friday, Saturday, and Sunday). To use this dataset to develop an emissions inventory and to support AERMOD dispersion modeling:

- (1) The roadway network was clipped to the Source Domain; some roadway segments were shortened and their lengths recalculated, while other segments had to be manually extended to meet the edge of the domain (namely, the roadway segments representing the San Francisco-Oakland Bay Bridge).
- (2) Roadway segments were excluded in Port terminal areas.
- (3) Corresponding roadway segments that represented the total 2-way directional traffic were merged, so that the resulting line geometry represented the approximate centerline of the roadway.¹⁵ As a result, there were 6,861 roadway segments in the West Oakland Source Domain.
- (4) By performing (3), the number of lanes and hourly traffic volume in both directions were added, and the hourly traffic speeds were averaged (weighted by hourly volume).
- (5) The data was then aggregated into two day types (WD, representing travel activity from Monday–Friday, and WE, representing travel activity from Saturday-Sunday) and averaged across all seasons.

A description of the parameters from Citilabs and other data sources used to develop a vehicle-type (Non-Truck/Truck) and day-type (WD/WE) specific emissions inventory are described in the following sections.

2.3.1 Roadway Attributes

The geometry of each roadway link is used to perform AERMOD dispersion modeling, while the associated roadway attributes are used to estimate emissions from on-road mobile sources. The roadway attributes required include: roadway length, road type, and number of lanes. A description of these attributes and how they are used to support developing the emissions inventory and/or dispersion modeling are provided in Table 2-7.

Table 2-7. Roadway attributes and associated data sources used for estimate emissions from on-road mobile sources.

Parameter	Purpose	Reference/ Data Source
Roadway Length	Determine (a) geographic locations of roadways (used in AERMOD dispersion modeling; Section 3.4.3), and (b) calculate vehicle miles traveled (VMT) used in estimating emissions.	Citilabs (updated by the District)
Road Type	Determine (a) roadway width (used in AERMOD dispersion modeling; Section 3.4.3), and (b) silt loading (to calculate road dust emissions).	Citilabs, CARB
Number of Lanes	Determine total width of roadway (used in AERMOD dispersion modeling; Section 3.4.3).	Citilabs (updated by the District)

¹⁵ The District did not QA the location of the roadway segment centerlines.

The road type assigned to each roadway segment was mainly based on the roadway functional class provided by Citilabs (based on HERE), which is defined as “a hierarchical network [index] used to determine a logical and efficient route for a traveler.”¹⁶ These classes were matched to corresponding U.S. Federal Highway Administration (FHWA) Road Types (which are based on level of service and are used to determine roadway widths) and CARB Road Types (which are based on “anticipated usage, modes of usage, and silt loading potential” (California Air Resources Board 2016) and are used to determine roadway surface silt loading factors; Table 2-8). Because of the mismatch between roadway classification systems, freeway on- and off-ramps, which are assigned to multiple functional classes, can then be assigned to numerous CARB and FHWA road types; for simplicity, the District did not adjust these assignments.¹⁷ Additionally, roadway segments were also assigned to road category (“Highway” and “Surface Street”; Table 2-8) which were created to align with available data and the source apportionment approach.

Finally, truck route type was assigned to each roadway segment based on information obtained from the City of Oakland:¹⁸ (1) prohibited truck routes, (2) major truck routes, or (3) neither (Figure 2-5). These route designations were used to determine fleet mix information (see Section 2.3.2(b)).

For the resulting 2-way merged roadway network, QA was performed on the number of lanes only for roadways where (a) the number of lanes in either direction was one, and (b) the total 2-way AADT \geq 5000.¹⁹ The District updated the number of lanes of 274 (4%) roadway segments. If the number of lanes for a segment was not a whole number (integer), the value was rounded down (e.g., 4.5 lanes was rounded to 4 lanes), as the fractional lane often corresponded to roadway sections designated for street parking.

Table 2-8. Cross-reference of road type classification schemes used in this analysis. Functional Class were obtained from Citilabs and mapped to CARB Road Type (based on California Air Resources Board (2016), used to determine silt loading factors for estimating road dust emissions), FHWA Road Type (based on FHWA and American Association of State Highway and Transportation Officials (2018), used to determine roadway width), and Road Category (used in this analysis for source apportionment).

Functional Class	CARB Road Type	FHWA Road Type	Road Category
2 - Major Highways	Freeway	Freeway	Highway
3 - Minor Highways	Major/Collector	Arterial	Surface Street
4 - Minor Streets	Major/Collector	Arterial	Surface Street
5 - Local Roads	Local	Local	Surface Street

¹⁶ See http://marketing.citilabs.com/hubfs/Here_Attributes.pdf (accessed February 2019).

¹⁷ This results in a conservative estimate for road dust emissions; on- and off-ramps are then assigned to arterial and local roads, which typically have more dust (higher silt loading factors) than freeways.

¹⁸ <https://www.oaklandca.gov/>.

¹⁹ According to the District’s current California Environmental Quality Act guidelines, a roadway with AADT < 10,000 is likely not a significant source. In this analysis, AADT < 5,000 was used to determine which roadways should be reviewed, to be conservative (Bay Area Air Quality Management District 2017).

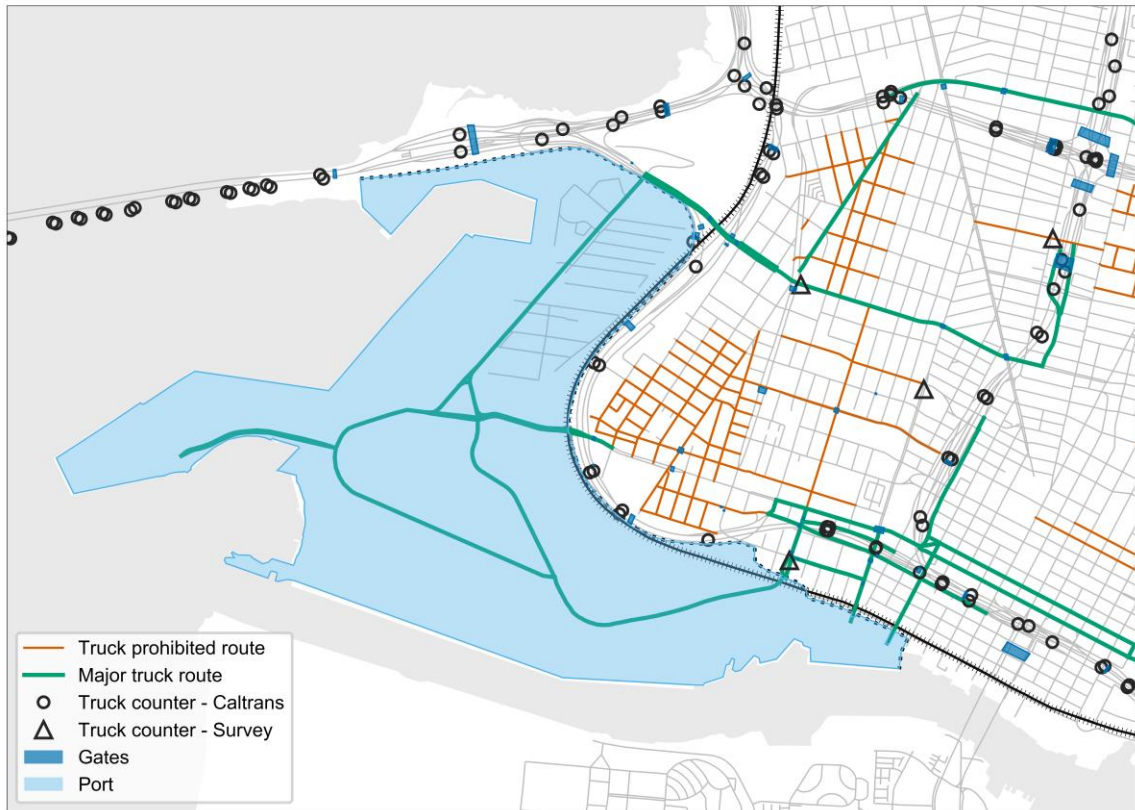


Figure 2-5. Roadway network and data sources used to develop the emissions inventory for on-road mobile sources. The roadways (solid lines, provided by Citilabs), traffic counters (open symbols), Port boundary (dashed line), and gates (blue polygons, used in the StreetLight InSight platform) are plotted. Caltrans truck counters may appear off of the Bay Bridge because the bridge was reconstructed (completed ~2013) and the location of the counters were not updated in PeMS. Only roadway segments modeled as volume sources in AERMOD are plotted (i.e., some roadways in the Port terminal areas are not displayed, since they were accounted for in the Port emissions inventory; see Section 2.8).

2.3.2 Travel Activity

Vehicle travel activity data characterizes the type of fleet and how that fleet travels on a roadway. Emissions are estimated based on these parameters, which include: volume, speed, fleet mix, and fleet average vehicle weight (Table 2-9). These parameters are further described below.

Table 2-9. Travel activity parameters and associated data sources used for estimate emissions from on-road mobile sources. Parameters can vary hourly and by roadway link.

Parameter	Description	Purpose	Reference/ Data Source
Volume	Average total traffic fleet volume.	Calculate VMT and VHT, which are used to estimate emissions from all processes (operational and road dust).	Citilabs
Speed	Average total traffic fleet speed.	(a) Estimate running exhaust emissions (emission factors are speed-dependent), and (b) estimate VHT.	Citilabs
Fleet Mix	Composition of vehicle fleet (i.e., volume fraction for each vehicle category).	Apportion fleet-total VMT to each vehicle category.	StreetLight, Caltrans Truck Traffic Volumes, Caltrans PeMS, Bay Area Air Quality Management District (2009)
Fleet average vehicle weight	Volume-weighted average weight of vehicle in fleet	Estimate road dust emission factors.	CT-EMFAC2017

(a) Volume and Speed

For each link, traffic volume and speed can be used to calculate:

- Vehicle miles travelled (VMT): the mileage of all vehicles traveling on a link over a specific period (e.g., hourly, daily). That is, VMT is the product of volume (unitless) and link length (mi). VMT is used to estimate emissions that are based on gram-per-mile (g/mi) emission factors (running exhaust, tire wear, brake wear, road dust).
- Vehicle hours traveled (VHT): the travel time of all vehicles traveling on a link over a specific period (e.g., hourly, daily). VHT is estimated by dividing VMT (mi) by speed (mph). VHT is used to estimate emissions due to running loss.

Hourly total fleet volume and speed data by roadway link and day type were obtained from Citilabs. Due to availability, this data was based on 2016 travel activity; to create a 2017 base year activity data set, the District then adjusted the total volumes (and therefore VMT and VHT) by a growth factor (0.6%) derived from the Alameda County VMT information in EMFAC2017. For each roadway link, Hourly VMT and VHT were calculated for each roadway link, and VMT was then allocated to vehicle types (Table 2-6) by using fleet mix information (see below).

(b) Fleet Mix

The annual average fleet mix by WD and WE were developed in two steps: (1) by deriving volume-based fleet mix fractions of Non-Truck, Truck 1 and Truck 2, and then (2) by splitting the Truck 2 fraction into POAK and Non-POAK-Truck 2. Due to data availability, this fleet mix information for step (1) was developed by road category, as follows:

- For Highways: the fractions of Non-Truck, Truck 1 and Truck 2 were first derived from the 2016 Truck Traffic Volumes (Truck AADT) from the California Department of Transportation (Caltrans).²⁰ The dataset contains traffic counts by axles at specific locations on freeways. Counts were then be allocated to Non-Truck, Truck 1, and Truck 2. However, given the limited spatial coverage of the counters (e.g., there are no counters on I-880), a second dataset was compiled to further develop fleet mix information, based on Caltrans Performance Measurement System (PeMS)²¹ counters. PeMS data contains total traffic flow and truck flow at specific locations on freeways. Data was obtained for 2016 and used to derive total truck fractions²² along remaining highway roadway segments. As PeMS truck flow represents the total traffic flow of all Trucks, the truck fraction from PeMS was split into fractions of Truck 1 and Truck 2 based on VMT from EMFAC2017 (for 2017 Alameda County) by truck category. The resulting truck fractions were assigned to highways links based on their spatial proximity to Caltrans Truck Traffic counters or Caltrans PeMS counters (Figure 2-5).
- For Surface Streets: the fractions of Non-Truck, Truck 1 and Truck 2 were derived based on traffic axle counts at four auto-counters located on surface streets from the 2009 West Oakland Truck Survey (Bay Area Air Quality Management District 2009; Figure 2-5, Table 2-10). The fractions were assigned to surface street links based on their spatial proximity to the counters. If a surface street link was a major or prohibited truck route, then the nearest counter of the same route type was used (this prevented assigning higher truck fractions to surface streets that were truck-prohibited routes). For roadway links within Port area, fleet mix fractions were derived from the counter at the Port access point (3rd Street/Adeline Street) only.

Table 2-10. Description of location of automatic traffic counters from the 2009 West Oakland Truck Survey (Bay Area Air Quality Management District 2009).

Automatic counter location	Total traffic level	Route description
3rd Street/Adeline Street	High	Major truck route (3rd Street)
West Grand Avenue/Mandela Parkway	High	Major truck route (West Grand Avenue)
18th Street/Market Street	Moderate	Truck-prohibited route (18th Street)
30th Street/Martin Luther King Drive	Low	Truck-prohibited route (30th Street)

²⁰ Available from <http://www.dot.ca.gov/hq/tsip/gis/datalibrary/Metadata/TruckAADT.html> (downloaded February 2019).

²¹ <http://pems.dot.ca.gov/>.

²² All truck flow (volume) data in the PeMS data used was marked as “imputed.” This means that the data are estimated from other available parameters from the traffic counter and/or other surrounding traffic counters in the PeMS network (see http://pems.dot.ca.gov/?dnode=Help&content=help_calc#truck).

Generally, the fleet mix by roadway link resulted in a higher proportion of Trucks on major Truck routes and some major arterials in West Oakland, and a lower proportion of Trucks on truck-prohibited routes and local roads (Figure 2-6). Notably, using this procedure resulted in a high Truck fraction in near the Port entrance at 3rd Street/Adeline Street and in the surrounding neighborhood, especially on weekdays.

In step (2), the fleet fraction of Truck 2 was split into POAK and Non-POAK-Truck 2 categories. At the time of this analysis, no traffic counts of Port Trucks from traffic measurements or travel models were readily available. Instead, the POAK fraction of Truck 2 was derived from origin-destination (O-D) analyses using the StreetLight InSight platform.²³ The platform simulates trips from Truck 2 vehicles (commercial vehicles) between origin and destination zones based on data from GPS navigation systems installed on the vehicles. A zone can be any size, so long as the geographic extents intersect a roadway. When a zone is drawn as a narrow polygon perpendicular to a roadway, it is often referred to as a “gate.” An O-D analysis generates a traffic “index” which quantifies the number of trips between an origin and a destination zone, as well as all trips in each zone independent of trip start or end locations.

In this analysis, it was assumed that all trips originating or ending at the Port were from Port Trucks, which are subject to CARB’s Drayage Truck Regulation²⁴ (i.e., they are POAK vehicles). The entire Port area was designated as a zone, in addition to 49 gates, which were located on highways and surface streets to account for different road types and traffic conditions (including 21 on freeways, 4 on on-/off-ramps, and 24 on surface streets; Figure 2-5). The O-D analyses were conducted for each Port and gate pair. The traffic index between the Port and gate was considered as surrogate of POAK volume, while the traffic index of all trips at gate was considered as surrogate of total Truck 2 volume. Therefore, the fraction of POAK within the Truck 2 category was equal to the POAK traffic index divided by the Truck 2 traffic index. This fraction was assigned to each roadway link based on the spatial proximity of the link to a gate, and then multiplied by the Truck 2 fraction (step (1)) to estimate the fraction of POAK in the entire vehicle fleet. The fraction of Non-POAK-Truck 2 was calculated as the remaining fraction of Truck 2 vehicles. From this, it was estimated that > 75% of the Truck fleet on roadways near or in the Port was composed of POAK vehicles (Figure 2-7).

²³ <https://www.streetlightdata.com/>.

²⁴ CARB adopted the Drayage Truck Regulation in 2011 (approved in 2007, changes approved and adopted in 2010; California Air Resources Board 2011b), which requires all Port Trucks to meet or exceed emissions standards for 2007 model year engines. The implementation of the rule has effectively reduced emissions from Port Trucks (e.g., Harley *et al.* 2014).



Figure 2-6. Total daily average fleet mix by roadway link in West Oakland for total (a, c) Trucks and (b, d) Truck 2 vehicles by day type (WD, WE). Fleet mix (%) is displayed by roadway (solid line), major truck route (thick solid line), and truck-prohibited route (dashed line). Total fleet volume varies by roadway link. Only roadway segments modeled as volume sources in AERMOD are plotted (*c.f.* Figure 2-1); emissions from on-road mobile sources operating within the Port are plotted as polygons.



Figure 2-7. As in Figure 2-6, but for total daily average POAK percentage of Truck 2 fleet on weekdays.

(c) *Fleet Average Vehicle Weight*

For each link, average vehicle weight of the vehicle fleet is required to estimate emission factors for road dust. The fleet average vehicle weight is calculated as follows, where subscripts denote vehicle aggregation levels (vehicle type, VT, or vehicle category, VC, where $x \in \{VT, VC\}$):

$$F_{VT} = \frac{VMT_{VT}}{VMT_{VC}}$$

$$F_{VC} = \frac{VMT_{VC}}{VMT_{fleet}}$$

$$W_{VC} = \sum_{VT} W_{VT} \cdot F_{VT}$$

$$W_{fleet} = \sum_{VC} W_{VC} \cdot F_{VC}$$

where

- F_x = VMT-based weighting factor for the vehicle type or category (unitless)
- VMT_x = VMT of all vehicles at vehicle aggregation level x (mi)
- W_x = weight of vehicle at vehicle aggregation level x (tons)

Therefore, the fleet average vehicle weight is simply the weighted-sum of all vehicle weights. Vehicle weights were taken from the Caltrans-EMFAC2017 (CT-EMFAC2017) tool²⁵ (California Department of Transportation 2019; using the Vehicle table in the underlying CT-EMFAC2017 database).

2.3.3 Emission Factors

Emission factors by emission process were developed for PM_{2.5} and TACs by vehicle category.

(a) Operational Emission Factors

Emission factors from on-road mobile sources are typically estimated using the EMFAC2017 for 2017 Alameda County, using default fleet mix within vehicle categories. As EMFAC2017 does not generate emission factors for TACs, the District leveraged the CT-EMFAC2017, which generates emission factors for PM_{2.5} and mobile source air toxics (MSATs).²⁶ CT-EMFAC2017 is based on emission factors and activity data from EMFAC2017, while emission factors for MSATs are based on EMFAC2017 data and chemical speciation profiles from CARB and EPA.

CT-EMFAC2017 can generate emission factors for Non-Truck, Truck 1, and Truck 2 categories. Annual average emission factors were obtained for 2017 Alameda County. The emission factors for POAK and Non-POAK-Truck 2 categories were then derived in the following manner:

- For POAK: PM_{2.5} emission factors were obtained directly from CARB’s EMFAC2017 web database.²⁷ A chemical speciation profile for HHDV vehicles from CARB²⁸ was applied to total organic gases (TOG) emission factors from the EMFAC2017 web database to derive emission factors for each TAC pollutant.
- For Non-POAK-Truck 2: The emission factor of all Truck 2 vehicles can be expressed as the weighted sum of the emission factors from POAK and Non-POAK-Truck 2:

$$EF_{T2} = (F_{POAK} \cdot EF_{POAK}) + (F_{NPT2} \cdot EF_{NPT2})$$

where EF_x are emission factors for a given pollutant, and F_x are the fleet mix fractions within the Truck 2 category. Then, PM_{2.5} and TAC emission factors can be back-calculated for POAK emission factors (from above), Truck 2 emission factors (from CT-EMFAC2017), and VMT-based vehicle category weighting factors (from the CT-EMFAC2017 database) as follows:

$$F_{POAK} = 1 - F_{NPT2}$$

²⁵ <http://www.dot.ca.gov/env/air/ctemfac-license.html>

²⁶ MSATs in CT-EMFAC2017 include the nine priority pollutants identified by the FHWA within the National Environmental Policy Act (NEPA): 1,3-butadiene, acetaldehyde, acrolein, benzene, DPM, ethylbenzene, formaldehyde, naphthalene, and polycyclic organic matter (POM) (Biondi, 2016). In this analysis, the emissions of these TACs were estimated except for POM (which is a group of compounds and therefore does not have a single associated toxicity value).

²⁷ <https://www.arb.ca.gov/emfac/2017/>

²⁸ <https://www.arb.ca.gov/ei/speciate/speciate.htm>.

$$F_{NPT2} = \frac{VMT_{NPT2}}{VMT_{T2}}$$

$$EF_{NPT2} = \frac{1}{F_{NPT2}} [EF_{T2} - (EF_{POAK} \cdot F_{POAK})]$$

This back-calculation approach can be applied to derive emission factors from all emission processes, including emission factors for running loss; while the associated activity is VHT, the VHT-based weighting factor will be equivalent the VMT-based weighting factor (since the travel data used from Citilabs does not distinguish speed by vehicle category).

(b) Road Dust Emission Factors

In this analysis, road dust emission factors were estimated for each roadway link following California Air Resources Board (2016), reproduced below:

$$EF_{fleet} = k \cdot sL^{0.91} \cdot W_{fleet}^{1.02} \cdot \left(1 - \frac{P}{4N}\right)$$

where

- EF_{RD} = road dust emission factor (g/mi)
- k = particle size multiplier (0.00033 lb/VMT for PM_{2.5})
- sL = road surface silt loading factor, based on CARB road type (Table 2-11) (g/m²)
- W_{fleet} = fleet average vehicle weight (ton)
- P = number of “wet” (precipitation ≥ 0.01 in) days in averaging period (days) ($P = 41$ days for Alameda County)
- N = total number of days in averaging period (days) ($N = 365$ days for annual analysis)

Table 2-11. Road surface silt loading factor (sL) by road type used in CARB method to estimate emission factors from road dust emissions. Values taken from California Air Resources Board (2016).

CARB Road Type	sL (g/m ²)
Freeway	0.015
Major/Collector	0.032
Local	0.320

2.3.4 Emissions

For operational emissions from on-road mobile sources, annual average daily emissions were estimated by roadway link by vehicle category (Non-Truck, Truck 1, Non-POAK-Truck 2, POAK), and day type (WD, WE), for each emissions process:

- For running exhaust, tire wear, and brake wear:

$$E_{VC} = \sum_{h=1}^{24} VMT(h)_{VC} \cdot EF(s(h))_{VC}$$

where emissions (E , in g) are summed over all hours (h) of the day (and VMT is a function of hour of day, and for running exhaust, the emission factor is a function of the speed by hour of day).

- For running loss:

$$E_{VC} = \sum_{h=1}^{24} VHT(h)_{VC} \cdot EF_{VC}$$

For road dust emissions, the total fleet annual average daily PM_{2.5} emissions were estimated by roadway link by day type (WD, WE):

$$E_{fleet} = \sum_{h=1}^{24} VMT(h)_{fleet} \cdot EF_{fleet}$$

For each link, the emissions from all processes are summed. The result is an annual average daily emissions inventory by pollutant, by day type, and by vehicle category. The emissions were then converted to emission rates (g/s²) with corresponding diurnal activity profiles (see Section 3.4.3). The total emissions by vehicle category are reported in Table 2-2.

2.4 Truck-Related Businesses

Numerous “truck-related businesses” are located in West Oakland. These businesses offer Port services, such as truck scales and delivery, or operate a fleet of trucks to support their own business activities. Emissions from idling trucks within the business premises were estimated and included in the emissions inventory; operational and road dust emissions from these trucks are already accounted for as part of on-road mobile source emissions inventory (Section 2.3).

2.4.1 Surveyed Businesses

The District worked with Environmental Defense Fund (EDF) and the Oakland Planning Department to develop a comprehensive list of businesses that may operate a fleet of trucks in West Oakland. The District expanded the initial business list from the 2009 West Oakland Truck Survey (Bay Area Air Quality Management District 2009) to include businesses that were self-registered on the West Oakland Works website²⁹ and from other field studies performed by EDF. To determine the current level of truck activity at each business, the District sent surveys to the

²⁹ <http://www.westoaklandworks.com/our-directory/>.

businesses to determine the average number of truck visits per day and the number of loading docks. The District received responses from 52 of 91 businesses surveyed.³⁰ Responses from the 2009 West Oakland Truck Survey were used for businesses where the District did not receive a response on the most recent survey. When no information was available, a default of either 5 or 10 trucks per day was used, based on the survey response received from similar business types. Businesses were then removed from the emissions inventory if:

- Emissions from trucks associated with a business were already accounted for under another source category (i.e., trucks operating at terminals or railyards);
- There were ≤ 3 trucks per day at the business; or
- The business did not have an active truck fleet (e.g., truck brokers, marketing companies).

See Attachment 3 for a list of truck-related businesses and truck fleet sizes.³¹

Because businesses were not asked to provide truck fleet mix information in the surveys, the District estimated a default truck fleet based on the results from the 2009 West Oakland Truck Survey (Table 2-12), which includes heavy heavy-duty trucks (HHDT), medium heavy-duty trucks (MHDT), light heavy-duty trucks (LHDT), and Port Trucks (T7 Port of Oakland drayage trucks; T7 POAK). This default was applied to all businesses except for those where the fleet was clearly not representative of the business operation type; for example, all vehicles were assumed to be buses at the Greyhound Bus Terminal, and all vehicles were assumed to be MHDVs at shredding facilities. Fleet mix type by business are also reported in Attachment 3.

Table 2-12. Default fleet mix used for truck-related businesses, as derived from the 2009 West Oakland Truck Survey (Bay Area Air Quality Management District 2009).

Truck category	Percentage of fleet (%)
HHDT	26.5
MHDT	13.5
LHDT	10.0
T7 POAK	50.0

CARB’s commercial motor vehicle idling regulation states that all heavy-duty vehicles in California with GVRW $\geq 10,000$ lb are prohibited from idling longer than five minutes (California Air Resources Board 2004). However, the regulation allows for longer idling times due to traffic congestion, inspection or service, operating a take-off device, adverse weather conditions, mechanical failure, passenger loading, queuing, or if the engine meets the optional clean idle certification standard. To be conservative, the District assumed that there was 15 min of idling per truck trip.

Emission factors for diesel-fueled truck categories³² were obtained from EMFAC2017 using a 2017 base year for Alameda County. The emissions were then estimated from each business using the following equation:

³⁰ District staff visited seven of these businesses in person.

³¹ For most truck-related businesses, truck fleet size was used as a surrogate for truck trips.

$$E_i = N \cdot I \cdot EF_i$$

where

- E_i = emissions of pollutant i (g)
- EF_i = emission factor of pollutant i (g/h)
- N = number of vehicles
- I = idling time (h) ($I = 0.25$ h)

To calculate the annual emissions, the District assumed that truck-related businesses operated 6 days per week (312 days per year).

2.4.2 Schnitzer Steel

A separate emission inventory for trucking operations was developed for Schnitzer Steel based on its permitted operations. Products are transported by trucks to bulk carriers which dock at the Schnitzer Steel deep-water terminal.

The District currently limits the number of trucks that can operate at Schnitzer Steel;³³ in 2017, there were 47,320 truck trips to the facility (approximately 152 truck trips per day, assuming six days of operation per week; see Section 3.4.4). Although there are no restrictions on the type of trucks that can operate at Schnitzer Steel, for this assessment, the District assumed that all trucks were diesel fuel MHDTs and HHDTs (modeled as either Non-POAK-Truck 2 or heavy-heavy duty diesel single unit truck (T7 Single, which usually has the highest emission factors of all T7 vehicles in EMFAC2017); the vehicle category varied depending on the emission factor available at the time of analysis, and are summarized in Table 2-13.

Unlike for the other truck-related businesses in the West Oakland emissions inventory, because of the size and characteristics of the property, emissions from trucks operating at Schnitzer Steel included driving-related emissions. Emissions due to running exhaust, idle exhaust, tire wear and brake wear (for PM), and road dust were calculated for Schnitzer Steel using the following assumptions: (1) there were 47,320 truck trips, (2) each truck idled for 15 min on the property (to be conservative), (3) each truck drove 800 m on the property (two-times the approximate length of the property, from the entrance to near the ship berth), (4) trucks drove at 10 mph on the property (consistent with the average truck speed of trucks driving within terminals at the Port; Ramboll 2018), (5) trucks drove on unpaved roads, which were modeled as Local Roads for the purposes of calculating re-entrained road dust (Table 2-11). Emissions were calculated as in Section 2.3.4, and are summarized in Table 2-13.

³² From EMFAC2017, emission factors for LHDT are based on that of LHD1 (which are highest among all LDVs), and emission factors for HHDTs are based on the composite of emission factors for all T7 vehicles except T7 POAK (Port Trucks).

³³ Schnitzer Steel’s current permit is for 63,875 truck trips per year.

Table 2-13. Emission estimates from trucks operating at Schnitzer Steel in 2017 by emission process. The Fleet indicates the EMFAC2017-based fleet from which the emission factor was derived. A hyphen (-) indicates that emissions from the emission process are not applicable.

Process	Fleet	Emissions (tpy)	
		PM _{2.5}	DPM
Running exhaust	Non-POAK-Truck 2	0.0073	0.0076
Idle exhaust	T7 Single	0.0034	0.0036
Tire wear	Non-POAK-Truck 2	0.0002	-
Brake wear	Non-POAK-Truck 2	0.0010	-
Road dust	Non-POAK-Truck 2	0.0267	-
Total		0.0386	0.0112

2.5 Ocean-Going Vessels

Emissions from OGVs were estimated for active terminals at the Port and the privately-owned terminal operated by Schnitzer Steel. Emissions from OGVs include emissions from transiting, maneuvering, and berthing. OGVs use propulsion engines for transiting, auxiliary engines for on-board electrical power, and small boilers to meet steam and hot water demands.

2.5.1 Port of Oakland

In 2017, OGVs calling at the Port were exclusively container ships, including some with the capability to handle roll on/roll off cargo. All ship calls in 2017 were exclusive to the Port and did not include visits to other ports. An estimated 1,596 vessel voyages³⁴ to the Port were reported in the 2017 Port inventory. Many vessels follow regular route and schedules; 66% of the total calls were from vessels visiting 4 to 10 times in 2017, while 15% of total calls were from vessels visiting 11 or more times. Most of the vessels are relatively new; 85% were built since 2000, and the call-weighted median age of vessels was 9 years old.

Vessel call data were provided by the Marine Exchange of San Francisco Bay Region (SFMX). This dataset included the vessel identification number, Port berth, and date and time of the beginning and end of each movement, from which the time at berth (time between ‘first line on’ and ‘last line off’) and at anchor was inferred. The vessel identification numbers were cross-referenced with data obtained from the 2018 IHS Fairplay database,³⁵ which contains vessel characteristics such as vessel build date (which was used to estimate the emissions control regulations for the engine, which in turn determines the emission factor), cruise speed, engine type, and installed power. These parameters affect estimates of engine load for each vessel call. Actual

³⁴ Vessel voyages account for inbound/outbound trips, whereas calls to the Port represent the number of berthing events (there can be multiple calls per voyage, e.g., when a vessel moves between berths at the Port).

³⁵ Ramboll (2018) extracted data from IHS Fairplay (Bespoke Maritime Data Services, Ship Data) on February 15, 2018.

vessel speed profiles (travel time by speed bin) were obtained from the Automatic Identification System (AIS),³⁶ provided by SFMX.

OGVs use propulsion engines for transiting, auxiliary engines for on-board electrical power, and small boilers to meet steam and hot water demands. Pollutants are emitted based on the operating mode of each OGV. Common modes include open ocean cruising, cruising at reduced speed (in the reduced speed zone [RSZ]) in the Bay, maneuvering (lower speed operation near berths), and hoteling (at berth). RSZ mode occurs after the bar pilot takes command of the vessel at the sea buoy until the vessel slows to a maneuvering speed directly in front of the Port. During hoteling, the main engines are turned off but the auxiliary engines are running. For this analysis, the District included emission from:

- Vessels transiting between the Port and the entrance to San Francisco Bay,
- Low speed vessel maneuvering south of the Bay Bridge within the West Oakland Source Domain, and
- Berthing at the Port.

Emissions associated with cruising from the open ocean and most of the RSZ emissions were excluded since these emissions are outside of the Source Domain.

Emissions were determined for each transport mode based on the engine rated power (the maximum power that the engine can produce), typical load factor (the fraction of the actual to the rated power that the engine operates for a given mode), and time elapsed at that load. Emissions per vessel were calculated from propulsion engines, auxiliary engines, and boilers using the emissions factors and methods from CARB (California Air Resources Board 2011c, as amended by California Air Resources Board (2014b) and CARB’s Marine Emissions Model v2.3L [California Air Resources Board 2014a]) as follows:

$$E_i = EF_i \cdot e \cdot LF \cdot T_o$$

where

- E_i = emissions of pollutant i (g)
- EF_i = emission factor of pollutant i (by engine type, operating mode, and fuel type) [g/(kW h)]
- e = rated power (maximum power the engine can produce) (kW)
- LF = load factor (unitless)
- T_o = operating time in mode (h)

Data from the 2018 IHS Fairplay database indicate that the most common propulsion engines used on vessels calling at the Port in 2017 were slow speed engines (2-stroke engines, typically lower than 200 rpm) followed by steam engines powered by boilers for the remaining ships. Emission rates assuming 0.1% fuel sulfur content were used based on CARB fuel regulation except for

³⁶ AIS data were available from June through December 2017. These data were used to calculate speed distributions. It is assumed that data during this period are representative of OGV transiting behavior over the whole year.

steamships for which 2.7% sulfur content was used. Emissions factors for DPM (based on emission factors for PM₁₀) and PM_{2.5} used for each OGV engine type are presented in Table 2-14.

Table 2-14. OGV DPM and PM_{2.5} emission factors by engine and fuel type. From Ramboll (2018), based on California Air Resources Board (2014a).

Engine Type	Fuel Type	Emission Factor [g/(kW h)]	
		DPM	PM _{2.5}
Slow speed	Marine distillate (0.1% sulfur)	0.250	0.230
Steam	Marine distillate (2.7% sulfur)	0.800	0.780
Auxiliary	Marine distillate (0.1% sulfur)	0.250	0.230
Auxiliary boiler	Marine distillate (0.1% sulfur)	0.133	0.130

Load factor for the propulsion power were determined using Stokes Law:

$$LF = (s/s_{\max})^3$$

where

- LF = load factor (unitless)
- s = vessel speed
- s_{\max} = vessel maximum speed

The speed and maximum speed of the vessel must be expressed in the same units. A load factor of 100% corresponds to the vessel operating at its maximum speed. When the vessel is cruising, the vessel cruise speed is assumed to be equal to its design speed, which is 93.7% of its maximum speed. Using the equation above, this results in a load factor of 0.823. The load factor varies depending on the vessel’s speed during other modes. Adjustment factors were also applied to obtain emission factors applicable to operation at low loads where the engine does not operate as efficiently.³⁷

Emissions from maneuvering estimated for in areas inside the Source Domain only. Vessels were assumed to be in maneuvering mode while moving between the Bay Bridge and the Port berths. This mode consists of short low speed transits, turns at the berth or in the turning basins, and a start and stop of the propulsion engine at the berth with tug assist. Maneuvering time is shorter for the Outer Harbor terminal calls (Berths 24 through 37) than the Inner Harbor terminal calls (Berths 55 through 68) because of the shorter distance from the Bay Bridge and proximity of the Outer Harbor turning basin to the Outer Harbor berths. Larger ships also require more time to turn. The time from the beginning to the end of the maneuvering mode was obtained from SFMX; 0.25 h were added to account for propulsion engine start up and shut down. The 0.75 h per shift (when a vessel moves between berths or from berth to anchorage) was also included in the emission estimates. Emissions associated with occasional vessel shifts between berths or between anchorage and berth were included in the maneuvering total for purposes of spatial allocation.

³⁷ This is consistent with the approach used in the 2014 Port of Los Angeles Inventory (Ramboll 2018).

Vessel auxiliary power is primarily used when propulsion engines are not running (e.g., at berth or in anchorage outside of the Source Domain). Vessel auxiliary power was derived from auxiliary generator capacity taken from the 2018 IHS Fairplay database or estimated from a comparable ship (by size and owner) if data were not available. The auxiliary engine load factors were assumed to be 50% for maneuvering and 18% for hoteling (California Air Resources Board 2011c). The running time of the auxiliary engine was estimated from each vessel call. For calls without shoreside power, the hoteling time was equal to the time at berth.

The at-berth time was determined from the SFMX berth report. In 2017, the average berthing time was 25 h per call. Emission reductions as a result of alternative marine power usage were addressed in the calculation of hoteling emissions by subtracting the time when shore power was used from the berthing time. When shore power is connected, the energy usage billed and connection time (hours) are recorded, thus affording an estimate of average load demanded. The use of shore power represents greater than 50% reduction in auxiliary engine operating hours at berth overall and resulting in 40–50% reduction in emissions for all pollutants. Auxiliary engine load at berth is equal to 1,147 kW based on the average shore power demand observed in 2017. Data from the Port for shore power calls in 2017 indicate that the average in-use power demanded was 10.5% of the auxiliary generator capacity for the significant shore power connections.

In-use boiler power estimates of 506 kW for container ships were assumed based on CARB’s Marine Emissions Model v2.3L. Boiler emission factor of 0.133 g/(kW h) for DPM (PM₁₀) was used (assuming 0.1% sulfur content fuel).

Emissions from OGV maneuvering (within the Source Domain) and berthing are summarized in Table 2-15. Propulsion steam and auxiliary boiler PM emissions are not included in the DPM total because they are not generated by diesel engines.

Table 2-15. PM_{2.5} and DPM emissions from OGV maneuvering and berthing by terminal. The District only included emissions from dredged disposal that was within the Source Domain (the emissions presented in this table are lower than those reported in the 2017 Port Inventory).

Terminal	Maneuvering (tpy)		Berthing (tpy)	
	PM _{2.5}	DPM	PM _{2.5}	DPM
TraPac	0.657	0.640	1.432	1.033
Nutter	0.376	0.366	0.818	0.590
OICT	2.650	2.578	5.770	4.162
Matson	0.262	0.255	0.571	0.412

2.5.2 Schnitzer Steel

Schnitzer Steel receives only bulk carriers calling for scrap steel. Emissions from vessel voyages associated with calls at Schnitzer Steel are not included in the Port’s maritime inventory because the Schnitzer facility is not owned or controlled by the Port of Oakland. Similar to the emissions inventory developed for the Port (Ramboll 2018), emissions from OGVs operating from Schnitzer Steel were estimated based on the rated power and load factor of each vessel, duration of each trip, and the pollutant-specific emission factors during transiting, maneuvering, and hoteling. Emissions

from container ship assist tugs (harbor craft) used to assist cargo vessels movements upon arrival and departure from the terminal were included in the OGV emissions. The District current limits the number of ship calls to Schnitzer Steel on an annual basis;³⁸ in 2017, there were 26 ship calls. PM_{2.5} emissions were used as a surrogate to represent DPM emissions. No temporal variations were estimated for OGV trips.

Due to confidentiality agreement, the District cannot release specific parameter information used to derive the OGV emissions for Schnitzer Steel. Emission factors for the main and auxiliary engines were taken from California Air Resources Board (2011c). Emission factors for auxiliary boiler operations were taken from the Port of Los Angeles Inventory of Air Emissions for 2017 (Starcrest Consulting Group, LCC 2018). Emission factors for harbor craft emission factors were taken from California Air Resources Board (2012b). Based on CARB fuel regulations, emission factors were based on fuel with 0.1% fuel sulfur content. Estimates of emissions were limited to within the Source Domain; transport outside of the domain were not estimated or modeled. The total emissions are summarized in Table 2-16.

Table 2-16. PM_{2.5} and DPM emissions from OGVs operating at Schnitzer Steel.

Activity	PM_{2.5} (tpy)	DPM (tpy)
Transiting	0.0598	0.0598
Maneuvering	0.0874	0.0874
Hoteling	0.1553	0.1553
Total	0.3024	0.3024

2.6 Commercial Harbor Crafts

CHCs are regularly used at the Port to support: (1) operation and maintenance dredging in the channels and at berths, (2) disposal of dredged material, (3) container ship assist tugs, and (4) tug trips and fuel pumping from fuel barges towed from Richmond to refuel ships’ bunkers at the Port. Most CHCs at the Port are tugs; otherwise, there are a few small work boats that assist dredging operations, and dredgers.

2.6.1 Operation and Maintenance Dredging and Disposal

Operation and maintenance (O&M) dredging is conducted annually at the Port to maintain the depth of channels and berths and to ensure safe navigation. Materials that are deposited into the Bay by stream and urban runoff are removed, and shallow areas are eliminated by redistributing the bottom sediments from shoaling. Dredging is conducted using diesel-powered derrick barge (clamshell) dredgers, accompanied by tender tugs and work boats. Dredged material is transferred to scows (barges), which are then towed to a disposal site by a diesel-powered tug. After the barge is emptied, the tug returns with the empty barge to pick up a new load.

³⁸ Schnitzer Steel’s current permit is for 32 ship calls per year.

Recent channel dredging was conducted from August 2017 into February 2018, while berth dredging was conducted in August, October, and the first two weeks of November 2017. During this period, 89,000 cubic yards of material from the Port's berth and 559,000 cubic yards of material from the channel were removed and disposed of at the San Francisco Deep Ocean Disposal Site, located 49 nmi west of the Golden Gate Bridge. These activities were treated as two separate activities in the 2017 Port Inventory: (1) O&M dredging, which includes operation of the clamshell dredge and associated support vessels, and (2) disposal, when dredge materials are transported from the dredging area to disposal sites. Only disposal was inside the Source Domain was included in this analysis (which includes only ~2.3 nmi of transit distance, or ~9.4% of total transiting emissions).

Emissions from dredging equipment was estimated as follows:

$$E_i = EF_i \cdot e \cdot LF \cdot T_o$$

where

- E_i = emissions of pollutant i (g)
- EF_i = emission factor of equipment of pollutant i [g/(bhp h)]
- e = engine brake horsepower rating (bhp)
- LF = time-weighted engine load factor (fraction of full load) based on different operating modes during a round trip (unitless)
- T_o = operating hours of equipment (h)

The dredging contractor provided a list of dredging equipment, engine characteristics, and hours of operation. In 2017, dredging operations were performed using clamshell dredge on a dredge barge (using a main and auxiliary diesel engine), and dredge tenders and work boats (each with two main propulsion diesel engines, and up to two auxiliary engines). Specific information on engine model, power, load factor, emissions factors, and hours of operation are provided in the 2017 Port Inventory. Vessel emission factors, deterioration factors, fuel correction factors, and load factors from CARB's Commercial Harbor Craft Emission Inventory tool (California Air Resources Board 2011a) were used to estimate emissions for all engines used on the dredging and support vessels. Emission factors for the dredgers were derived from CARB's OFFROAD model,³⁹ which are based on the model year and age of equipment (in 2017). Emission factors for diesel engines on tugs and tenders were estimated based on load factors, zero-hour emission factors, and deterioration factors available in California Air Resources Board (2011a). The resulting emissions are presented in Table 2-17.

³⁹ See <https://ww3.arb.ca.gov/msei/ordiesel.htm> for more information.

Table 2-17. Emissions of PM_{2.5} and DPM from O&M dredging and disposal of dredge material. The District only included emissions from dredged disposal that was within the Source Domain (the emissions presented in this table are lower than those reported in the 2017 Port Inventory).

Activity	PM _{2.5} (tpy)	DPM (tpy)
O&M Dredging	1.080	1.11
Dredge disposal	0.043	0.04

2.6.2 Assist Tugs

Tugs are used to assist cargo vessel movements upon arrival, berthing, and departure from the Port, and tow or push a wide variety of barges and other equipment. Assist tugs ensure safe navigation within the Bay, especially when vessels are reversing direction near berths in the Inner and Outer Harbor. Tugs are matched to vessels to ensure they are equipped to handle the vessel based on their size, power level, etc. On average, two tugs are used for each cargo vessel that are inbound or outbound between berths at the Port and the Federal Channel near the Bay Bridge, though up to five tugs are required to assist larger vessels. Emissions from assist tugs were estimated for when they were (1) assisting vessel operation, and (2) transiting to and from berthing bases to conduct the assists.

Tugs assigned to ships calling at the Port are operated by five companies: AMNAV, Foss Maritime, Starlight Marine (part of Harley Marine Services), Crowley, and BayDelta. Vessel call data specific to the Port was provided by SFMX. The activity of each company in 2017, based on the number of calls to the Port, are reported in Table 2-18. Although these tugs are used elsewhere in the Bay, emissions were only estimated for activity during transiting and assisting ship calls at the Port.

Table 2-18. Activity (percentage of total calls) of assist tugs calling to the Port by operator. The base indicates where the company bases their operations (at/near). Based on calls to the Port in 2017.

Operator	% calls	Base
AMNAV	78	Berth 9, Port of Oakland
Starlight Marine		Alameda side of Inner Harbor Turning Basin
Foss Maritime	7	Richmond
Crowley	8	Bay Bridge, San Francisco
BayDelta	8	Bay Bridge, San Francisco

Assist tugs emissions were estimated based on the methods presented in California Air Resources Board (2011a). The equation used to estimate emissions from each assist tug class was as follows:

$$E_i = AEF_i \cdot e \cdot LF \cdot T_o$$

where

$$E_i = \text{emissions of pollutant } i \text{ (g)}$$

- AEF_i = adjusted emission factor of pollutant i for main or auxiliary engine (adjusted for model year, deterioration rate, and fuel, averaged by tug class) [g/(bhp h)]
- e = engine brake horsepower rating, as a weighted average between main propulsion and/or auxiliary engine brake horsepower rating of engines in the tug class (bhp)
- LF = time-weighted engine load factor (fraction of full load) for the maneuvering phase for the main engine and/or auxiliary engine (unitless)
- T_o = operating hours by tug class (based on number of vessel calls, average maneuvering time per call, average number of tugs assigned to each assist by inbound/outbound direction) (h)

The characteristics of tugs by company that were in operation in 2017 were obtained, including: engine model year, main engine power and tier regulation, and auxiliary power. The total assists by company were evenly distributed among individual tugs. Maneuvering time was estimated for each call based on the Port berth location and the vessel length. Time transiting to and from assists for each tug was estimated using the distances from each operator’s base (Table 2-18) to various assist destinations, assuming the transit trips were made at an average speed of ~ 9.2 mph (8 kt). For each trip, emissions were calculated for inbound vessels assuming 2.20 tugs, and for outbound trips using 2.08 tugs. Time for each assist including maneuvering ships inbound and outbound from the Port and transiting to and from maneuvering assists.

Zero-hour emission factors, engine emissions deterioration factors, and fuel correction factors for both main propulsion and auxiliary engines were based on California Air Resources Board (2011a). The engine load factor for main engines and auxiliary engines was 0.31 and 0.43, respectively.

The total emissions from assist tugs are presented in Table 2-19.

Table 2-19. PM_{2.5} and DPM emissions from assist tugs.

Operator	PM _{2.5} (tpy)	DPM (tpy)
AMNAV		
BayDelta	2.82	2.91
Crowley		
Foss Maritime		
Starlight Marine	0.81	0.84

2.6.3 Bunkering Barges

Bunkering is when ships are supplied with fuel. At the Port, tugs tow fuel barges from Richmond to refuel ships at berth. The bunkering barge was towed from and returned to the Richmond long wharf, approximately 10 nmi from the Port; only the portion of the bunkering trip from the Port to Richmond within the Source Domain (a distance of ~1.8 nmi) was used to estimate the emissions. Foss Maritime provided the date and fuel costs for bunkering events in 2017, which was used to develop the emissions inventory for this activity.

Bunkering emissions were estimated using the same approach as that described for dredging (Section 2.6.1) since each operation involves a barge and an accompanying tug. The tug load and time in mode for movement of the bunkering barge were used to estimate the emissions during the transit trip. Emissions from the tug used to tow the fuel barge between Richmond and the Port were estimated following the method used to estimate emissions from tugs towing dredge material for disposal (Section 2.6.2). Emissions from the barge-mounted diesel-powered pumps were estimated using the emission rate for pumps in CARB’s OFFROAD model.

A total of 314 bunkering events occurred in 2017 across 219 unique dates. This means that, for the 95 events that occurred on the same day as another event, there was likely no return trip to Richmond between events. Therefore, only 219 round trips to Richmond from the Port were accounted for in the emissions analysis.

Assuming the one-way trip from Richmond to the Port takes 2.5 h, the total operating hours for towing barges for bunkering was 1,095 h. Time to refuel ships took up to 8 h. Taking the travel time and time required to refuel, the average bunkering event was assumed to take 4 h for pumping (1,256 h of pumping for all 314 bunkering events). Pumping was performed by two 500 hp model year 2003 diesel barge pumps using non-road Tier 2 engines. The propulsion and auxiliary engine model year and power for the two tugs used to tow the bunkering barges are presented in the 2017 Port Inventory.

Total emissions for the bunkering operation to tow boats and barge pumps are shown in Table 2-20.

Table 2-20. PM_{2.5} and DPM emissions from bunkering barges and pumps by terminal operator.

Terminal	Bunkering Barges (tpy)		Bunkering Pumps (tpy)	
	PM _{2.5}	DPM	PM _{2.5}	DPM
TraPac	0.01430	0.01000	0.01260	0.01000
Nutter	0.00815	0.01000	0.00718	0.01000
OICT	0.05750	0.05930	0.05060	0.05500
Matson	0.00569	0.00586	0.00501	0.00544

2.7 Cargo Handling Equipment

CHE is primarily used to transfer freight between modes of transportation, such as between marine vessels and trucks or between trains and trucks. At the Port, CHE are used almost exclusively to move shipping containers. As such, the types of CHE at the Port are limited to yard tractors, rubber-tired gantry (RTG) cranes, top or side handlers (also called picks), and forklifts. Other types general purpose CHE, such as sweepers, bulldozers, backhoes, excavators, and other off-road equipment, were not included as part of the CHE category since they are used at the Port for facility maintenance and construction. A more detailed explanation of emissions estimates can be found in the 2017 Port Inventory report.

Annual 2017 emissions for each piece of CHE equipment were estimated at each Port terminal based on the equipment type, engine characteristics (model year, rated power, after-treatment retrofit control device), and equipment operation (hours of operation, fuel consumption rate). Equipment population and operation estimates were derived from surveys of on-dock terminal, off-dock terminal, and railyard activity conducted by the Port in late 2017 and early 2018.

The types of equipment were used to categorize CHE consistent with CARB guidance (California Air Resources Board 2011d) include cranes (including rubber-tired gantry cranes), forklifts, container handling equipment (top or side handlers), and yard trucks (or yard tractors). Annual emissions from CHE were calculated using the following equation for equipment in these categories as:

$$E_i = [EF_i + (dr \cdot T_C)] \cdot e \cdot FCF \cdot LF \cdot CF \cdot T_O \cdot N$$

where

- E_i = emissions of pollutant i (g)
- EF_i = zero-hour emission factor of equipment [g/(bhp h)]
- dr = deterioration rate or increase in zero-hour emissions as the equipment is used [g/(bhp h)/h]
- T_C = cumulative hours of equipment use (h)
- e = engine brake horsepower rating (bhp)
- FCF = fuel correction factor (percent reduction) used to adjust the base emission factor to account for use of California diesel fuel (unitless)
- LF = weighted load factor (average load expressed as a percent of rated power) (unitless)
- CF = control factor (percent reduction) associated with use of emission control technologies (unitless)
- T_O = annual operating hours of the equipment (h)
- N = number of pieces of the equipment

The Port sent confidential surveys regarding equipment make and model to all tenants on-dock and off-dock of the BNSF railyard. When information was missing from the survey, assumed default values based on similar make and model of equipment and hours of operation were used.

For diesel-powdered CHE, zero-hour emission factors, deterioration rates, fuel correction factors, and emission control factors were obtained from CARB's 2011 Cargo Handling Equipment Inventory (CHEI) model (California Air Resources Board 2012a). Because the current version of the CHEI model does not support emission estimates for non-diesel equipment, emission factors for gasoline and propane powered equipment were obtained from CARB's 2011 CHE Calculator (California Air Resources Board 2011d), following the methodology described in the 2005 original rulemaking for CHE operating at ports and intermodal railyards (California Air Resources Board 2005a).

Of the 386 total pieces of CHE, 345 were diesel-powered, 39 were gasoline-powered, and 2 were liquid petroleum gas-powered (Table 2-21). Summary of the average horsepower, annual operating hours by equipment and power range can be found in the 2017 Port Inventory.

Table 2-21. CHE equipment types used at the Port, based on survey results.

Equipment	Equipment Population	% Total
Container handling equipment (top picks and side picks)	123	32
Forklift	14	4
RTG Crane	24	6
Yard Tractor	105	27
Yard Tractor (on-road)	120	31

Emissions were split between on-dock and off-dock operations, based on the mix of equipment types used at the marine terminals as compared to the BNSF railyard. Approximately 83% of DPM and PM_{2.5} emissions were associated with the marine terminals, while the remaining 17% were from the BNSF railyard. CHE emissions were further assigned to each terminal based on the proportion of ship calls made to each terminal in 2017. Emissions from CHE by terminal and yard and the hours of operations are summarized in Table 2-22 and Table 2-23, respectively. All PM₁₀ from diesel engines were assumed to be DPM, and PM_{2.5} emissions were calculated as a fraction of PM₁₀ based on the fuel type-specific factors provided in California Air Resources Board (2013).

Table 2-22. PM_{2.5} and DPM emissions from CHE by location (terminal or railyard).

Location	Emissions (tpy)	
	PM_{2.5}	DPM
TraPac Terminal	0.220	0.22
Nutter Terminal	0.126	0.12
OICT Terminal	0.886	0.88
Matson Terminal	0.088	0.09
BNSF Railyard	0.270	0.27

2.8 Port Trucks at Terminals

Port Trucks, or “drayage trucks,” transport containers between marine terminals, freeway interchanges, and nearby railyards. Port Trucks travel along truck routes between marine terminals, three nearby freeway interchanges, and two railyards (UP and BNSF). Trucks can only arrive or depart from the Port area via three freeway access points: Maritime Street/West Grand Street, 7th Street, and Adeline Street (via the Adeline Street and Market Street on/off-ramps to I-880).

Table 2-23. Terminal operating hours used to develop temporal activity profiles for CHE. Information as of January 25, 2019.

Location	Day of week			
	Monday - Thursday	Friday	Saturday	Sunday
TraPac Terminal	7:00 AM – 12:00 PM 1:00 PM – 4:30 PM 6:00 PM – 2:00 AM	7:00 AM – 12:00 PM 1:00 PM – 4:30 PM	None	None
Nutter Terminal	7:00 AM – 4:15 PM	7:00 AM – 4:15 PM	None	None
OICT Terminal	7:00 AM – 3:00 AM	7:00 AM – 6:00 PM	None	None
Matson Terminal	8:00 AM – 11:45 AM 1:00 PM – 4:45 PM	8:00 AM – 11:45 AM 1:00 PM – 4:45 PM	None	None
BNSF Railyard	6:00 AM – 6:00 PM	6:00 AM – 6:00 PM	7:00 AM – 4:00 PM	None

To calculate total emissions from Port Trucks operating at terminals, vehicle operating modes were separated into four categories: (1) idling inside marine terminals, (2) idling at gate queues, (3) driving within marine terminals, and (4) driving on surface streets between terminals and freeways interchanges or railyards. For each of these modes, the average time and travel speed determine the emissions for each trip. Emissions per trip were calculated by multiplying the appropriate emission factor (idling or by speed bin) by the activity level indicator (idling time or travel distance). For running exhaust, emissions are calculated as:

$$E_i = N \cdot L \cdot EF_i$$

where

- E_i = emissions of pollutant i (g)
- EF = emission factor of pollutant i (g/mi)
- N = number of vehicles (unitless)
- L = travel distance (mi)

For idling exhaust, emissions were calculated in the same manner as presented in Section 2.4.

Details regarding the method used to estimate each of the emissions parameters are provided in the 2017 Port Inventory. The 2017 truck trip counts at the marine terminals were derived from gate counts (as provided by the Port or the terminal operators) and container lift counts (i.e., the number of containers moved on or off a ship). In the railyards, the reported number of lifts was doubled to estimate the sum of inbound and outbound truck trips. However, trucks may move a container in and out on a single terminal entry or reposition an empty chassis so that the gate counts do not exactly match the number of container lifts. The counts do not include trips to truck parking areas in the Port (such as the former Ports America Outer Harbor terminal and Howard Terminal) since the trucks were already counted when they entered at one of the three access points.

VMT within marine and rail terminals is limited to driving between the terminal gates and container storage areas. Previous surveys of terminal operators conducted by the Port was used to estimate 2017 activity including truck speed, travel distance, and idling time (Table 2-24).

Table 2-24. Average activity level for Port Trucks at terminals. Values are estimated from surveys conducted in 2005 and 2012 and terminal trip activity in 2017.

Mode	Average value
Idling at gate (h)	0.14
Idling in terminal (h)	0.34
Distance traveled (mi)	2.54
Speed (mph)	13.5

Emission factors for truck running exhaust, extended idling, tire wear, and brake ware were taken from EMFAC2017. Emission factors from on-road trucks depend on the age distribution of the trucks and site conditions such as temperature, humidity, fuel sulfur, and average speeds. Port Truck hours of operation were assumed to be the same as those for CHE (Table 2-23).

In 2017, all Port Trucks used diesel fuel; PM₁₀ running exhaust emissions are therefore DPM emissions, but total PM₁₀ and total PM_{2.5} also include (non-diesel) PM from brake wear, tire wear, re-entrained road dust. DPM emissions by terminal were back-calculated from total DPM emissions associated with Port Truck trips and the fraction of activity based on ship calls by terminal. Total PM_{2.5} emissions in the 2017 Port Inventory do not include road dust emissions; to estimate these emissions, the District first separated idling exhaust emissions from “driving emissions” (running exhaust, tire wear, brake wear) based on the fraction of emissions by activity by terminal (provided by Till Stoecknenius, Ramboll, personal communication, 12 June, 2019). Using emission inventories developed for Port Trucks on roadways within the Port area (Section 2.3), an average ratio of 4.76 (across all roadways links) of road dust emissions to “driving emissions” was obtained. This ratio was then applied to the “driving emissions” within the Port terminals to obtain PM_{2.5} road dust emissions.

The spatial allocation of Port Truck emissions was based on the percentage of emissions between marine terminals and the railyards (Table 2-25). Port Truck emissions were further assigned to each terminal based on the proportion of ship calls made to each terminal in 2017. Consistent with the 2017 Port Inventory, it was assumed that two-thirds of Port Truck travelling to railyards went to the UP railyard, while the remaining one-third went to the BNSF railyard. The emissions by terminal are reported in Table 2-26.

Table 2-25. Emissions allocated by Port Truck terminal type trip destination. Information provided by Ramboll (Till Stoecknenius, Ramboll, personal communication, 25 February, 2019).

Terminal type	Emissions (%)	
	PM _{2.5}	DPM
Marine	87	88
Railyard	13	12

Table 2-26. PM_{2.5} and DPM emissions from Port Trucks operating at Port terminals. PM_{2.5} emissions include all operational and road dust emissions. Total values are consistent with Ramboll (2018), with the exception of added PM_{2.5} road dust emissions.

Terminal type	Location	Emissions (tpy)	
		PM _{2.5}	DPM
Marine	TraPac	0.398	0.038
	Nutter	0.227	0.022
	OICT	1.602	0.154
	Matson	0.158	0.015
Railyard	BNSF	0.115	0.011
	UP	0.230	0.021
Total		2.730	0.261

2.9 Locomotives (Rail Lines)

The geographical locations of rail lines in the Bay Area was available in a shapefile from the Topographically Integrated Geographic Encoding and Referencing (TIGER) Line spatial database.⁴⁰ When the shapefile was transposed onto satellite imagery (as viewed in Google Earth), the locations of the lines did not align with visible rail lines; in some cases, they were misaligned up to ~90 m. The rail lines in the shapefile were then manually re-aligned to match the satellite imagery.

In the shapefile, each rail line is made up of many smaller segments that span short distances (0.81–3.8 mi) along each track. In the Bay Area, passenger and freight services may run along a single track (i.e., the track is shared by both services), or along parallel tracks. To determine the cumulative impacts from all rail services on West Oakland, emissions from parallel tracks were consolidated onto a single track (see Figure 3-15). In addition, emissions from locomotives that perform switching operations (referred to as “switchers”, which move individual or a small number of rail cars to assemble trains) were evenly distributed along the length of the subdivision line.

In total, emissions were estimated on six rail segments within West Oakland Source Domain. Emissions along each segment represent the combined emissions from all services, though in the following sections (Section 2.9.1 and 2.9.2), emission estimates are presented by service.

Because of the limited data available, the District was not able to include emissions from rail sidings. Emissions from railyard activity were evaluated separately (see Section 2.10).

2.9.1 Freight Haul Lines

Only rail lines within the Source Domain were included in this analysis (Table 2-27). There are two freight rail carriers in the Bay Area: BNSF, and UP. Both freight lines transport goods to and

⁴⁰ <https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html>.

from the Bay Area to San Joaquin Valley (east), Sacramento (north), and down the Peninsula (south).

Table 2-27. Freight subdivision lines in Alameda County.

Subdivision	Start Location	End Location
Martinez	10 th Street, Oakland	Alameda County Line
Niles	10 th Street, Oakland	Newark

BNSF and UP provided the District with the average diesel fuel consumption and miles traveled in 2017 along each county subdivision line in the Bay Area, and EPA fuel-based emission factors (g/gal) for converting fuel consumption to emissions. The railroad companies provided combined fuel consumptions along rail lines that are shared by both carriers. Emissions from switchers were included in the fuel-based emissions estimates and distributed uniformly across specific subdivision lines. The total emissions from freight haul lines was 0.454 tpy of DPM and 0.426 tpy of PM_{2.5} (assuming a size fraction of 0.94).

2.9.2 Passenger Rail Lines

There are several intercity passenger rail lines within the Source Domain, which are serviced by Amtrak along the Capital Corridor, California Zephyr, Coastal Starlight, and San Joaquin passenger lines. Emissions by link were estimated based on latest available schedule for 2017 or 2018 (where available). For each link, emissions were estimated as the sum of emissions associated with exhaust from the locomotive, and idling emissions while loading passengers at stations.

To estimate the emissions, the number of locomotives per day that run along each link, as well as the activity along each line, are required. The activity along each Amtrak route is a function of the estimated average speed of the train and the frequency of the stops. To determine the number of stops, the District used the latest posted timetable and schedule by Amtrak.⁴¹ The timetables provide the number of train stops at each station, and the times and frequency of the train stops. These were used to determine the following:

- The daily number of trains was calculated as the number of weekday and weekend trains weighted by 5/7 and 2/7, respectively.
- The idling times varied from 2 – 10 min at certain stations to accommodate timed connections to other public transportation; the average idling time at a station (to pick up and drop off passengers) was approximately 90 s at most stations. Trains can also spend up to 20 min idling to power on (power down) the engine at the beginning (end) of a run.

Based on the timetable, the number of daily trips along each route is presented in Table 2-28. The level of service and number of trains was assumed to remain constant.

⁴¹ In most cases, the most recent timetable was posted in 2017 or 2018. Timetables were obtained from <http://www.amtrak.com/train-schedules-timetables> (accessed January 2019).

Table 2-28. Amtrak activity by route.

Routes	Destinations	Weekday trains per day	Weekend trains per day
Capital Corridor	Fairfield – Oakland	30	22
	Oakland – Coliseum	18	15
	Coliseum – San Jose	14	14
California Zephyr	Emeryville – Fairfield	2	2
Coastal Starlight	Gilroy – Fairfield	2	2
San Joaquin	Antioch – Oakland	5	0

Locomotives operate under a series of load modes (notches) that, combined with idling, determine the operating mode and the corresponding emission factors. The throttle notch is based on the load expected at each station, as well as the average speed. Emission factors and speeds that were used for each passenger line are presented in Table 2-29. The average speed was estimated using the distance traveled by the train on a route (or a portion thereof) divided by the elapsed travel time (based on the scheduled departure and arrival times) of the train between stations. An average throttle notch of three was used for the Capital Corridor because of the frequent stops, while for all remaining routes (which have fewer stops), a throttle notch of four was used.

Table 2-29. DPM emission factor (EF) and average speeds by Amtrak service/route.

Train service	Mode/ Throttle notch	EF (g/h)	Average speed (mph)
All passenger service	Idling	47.9	0.0
Capitol Corridor	3	210.9	35.0
California Zephyr	4	226.4	36.8
Coastal Starlight	4	226.4	40.0
San Joaquin	4	226.4	44.4

DPM emission factors were derived from the Port of Oakland 2005 Seaport Air Emissions Inventory (Environ International Corporation 2008), adjusted for fuel sulfur content of 15 ppm by weight in compliance with CARB’s Marine and Locomotive Diesel Fuel regulation (adopted November 2004; California Environmental Protection Agency 2014). All passenger rail services were assumed to have a fleet mix based on GP4x and Dash 9 locomotives with respective certification levels being pre-controlled and achieving Tier 1 emissions.

Emissions were estimated for locomotives based on idling at stations or turnarounds and running exhaust between stations. Daily running exhaust emissions of DPM on each link were estimated as:

$$E_{DPM} = \frac{1}{S} (EF_{DPM} \cdot N \cdot L)$$

where

- E_{DPM} = emissions of DPM per rail link per day (g)
- s = average speed (mph) (Table 2-29)
- EF_{DPM} = emission factor by rail link (g/h) (Table 2-29)
- N = number of locomotives that travel on the rail link per day (unitless)
- L = length of rail link (mi)

Running exhaust emissions were assumed to occur along each link except within 1,000 ft (0.189 mi) of a station. To be conservative, idling emission factors were used to estimate emissions within 500 ft before and after a station (equivalent to 1,000 ft). Idling emissions were used exclusively if the link was less than 0.189 miles and a station was situated on the link. Idling emissions were estimated by multiplying the emission factor by the number of stops on each link and the length of time of each stop, which varied by rail service and link:

$$E_{DPM} = EF_{DPM} \sum_i N_i \cdot T_i$$

where

- E_{DPM} = emissions of DPM per rail link per day (g)
- EF_{DPM} = emission factor for DPM by rail link (g/h) (Table 2-29)
- N = number of locomotives that travel on the rail link i per day
- T = idling time for each stop or turnaround on rail link i per day (h)

Even though activity levels varied per hour for each train route, the diurnal profile (fraction of total daily emissions that are produced per hour) for emissions from passenger rail were assumed to be evenly distributed throughout a 24 h period. The total emissions from passenger rail lines was 0.634 tpy of DPM and 0.596 tpy of PM_{2.5} (assuming a size fraction of 0.94).

2.10 Railyards

There are three railyards in the West Oakland Source Domain. The Port has two railyards on its property: Oakland International Gateway railyard, which is leased by the BNSF railway, and Outer Harbor Intermodal Terminal, which is operated by the OGRE. BNSF is a Class I interstate railroad, while OGRE is a small regional Class III railroad serving portions of the former Oakland Army Base. The Union Pacific (UP) railyard is also located within the Port area, but it is privately owned and operated. It serves as an intermodal yard for freight movements through the Port as well as a yard for handling domestic non-Port freight.

2.10.1 BNSF

The BNSF railyard is a near-dock transfer point that handles Port cargo containers. Locomotives are used for line-haul operations (movement of long-haul trains into and out of California) and switching operations (switchers). Line-haul locomotives move into and out of the railyard and idle after arrival and prior to departure. Switching engines operate in the railyard, with idling periods

interspersed throughout the day. Locomotives and trains enter the Port area from the north via the UP main line and leave in the same direction via tracks going north through Richmond, and then onto BNSF lines leading out of the Bay Area.

To characterize emissions from switchers, BNSF provided the Port with a sample of engines used in 2017. Switchers assigned to BNSF rotate in and out of service, but a GP25 or GP60 model were typically used (Table 2-30).

Table 2-30. Locomotive engine characteristics at the BNSF railyard.

Model	Certification Tier	hp	Number of Engines	Engine Surrogate
GP25	Precontrolled	2500	1	Average of GP-3x (2000 hp) and GP-4x (3000 hp)
GP60	Precontrolled	3600 – 3800	2	GP60 (3600 hp)

Locomotives and switchers operate using a series of load/power modes called “notches.” The operating profile for a locomotive is defined by the notch settings and idling periods. Following CARB’s guidance on rail yard emission modeling (California Air Resources Board 2006), emissions were estimated using emission rates per engine model and per mode, with average activity (time in mode) profiles for each visit multiplied by the number of engines visiting the railyard. The relative time per mode for switcher engine activity was taken from the 2006 Port of Oakland inventory (Environ International Corporation 2008; Table 2-31). Switching activity consists of one engine operating for 7.5 h per day (365 days per year); however, for consistency with the locomotive line-haul operations (see Section 2.9.1), the District assumed activity would occur over the entire day (24 h) for each day of the year.

Activities of line-haul engines include arriving with a train, separating from the train, potentially moving to the ready area where the engines are assigned to a train, moving to an assigned train, and leaving the yard. Twelve locomotive models and engine tiers were used at the BNSF yard for these operations. A sample of the line-haul engine activity was used to develop the average time in mode for line-haul locomotive arriving and departing from the yard. Because almost all line-haul locomotives have automatic idling-reduction devices (beginning with model year 2001), and idling is restricted to 15 min per event (per CARB agreement; California Air Resources Board 2005b), the idle time was adjusted to 1 h, assuming four in-yard movements per arrival and departure. The average time in mode for line-haul locomotives is summarized in Table 2-32.

Table 2-31. Percentage of time in mode of locomotives at the BNSF railyard.

Mode/ Throttle notch	Time (%)
Dynamic Braking	1.4
Idle	59.8
1	6.6
2	15.0
3	9.5
4	4.4
5	1.9
6	0.3
7	0.0
8	1.0

Table 2-32. Average time in mode of locomotives at the BNSF railyard. Idling time is based on assuming 0.5 h per arrival and departure.

Mode/ Throttle notch	Time (h)
Dynamic Braking	0.2963
Idle	1.0
1	0.1726
2	0.0758
3	0.0340
4	0.0049
5	0.0059
6	0.0004
7	0.0036
8	0.0017

Emission factors and fuel consumption by notch are consistent with previous Port inventories with adjustments to account for the idling-reduction devices and in-use fuel characteristics of no more than 15 ppm fuel sulfur content. Using California diesel fuel also reduces PM emissions by 7%; a factor of 0.93 was applied in the emissions estimates (Ramboll 2018). The combined emissions from line-haul and switcher activities at the BNSF railyard was 0.182 tpy of DPM and 0.168 tpy of PM_{2.5} (as exhaust only).

2.10.2 OGRE

OGRE is a Class III, Surface Transportation Board-certified short line rail company created in 2014 that is currently operating at the former Oakland Army Base. In 2017, OGRE exclusively served non-marine facilities located on Army Base. Switching engine fleet characteristics and annual activity were provided by OGRE. Emission factors for locomotives at OGRE were estimated using locomotive engine surrogates of similar power (Table 2-33).

Table 2-33. Locomotive engine characteristics at the OGRE railyard.

Model	Certification Tier	hp	Number of Engines	Engine Surrogate
EMD GP9/16	Precontrolled	1500/1600	2	EMD 12-645E (1500 hp)
EMD MP15	Precontrolled	1500/1600	2	EMD 12-645E (1500 hp)

OGRE estimated the total switching engine activity to occur over 780 h (annually). The time in mode for the switchers at BNSF was used for the switchers at OGRE (Table 2-31); the total hours were distributed by notch, then the total emissions were obtained by summing the emissions by notch. The combined emissions at the OGRE railyard from line-haul and switcher activities was 0.077 tpy of DPM and 0.071 tpy of PM_{2.5} (exhaust only).

2.10.3 UP

The UP Oakland Railyard is bounded by highway I-880, the Port, and residential, industrial, and commercial properties. The UP railyard is a cargo handling facility where intermodal containers arrive by truck to be loaded onto trains for transport, or arrive by train and unloaded onto chassis for transport by truck. Both cargo containers and chassis are temporarily stored at the yard. The railyard also has facilities for crane and yard hostler maintenance, locomotive service and repair, and on-site wastewater treatment.

Rail cars on arriving and departing line haul locomotives are moved using switchers. Switchers are used to move sections of inbound locomotives to appropriate areas within the railyard (e.g., intermodal rail cars go to the intermodal ramp for unloading and loading), and to move sections of outbound locomotives to tracks from which they will depart. Switchers are remote controlled in the UP railyard; while some are operated exclusively in the railyard, others are operated in the railyard at other outside facilities.

Emissions from the UP railyard were provided to the District by UP, and estimated using annual fuel consumption of eight switcher locomotives operating on the Niles Subdivision operating 8–12 h per day for every day of the year (365 days), as well as other equipment operating in the UP railyard (CHE, TRUs, and service/repair operations). The total emissions thus reflect the total activity at the UP railyard in 2017, estimated as 1.1098 tpy of DPM, and 1.0210 tpy of PM_{2.5}.

2.11 Commuter Ferries and Excursion Vessels

PM emissions from ferry and excursion vessel operations within the Source Domain were estimated based on information gathered from CARB, the San Francisco Bay Area Water Emergency Transportation Authority (WETA), ferry and excursion vessel schedules, and field studies.

WETA operates the San Francisco Ferry fleet, composed of 14 high speed passenger-only ferry vessels.⁴² There are two commuter ferry terminals inside the West Oakland Source Domain: the Oakland Jack London Square ferry terminal (in Oakland), and the Alameda Main Street ferry terminal (in Alameda). A private excursion cruise operator, Commodore Cruises and Events, is also located within the domain.

2.11.1 Navigating

PM₁₀ emissions were estimated using the methods for CHC engines (California Air Resources Board 2012b):

$$E_{PM_{10}} = EF_0 \cdot F \cdot \left[1 + D \cdot \frac{A}{UL} \right] \cdot LF \cdot HP \cdot T_O$$

where

- $E_{PM_{10}}$ = emissions of PM₁₀ (g)
- EF_0 = zero-hour PM emission factor as a function of model year, horsepower, and engine use (propulsion or auxiliary) [g/(hp h)]
- F = fuel correction factor (to account for emission reductions from burning cleaner fuel) (unitless)
- D = engine deterioration factor (percentage increase of emissions when the engine is at the end of its useful life) as a function of horsepower (unitless)
- A = current age of engine (y)
- UL = engine useful life as a function of vessel type and engine use (y)
- LF = engine load factor as a function of vessel type and engine use (unitless)
- HP = engine horsepower rating (hp)
- T_O = operating hours for activity (h)

Emission factors specific to the main propulsion and auxiliary engine by model year are required, in addition to a deterioration rate and a fuel correction factor. As vessel-specific data was not always available, state-wide and Bay Area average emission factors and parameters were used based on data from CARB and WETA (Table 2-34). Specifically:

- For commuter ferries, state-average emission factors, load factor, deterioration factor, number of engines per vessel, engine useful life, and fuel correction factors were taken from California Air Resources Board (2012b).
- Ferry-specific engine counts, engine age, engine horsepower, and load factor on commuter ferries used at the two ferry terminals were provided by WETA.⁴³
- For excursion vessels, Bay Area-specific data for excursion vessels for main and auxiliary engines were obtained from CARB based on their 2017 Statewide CHC survey (personal communication, August, 2018).

⁴² Not all vessels operate at the same time. The WETA San Francisco Bay Fleet information can be found at <https://sanfranciscobayferry.com/sites/default/files/SFBFfleet.pdf> (accessed December 2018).

⁴³ Obtained from K. Stahnke, San Francisco Water Emergency Transportation Authority, personal communication, September, 2018.

Table 2-34. Commuter ferry and excursion vessel operating parameters. Values obtained from CARB (2012b and personal communication, August, 2018), except number of vessels (n), vessel age (A), horsepower (HP), and load factor (LF) obtained from WETA. EF, F, and D are specific to PM₁₀ (DPM). Values reported for excursion vessels are averages over the operating fleet.

Vessel type	Engine	n	EF [g/(hp h)]	F	D	A (y)	UL (y)	LF	HP (hp)
Ferry	Main	2	0.10	0.80	0.67	3	20	0.38	1950
	Auxiliary	1	0.09	0.80	0.44	3	20	0.38	162
Excursion	Main	2.01	0.15	0.50	0.75	0.67	20	0.42	1473
	Auxiliary	1.23	0.22	0.71	0.75	0.44	20	0.43	116

To obtain in-transit operating activity, information from ferry schedules were reviewed for each ferry route. Based on departure and arrival times, the duration of travel time was estimated for the Oakland–Alameda route and for runs directly from ferry terminals to the extents of the Source Domain. Operating activity for excursion vessels was taken from the CARB 2017 Statewide CHC survey. In-transit emissions estimates for each route are presented in Table 2-35, where DPM emissions were assumed to equal PM₁₀ emissions, and PM_{2.5} emissions were obtained by multiplying the DPM emissions by a size fraction factor of 0.97 (consistent with similar vessels in the 2017 Port Inventory).

Table 2-35. PM_{2.5} and DPM emissions from commuter ferry and excursion vessel in-transit activity.

Vessel type	Route	PM _{2.5} (tpy)	DPM (tpy)
Ferry	Oakland – Alameda	0.0738	0.0761
	Oakland – San Francisco	0.2781	0.2867
	Oakland – South San Francisco	0.0884	0.0911
	Alameda – San Francisco	0.2940	0.3031
	Alameda – South San Francisco	0.0619	0.0638
Excursion	Commodore Events and Cruises (to San Francisco)	0.0392	0.0404

2.11.2 Berthing

As aforementioned, there are two commuter ferry terminals inside the West Oakland Source Domain (one in Oakland, and the other in Alameda), and a berth associated with a privately-operated excursion vessel company (Commodore Cruises and Events).

To estimate the PM_{2.5} emissions from berthing, the number of trip visits at each terminal was determined based on ferry schedules. For excursion vessels, since there was no daily schedule and operating hours vary by event, berthing activity was based on operator data taken from the CARB 2017 Statewide CHC survey. Commuter ferry berthing time was based on a sample of observations taken by District staff in 2018 at the two ferry terminals, where the average berthing time to load and unload commuters at a terminal was approximately 10 min. Both the main and auxiliary

engines were observed to run the entire time during this berthing process. Emissions were calculated as described above Section 2.11.1 and are summarized in Table 2-36.

Table 2-36. PM_{2.5} and DPM emissions from commuter ferry and excursion vessel berthing.

Vessel type	Berth	PM_{2.5} (tpy)	DPM (tpy)
Ferry	Oakland (Jack London Square terminal)	0.0058	0.0060
	Alameda (Main Street terminal)	0.0061	0.0063
Excursion	Commodore Cruise and Events terminal	0.1552	0.0600

3. Air Dispersion Modeling

The dispersion model applied in the technical assessment for West Oakland was the American Meteorological Society/EPA Regulatory Model Improvement Committee Regulatory Mode (AERMOD). AERMOD was used to perform dispersion modeling using unit emission rates to represent the emissions from a variety of sources (Section 2): permitted stationary sources, on-road mobile sources, truck-related businesses, OGVs, CHCs, CHE, Port Trucks at Port terminals, locomotives, railyard activity, commuter ferries and excursion vessels, and ferry berths. Meteorological data (Section 3.2) are used to simulate dispersion using AERMOD (Section 3.3), where the emissions from sources with specific temporal and spatial allocations (Section 3.4) are dispersed, and concentrations are sampled downwind at receptors (Section 3.5). Source contributions at each receptor can then be summed to evaluate total PM_{2.5} concentrations and cancer risk (Section 4).

3.1 Modeling Approach

The AERMOD modeling system is comprised of three modules: (1) AERMET, a preprocessor for making compatible meteorological data sets, (2) AERMAP, a processor for digital terrain data, and (3) AERMOD, an air dispersion model. Data generated from AERMET and AERMAP are used by AERMOD to estimate downwind concentrations. AERMOD (Cimorelli *et al.* 2004) is a steady-state Gaussian-based plume dispersion model based on planetary boundary layer turbulence structure and scaling concepts. AERMOD can model dispersion from both surface and elevated sources, in simple and complex terrain, and in rural and urban areas.

In AERMOD, emissions are dispersed from a *source*, and concentrations are sampled at a *receptor*. A source is defined by entering its location, physical characteristics (e.g., width, height), and emissions characteristics (i.e., emission rate, and changes of that rate over time). In AERMOD, a source can be defined by using different source types: point, area, and volume sources. Different sources types are better suited for representing different types of emission sources; for example, point sources are typically used to model dispersion from single facility stacks. A receptor is a location where air pollutant concentrations are estimated by the model. Receptors could correspond to the locations of monitoring sites or specific locations of interest (e.g., sensitive receptors). Many receptors must be placed within a modeling domain to adequately sample the spatial extent and gradients of pollutants near emission sources.

Because of its ability to handle multiple source types, the AERMOD modeling system was used to model dispersion from all sources in West Oakland. The AERMOD FORTRAN source code (version 18081, dated March 22, 2018) was downloaded from the U.S. EPA Support Center for Regulatory Air Models (SCRAM) web site.⁴⁴ The source code was compiled on the District's Linux clusters using the Portland Group, Inc., FORTRAN 90/95 compiler (pgf95 v8.0-6 64 bit). AERMET (version 18081) and AERMAP (version 18081) were installed on the District's Microsoft Windows computers via AERMOD View (provided by Lakes Environmental).

⁴⁴ http://www.epa.gov/scram001/dispersion_prefrec.htm.

Modeling a large number of sources requires a large amount of computing time, especially when there are many receptors (see Section 3.5). To reduce the wall time required to complete the analysis, model runs by individual source were distributed across a large number of computer processors.⁴⁵ And, as the dispersion from each source was modeled separately, individual source contributions could be tracked and assessed.

Dispersion modeling requires many input parameters to characterize emission sources, including an emission rate, which may vary over the modeling period (e.g., by hour of day, by day of week, etc.). For a single source, emission rates also vary by pollutant; ordinarily, in a multi-pollutant analysis, the number of model runs required is equal to the number of pollutants. However, the number of model runs can be reduced by using a *unit emission rate*⁴⁶ (1 g/s for point and volume sources, 1 g/(s m²) for area sources) for each source. Temporal changes in the unit emission rate are scaled using the emissions or activity profile (e.g., hours of operation) of the source. AERMOD output are then *dispersion factors* with units of concentration per unit emissions ([μg/m³]/[g/s] for point and volume sources, or [μg/m³]/[g/(s m²)] for area sources) at each receptor. Following this approach, average concentrations can be calculated by multiplying the dispersion factor by an average emission rate in a post-processing step (see Section 4.1.2). Using this method holds so long as (a) the emission rates for different pollutants are related to the same changes in source activity, and (b) the dispersion factor and emission rate are averaged over the same time scales.⁴⁷ This method does not account for any chemical transformations.

3.2 Meteorological Data

3.2.1 Surface meteorology

The District operates a meteorological monitoring network of stations within the nine Bay Area counties that provide measurements of ambient meteorological parameters to support many air quality-related programs. Several of these stations are near West Oakland. The Oakland Sewage Treatment Plant (OST) station is operating in the current network (Figure 3-1). The National Oceanic and Atmospheric Administration (NOAA) operates a network of buoy and land-based weather stations in the Bay as part of the National Ocean Service's Center for Operational Oceanographic Products and Services (CO-OPS) network that monitors atmospheric and ocean/bay surface conditions. Three land-based stations (Oakland Berth 34 [OKXC1], Oakland Middle Harbor Met [OMHC1], and Oakland Berth 67 [LNDC1]) are also located near West Oakland (Figure 3-1). All these stations measure wind speed, wind direction and temperature, which are required parameters for the AERMOD model. The OST data are reported as hourly averaged, while the CO-OPS data are two-minute averages reported every six minutes.

⁴⁵ Two computer platforms were used: (1) a 14 node Linux cluster, each with eight Intel® Xeon® E5335 2 GHz processors; and (2) a 12 node Linux cluster, each with 20 Xeon E5-2640 Broadwell 2.4 GHz processors. Processors were used as they became available to complete modeling runs using a job queuing system.

⁴⁶ Using unit emissions is sometimes referred to as the χ/Q (“chi over q”) method. The origin of this reference stems from the conventional use of χ to represent average concentration, and Q to represent an emission rate.

⁴⁷ For example, in this analysis, for on-road mobile sources, dispersion factors and emission rates were developed separately by day of week (weekend and weekday), and then summed to obtain an annual average concentration. All other sources were modeled as annual averages.

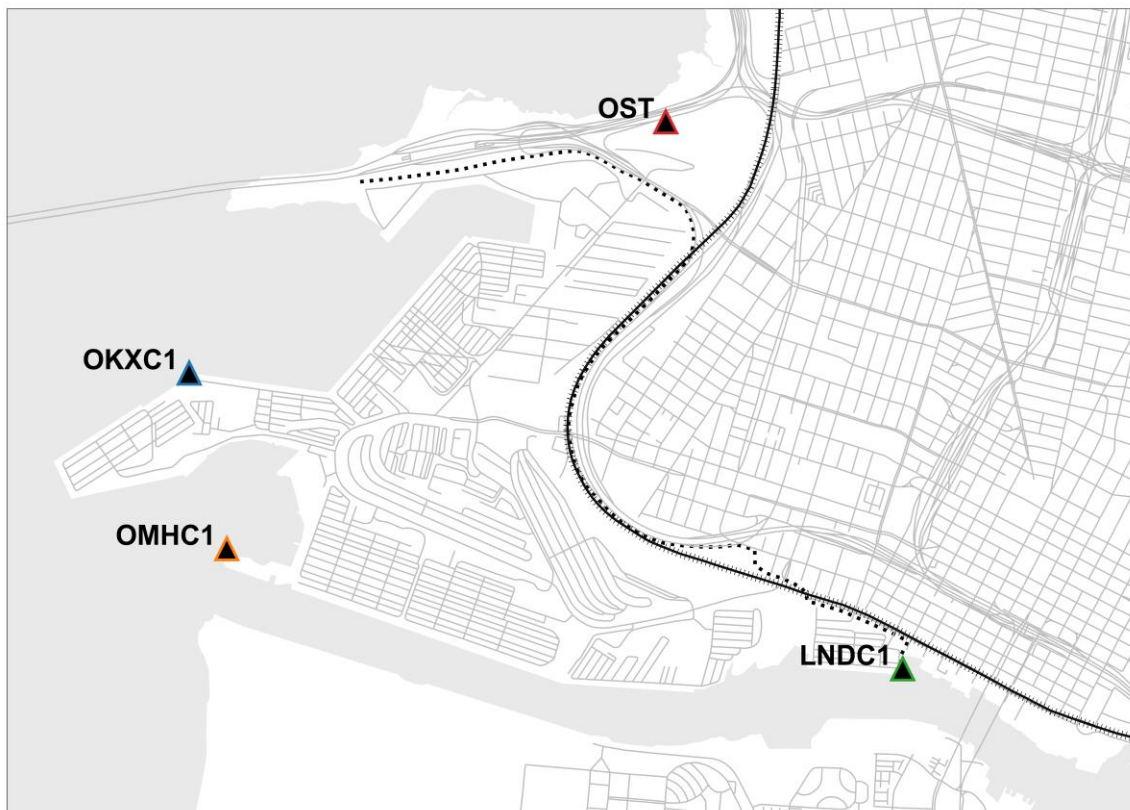


Figure 3-1. Surface meteorological monitoring stations considered for this analysis: OST (Oakland Sewage Treatment Plant), Oakland Berth 34 (OKXC1), Oakland Middle Harbor Met (OMHC1), and Oakland Berth 67 (LNDC1).

Of the four meteorological stations, only OST was sited to meet EPA modeling guidelines. The CO-OPS station sitings were meant to aid in the docking of container ships and in navigating the Oakland inner harbor. The wind vanes on all three CO-OPS stations are well below the recommended 10 m installation height (7.6 m at OKXC1 and LNDC1, and 6.7 m at OMHC1). OKXC1 and OMHC1 are also located at the land/water interface, with open water to the west, which is the dominant wind direction in West Oakland. The smooth upwind water surface could lead to lower mechanical mixing (lower dispersion) when modeled in AERMOD. LNDC1 is also sited in a location that is not ideal to support AERMOD modeling, as the surrounding surface roughness can vary depending on the placement of shipping containers and the movement of the shipping cranes, which can in turn affect measurements at the site. OST wind sensors were installed higher (16.3 m) than the minimum recommended height (10 m) to compensate for the heights of nearby structures. For these reasons, OST meteorological data was selected for the West Oakland AERMOD modeling.

OST data for year 2014 were selected for the AERMOD modeling as subsequent years had significant periods of missing data. In 2014, winds were most frequent from the west and west-northwest at speeds of 2.0–6.0 m/s (4.5–13.4 mph) (Figure 3-2). The OST data were processed through AERMET to create meteorological inputs used in subsequent dispersion modeling using AERMOD.

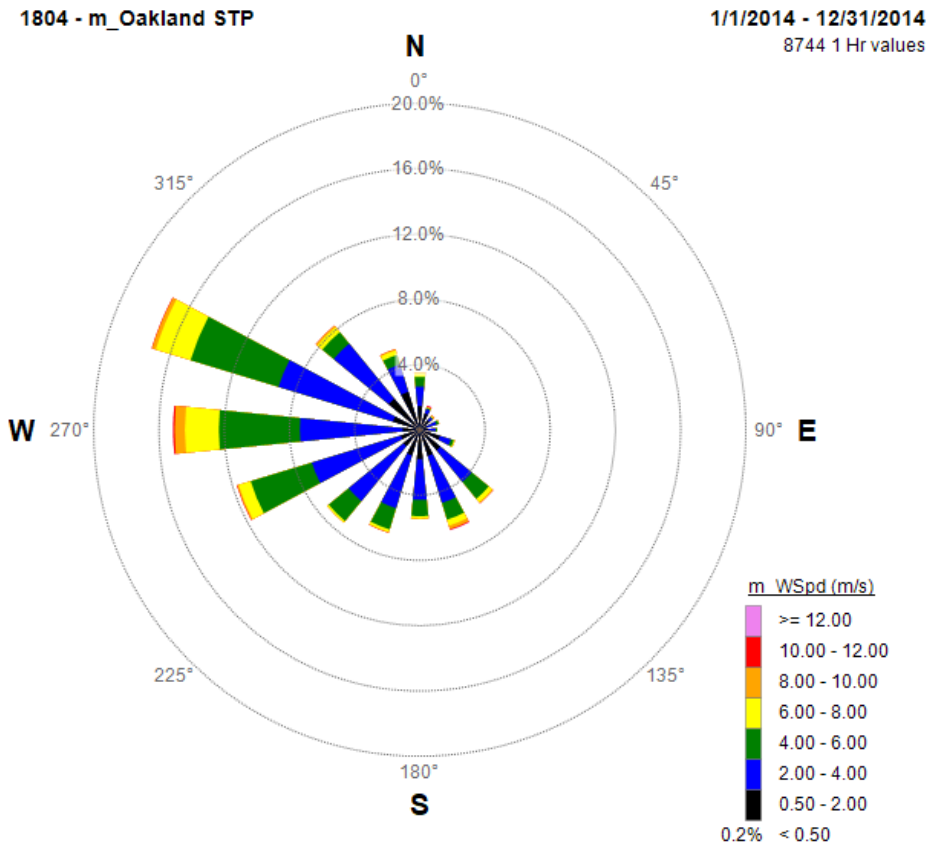


Figure 3-2. Annual windrose at the Oakland Sewage Treatment Plant (OST) in 2014. Compass sectors indicate the direction from which the wind is blowing. The percentage of calm winds (WSpd < 0.5 m/s) are also indicated.

3.2.2 Upper-air meteorology

The twice-daily (4:00 AM LST and 4:00 PM LST) upper air sounding data from the Oakland International Airport (KOAK; +37.744408° N, -122.223510° W) were also processed through AERMET to create input data for AERMOD dispersion modeling. The KOAK sounding is the only National Weather Service (NWS) upper air station in Northern California. Data from these soundings are namely used to calculate the convective mixing height during daylight hours.

3.3 AERMOD Model Configuration

Dispersion factors were modeled using default regulatory model options, including: stack-tip downwash, accounting for elevated terrain, calms processing routine,⁴⁸ missing data processing routine,⁴⁹ and an urban roughness length of 1.0 m. Additionally, no dry or wet deposition was included. Building downwash effects were not incorporated since individual building heights were not generally available. All sources were classified as urban sources, which is representative of land cover in West Oakland. The urban population (used as a surrogate to define the magnitude of the nighttime urban heat island, which enhances dispersion in the stable boundary layer) used was 650,000.⁵⁰ The height of each receptor was set to 1.8 m agl (referred to as “flagpole receptors”), which represents the breathing height of an average adult.

Dispersion factors were output as a daily average over the entire modeling period. Modeling was based on a meteorological dataset from 2014 (see Section 3.2). For on-road mobile sources, two modeling periods were used: all weekdays (261 days), and all weekend days (104 days). Otherwise, the period was defined as the entire year (January 1, 2014, through December 31, 2014).

The geographic coordinate system used throughout the modeling was a Universal Transverse Mercator (UTM) projection for zone 10 North with the North American Datum of 1983 (NAD83). Unless otherwise stated, for simplicity, the base elevation of each source was assigned by taking the elevation of the closest receptor as generated using AERMAP (see Section 3.5).

All sources in this analysis were located within the Source Domain, which encompassed the entire West Oakland community and Port of Oakland, and includes all emission sources discussed in Section 2 (Figure 2-2). A smaller “Receptor Domain” (Figure 3-3), embedded within the Source Domain, was used to define the extents of where receptors should be placed in AERMOD (see Section 3.5). The location of receptors is more spatially constrained so that they are located in areas where the population could be exposed (i.e., receptors were not placed over the Oakland harbor).

⁴⁸ In the calms processing routine, the concentration for a given hour is set to zero if the wind speed of that hour is calm. The (zero) concentration is then excluded when longer term (period) average concentrations are calculated (U.S. Environmental Protection Agency 2018b).

⁴⁹ In the missing data processing routine, hours with missing meteorological data are treated the same way as in the calms processing routine (U.S. Environmental Protection Agency 2018b).

⁵⁰ This is the total population of Berkeley, Piedmont, Emeryville, Oakland, and Alameda, based on the U.S. Census Bureau July 1 2017 (V2017) dataset (available via <https://www.census.gov/quickfacts>). The total population from these areas was rounded to the nearest thousand (U.S. Environmental Protection Agency 2015a). A slight over- or under-estimate of the population will not adversely affect modeling results since the urban algorithms in AERMOD depend on the population to the one-fourth power (Cimorelli *et al.* 2004).

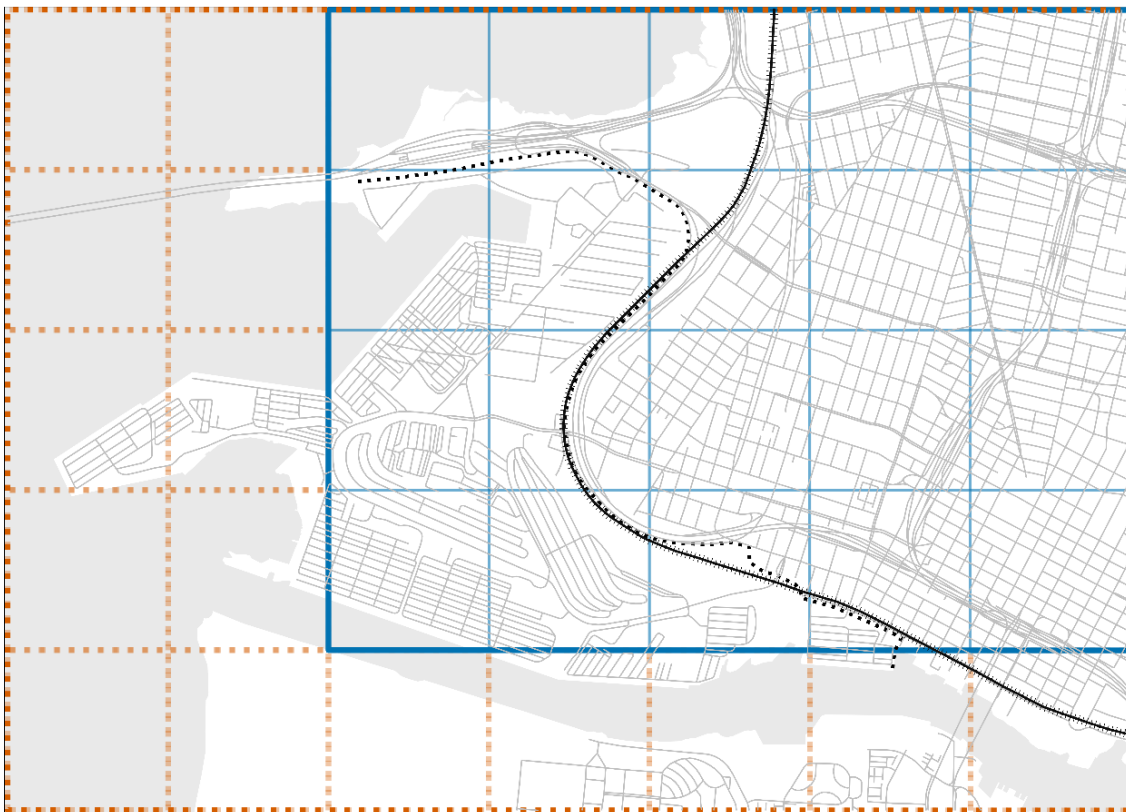


Figure 3-3. Extents of the Source Domain (red dotted lines) and Receptor Domain (blue solid lines) used in AERMOD modeling. The inner tiles represent the 1 km × 1 km grid cells of the regional modeling.

3.4 Sources

3.4.1 Overview

Source-specific modeling parameters used for the emission sources in West Oakland (Section 2) are described in this section. In AERMOD, the user (modeler) must identify how each emissions source will be modeled (i.e., as a point, area, or volume), and input the location and associated modeling parameters. Location information includes the x coordinate (longitude), y coordinate (latitude), and z coordinate or base elevation (m asl). For point and volume sources, the x and y coordinates correspond to the center of the source. Multiple x and y coordinates are required for area sources when represented as polygons. In general, the parameters required by source type are:

- **Point:** emission rate (g/s), stack height (m agl), stack gas exit temperature (K), stack gas exit velocity (m/s), and interior stack diameter (m).
- **Area:** emission rate [g/(s m²)], release height (*Relhgt*, m agl), and initial vertical dispersion coefficient (*Szinit*, m).
- **Volume:** emission rate (g/s), release height (center of volume) (*Relhgt*, m agl), initial lateral dispersion coefficient (*Syinit*, m), and initial vertical dispersion coefficient (*Szinit*, m).

These modeling parameters are important for determining plume rise and how emissions are transported downwind of the source. As aforementioned, the emission rate for all source types was set to a unit emission rate. An optional modeling parameter to vary the emission rate was applied to sources when the diurnal activity profile was available.

The type of source used to model emission sources in West Oakland depended on the source category (Table 3-1). The general process used to determine the location (*x* and *y* coordinates) of sources for each source type in described below, while specific parameters by category are summarized in the sections that follow.

Table 3-1. AERMOD source types used by source category for emissions sources in West Oakland. Point sources include point, capped, and horizontal emission releases. Ferry berths include berthing locations for commuter ferries and excursion vessels.

Section	Source Category	AERMOD Source Type			
		Point	Area	Volume	
				Single	Adjacent
3.4.2	Permitted stationary sources	×		×	
3.4.3	On-road mobile sources				×
3.4.4	Truck-related businesses		×		
3.4.5	OGVs (transiting, maneuvering, berthing)		×		
3.4.6	CHCs		×		
3.4.7	CHE		×		
3.4.8	Port Trucks at terminals (transiting, idling)		×		
3.4.9	Locomotives				×
3.4.10	Railyards		×		
3.4.11	Commuter ferries and excursion vessels – navigating				×
3.4.11	Commuter ferries and excursion vessels – berthing		×		

(a) Point Source and Single Volume Source Locations

The only point and single volume sources in this analysis were permitted stationary sources. The District maintains a database of these sources and their locations, from which the location of each stack was obtained after QA (Section 2.2).

(b) Area Source Locations

Area sources were manually traced using Google Earth. The polygons were then saved as a shapefile, and an automated program was used to extract the *x* and *y* coordinate values of the vertices and create AERMOD-ready input files.

(c) Adjacent Volume Source Locations

In this analysis, mobile sources were modeled following much of EPA’s current guidance for PM hot-spot analyses for transportation projects (U.S. Environmental Protection Agency 2015b, 2015c).⁵¹ On-road mobile sources were modeled using adjacent volume sources. Both adjacent area and volume sources can be used to represent emissions from on-road mobile sources in AERMOD, though adjacent area sources are usually favored since they “may be easier to characterize correctly compared to [adjacent] volume sources” (U.S. Environmental Protection Agency 2015b, p. 105). This is because adjacent volume sources must be placed so that the volume centroids are equidistant from each other along the length of the emissions source (e.g., roadway), resulting in up to thousands of individual volume sources to characterize a single emissions source. Common errors made when configuring adjacent volume sources include incorrect volume centroid spacing (so that volumes are no longer adjacent), and using an inappropriate source width (e.g., street width) (Desser 2014). Typically, the initial lateral dispersion coefficient, *Syinit*, is calculated as the source width divided by 2.15. For volume sources, the exclusion zone (EZ) is an area around each volume source where AERMOD does not calculate results,⁵² and no receptors should be placed. The radius of the EZ (r_{EZ}) from the centroid of the volume is calculated as:

$$r_{EZ} = (2.15 \cdot Syinit) + 1.0$$

As receptors are to be placed as close as 5.0 m to roadways to adequately sample spatial concentration gradients, the maximum width of a roadway in AERMOD should be 8.0 m (U.S. Environmental Protection Agency 2015c); roadways that exceed this width should be modeled as several series of adjacent volume sources, such as to represent different travel lanes.

Because of the complexity of configuring adjacent volume sources, commercial software can help simplify this task by using a graphical user interface. Though, the process remains arduous if many emissions sources need to be included, such as in this analysis, where all roadways in West Oakland were modeled. For this reason, the District created an internal software package designed to automate the process of configuring adjacent volume sources for all emissions sources that are linear in nature – on-road mobile sources, locomotives on rail lines, and commuter ferries and excursion vessels.

In this process, the required inputs are a shapefile containing a network of line geometries representing the centerline of the emissions sources (roadway, ferry track, rail line), with a source width assigned to each segment (for roadways, the number of lanes can also be supplied). As a first pass, the number of volumes per line segment is determined by dividing the total length of the segment by its width, and each volume centroid is placed a distance of a width apart.⁵³ For roadways, if the total width exceeds a maximum width threshold (8.0 m), then the number of lanes is used to create a new series of roadway (lane) ‘centerlines’ parallel to the input centerline, and

⁵¹ That being said, as this analysis is not a formal PM hot-spot analysis, some aspects to the modeling approach differed.

⁵² Suppose there is a receptor *A* within the EZ of volume source *a*; AERMOD will not calculate results (output is 0.0) at *A*. However, if the model is configured with multiple volume sources – *a*, *b*, *c* – and receptor *A* is only within the EZ of volume source *a*, then the results at receptor *A* only represents the contributions from volume sources *b* and *c*, which is an underestimate of the expected results.

⁵³ Only a whole number (integer) of volumes can be placed along segment. The first volume centroid is located at a position whose distance is half the width of the source from the starting coordinate of the segment.

the new width is equal to the total width divided by the number of lanes. Multiple iterations are performed to minimize the number of overlapping volume sources at network nodes, as the overlaps can cause spurious small-scale “hot spots” of emissions.

3.4.2 Permitted Stationary Sources

Depending on the specific source category, emissions from permitted stationary sources were modeled as either point or volume sources in AERMOD. Modeling parameters were based on the most recent data available. All point and volume centroid locations were based on the coordinates available in the 2017 CEIDARS report (see Figure 2-4). The District also promulgates the release parameters as part of the CEIDARS report (by individual source at each facility). However, more recent release parameters may be provided by facilities in permit applications (in health risk assessments [HRAs] or in prevention of significant deterioration [PSD] analyses) is conducted as part of a permit application and are therefore not available through CEIDARS. The District therefore collected permit applications (available up to November 2018) and manually updated the 2017 CEIDARS modeling parameters for each source in West Oakland. Increasing the accuracy of the release parameters should result in higher confidence in dispersion model performance and therefore higher confidence in the estimated downwind concentrations.

(a) GDFs

Emissions from GDFs were modeled as volume sources in AERMOD, where the initial release parameters were determined by the number of gasoline dispensers at the facility. When the number of dispensers at the facility was known, *Syinit* was estimated using the equation:

$$Syinit = -0.00393 \text{ m} \cdot n^2 + 0.3292 \text{ m} \cdot n + 0.7285 \text{ m}$$

where *n* is the number of gasoline dispensers (based on Sonoma Technology Inc. 2011). *Relhgt* was always set to 1.03 m (see Table 3-2 for a summary of these parameters).

(b) All other permitted stationary sources

Emissions from permitted stationary sources were modeled as point sources when stack release parameters or default parameters were available. Otherwise, the emissions were modeled as volume sources. Default parameters (used when information was not available) for point and volume sources are listed in Table 3-2.

Table 3-2. Default modeling parameters for permitted stationary sources. These values were applied when no other modeling information was available. The source type indicates the type of source in AERMOD that was used for dispersion modeling. The following variables are used: *Relhgt* (release height), *Syinit* (initial lateral dispersion coefficient), *Szinit* (initial vertical dispersion coefficient). For gasoline dispensing facilities, *n* is the number of dispensers at the facility.

Source Description	Source Type	Default	
		Parameter	Value
Prime or Standby Generator	Point	Stack height	3.66 m (12 ft)
		Stack diameter	1.83 m (0.6 ft)
		Exit temperature	739.8 °C (872 °F)
		Exit velocity	45.3 m/sec (8,923 ft/min)
Sources that have incomplete modeling information	Point	Stack height	6.1 m (20 ft)
		Stack diameter	3.05 m (1 ft)
		Exit temperature	644 °C (700 °F)
		Exit velocity	17.8 m/s (3,500 ft/min)
No information available	Volume	<i>Relhgt</i>	1.8 m
		<i>Syinit</i>	10 m
		<i>Szinit</i>	1.0 m
Gasoline Dispensing Facility (Gas Station)	Volume	<i>n</i>	4
		<i>Relhgt</i>	1.03 m (3.4 ft)
		<i>Syinit</i>	1.98 m if <i>n</i> = 4; otherwise use equation in Section 3.4.2

3.4.3 On-Road Mobile Sources

The approach for modeling emissions from on-road mobile sources depended on location: those from roadways within terminals at the Port, and those within the rest of the Port area and West Oakland community. This section presents the modeling approach for the latter group; emissions from on-road mobile sources on roadways within terminals are discussed in Section 3.4.7.

On-road mobile source emissions were modeled in AERMOD as adjacent volume sources. The location of the volumes (centroids) was developed using a roadway network obtained from Citilabs, and the elevation (expressed as an adjusted release height) was determined from a lidar dataset. Other emissions characteristics were based on current EPA PM hot-spot guidance.

(a) *Location (x, y, and z coordinates)*

A shapefile containing the geographic location of roadways and roadway attributes in Alameda County was obtained from Citilabs (Streetlytics platform) to develop the locations and extents (widths) of adjacent volume sources. A description of this data set and the filtering and QA process applied by the District is described in Section 2.3. While the accuracy of volume source locations is dependent on the accuracy of the roadway network obtained from Citilabs, the District did not directly QA the roadway segment centerline locations.

While roadway (source) width is not a readily available parameter, it is needed to determine *Syinit* of each volume; a combination of the roadway functional class and the number of lanes was used to approximate the roadway width, where the total width was taken as the number of lanes times the width per lane. The width per lane was based on guidance for roadways in urban areas as classified by FHWA (Table 2-8): 3.6 m for freeways, 3.0 m for arterials, and 2.7 m for local roads (American Association of State Highway and Transportation Officials 2018).⁵⁴

Adjacent volume source locations were generated using the algorithm described in Section 3.4.1(c) (Figure 3-4). Volume source locations were identical for Non-Trucks and Trucks. Once the *x* and *y* coordinates of each volume source were determined, the *z* coordinate (base elevation) was taken from the nearest receptor (Section 3.5).



Figure 3-4. Locations of adjacent volume sources used to model emissions from on-road mobile sources. In the inset, the grey lines represent the location of roadways centerlines. The location of the marker represents the centroid of the volume source; the size of the marker does not reflect the dimensions of the volume source.

(b) Elevation (Adjusted release height)

In West Oakland, there are many roadway segments that are elevated, i.e., where the road surface is above grade, such as freeway overpasses. In this analysis, the elevated roadway structure heights were added to the emissions release heights (see (c)) to obtain an adjusted release height. The

⁵⁴ Based on the Citilabs network, on- and off-ramps were assigned to both arterial and local road categories.

roadway surface heights were developed from two lidar raster datasets obtained from the U.S. Geological Survey (USGS), downloaded via the National Oceanic and Atmospheric Administration (NOAA) Data Access Viewer:⁵⁵ *2010 USGS San Francisco Coastal Lidar* (at 1 m resolution), and *2006 USGS Topographic Lidar: Alameda County* (at 2 m resolution). Both datasets were available in UTM zone 10 North projection (NAD83). The latter (older) dataset was needed to increase the spatial coverage of elevation information, so that elevation data would be available for the entire West Oakland Source Domain. Roadway surface structure heights were developed as follows:

- (1) The ground elevation (Z_{Ground} , m asl) and Unclassified (Class 1) elevation ($Z_{Unclassified}$, m asl) data channels were obtained. Unclassified includes the elevation of vegetation, buildings, and other structures (such as roadways). For each channel:
 - a. The 2006 dataset was resampled to the resolution of the 2010 dataset.
 - b. The 2010 dataset was filled with the 2006 dataset where there was missing data within the Source Domain.
 - c. Remaining missing pixel values were filled using an inverse distance weighted (IDW) interpolation.
- (2) The resulting absolute structure height, Z_s , was calculated as:

$$Z_s = Z_{Unclassified} - Z_{Ground}$$

To reduce some noise in the data, all values ≤ 1.8 m were coerced to 0.0 m.

- (3) The average absolute structure height, $\overline{Z_s}$, was added to the release height of each volume source. Given the area of the volume defined as a circle from the volume centroid (x, y) with a radius of *Syinit* (which may vary by roadway link):
 - a. For non-overlapping volumes, $\overline{Z_s}$ was taken as the average of all pixel values within the circular area.
 - b. For overlapping volumes, which can occur at roadway intersections or for roadways overpasses, the release height was calculated by linear interpolation of $\overline{Z_s}$ values from adjacent volumes along the same roadway link.

Given the input datasets and algorithm, this process may not always determine the correct roadway heights due to channel noise, confounding data (e.g., vegetation overhanging roadways, which results in a higher interpreted structure height), or because of nearly-parallel overlapping roadways resulting in a significant number of overlapping volumes (e.g., an overpass over another street). Some freeway segments⁵⁶ ($n = 12$) with incorrect $\overline{Z_s}$ assignments were manually identified and corrected using an IDW interpolation between the known $\overline{Z_s}$ values start and end of the segment. The resulting values of $\overline{Z_s}$ at each volume centroid are shown in Figure 3-5; these results could be further improved with additional QA and filtering techniques (see Section 6.2.2).

⁵⁵ <https://coast.noaa.gov/dataviewer/>.

⁵⁶ Freeway segments were prioritized since they will have the highest AADT and therefore highest emissions.



Figure 3-5. Average absolute structure heights of roadways at volume source centroids derived from lidar datasets. A \bar{Z}_s value of 0 m agl indicates (white, not visible) that the volume source is at ground level and the roadway is at grade.

(c) Emissions characteristics

Though the location of volume sources by vehicle categories (Non-Trucks and Trucks), were identical,⁵⁷ they were modeled separately to track individual contributions to concentrations at receptors. While dispersion release parameters differ between Non-Trucks and Trucks, diurnal emission (activity) profiles also differ by day of week. This resulted in a four AERMOD dispersion modeling runs for on-road mobile sources for a given roadway segment: (a) Non-Trucks on WD, (b) Non-Trucks on WE, (c) Trucks on WD, and (d) Trucks on WE. For roadways located in the Port but that were not within active terminals, only Truck-configured runs were performed but used to characterize the emissions from all vehicle types.⁵⁸

For all adjacent volume sources, the initial horizontal and vertical dispersion coefficients were based on the AERMOD User's Guide for surface-based sources (U.S. Environmental Protection Agency 2018b):

⁵⁷ As suggested by EPA, "overlapping versions" of each roadway segment can be used to represent the total emissions, treated each version with appropriate parameters to represent different vehicle categories (U.S. Environmental Protection Agency 2015c).

⁵⁸ This was done for convenience, but also because it is assumed that there is a low percentage of Non-Trucks on roads within the Port.

$$Sy_{init} = W / 2.15$$

$$\begin{aligned} Sz_{init} &= PH / 2.15 \\ &= (H \cdot \gamma) / 2.15 \end{aligned}$$

where W is the source width, PH is the initial vertical dimension of the source plume (plume height), H is the average source (vehicle) height, γ is a parameter to account for the effects of vehicle-induced turbulence, which equals 1 when vehicles are not moving, or 1.7 when vehicles are in motion (U.S. Environmental Protection Agency 2015c). H depends on the vehicle category, and was taken as 1.53 m for Non-Trucks, 4.0 m for Trucks. Therefore, Sz_{init} was set to 1.2098 m for Non-Trucks and 3.1628 m for Trucks.

Finally, the release height was estimated as the midpoint of the initial vertical dimension, i.e., $Relhgt = 0.5 \cdot PH$. Therefore, $Relhgt$ was initially set to 1.3 m for Non-Trucks, and 3.4 m for Trucks. For volumes that were not at-grade, $Relhgt$ was then adjusted by \bar{Z}_s to obtain an adjusted release height.

To facilitate a unit emissions modeling approach, diurnal emission profiles for each roadway segment by vehicle category and day type were developed based on activity data (as described in Section 2.3). The diurnal activity profiles are comprised of ratios derived from hourly traffic volume normalized by the average daily traffic volume. These values are then used to scale the unit emission rate during the AERMOD run so that the hourly unit emission rate reflect the actual emission rates. For roadway segments located in the West Oakland community, diurnal profiles were link-specific for Non-Trucks, and road type-specific for Trucks (Figure 3-6). For roadway segments in the Port, diurnal profiles for Non-Trucks and Trucks were identical (since only one set of runs was performed, as noted above; Figure 3-7).

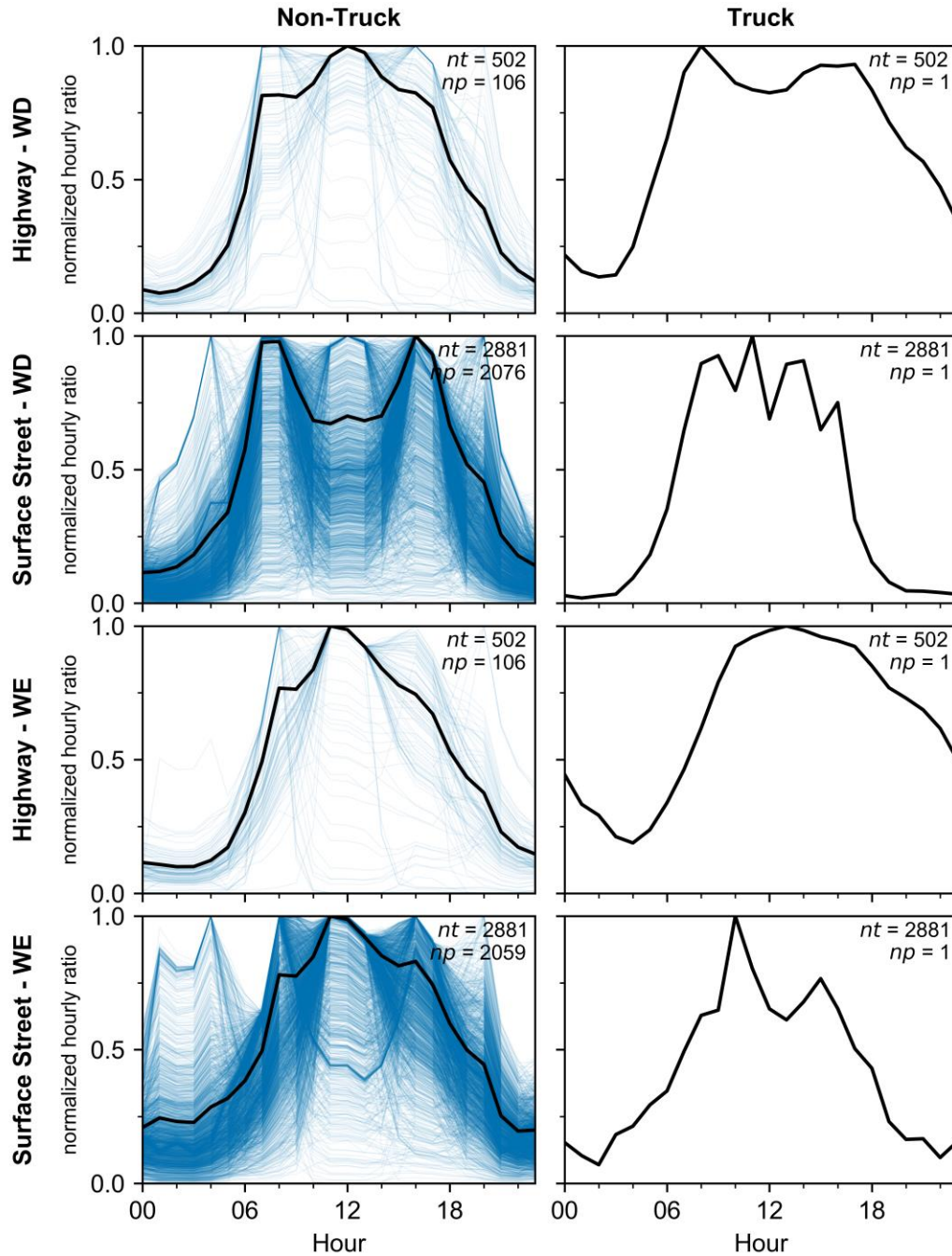


Figure 3-6. Diurnal emission profiles used for individual roadway segments in the West Oakland community normalized by maximum hourly volume. Profiles differ by road type (Highway, Surface Street) and day type (WD, WE) (rows), and vehicle category (Non-Truck, Truck) (columns). The number of unique profiles (np) and total number of roadway segments (nt) is annotated for each case. Individual profiles by roadway segment are plotted (thin blue lines), as well as the average profile (thick black lines); in cases where $np > 1$, the average profile is for illustrative purposes only. For unit emissions modeling, profiles normalized to the average daily traffic volume were used.

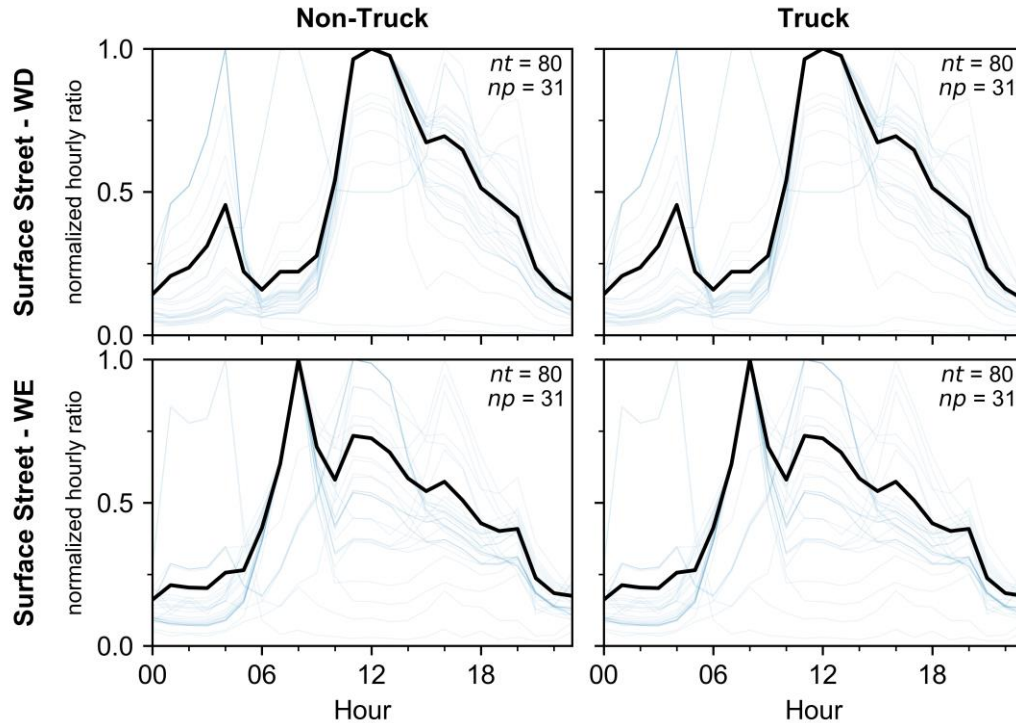


Figure 3-7. As in Figure 3-6, but for roadway segments in the Port area.

3.4.4 Truck-Related Businesses

Groups of idling vehicles in the same location can be modeled as an area source (U.S. Environmental Protection Agency 2015c). Emissions from truck activity at businesses with truck fleets (Attachment 3) were modeled as area sources. The areas were manually developed using satellite imagery, and then verified using Google Street View. The activity within these areas was associated with idling only; therefore, dispersion parameters were calculated as in Section 3.4.3, but with $\gamma = 1$ (no vehicle-induced turbulence, which aligns with modeling guidance provided in U.S. Environmental Protection Agency (2015c)). The height of all trucks was assumed to be 4.0 m, which results in $Sz_{init} = 1.86$ m, and $Rel_{hgt} = 2.0$ m. Emissions from truck-related businesses were assumed to be evenly distributed from 8:00 AM to 5:00 PM on Monday through Saturday (no activity on Sunday).

Emissions from truck activity at Schnitzer Steel was also modeled as an area source (Figure 3-8); this includes emissions from all emission processes, where applicable (running exhaust, idling exhaust, tire wear, brake wear, and road dust). The area was determined from satellite imagery so that it would not encompass the buildings or stockpiles. A release height of 5.5 m and an initial vertical dispersion coefficient of 2.558 m was used, consistent with modeling performed in California Air Resources Board (2008a). Emissions were evenly distributed over the hours of operation: 4:00 AM to 3:30 PM for Monday through Friday, and 5:00 AM to 12:00 PM on Saturday, with no activity on Sunday.



Figure 3-8. Area source polygons used to model emissions from truck-related businesses. The “S” indicates the location of Schnitzer Steel.

3.4.5 Ocean-Going Vessels

Emissions from maneuvering and berthing OGVs were modeled as two-dimensional area sources that were associated with specific terminal operators. Based on information provided by Ramboll (2018), Port-related OGV emissions were spatially allocated based on AIS records of ship positions in 2017 (2017 NOAA Cadastre AIS dataset). AIS relies on satellite positioning to track locations of commercial marine harbor crafts and large ships, which is required since 2016.⁵⁹ The AIS ship position records for ships headed to and from all Port berths were plotted, and the polygons were drawn around the bulk of the data points. For maneuvering and berthing, the positions of ships that headed to and from the four Port terminals were plotted to provide a guide to normal operating zones (by terminal). Spatial allocations according to operating mode were made as follows:

- OGV maneuvering emissions were assigned to polygons extending from the Inner and Outer Harbor channels and towards the entrance to these channels and the Bay Bridge (Figure 3-9). These polygons were defined to represent the most likely maneuvering areas applicable to each terminal operating during 2017 (TraPac, Nutter, OICT, and Matson).

⁵⁹ <https://www.navcen.uscg.gov/?pageName=AISRequirementsRev>.

- OGV berthing emissions were assigned to polygons at each terminal berth (Figure 3-10). Emissions were allocated between terminals based on the vessel call data from the 2017 SFMX Berth Report.

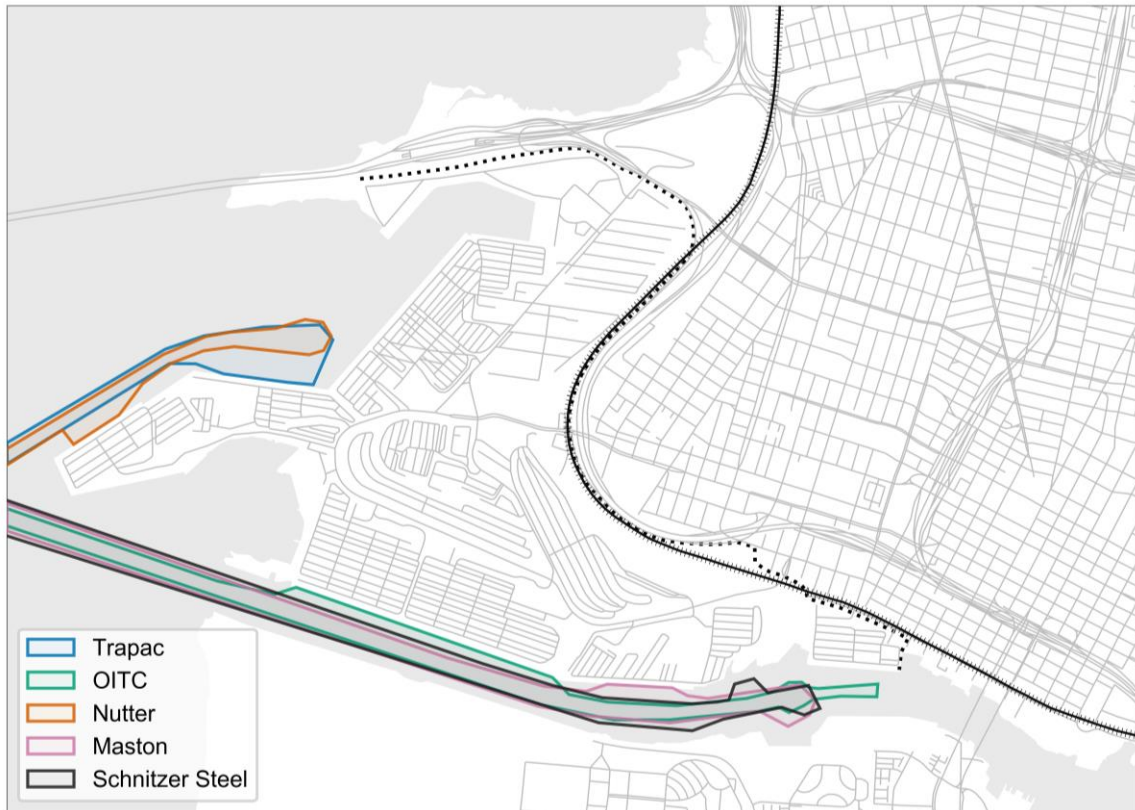


Figure 3-9. Area source polygons used to model emissions from OGV maneuvering.

An initial release height of 50 m was used for both OGV maneuvering and berthing activities. Emissions by activity were then temporally allocated by hour of day (ship call and twenty-foot equivalent unit (TEU) cargo volume throughput data showed little seasonal variation). A diurnal profile was developed for OGV maneuvering activity based on an analysis of hourly vessel movements (Figure 3-11). The highest frequency of arrival and departure times occurred near the start of labor shifts;⁶⁰ therefore, maneuvering emissions were assigned hour-specific allocation factors based on the arrival/departure frequency pattern. OGV berthing emissions at the Port were assigned a constant diurnal profile.

Emissions from OGV transiting and maneuvering for ships to Schnitzer Steel were also modeled as an area source, which was approximated based on the spatial coverage of OGVs transiting to the Port. All OGV activities from Schnitzer Steel (transiting, maneuvering, hoteling) were modeled with a release height of 37.5 m, and emissions were assumed to be constant in time.

⁶⁰ Based on AIS records, a median of 23 min before ship arrival (denoted by ‘first line on’ time stamp in the SFMX berth report) and 19 min after departure (‘last line off’) was used to estimate the relative number of events by time of day for this mode within the Source Domain.

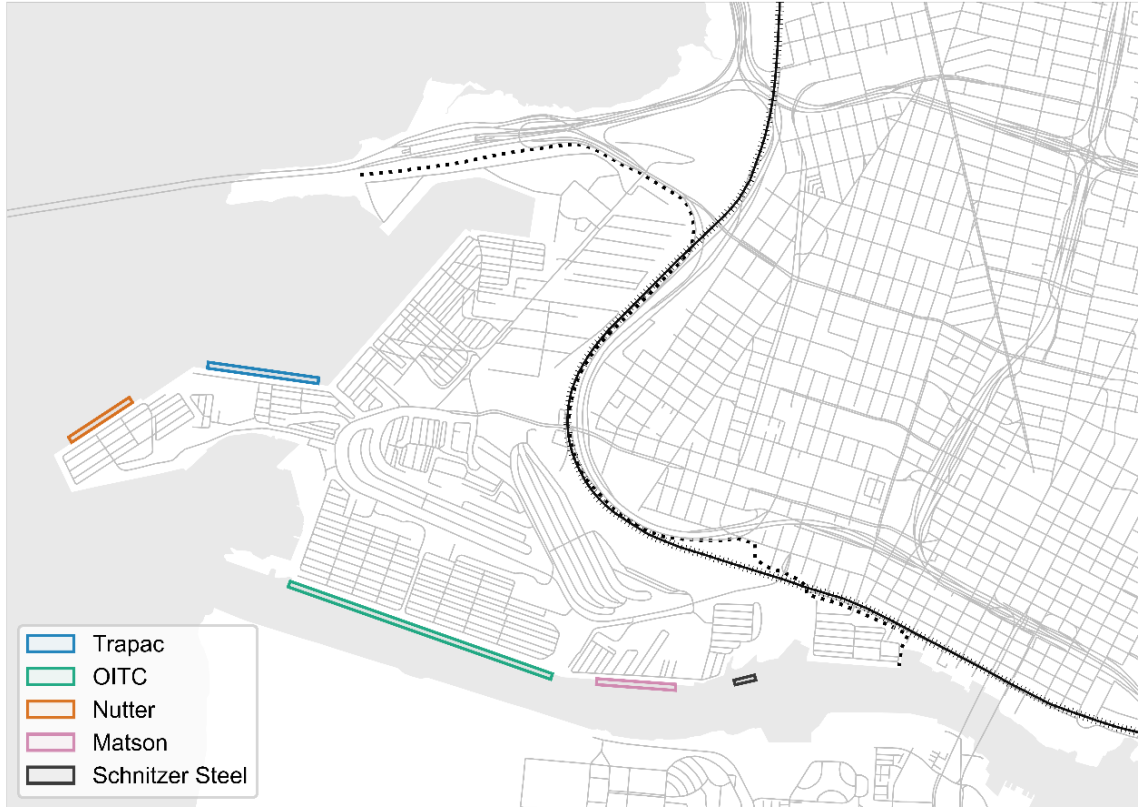


Figure 3-10. Area source polygons used to model emissions from OGVs at berths.

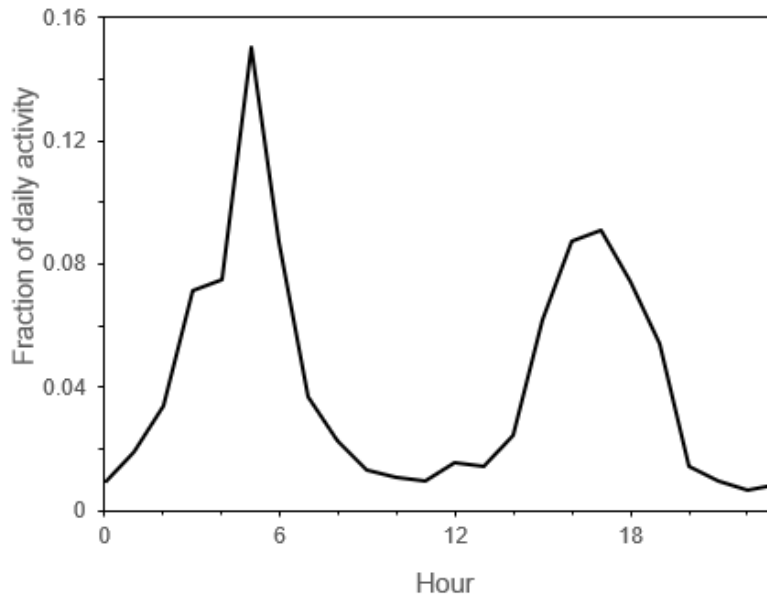


Figure 3-11. Diurnal emissions profile of Port OGV maneuvering. The profile is based on activity data from the 2017 Port Inventory.

3.4.6 Commercial Harbor Crafts

Emissions from all types of CHCs were modeled as area sources, while the spatial and temporal allocations of emissions varied by vessel type.

Dredging operations were assigned to two separate ship channels and berthing areas where these activities occurred (Figure 3-12). The area of the activity was created based on OGV AIS ship positioning information, which occurred near the main channel areas and berths that were dredged in 2017; the area was then extended to include unused Berths 23 and 24 in the Outer Harbor, and exclude the Berths 67 and 68 (which are rarely used).⁶¹ Emissions were then allocated temporally based on the dredging schedule in 2017; dredging only occurred on 153 days (from January – February, and from August – December), and during daylight hours (8 AM – 6 PM). A release height of 6 m was used, with $Sz_{init} = 4.744$ m (consistent with California Air Resources Board (2008a)).

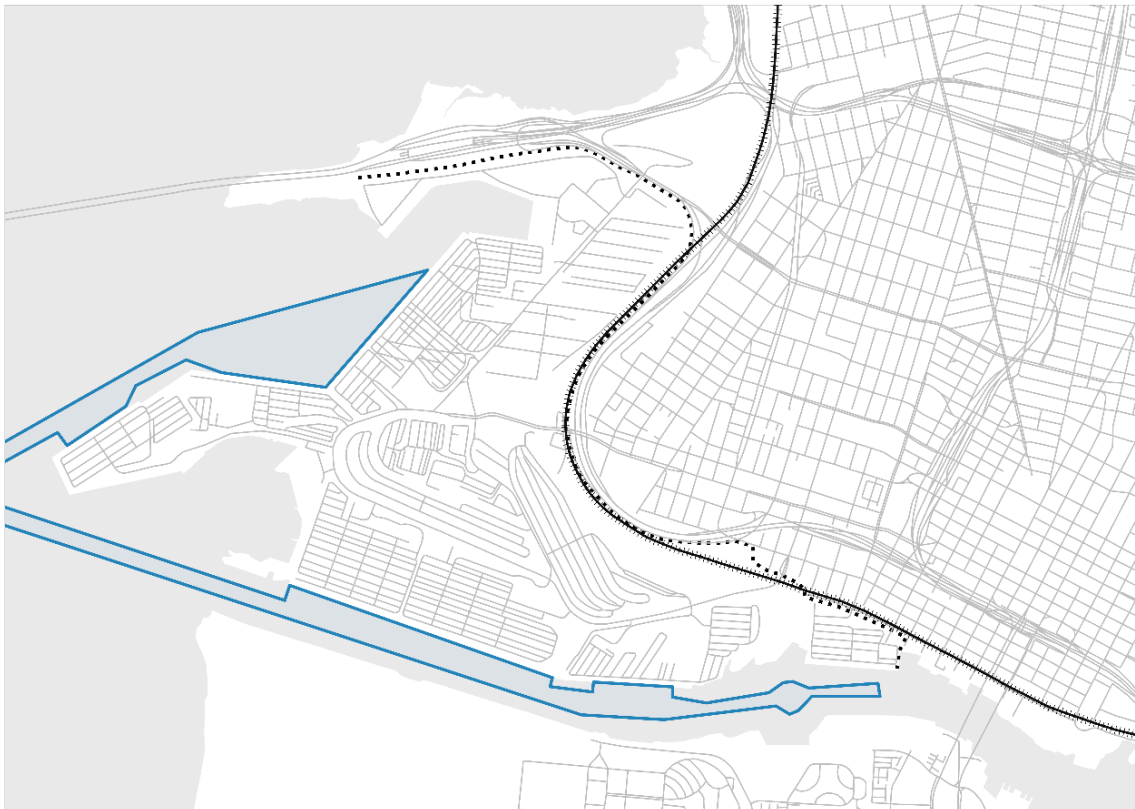


Figure 3-12. Area source polygons used to model emissions from dredgers.

Two areas sources were defined for assist tug operations, with one area representing tugs from the companies AMNAV Maritime Services, BayDelta, Crowley, and Foss Maritime, and the other representing tugs from Starlight Marine Services (Figure 3-13). Areas were derived based on AIS vessel position records during maneuvering and transit between the companies’ base locations

⁶¹ Based on communication with the company who performed the dredging.

(Table 2-18) to the Port. Emissions from assist tugs were temporally allocated in the same manner as OGV maneuvering (Section 3.4.5). A release height of 6 m was used, with $Sz_{init} = 4.744$ m (consistent with California Air Resources Board (2008a)).

Bunkering barges and bunkering pumps by terminal operator were assumed to operate in the same areas previously defined for OGV maneuvering and berthing, respectively (see Figure 3-9 and 3-10). Based on monthly bunkering events in 2017 (provided by Ramboll), emissions from bunkering varied by 6.4% to 9.6% on a monthly basis; for simplicity, emissions from bunkering activities were then assumed to be constant over the entire year. Emissions from bunkering barges were temporally allocated in the same manner as those from OGV maneuvering (Figure 3-11), whereas emissions from bunkering pumps were assumed constant.

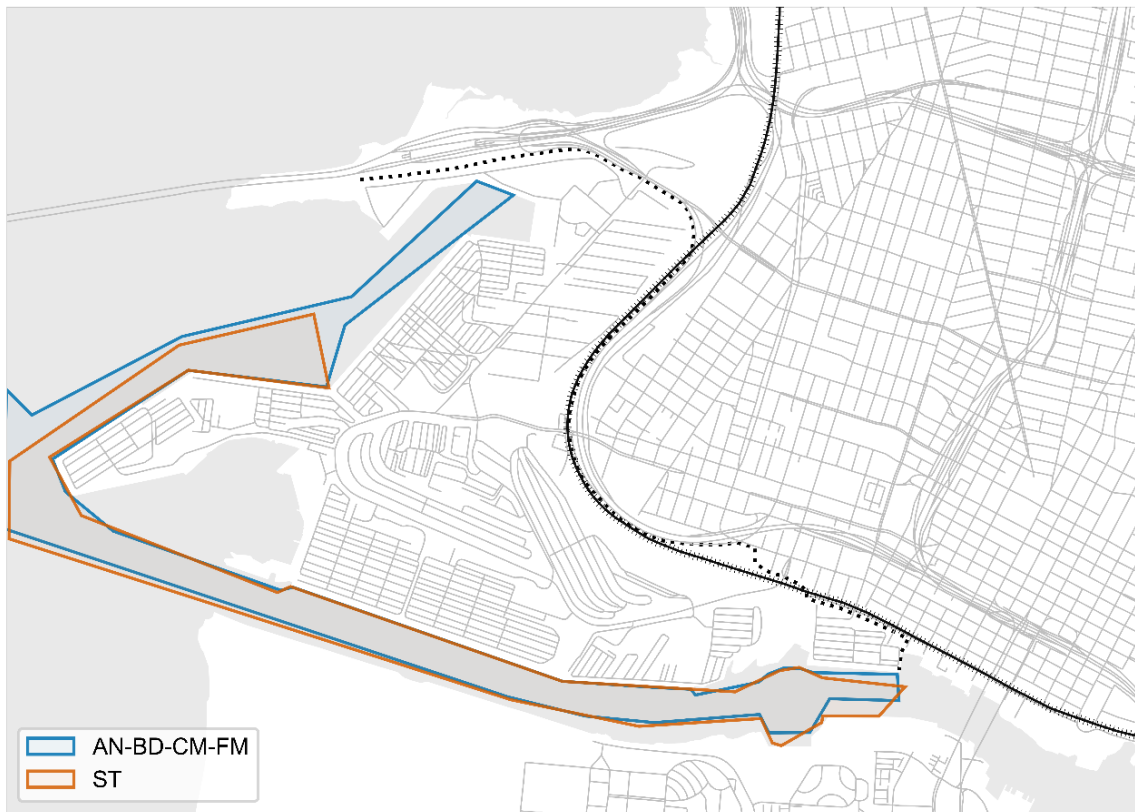


Figure 3-13. Area source polygons used to model emissions from assist tugs. Activity from AMNAV Maritime Services, BayDelta, Crowley, and Foss Maritime (AN-BD-CM-FM), and Starlight Marine Services (ST) were modeled separately.

3.4.7 Cargo handling equipment

Emissions from CHE were assigned to areas encompassing four terminals at the Port operating in 2017 (Figure 3-14). Emissions from CHE in the BNSF railyard were also accounted for. Based on California Air Resources Board (2008a), a release height of 5.5 m and an initial vertical dispersion coefficient of 2.558 m was used. The operating hours (Table 2-23) were used to develop temporal profiles for AERMOD dispersion modeling.

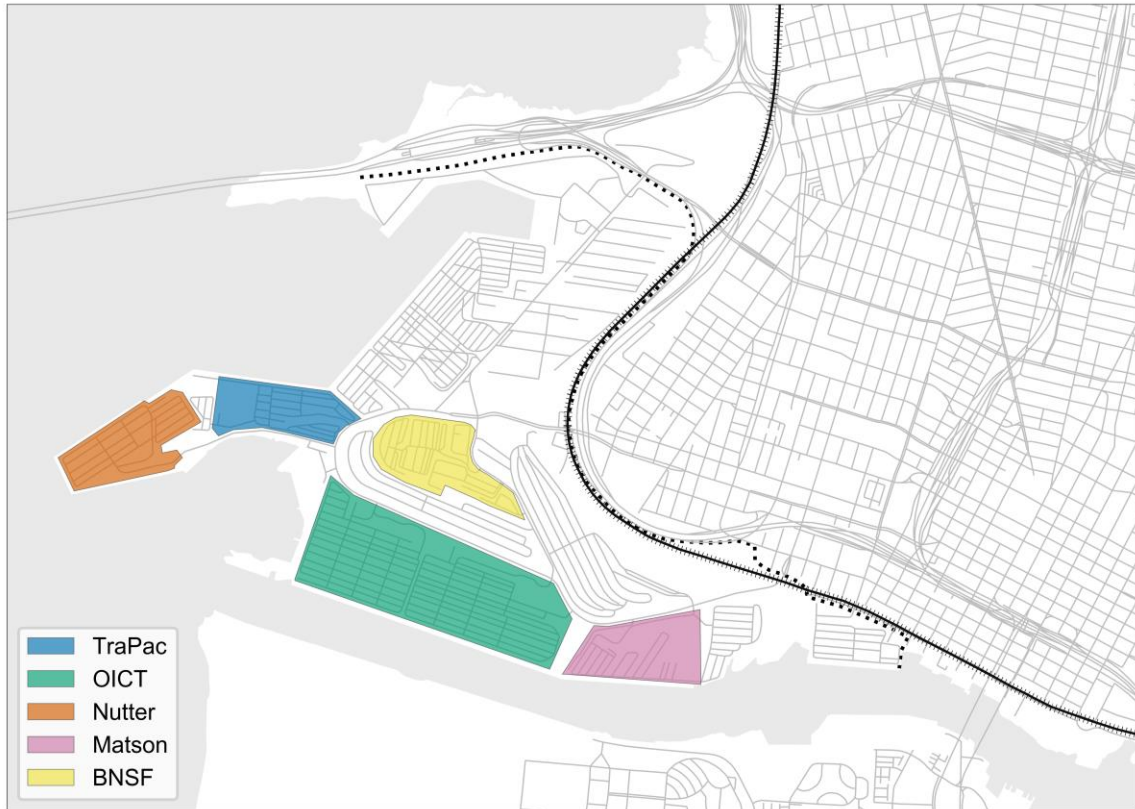


Figure 3-14. Area source polygons used to model emissions from CHE.

3.4.8 Port Trucks at Terminals

Emissions from Port Trucks operating within port terminals were assigned to source areas defined for BNSF Railyard (see Figure 3-16) and the same source areas defined for CHE (Figure 3-14). The same dispersion modeling parameters as CHE were used for Port Trucks ($Relhgt = 5.500$ m, $Szinit = 2.558$ m), as well as the same operating hours to temporally distribute the emissions (Table 2-23).

3.4.9 Locomotives (Rail Lines)

Emissions from locomotives on consolidated rail lines⁶² in West Oakland were modeled as adjacent volume sources. A shapefile containing the geographic location of six rail lines in the West Oakland was used, which includes rail line segments with activity from BNSF and Amtrak. Volume source locations were developed using the algorithm described in Section 3.4.1(c), with a width of 6.25 m (width of locomotives plus wake effects). The release height of the locomotives was assumed to be 4.78 m (locomotive stack height). *Syinit* and *Szinit* were determined based on the equations used for on-road mobile sources (Section 3.4.3): *Syinit* = 2.9070 m, and *Szinit* = 3.7795 m. Emissions were assumed to be constant in time.

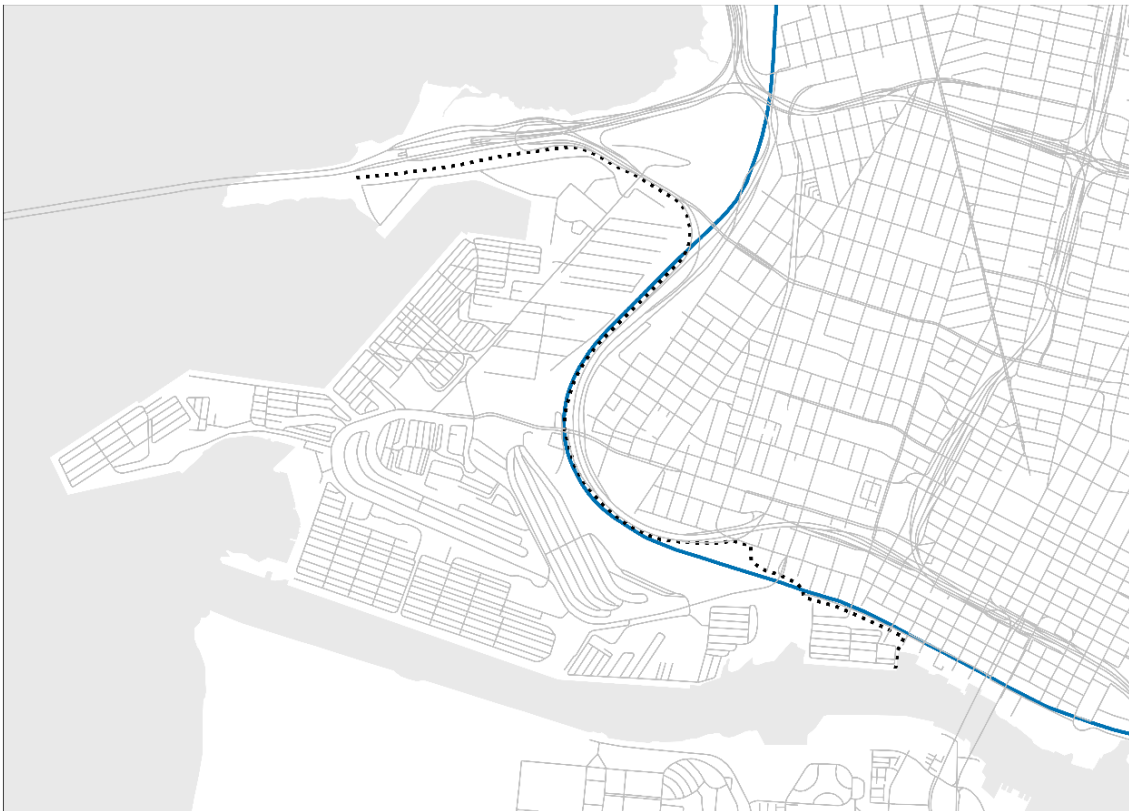


Figure 3-15. Locations of adjacent volume sources used to model emissions from locomotives. The size of the markers does not reflect the dimensions of the volume sources.

⁶² For simplicity, emissions from all rail services (passenger, freight) were consolidated to single rail lines, which were then modeled in AERMOD. See Section 2.9 for further information.

3.4.10 Railyards

Emissions from three railyards were modeled as area sources (Figure 3-16). The BNSF and OGRE railyards are considered part of the Port, while the Union Pacific (UP) railyard is a separate entity. A release height of 4.78 m was used for locomotives operating at each of the railyards. *Szinit* was set to 3.7795 m, based on the equations for on-road mobile sources (Section 3.4.3). Emissions were assumed to be constant in time.



Figure 3-16. Area source polygons used to model emissions from locomotives in railyards.

3.4.11 Commuter Ferries and Excursion Vessels

Emissions from commuter ferries and excursion vessels were modeled using adjacent volume sources; all parameters were the same for both types of vessels. A network of ferry routes was developed using satellite imagery (Figure 3-17), and volume source locations were determined using the algorithm described in Section 3.4.1(c). Guidance used for on-road mobile source emissions (Section 3.4.3) were also used to determine modeling dispersion parameters for commuter ferries and excursion vessels. A width of 10.56 m was used, based on the weighted average beam of the vessels in the commuter ferry fleet.⁶³ The release height was calculated as 9.0695 m, based on a stack height of 10.67 m (35 ft).⁶⁴ The resulting dispersion parameters were:

⁶³ Obtained from the WETA San Francisco Bay Fleet information at <https://sanfranciscobayferry.com/sites/default/files/SFBFfleet.pdf> (accessed December 2018).

⁶⁴ In 2017, the exhaust stacks on the types of commuter ferries operating from Oakland and Alameda were above passenger decks.

$Sy_{init} = 4.9209$ m, and $Sz_{init} = 8.4367$ m. Emissions for commuter ferries were temporally allocated based on their operating schedules by day of week,⁶⁵ this reflects only the operating hours of the ferries and not necessarily the level of activity by hour. Because of the variable schedule of excursion vessels, emissions were assumed to be constant in time.

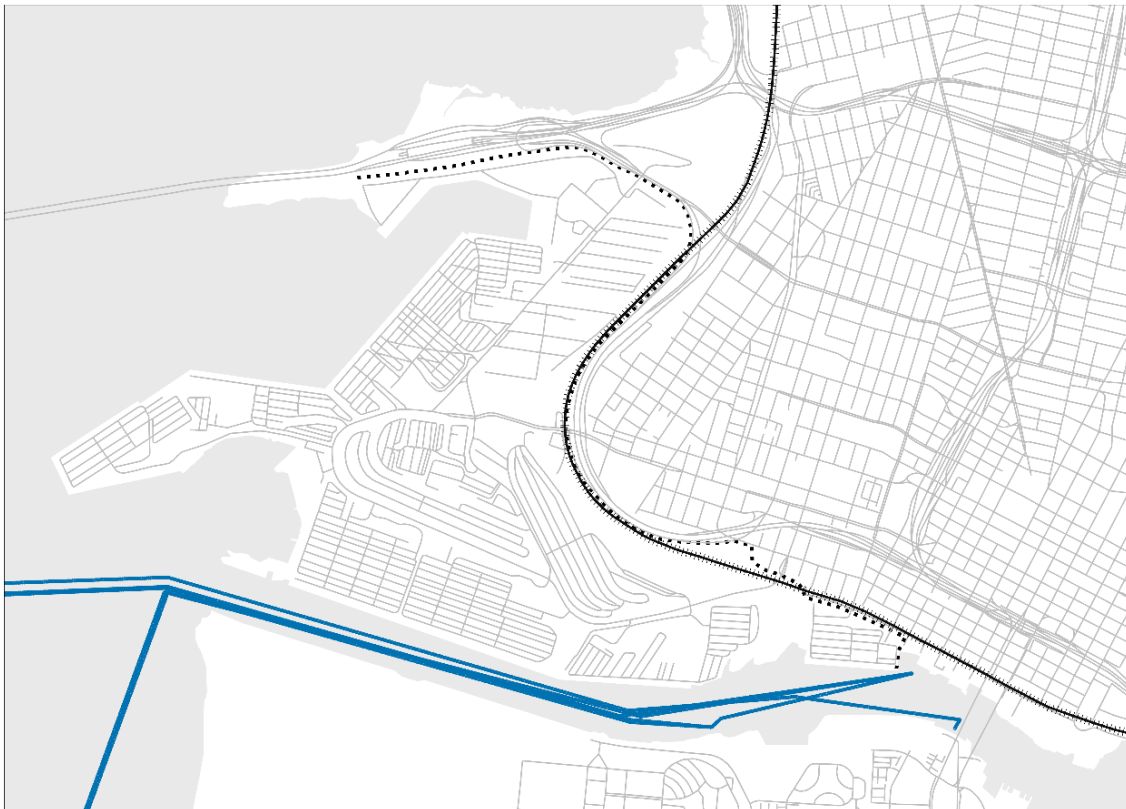


Figure 3-17. Locations of adjacent volume sources used to model emissions from commuter ferries and excursion vessels. The size of the markers does not reflect the dimensions of the volume sources.

Within the Source Domain, there are berths for both commuter ferries and excursion vessels. Emissions from ferry berths were modeled as area sources for AERMOD dispersion modeling (Figure 3-18). Because of the orientation of the exhaust stacks on some vessels, the release height was set to the physical height of the stack ($Relhgt = 10.67$ m). Since berthing vessels are stationary, the initial vertical dispersion coefficient was calculated using $\gamma = 1$ (i.e., there is no motion-induced turbulence that will increase initial dispersion), resulting in $Sz_{init} = 4.9620$ m.

⁶⁵ Based on the WETA San Francisco Bay ferry schedule (effective January 7, 2019) <https://sanfranciscobayferry.com/sites/sfbf/files/masterschedule010719.pdf> (accessed February 2019). The temporal allocation is based on operating hours; it was assumed that the operating hours were similar to those in 2017–2018.



Figure 3-18. Area source polygons used to model emissions from ferries and excursion vessels at berths.

3.5 Receptors

A master receptor grid was generated with receptors spaced every 20 m in the x and y directions within the Receptor Domain (Figure 3-3), resulting in 52,671 discrete cartesian receptors.⁶⁶ A spacing of 20 m was deemed sufficient to resolve the spatial concentration gradients around small emissions sources (e.g., roadways) and the spacing of city blocks, which are on the scale of tens of meters; it is also consistent with the “dense” spacing suggested for a PM hot-spot analysis around roadways (U.S. Environmental Protection Agency 2015b).

As mentioned, the height of each receptor was set to 1.8 m agl. AERMAP was run to assign terrain elevations (m asl) and hill height scales to each receptor from Shuttle Radar Topography Mission (SRTM) digital terrain data (with an approximate resolution of $30\text{ m} \times 30\text{ m}$ within $1^\circ \times 1^\circ$ tiles), which are used to determine the dispersion of plumes in the vicinity of topographic features. The West Oakland area is relatively flat, where elevation is near sea level close to the Bay, and slopes upward gently towards the East (Figure 3-19).

⁶⁶ While the Source and Receptor Domains must align between models, the projections used are different (UTM in AERMOD, and Lambert conformal conic in CMAQ). Additional receptors were initially modeled (totaling 56,658 receptors), and then filtered so that only those within the Receptor Domain were used in subsequent analyses.

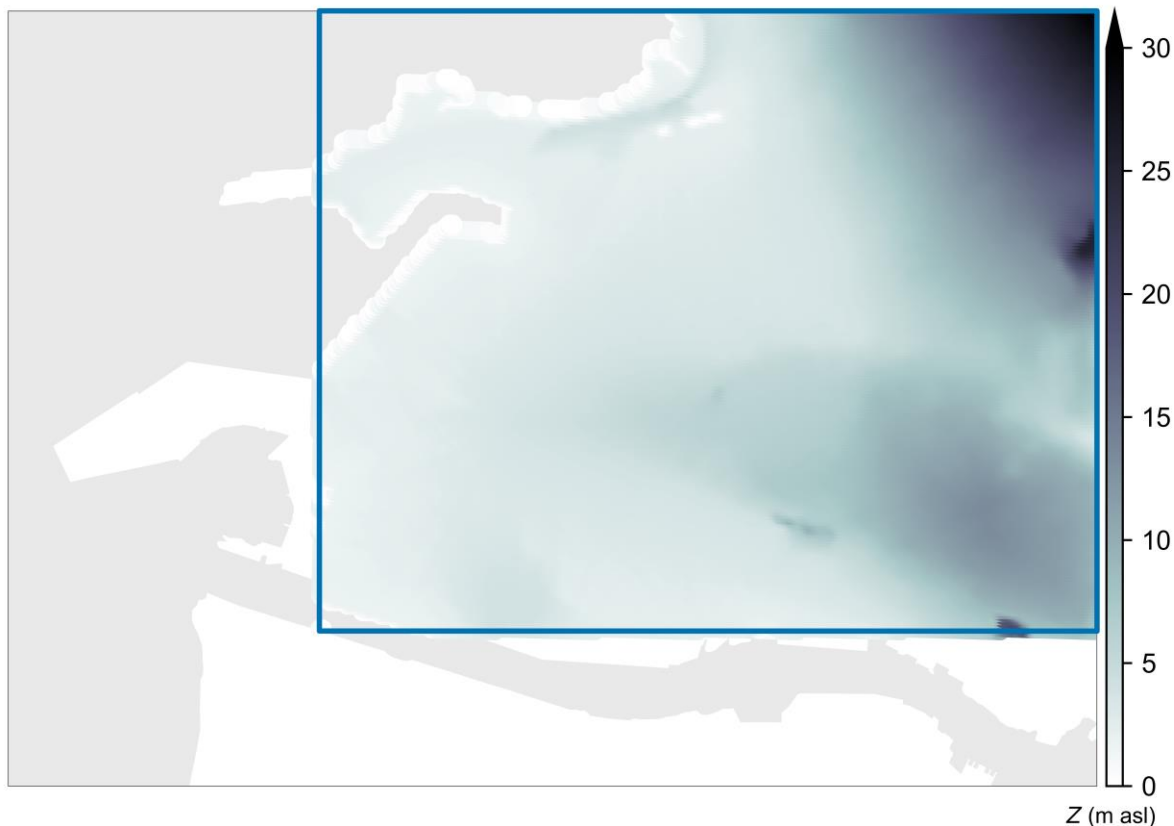


Figure 3-19. Elevation based on SRTM digital terrain data processed through AERMAP. Elevations are assigned to receptor locations only within the West Oakland Receptor Domain (blue polygon).

For emission sources modeled as point or area sources, the entire master receptor grid was used. For emission sources modeled as volume sources, individual receptors were removed from the master grid where they intersected a volume source EZ (Section 3.4.1(c)); results were imputed to these locations in a post-processing step (see Section 4.4.1).

3.6 Background Concentrations

AERMOD provides estimates of pollutant concentrations associated with local sources in West Oakland. However, total pollutant concentrations in the community are also impacted by regional emissions sources that are located in other parts of Alameda County, the Bay Area, and beyond. To account for the impact of these regional emission sources on air pollutant concentrations in West Oakland, the U.S. EPA’s Community Multi-scale Air Quality (CMAQ) model was applied at a 1-km grid resolution over the entire Bay Area (Figure 3-20). CMAQ is a complex photochemical grid model that simulates physical and chemical processes in the atmosphere to predict the airborne concentration of gases and particles, as well as the deposition of these pollutants to Earth’s surface. CMAQ requires two primary types of input data: (1) meteorological information such as temperature, wind speeds, and precipitation rates; and (2) emissions estimates for all anthropogenic and natural emission sources in the modeling domain.

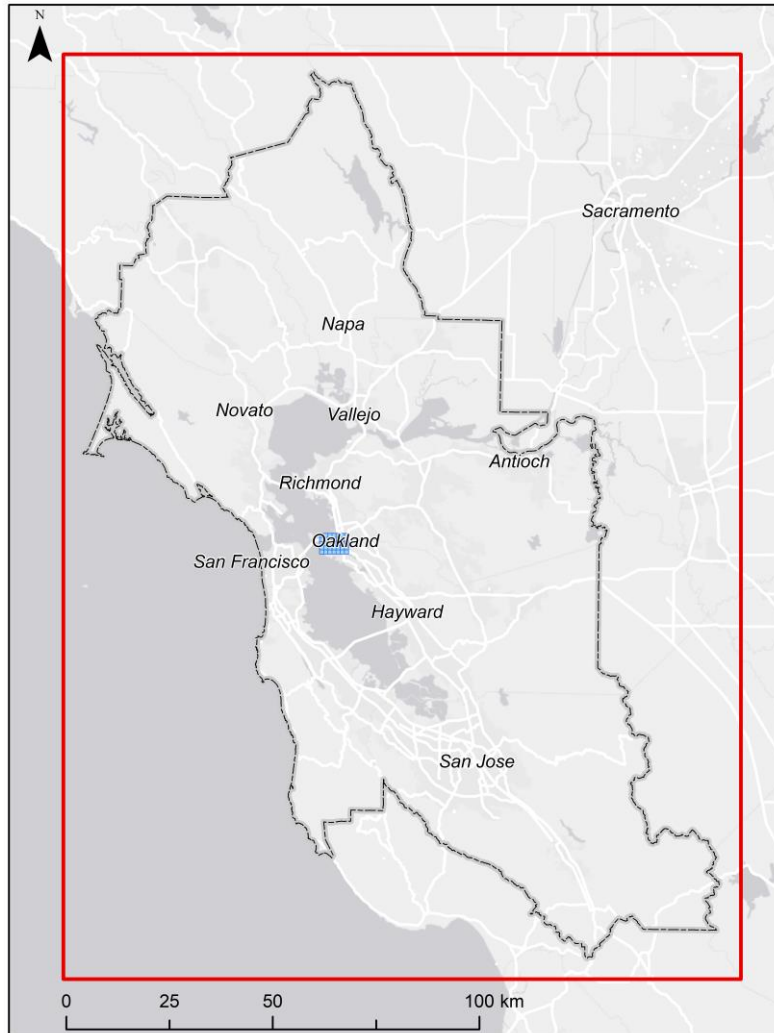


Figure 3-20. Regional-scale modeling domain (red rectangle). The subset of grid cells that comprise the community-scale (AERMOD) modeling are indicated by blue squares. The extents of the BAAQMD are also outlined (grey dashed line).

Meteorological inputs for CMAQ were prepared using the Weather Research and Forecasting (WRF) model version 3.8 (Skamarock *et al.* 2008). The WRF model configuration was tested using available physics options, including planetary boundary layer processes, strategies for assimilating meteorological measurement data into the simulations, horizontal and vertical diffusion parameters, and advection schemes. The final choice of options was the one that proved to best characterize meteorology in the domain based on a statistical evaluation. WRF model performance was evaluated by comparing model outputs to available meteorological data from the EPA’s Air Quality System (AQS), the District’s meteorological network, and the National Centers for Environmental Information (NCEI, formerly the National Climate Data Center [NCDC]). These comparisons were conducted by using the METSTAT program⁶⁷ to statistically evaluate the performance of WRF using established metrics such as bias, gross error, root mean square error

⁶⁷ version dated December 9, 2013; retrieved from Ramboll Environ: <http://www.camx.com/download/support-software.aspx>

(RMSE) and index of agreement (IOA). WRF's performance was determined to be within established criteria for these metrics for every day of 2016.

Emissions inputs for CMAQ were assembled from a variety of data sources, including the District's estimates, emissions data from CARB, outputs from CARB's EMFAC2017 model, and outputs from EPA's Biogenic Emission Inventory System (BEIS) version 3.61. These emissions data were processed through the Sparse Matrix Operator Kernel Emissions (SMOKE) processor (Houyoux and Vukovich 1999) version 4.5⁶⁸ to develop CMAQ-ready emissions inputs for each day of 2016. SMOKE uses a variety of processing steps to convert "raw" emissions data to the spatial, temporal, and chemical resolution required by CMAQ or an equivalent air quality model. For example, SMOKE disaggregates TOG and PM_{2.5} emissions into a series of model species that CMAQ uses to represent atmospheric chemistry.

For the Bay Area regional modeling, speciation profiles developed for the SAPRC-07 chemical mechanism were applied to TOG emissions from all sources, and profiles developed for the AERO6 aerosol module (AE6) were applied to PM_{2.5} emissions from all sources. The SAPRC-07 mechanism treats some toxic species explicitly, including acetaldehyde, benzene, and formaldehyde, while others are lumped into model species that act as surrogates for multiple compounds with similar mass and reactivity. Therefore, existing SAPRC-07 speciation profiles were modified to treat additional air toxics (acrolein and 1,3-butadiene) explicitly. In addition, AE6 profiles were modified to track DPM emissions separately from other PM emissions. Lastly, emissions estimates for five trace metals that are not included in the AE6 mechanism (cadmium, hexavalent chromium, lead, mercury, and nickel) were taken from EPA's 2014 National Air Toxics Assessment (NATA) inventory.

Once all inputs were prepared, CMAQ version 5.2 (U.S. Environmental Protection Agency 1999) was run to simulate PM_{2.5} and TAC concentrations for the Bay Area for 2016. CMAQ model performance was evaluated by comparing model outputs to available ambient data from the District's Data Management System and the EPA's AQS. Various statistical metrics were used to evaluate the performance of CMAQ, in keeping with EPA's latest modeling guidance (U.S. Environmental Protection Agency 2018a). The CMAQ model performed reasonably well, meeting the performance goals proposed by Boylan and Russell (2006) and criteria by Emery *et al.* (2017), two well-known references for PM model evaluation. The model also showed reasonable agreement with the limited air toxics observations that were available for comparison.

The modeling framework was run (a) with emissions in the West Oakland Source Domain to obtain the total concentrations over the community and perform the model evaluation, and then (b) without emissions to provide an estimate of background pollutant levels in West Oakland. From (b), CMAQ results for the 1-km grid cells in the West Oakland Receptor Domain were extracted and analyzed to develop average background concentration values for the community. The background values for PM_{2.5}, DPM, and cancer risk, which represent expected levels in the absence of any local emissions in West Oakland, are summarized in Table 3-3.

⁶⁸ For further information and technical documentation, see https://www.cmascenter.org/smoke/documentation/4.5/manual_smokev45.pdf

Table 3-3. Background pollutant concentrations and cancer risk for West Oakland. Values are derived as an annual average across all grid cells in the Receptor Domain.

Parameter	Value	Units
PM _{2.5} concentration	6.9	µg/m ³
DPM concentration	0.46	µg/m ³
Cancer risk	421	Additional cancer cases per million people

Additional information on the CMAQ simulations are available in separate reports on the District's 2016 PM_{2.5} modeling (Tanrikulu *et al.* 2019a) and air toxics modeling (Tanrikulu *et al.* 2019b).

4. Analysis Methods

In this section, the methods applied to determine pollutant concentrations and cancer risk from emission sources that were identified, quantified, and provided as inputs to dispersion models are outlined. The approach used to aggregate and display the results are also described.

4.1 Estimating Pollutant Concentration and Cancer Risk

4.1.1 Totals at Receptors

The total of a quantity at a receptor can be calculated by summing the contributions from all sources; based on the community-scale (AERMOD) dispersion modeling, this represents the local contribution to a total quantity, as in Figure 1-2. This can also be expressed mathematically; that is, the *incremental contribution* from a specific emissions source s_j (where j is the index of any individual source modeled in AERMOD) to the total of quantity Y (which may a dispersion factor, F ; pollutant concentration, C_p ; or cancer risk, *risk*) at a receptor r_i (where i is a location index, and r_i is located at coordinates (x_i, y_i, z_i) , and $z_i = 1.8$ m at all receptors in this analysis) can be denoted as: $Y_{ij} \equiv Y(r_i, s_j)$. The total quantity of Y_i is then the sum over all contributions from all sources:

$$Y_i = \sum_j Y_{ij}$$

However, as previously explained, individual receptors were removed from the master “grid” (a set of receptors placed every 20 m) where they intersected a volume source EZ (used for modeling on-road mobile sources, locomotives along rail lines, and commuter ferries and excursion vessels). This means that if using only the direct model outputs, at some receptors, Y_i can only be partially summed over all sources because the incremental contribution from some sources was not sampled at r_i . Therefore, dispersion factors were imputed at locations of receptors from the master grid that were removed for AERMOD modeling in these instances. Because the receptors that were removed from EZs are likely in areas of high concentrations (since they are closest to emission sources), values at receptors were imputed using the local maximum dispersion factors from a set of $k_{max} = 8$ closest receptors filtered within a distance (radius) of $d_{max} = 28.78$ m (the maximum diagonal distance between two receptors plus 0.5 m); the final number of receptors is therefore $k \leq k_{max}$. If no receptors were available within d_{max} , the value was imputed using the IDW with a power value of two (i.e., inverse distance squared weighting, IDW2) from the k_{max} (or $k \leq k_{max}$ if only k receptors were defined) nearest receptors. The resulting values at receptors could therefore be derived from a mix of local maxima and IDW2 interpolation.

To assess the air quality at receptors, the total pollutant concentrations of PM_{2.5} and DPM were calculated, as well as cancer risk. While the summation technique is identical, calculating the values of each quantity at each receptor requires additional information with respect to emission rates and toxicity, as detailed in the following sections.

4.1.2 Pollutant Concentration

The concentration of a pollutant at each receptor location was calculated for a modeled source by multiplying annual average emission rate of a pollutant from a source by the dispersion factor from the source. At each receptor r_i from each source s_j , the concentration of pollutant p is then:

$$C_{pij} = ER_{pj} \cdot F_i$$

where

- C_p = Annual average concentration for pollutant p ($\mu\text{g}/\text{m}^3$)
- ER_p = Annual average emission rate for pollutant p [$\text{g}/(\text{s m}^2)$ for area sources, g/s for point and volume sources]
- F = Dispersion factor, concentration per unit emission rate [$(\mu\text{g}/\text{m}^3)/(\text{g}/(\text{s m}^2))$ for area sources, $(\mu\text{g}/\text{m}^3)/(\text{g}/\text{s})$ for point and volume sources]

The concentration contributions can then be summed over all sources at a receptor to obtain the total concentration from local sources.

4.1.3 Cancer Risk

Cancer risk is the incremental probability that an individual will develop cancer over a lifetime as a direct result of exposure to potential carcinogens from anthropogenic sources. The estimated risk is a unitless probability, often expressed as the number of people who might experience cancer per million people who are similarly exposed (a value “in-a-million”). Chemical species included in the dose calculate include acrolein, benzene, DPM, ethylbenzene, hexane, naphthalene, toluene, and xylene, among others (see Attachment 1); the type of TAC emitted depends on the emissions source.

The risk assessment method used here follows guidelines from the California EPA (CalEPA) Office of Environmental Health Hazard Assessment (OEHHA) and the risk management guidance for stationary sources adopted by the CARB and the California Air Pollution Control Officers Association (CAPCOA). Cancer risk was calculated over an assumed 70-year lifetime by multiplying the annual average chemical concentrations of TACs by the chemical intakes and chemical-specific cancer potency factors (CPFs)⁶⁹ (Attachment 1). The chemical concentrations were modeled from the emission sources to the exposure point at the downwind locations (receptors). Contributions from all emissions sources (Section 2) were aggregated to determine the cumulative risk. The District assumed that all emissions sources would remain operational for 30 years at the same level of emissions (the District has previously adjusted emissions for certain source categories where operations will be phased out); the District also assumed that emission factors for on-road mobile sources do not change in future years. The resulting analysis therefore represents a ‘snapshot’ of the level of cancer risk that would result from the base year emissions.

⁶⁹ A CPF is a chemical-specific “theoretical upper bound probability of extra cancer cases occurring in an exposed population assuming a lifetime exposure to the chemical” (Office of Environmental Health Hazard Assessment 2015).

The chemical intake or *dose* describes the frequency and duration of the exposure, estimated using the breathing rates, exposure durations, and exposure frequencies. In accordance with OEHHA’s revised health risk assessment guidelines (Office of Environmental Health Hazard Assessment 2015), the intake methodology was updated to address children’s greater sensitivity and health impacts from early exposure to carcinogenic compounds. The updated calculation procedures include the use of age-specific weighting factors, breathing rates, fraction of time at home, and reduced exposure durations. Each factor is described below:

- Age Sensitivity Factors (ASFs) account for the heightened sensitivity of children to carcinogens during fetal development and early childhood. Consistent with OEHHA, the District uses ASF values as listed in Table 4-1. The District has incorporated ASFs in its air permits since 2010.
- Daily Breathing Rate (DBR) is the age-specific daily air intake. OEHHA developed a range of rates for four age groups: last trimester to newborn, newborn to two years of age, two years to 16 years of age, and older than 16 years of age. CAPCOA and CARB recently recommended the use of 95th percentile breathing rates for the most sensitive age group (less than two years of age) and 80th percentile for all other age groups.
- Fraction of Time at Home (FAH) refers to the estimated amount of time residents stay at home. In past HRAs, the District assumed that residents are home 24 hours per day, 7 days per week. In the 2015 Risk Assessment Guidance, OEHHA recommends less than 100% of time to be used as a FAH based on population and activity statistics. Consistent with OEHHA, this analysis incorporates a FAH of 0.73 for individuals ≥ 16 years old and 1.0 for individuals < 16 years old to address exposures at local schools in close proximity to emitting facilities.
- Exposure Duration (ED) is the length of time an individual is continuously exposed to air toxics. Previously, the District used a 70-year lifetime exposure duration for residents over a 70-year lifespan. Based on updated demographic data, the District follows the OEHHA recommendation of a 30-year exposure duration, consistent with US EPA, for residents.

The values of these factors are summarized in Table 4-1.

Table 4-1. Factors used to calculate chemical intake, based on a 30-year average. Age intervals are left-bounded.

Factor	Unit	Age Groups			
		Last Trimester to Newborn	0 – 2 years old	2 – 16 years old	16 – 30 years old
DBR	L/(kg day)	361	1090	572	261
ASF	unitless	10	10	3	1
FAH	unitless	1	1	1	0.73
ED	years	0.25	2	14	14

The equation used to calculate the dose for the inhalation pathway of a pollutant p is as follows:

$$dose_{pij} = \frac{1}{AT} \left[c \cdot ef \cdot \sum_y^{30 \text{ years}} C_{pijy} \cdot DBR_y \cdot FAH_y \cdot ED_y \cdot ASF_y \right]$$

where

- $dose_p$ = accumulated dose for an individual breathing pollutant p for 30 continuous years [mg/(kg day)]
- AT = averaging time [25,550 days, equivalent to 70 year lifespan]
- c = conversion factor [10^{-6} (mg/m³)/(μg/L)]
- ef = exposure frequency (350 days per year⁷⁰)
- C_{py} = annual average concentration of pollutant p during year y [μg/m³]
- DBR_y = daily breathing rate during year y [L/(kg day)]
- FAH_y = fraction of time at home during year y [unitless]
- ED_y = exposure duration of year y [years]
- ASF_y = age sensitivity factor for year y [unitless]

The cancer risk from a pollutant (p) at a receptor (i) from a specific source (j) is equal to the dose multiplied by the chemical-specific inhalation CPF (Attachment 1):

$$risk_{pij} = CPF_p \cdot dose_{pij}$$

In most cases, CPF specific for the inhalation pathways were used. However, some chemicals, in addition to being inhaled, can deposit on the ground in particulate form and contribute to risk through ingestion of soil or through other routes. To account for the additional risks from exposure to non-inhalation pathways, multi-pathway CPFs were used where available from OEHHA. Risks were not estimated for chemicals lacking OEHHA approved toxicity values.

The total cancer risk is then the sum of the pollutant-specific risk values (p). These can be further summed over all emission sources (j).

4.2 Spatial Distributions and Source Apportionment

4.2.1 Source Apportionment

As modeling was performed for each emissions source separately (Section 3.1), the contributions from each source s_j to the quantity Y_i at each receptor r_i can be tracked and then compared to those contributions from other sources; this is generally termed a *source apportionment*. In this analysis, the results are already apportioned to sources by virtue of running each source individually in AERMOD.

⁷⁰ An ef of 350 days per year was used, which represents the number of days an individual will reside in their home less approximately two weeks of vacation. This value is consistent with current OEHHA and EPA guidance.

Furthermore, rather than examine the contributions at receptors from each individual source (e.g., a single generator, on-road mobile sources on individual roadways), contribution can be examined from *source categories* (e.g., permitted stationary sources, passenger vehicles on freeways). Sources within a source category may be similar in how they are managed or regulated, their emissions processes, their geographic locations, or are of particular research interest. An individual source can only belong to a single source category. Then, the total of a quantity at a receptor can be expressed as the sum of contributions from different source categories s_j , as:

$$Y_{ij} = \sum_{j \in J} Y_{ij}$$

and $Y_i = \sum_J Y_{ij} = \sum_j Y_{ij}$

4.2.2 Interpreting Map Products

Annual average PM_{2.5}, DPM, and cancer risk in West Oakland are presented in a series of maps and map-based products (tables and charts at different locations within the domain). When drawing conclusions from maps, it is important to consider the assumptions used to derive the underlying data.

Specifically, the maps were derived from air dispersion modeling that were used to calculate concentrations and cancer risk estimates from direct emissions. The maps themselves, therefore, portray concentrations associated with directly emitted PM_{2.5} and DPM, as well as cancer risk associated with directly emitted TACs. The results do not reflect regional or long-range transport of air pollutants, nor the effects of the chemical transformation (formation or loss) of pollutants. However, some discussion of background concentrations resulting from those processes is provided (Section 3.6).

Finally, output from AERMOD at receptors represents a value sampled at a single point in space; that is, the values are not averages over grid cell volumes (as output from models such as CMAQ). Therefore, while results at regularly spaced receptors can be mapped as “grid cells” (raster), the values do not necessarily represent the average value over the area of the “grid cell.” The results at receptors also reflect the choice of flagpole receptor height (1.8 m); while some sources may emit a large quantity of pollutants, these pollutants may not necessarily impact receptors near ground-level if the release heights are much higher.

4.2.3 Spatial Aggregation

Receptors were placed every 20 m within the Receptor Domain to adequately capture concentration gradients around various sources. Results can be plotted as “grid cells” centered at each receptor. However, results summarized at larger spatial scales can be more useful when examining population exposures or proposed mitigation measures.

In this analysis, spatially aggregated results were generated by computing the arithmetic average within specific polygons, i.e., the sum from all source categories over all receptors within the

polygon divided by the number of receptors. If a polygon contains a subset of receptors $n = |I|$ ($r_{i \in I}$), then:

$$Y_{IJ} = \frac{1}{n} \sum_{i \in I} Y_{iJ}$$

and $Y_I = \sum_J Y_{IJ}$

Three types of spatial aggregation polygons were used, and further details of how they were defined are discussed below:

- (1) **Hexagons** were used to form a complete “hexagon grid” of adjacent regular hexagons with a long diagonal of 100 m (incircle radius of 43.3 m);
- (2) **Zone polygons** covering seven areas in the West Oakland community (Figure 4-1).⁷¹ Within these zones, results were also presented as pie charts, where source categories were further aggregated for simplicity (Highways, Surface Streets, Port, Rail, Permitted, and Other); and
- (3) **Census blocks** within the West Oakland community were namely used to obtain a population-weighted result (or “residential impact”). Population-weighted results can help emphasize how air pollution affects areas where residents live. For this approach, the TIGER polygons from the 2010 Decennial Census were used with corresponding 2010 population (Figure 4-2), and results were weighted by the population within the polygon as a proportion of the total population summed across all polygons.⁷²

Results based on source category and spatial aggregations were combined into interactive maps, which can be used to represent the spatial variation of pollutant concentrations and cancer risk across West Oakland, and to represent the spatial variation of the incremental contributions from different source categories across West Oakland. Taken together, these results are intended to aid local planning efforts by identifying areas or sources where emission reductions may be needed and by providing information on the sources which are contributing to air quality impacts at specific receptor locations.

⁷¹ These locations were selected in consultation with project co-leads and generally represent areas where pollutant concentrations are known to be elevated based on previous research and/or sensitive receptors.

⁷² Although the absolute population of West Oakland has changed since 2010, the population-weighted results only depend on the relative spatial distribution of population among census blocks. Relative changes in this distribution during inter-decennial years (2011–2019) are difficult to estimate accurately; population data at the block level are not published as part of inter-decennial Census products (e.g., American Community Survey).

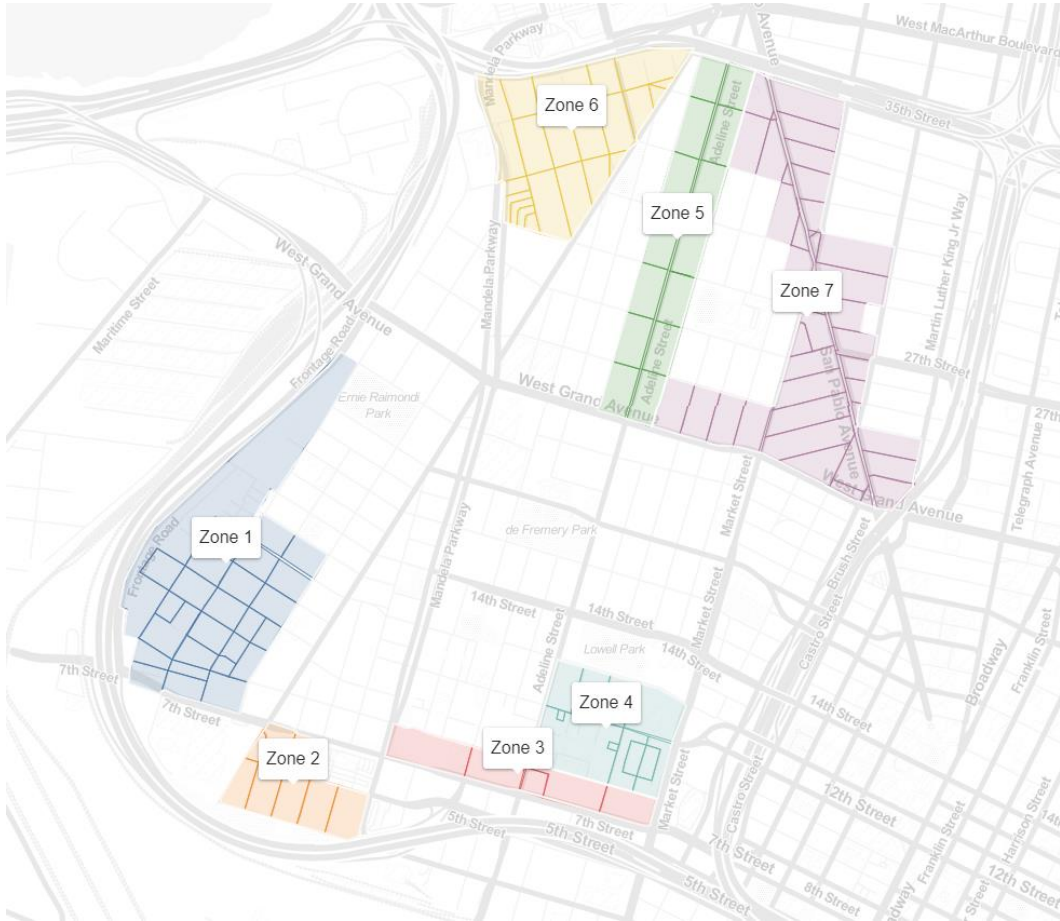


Figure 4-1. Zones in the West Oakland community used to assess air quality in this study: 1: Lower Bottoms / West Prescott, 2: 3rd Street, 3: 7th Street, 4: Acorn, 5: Upper Adeline, 6: Clawson, 7: West Grand & San Pablo.



Figure 4-2. Percentage of total population by census block in West Oakland, based on 2010 Decennial Census data. Total population for the census blocks examined in West Oakland in 2010 was 33,561 (based on 1,029 census blocks). Only census blocks within the West Oakland community boundary are outlined (blue lines); census blocks with no population are not colored.

5. Results

Annual average PM_{2.5}, DPM, and cancer risk results derived from dispersion modeling are presented in this section in a series of maps. Additionally, a source apportionment is performed where information is provided on the relative contributions of the source categories described in previous sections: permitted stationary sources, on-road mobile sources (by road type and vehicle category), Port-related sources (e.g., OGVs, CHE), locomotives on rail lines and at railyards, and other sources (e.g., truck-related businesses). All results are presented with respect to the total emissions represented in the community-scale emissions inventory as noted in Section 2.1.5, unless otherwise specified.

5.1 PM_{2.5} Concentrations

Based on combined AERMOD results from all sources, the annual average PM_{2.5} concentration associated with local sources in the West Oakland averaged over the community domain⁷³ was 1.71 µg/m³, with concentrations exceeding 4 µg/m³ in areas that are proximate to large emission sources and roadways (Figure 5-1). This annualized value reflects an average of all receptors in the domain; when the calculation is weighted by population in Census blocks (i.e., residential areas), the annual average PM_{2.5} concentration increases slightly to 1.74 µg/m³, largely due to the higher levels of road dust emissions in the residential areas.

The average local PM_{2.5} concentration was 1.71 µg/m³, whereas the background concentration was 6.9 µg/m³ (Section 3.6), resulting in a total average PM_{2.5} concentration of 8.61 µg/m³. This value compares well with the annual average PM_{2.5} concentration of 8.7 µg/m³ measured at the West Oakland monitoring site (in 2016). Based on this modeling analysis, local sources account for about 19% of the annual average PM_{2.5} concentration in West Oakland.⁷⁴

5.2 DPM Concentrations

The annual average DPM concentration associated with local sources in the West Oakland was 0.39 µg/m³, with concentrations exceeding 1 µg/m³, namely in areas that are proximate to the Port and railyards (Figure 5-2). When the calculation is limited to receptors in residential areas, the annual average DPM concentration decreases to 0.25 µg/m³, as the highest DPM concentrations are generally near the Port rather than residential areas.

The average local DPM concentration was 0.39 µg/m³, whereas the background concentration (Section 3.6) was estimated as 0.46 µg/m³, resulting in a total average DPM concentration of 0.85 µg/m³ in West Oakland. Based on this modeling analysis, local sources account for about ~46% of the annual average DPM concentration in West Oakland.

⁷³ Results averaged over the “community domain” include all receptors within the Receptor Domain that intersect the Community Boundary (c.f. Figure 1-1, Figure 5-1). The Receptor Domain does not completely cover the Community Boundary; the areas that are excluded are mainly in the Port and over the Bay Bridge.

⁷⁴ This local contribution only accounts for directly emitted PM_{2.5} emissions. However, it is likely that the secondary formation of PM_{2.5} from precursor emissions in the West Oakland domain will largely occur beyond the boundaries of the domain.

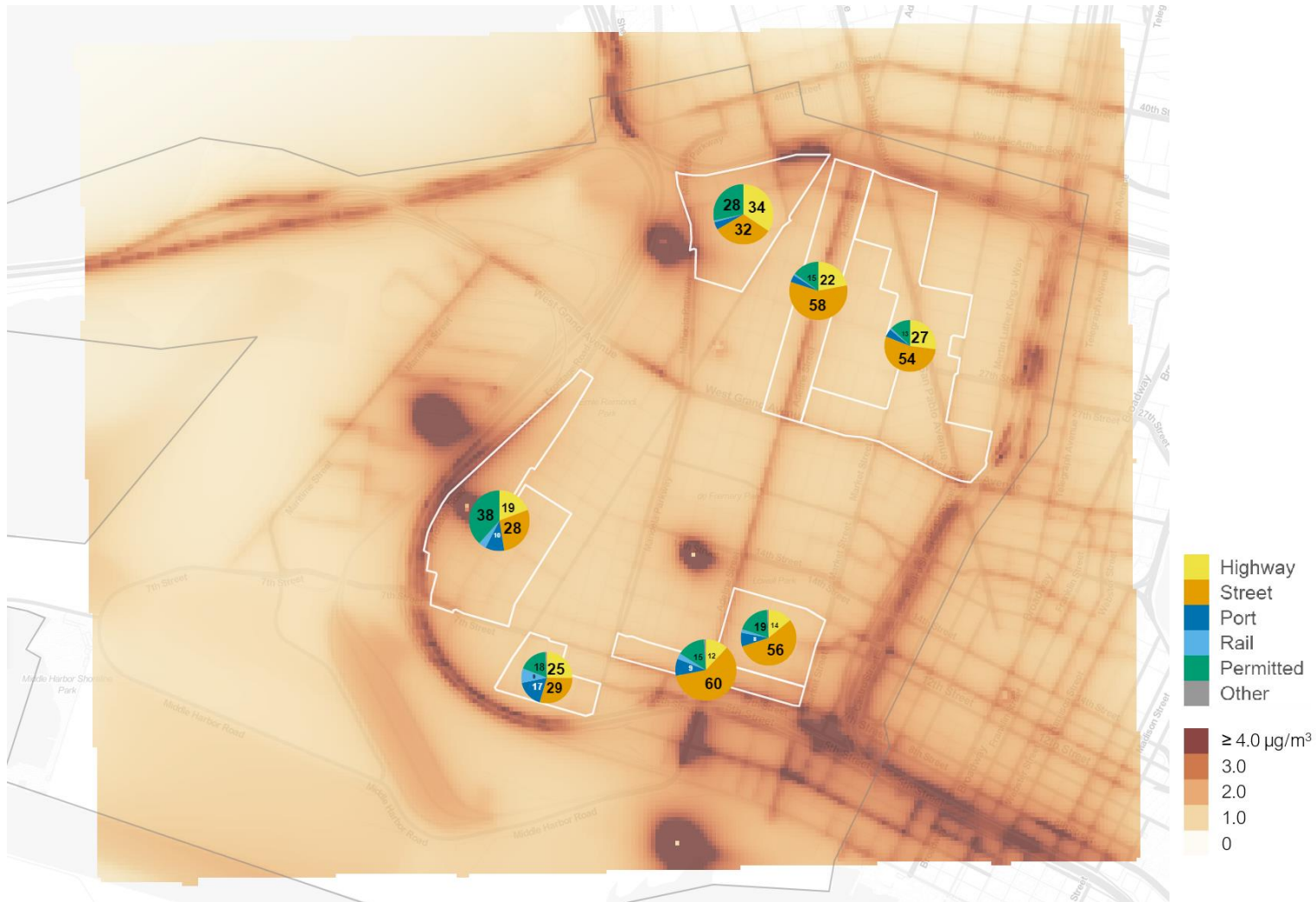


Figure 5-1. Annual average PM_{2.5} concentrations associated with local sources in the West Oakland Receptor Domain (colored extents). Pie charts indicate the percentage of concentrations contributed from specific Source Categories in each zone (white polygons, Figure 4-1); the size of the pie chart indicates the total magnitude of the concentration. The grey line indicates West Oakland Community Boundary.



Figure 5-2. Annual average DPM concentrations associated with local sources in the West Oakland Receptor Domain (colored extents). Pie charts indicate the percentage of concentrations contributed from specific Source Categories in each zone (white polygons, Figure 4-1); the size of the pie chart indicates the total magnitude of the concentration. The grey line indicates West Oakland Community Boundary.

5.3 Cancer Risk

Based on combined AERMOD results from all sources, the excess cancer risk associated with local emissions sources in the West Oakland Source Domain was 307 cases in-a-million people, with risk values exceeding 1,000 in-a-million in areas that are proximate large emission sources, especially those that emit high levels of DPM (Figure 5-3). Furthermore, the annual excess cancer risk decreases to 203 in-a-million when weighted by population, as the highest air toxic concentrations are generally near the Port and the Schnitzer Steel facility rather than residential areas.

The total excess cancer risk in West Oakland is than 728 in-a-million, based on a background value of 421 in-a-million (Section 3.6) and a local value of 307 in-a-million. Based on this modeling analysis, local sources account for about ~42% of the excess cancer risk in West Oakland.

5.4 Source Apportionment

To support source apportionment analyses, AERMOD results for all sources were combined in a series of interactive maps that allow users to click on a location of interest and view a tabular summary of the contributions of individual local sources to the PM_{2.5} concentration, DPM concentration, and excess cancer risk at that location. The percentage contribution from source categories to the domain-wide averages, and by location or zone were also generated (as depicted by the pie charts in Figures 5-1, 5-2, and 5-3).

Source contributions to the residential-weighted annual average PM_{2.5} concentration (1.71 µg/m³), annual average DPM concentration (0.39 µg/m³), and excess cancer risk (307 in-a-million) are tabulated by emissions source category in Table 5-1. For PM_{2.5}, the main sources include road dust, passenger vehicles (especially on highways) and MHDT/HHDTs. Some stationary sources (e.g., Pinnacle Ag Services, Schnitzer Steel) also contribute a comparable amount. For DPM and cancer risk, the main source include MHDT/HHDTs, assist tugs, OGVs, and locomotives and railyard activity.

Source contributions to local PM_{2.5} concentrations, DPM concentrations, and excess cancer risk within Zones in the West Oakland domain vary by location, and the interactive maps described above allowed users to investigate those variations. For example, while Zone 2 (3rd Street) and Zone 3 (7th Street) are close to each other (< 1 km), the proportions of difference source categories to the overall excess cancer risk within the zones varies considerably (Figure 5-3, Table 5-1).⁷⁵ Within Zone 2, key sources include those in the Port (especially assist tugs and OGVs) and rail (UP railyard and locomotives on rail lines). In contrast, within Zone 3, key sources include those in the Port (assist tugs and OGVs) and on-road mobile sources on surface streets (especially MHDTs/HHDTs).

⁷⁵ The results within two zones are presented here. Results at other sensitive receptors in West Oakland are available elsewhere.

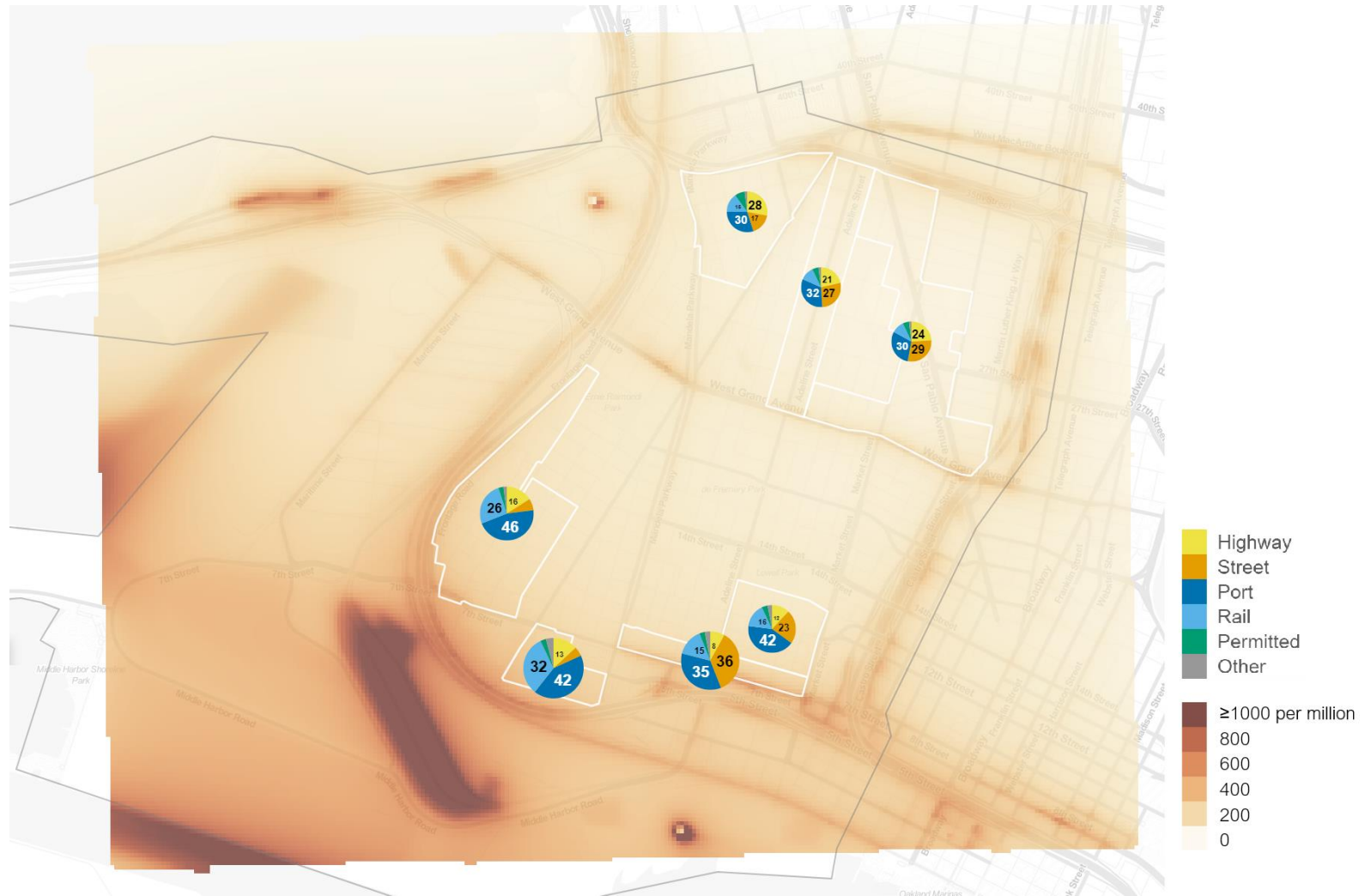


Figure 5-3. Annual average excess cancer risk associated with local sources in the West Oakland Receptor Domain (colored extents). Pie charts indicate the percentage of risk contributed from specific Source Categories in each zone (white polygons, Figure 4-1); the size of the pie chart indicates the total magnitude of the risk. The grey line indicates West Oakland Community Boundary.

Table 5-1. Source contributions to the annual average PM_{2.5} and DPM concentrations and excess cancer risk across residential areas in West Oakland. Port Truck contributions represent those from Port Trucks on all roads and within Port terminals.

Source Category	PM _{2.5}		DPM		risk	
	µg/m ³	% of total	µg/m ³	% of total	per million	% of total
Highway						
Non-Trucks	0.242	14	0.004	1	6.5	2
LHDT	0.009	1	0.002	1	1.6	1
MHDT/HHDT	0.058	3	0.043	11	32.6	11
Road dust	0.103	6	-	-	-	-
Surface Streets						
Non-Trucks	0.107	6	0.002	1	4.0	1
LHDT	0.005	< 1	0.001	< 1	1.1	< 1
MHDT/HHDT	0.038	2	0.029	7	22.2	7
Road dust	0.395	23	-	-	-	-
Port						
OGV – maneuvering	0.023	1	0.023	6	16.9	6
OGV – berthing	0.053	3	0.038	10	28.3	9
Dredging	0.020	1	0.020	5	15.0	5
Assist Tugs	0.068	4	0.070	18	51.9	17
Bunkering (tugs, pumps)	0.003	< 1	0.003	1	2.5	1
CHE	0.027	2	0.027	7	20.0	7
Port Trucks	0.065	4	0.012	3	9.5	3
Railyard – OGRE	0.004	< 1	0.005	1	3.5	1
Railyard – BNSF	0.009	1	0.010	3	7.5	2
Rail						
Locomotives	0.026	2	0.028	7	20.5	7
Railyard – UP	0.057	3	0.062	16	46.0	15
Permitted						
CA Waste (10th Street)	0.029	2	-	-	-	-
California Cereal	0.034	2	-	-	< 0.1	< 1
CASS	0.005	< 1	-	-	< 0.1	< 1
Dynegy	0.001	< 1	< 0.001	< 1	< 0.1	< 1
EBMUD	0.056	3	0.002	1	1.6	1
Pinnacle Ag Services	0.095	6	-	-	-	-
Schnitzer Steel – stationary	0.090	5	-	-	5.4	2
Sierra Pacific	0.054	3	-	-	-	-
Other	0.022	1	< 0.001	< 1	2.4	1
Other						
Ferry/Excursion vessels	0.006	< 1	0.006	2	4.7	2
Schnitzer Steel – OGV	0.002	< 1	0.002	1	1.6	1
Schnitzer Steel – trucks	0.001	< 1	< 0.001	< 1	0.2	< 1
Truck-related businesses	0.002	< 1	0.002	1	1.6	1
Total	1.709	100	0.392	100	307.1	100

Table 5-2. Source contributions to excess cancer risk within Zone 2 (3rd Street) and Zone 3 (7th Street). Values have been rounded and may not necessarily sum to the values indicated in the Total row. Port Truck contributions represent those from Port Trucks on all roads and within Port terminals.

Source Category	Zone 2		Zone 3	
	per million	% of total	per million	% of total
Highway				
Non-Trucks	5.2	1	3.9	1
LHDT	1.7	< 1	1.1	< 1
MHDT/HHDT	37.7	11	22.0	7
Surface Streets				
Non-Trucks	3.6	1	8.1	2
LHDT	0.9	< 1	2.6	1
MHDT/HHDT	13.9	4	108.3	33
Port				
OGV – maneuvering	19.9	6	15.6	5
OGV – berthing	32.9	9	24.6	7
Dredging	14.0	4	10.0	3
Assist Tugs	51.2	15	39.9	12
Bunkering (tugs, pumps)	2.4	1	1.7	1
CHE	10.6	3	5.6	2
Port Trucks	8.2	2	12.5	4
Railyard – OGRE	3.2	1	1.9	1
Railyard – BNSF	5.0	1	2.4	1
Rail				
Locomotives	36.7	11	21.0	6
Railyard – UP	76.2	22	26.7	8
Permitted				
EBMUD	0.8	< 1	0.9	< 1
Schnitzer Steel – stationary	7.3	2	7.5	2
Other	1.2	0	1.6	< 1
Other				
Ferry/Excursion vessels	6.1	2	5.6	2
Schnitzer Steel – OGV	2.6	1	2.2	1
Schnitzer Steel – trucks	0.3	< 1	0.3	< 1
Truck-related businesses	6.7	2	0.9	< 1
Total	348.3	100	326.9	100

6. Limitations, Uncertainties, and Future Improvements

In this analysis, the District qualitatively evaluated uncertainties associated with the data and methodologies used to create a bottom-up emissions inventory for the West Oakland community, the community-scale modeling approach using the AERMOD dispersion model, and the approach used to quantify air pollutant exposure, cancer risk, and perform the source apportionment. Such assumptions are inherent in efforts to characterize emissions and associated risk in complex settings and can result in or under- or over-predictions in concentration and risk estimates. While a quantitative analysis of the uncertainties may provide more useful information as to the potential variability of impacts, it was beyond the scope of this analysis,⁷⁶ especially given that uncertainties for emissions and modeling parameters are generally not available. A qualitative assessment of uncertainties can be useful as a component of a model evaluation, where the quality of the output information (emissions, dispersion factors, concentration and risk calculations) are determined. The following sections summarize common sources of uncertainty associated with the emissions estimation, air dispersion modeling, and risk estimation components of the risk assessment.

6.1 Emissions Inventory

There are several sources of uncertainty associated with the bottom-up estimation of emissions from each of the source categories that may affect the subsequent estimation of exposure concentrations and risk characterization. The District identified several emission sources categories where emissions estimates could be improvement.

6.1.1 Permitted Stationary Sources

The emissions inventory for permitted stationary source in West Oakland was developed using the District's 2017 CEIDARS report. Rather than following a traditional calendar or fiscal year, the District issues permits to facilities on a rolling 12-month period, and renews those permits every one to three years. Because of this, the emissions shown in the 2017 CEIDARS report may represent a facility's emissions from either 2015, 2016, or 2017. Uncertainties associated with the emission estimates also stem from throughput information, which varies from year to year, and the use of default emission factors. The District did attempt to correct emissions for the largest emissions sources (such as Schnitzer Steel) to better reflect the latest source test results and upcoming facility modifications. The District will continue to make improvements to the stationary source database by incorporating source test results as they become available, and by updating emissions factors as necessary

6.1.2 On-Road Mobile Sources

For on-road mobile emissions, uncertainties are primarily associated with link-specific traffic activity, especially fleet mix, and emission factors for Port Trucks, as well as tire wear, brake wear, and road dust.

⁷⁶ The District is performing a quantitative evaluation of AERMOD dispersion modeling results for black carbon in a separate study.

(a) Fleet Mix

Estimates of fleet mix by roadway link, represented as the fraction of trucks of the total fleet, have significant uncertainties. On surface streets, truck fraction information relied on traffic counts from only four counters over a limited period (1 week) in 2008; the fleet mix could therefore be outdated, and the data from these counter locations may not be representative of all surface streets. On highways, while truck fractions were derived from PeMS, which has higher spatial and temporal coverage (e.g., based on a full year of continuous measurements at several counter locations on each highway), the method of detection still has inherent uncertainties: single loop detectors were used to estimate truck volume based on lane-by-lane flow and occupancy at 5 min resolution, instead of actual truck counts measured by the Automatic Vehicle Classifiers (AVCs) using technologies such as weigh-in-motion (WIM). WIM-based truck traffic counts were available at a limited number of locations but only in 2010, and were therefore not used in this analysis.

The fraction of Port Trucks within the Truck 2 category (MHDTs and HHDTs) was derived using O-D analysis on the StreetLight platform. Data on this platform is GPS-based, and the District designed 49 gates to best capture Port Truck activity in the West Oakland community. There is uncertainty in both actual traffic counts (as no evaluation was performed) and the limited spatial coverage of gates selected.

For the West Oakland community, the VMT-based overall Port Truck fraction within the Truck 2 category derived from StreetLight for 2017 is about half of that estimated in the 2009 truck survey. The decrease could be largely explained by the truck prohibition regulation the City of West Oakland has implemented since 2010. However, further verification is in need when the direct measurements in more recent years become available. For example, a study using video footage acquired from Automated License Plate Readers (ALPR) to collect vehicle counts and license plates at key locations in West Oakland could be used to better estimate the size and characteristics of the Port Truck fleet. The license plate data would provide the necessary information to link registration data from the Department of Motor Vehicles (DMV) or International Registration Plan (IRP) to a list of Vehicle Identification Numbers (VINs) from the Port of Oakland and the Drayage Truck Registry database, which could be used to obtain import vehicle characteristics (e.g., model year, weight class, emission control technologies, and whether the vehicle is a Port drayage truck or not). These characteristics could then be used to better estimate emission factors and emissions. If implemented, the proposed study would provide ground-truth to improve our understanding and help validate the fleet mix data used in this analysis.

(b) Emission Factors

Emission factors for on-road mobile sources were obtained from EMFAC2017 and CT-EMFAC2017, which were used to estimate emissions from roadways in West Oakland, as well from fleet operating at truck-related businesses and Port Trucks operating within Port terminals.

In the future, brake wear, tire wear and re-entrained road dust emissions will dominate total PM emissions, due to increasingly stringent standards for exhaust emissions (Reid *et al.* 2016). However, uncertainties in the emission factors from these processes is much higher because of their complexity and limited research, as they are currently unregulated processes. The methods

used to estimate emission factors are either outdated or based on limited measurements or unreliable assumptions. For example, brake wear emissions factors in EMFAC2017 are assumed to be independent of vehicle travelling speed, despite the fact that there are often more braking events during low speed driving. CARB is sponsoring four studies that are expected to be completed next year to improve the emissions factors for brake and tire wear. While road dust emissions are estimated using AP-42, the empirically-derived equation (see Section 2.3.3(b)) does not take into account vehicle speed, which can affect the emission factor (U.S. Environmental Protection Agency 2011), and does not restrict the maximum emissions by the number of vehicles. Silt loading values are inherently site-specific as they vary by road type and geographic locations. In this analysis, the county-average default values were used since values specific to West Oakland roadways are not available. Uncertainty in road dust emissions is further complicated by the mismatch between roadway classification systems of the data available, where freeway on- and off-ramps were assigned to multiple functional classes and thus numerous CARB road types, which are used to determine the silt loading factor by roadway segment. This likely resulted in a slight overestimate of road dust emissions from these roadway segments.

Of critical importance to West Oakland is the estimation of emissions from Port Trucks, which in part relies on the emission factors. Some field studies have suggested that there are uncertainties in the emission factors for Port Trucks for specific model years; for running exhaust emission factors for model years 2007 to 2009, a ~50% increase in black carbon and ~100% increase in PM_{2.5} between calendar years 2013 and 2015 has been observed, while EMFAC2017 estimates only a ~26% increase in PM_{2.5} (Preble *et al.* 2016). The inconsistency is likely due to the underestimates of high emitters caused by deterioration of Diesel Particle Filters (DPFs) in EMFAC2017. Further drayage truck studies conducted near the Port of Los Angeles exhibited a similar increase in emission factor in 2015, but showed emission factors in 2017 were closer to 2013 levels (Bishop and Haugen 2018). This suggests that the underestimate of emission factors did not continue in 2017. As noted in Bishop and Haugen (2018), a potential explanation for fewer high-emitting vehicles in 2017 is that there was increased roadside compliance testing and issuance of statewide citations since 2015 by CARB; this may have encouraged corrective maintenance or relocation for some of the high-emitting trucks observed in 2015.

To develop a better understanding of how DPF failure rates can affect emission factors of Port Trucks, the District conducted a sensitivity analysis for base year 2017 where EMFAC2017-based emission factors of affected model years were adjusted to reflect the same deteriorations observed by Preble *et al.* (2016). The analysis suggested a < 50% underestimate in Port Truck PM_{2.5} running exhaust emissions, which corresponds to a ~ 1% underestimate in the overall 2017 emissions inventory for West Oakland. For future years 2024 and 2029, there should be no impact as the 2007-2009 model year group will be phased out by January 1, 2023 according to CARB's Truck and Bus Rule.

6.1.3 Truck-Related Businesses

Estimating emissions from truck-related businesses is inherently uncertain since business operations, such as activity patterns and fleet mix, are generally unknown. Truck fleet size estimates were based on responses District surveys (2009 or 2019 when available). When the District did not receive a response, a default truck fleet size and mix were assigned to the business. The District also applied a default truck fleet mix based on the 2009 West Oakland Truck Survey

since fleet mix was not reported in the 2019 survey. The number of trucks reflects the trucks owned or operated by the business but excludes other trucks that visit the premises for business purposes.

In previous surveys conducted by the District (Bay Area Air Quality Management District 2009), the District found that all trucks complied with the 5 min idling regulation adopted by CARB (California Air Resources Board 2004). To be conservative, the District intentionally used a higher value of 15 min of idling per truck trip for all businesses. The accuracy of this assumption is unknown; this will certainly cause an over-prediction of air pollutant exposure from this source category, but without a more detailed or recent survey, it is difficult to quantify the uncertainties.

The results of this analysis suggest that truck-related businesses are relatively minor contributors to the overall air pollution and cancer risk in West Oakland. However, the District may consider a more detailed survey in the future to ensure the accuracy of the predictions and include any changes in business operations. The District may also incorporate additional truck-related businesses as information becomes available.

6.1.4 Port-Related Sources

Emissions for Port related activities were taken from the 2017 Port Inventory, prepared by Ramboll (2018). Because the District relied on data provided by the Port, it is difficult to quantify the uncertainties in the emissions estimates. In general, emission inventories have several sources of uncertainties including emission factors, equipment population and age, equipment activity, load factors, and fuel type and quantity. Most uncertainties are associated with the emission factors and engine load factors that were obtained from previous studies, literature reviews, and emission models developed by CARB. To improve the accuracy of the emissions estimates (and reduce uncertainty), the District only used emissions developed using more accurate data on OGV speeds inside the Bay, more realistic OGV emission factors under low load operations, and inclusion of emissions from bunkering that was not quantified in past inventories.

The 2017 Port Inventory, and therefore the emissions inventory presented herein, excludes emissions from smaller emissions sources within the Port, such as TRUs and gasoline powered light-duty vehicles. However, TRUs plug into shore power at the Port (which means they do not run their own engines, thus reducing emissions), and there are few gasoline powered vehicles compared to diesel-powered trucks operated by the Port. Therefore, emissions from these sources are not considered significant, and the overall effect on the Port emissions inventory is minimal.

6.1.5 UP Locomotives and Railyard

Freight activity is not always predictable and annual emissions vary by year depending on regional economics. Although the District used the most accurate emissions available, the District can improve the rail emissions inventory by (1) using Tier-specific emissions factors for locomotives and switchers, (2) including other activities and associated emissions at the railyard, and (3) spatially and temporally allocating activities and emissions along the yard and rail lines.

Using a fuel-based emissions inventory is the preferred method for developing an accurate inventory, as performed for the UP freight locomotives and railyard. The District converted the

fuel consumption by rail link provided by UP to emissions using a fuel-based emission factor obtained from EPA, which are based on average operating duty cycles and an estimated average nationwide fleet mix for both switcher and line-haul locomotives. Using locomotive-specific conversion factors would yield better estimate of emissions, as fleet mixes vary from railroad to railroad and can be highly regionalized. And, though the use of Tier-specific emission factors (e.g., as shown in Table 6-1) could be used to improve the emissions inventory, it is also recognized that individual engines and thus emission factors are highly variable within Tier categories, depending on the specific locomotive model, operation cycle, and condition of operation (Bergin *et al.* 2012). In this analysis, it is not known whether the use of nationwide fuel-based emission factors may have resulted in under- or overestimates of emissions, given that detailed information on the locomotive characteristics and activity is not available.

Table 6-1. Fuel-based PM₁₀ emission factors for locomotive engines by Tier. Values from California Air Resources Board (2017c).

Tier	PM₁₀ (g/gal)
Pre-Tier	6.66
Tier 0	6.66
Tier 0+	4.16
Tier 1	6.66
Tier 1+	4.16
Tier 2	3.74
Tier 2+	1.66
Tier 3	1.66
Tier 4	0.31

Another improvement for future modeling efforts is the inclusion of other sources of emissions at the UP railyard. This analysis focused on emissions from line-haul locomotives and switchers, and excluded other sources of emissions at the railyard due to lack of data. In 2008, CARB completed an HRA for the UP railyard in Oakland that evaluated the health impacts associated with TACs emissions (California Air Resources Board 2008b). According to this report, activities in the railyard include receiving inbound trains, switching rail cars, loading and unloading intermodal trains, storing intermodal containers and truck chassis, assembling outbound trains, releasing outbound trains, and repairing freight cars and intermodal containers/chassis. Specific emission sources associated with these activities include locomotives, on-road diesel-fueled trucks, CHE, TRUs and refrigerated rail cars (reefer cars), and fuel storage tanks. DPM emissions from the UP railyard in 2005 inventory from California Air Resources Board (2008b) and the 2017 fuel-based emissions in this Action Plan are presented in Table 6-2. Although the District’s analysis did include the largest sources of emissions primarily from switcher locomotives moving rail cars, line-hauls, and on-road trucks, the analysis did exclude cargo handling equipment and TRUs/reefer cars which contribute 49% of the emissions in the 2005 inventory. For this analysis, UP confirmed that the District modeled the most significant sources of diesel PM at the railyard and that the excluded sources were minor (James Brannon, UP, personal communication, 4 April, 2019). Additionally, at the time of this analysis, emissions from these other sources were not readily available from UP, and it is unknown whether the current activity levels are consistent with

operations in 2005. The decline in switcher and line-haul emissions may be an indication that non-modeled sources would likewise experience a decline due to the introduction of new equipment and fleet turnover, resulting in lower emissions.

Table 6-2. UP railyard DPM emissions (tpy) in 2005, from California Air Resources Board (2008), and 2017, based on the West Oakland Action Plan (this document). The percent change from 2005 to 2017. The 2017 emissions from freight haul lines includes emissions from both UP and BNSF locomotives. “n/a” indicates that the source category was not included in the 2017 emissions inventory for UP operations.

Source Category	2005	% total	2017	% total	% change
Locomotives					
Haul lines (freight)	1.6	14	0.5044	30	-68.5
Switchers (railyard)	1.9	17	1.1098	67	-41.6
Service/testing	0.5	4	n/a	–	–
TRUs, reefers	3.2	28	n/a	–	–
CHE	2.2	19	n/a	–	–
On-road trucks	1.9	17	0.0416	3	-97.8
Total	11.3	100	1.6558	100	

The last improvement is the spatial and temporal allocation of emissions at specific railyard source locations. At the time the modeling was completed, information regarding locations of specific sources was not known. Instead, switcher engines and on-road trucks emissions were allocated on to an area that encompassed all of the rail lines, intermodal gates, locomotive service, and main yard. In subsequent discussions with UP, they confirmed that individual source locations identified in the 2008 CARB report were valid for 2017 operations (Gary Rubenstein, personal communication, 5 April, 2019; see Figure 6-1). The modeling assumed constant activity throughout the year but adjustments can be made in the modeling to account for temporal variations in activity level by season, time of day, or weekly.

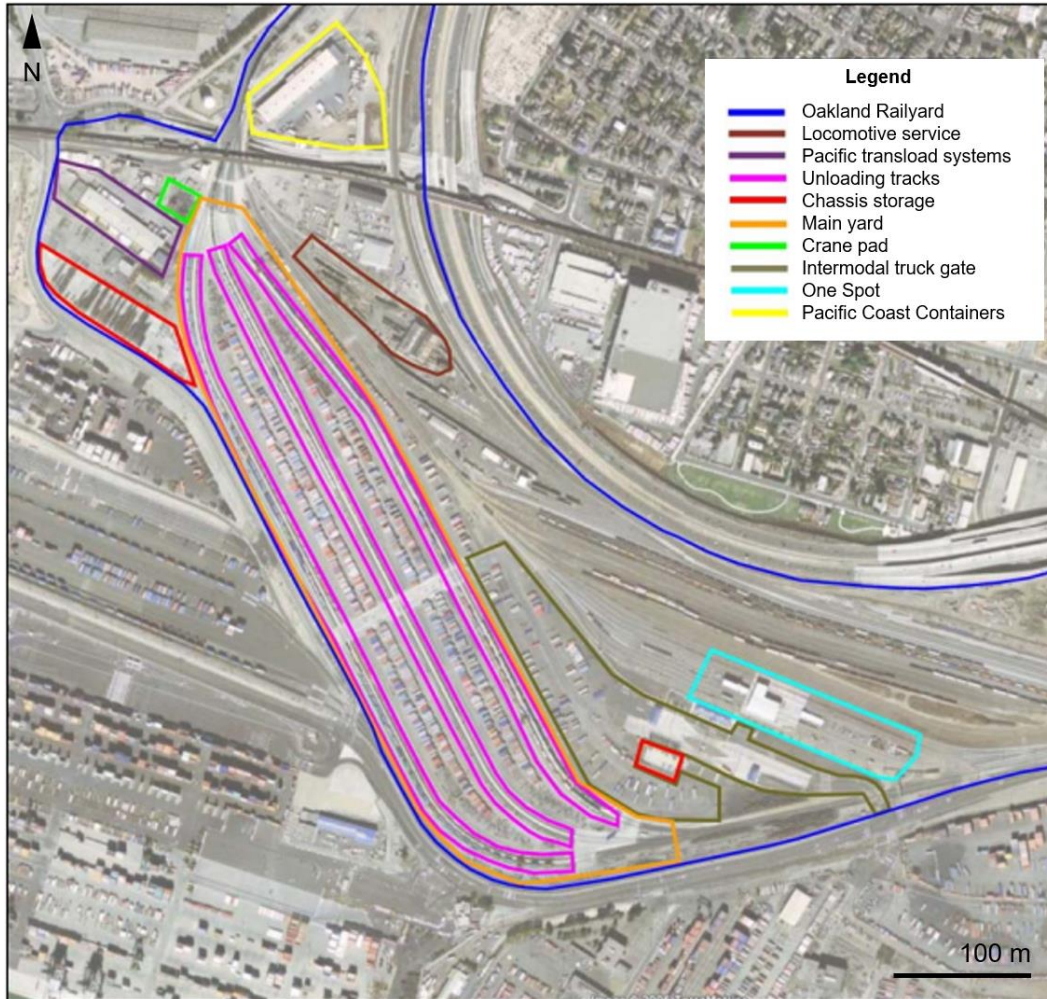


Figure 6-1. Layout of operations at the UP railyard in West Oakland. The components delineated represent different emissions sources (obtained from Gary Rubenstein, personal communication, 5 April, 2019).

UP is in the process of developing a detailed, comprehensive emissions inventory for the Oakland railyard which is expected to be completed by the end of 2019. UP expects to capture individual locomotive characteristics and movements to develop a bottom-up inventory of sources and emissions in the railyard. The District plans to use this detailed inventory in future UP emissions estimates that will address most of the uncertainties identified in this analysis.

6.1.6 Omitted Emissions Sources

Emissions from other sources that were not included in the community-scale inventory and modeling were estimated using a top-down approach, as reported in Table 2-3. Further refinements to the emissions estimates of these source categories, in addition to their temporal and spatial allocation, would further improve the estimates of community exposure in West Oakland.

(a) Commercial Cooking

Commercial cooking emissions for West Oakland were estimated by disaggregating the District’s emissions estimates for Alameda County by using spatial surrogate data developed for the regional modeling. The spatial surrogate for commercial cooking was based on the fraction of Alameda County restaurants that fall within the West Oakland community-scale Source Domain. Approximately 10% of Alameda County restaurants fall within the West Oakland domain, resulting in 20.63 tpy of PM_{2.5} emission in 2017.

To start to refine the District’s understanding of commercial cooking emissions at a community-scale in West Oakland, specific restaurant locations were identified from a database purchased from InfoUSA.⁷⁷ There are 537 restaurants within the West Oakland Source Domain, where most of the facilities are in Chinatown (south of Downtown), southwest of the West Oakland community (Figure 6-2). In fact, only 74 of the restaurants fall within the main residential area of West Oakland, some of which may not use cooking devices that emit PM_{2.5} (e.g., charbroilers, deep fat fryers, or griddles). Additional analyses are underway to evaluate the potential impact of commercial cooking in West Oakland, especially given that the majority of commercial cooking facilities are generally downwind of the West Oakland community.

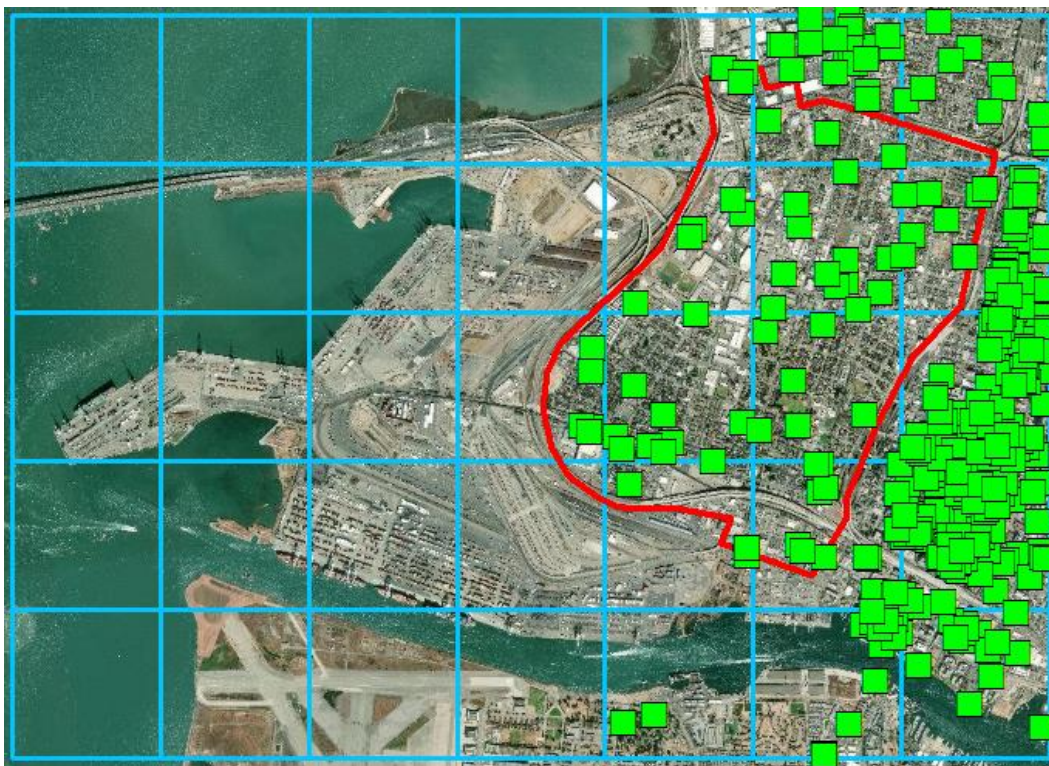


Figure 6-2. Restaurant locations (green squares) within the West Oakland Source Domain (blue grid). The major residential area of the West Oakland community is outlined (red line).

⁷⁷ <https://www.infousa.com/>

(b) Construction

Emissions from construction equipment and construction dust for West Oakland were estimated by disaggregating CARB’s emissions estimates for Alameda County using spatial surrogate data developed for the regional modeling. Alameda County emissions data were obtained from CARB’s 2016 SIP Emissions Projections Tool,⁷⁸ and the spatial surrogate was developed based on land use data from the Association of Bay Area Governments (ABAG). Specifically, ABAG’s Existing Land Use Data for 2000 and 2005 were compared to identify land use changes and determine where construction activity likely occurred. This approach leads to high uncertainty in emission estimates for 2017, as construction activity is highly transient, changing in scope and location from year to year. Construction emissions were not included in the community-scale modeling for West Oakland due to uncertainties associated with 2017 emission estimates and the spatial distribution of construction activities in the community. ABAG has not updated the Existing Land Use Data since 2005, and the District is currently exploring other sources of information for recent and projected construction activity in West Oakland.

(c) Transportation Refrigeration Units (TRUs)

Emissions from TRUs were estimated at the county-level using CARB’s OFFROAD model. The District disaggregated Alameda County TRU emissions to West Oakland using an industrial land use spatial surrogate which was derived from ABAG’s 2005 Existing Land Use Data. Based on this surrogate, ~4% of Alameda County TRU emissions occur in West Oakland.

CARB has also provided the District with estimates for TRU emissions in West Oakland. CARB allocated a portion of Alameda County emissions to West Oakland using a spatial surrogate based on facilities that operate TRUs or are frequented by TRUs.⁷⁹ Such facilities include grocery stores, liquor stores, cold storage warehouses, and trans-load facilities. Approximately 80% of West Oakland emissions were classified by CARB as large (> 200,000 ft²) and medium (50,000 – 200,000 ft²) sized facilities. The remaining 20% of TRU emissions were allocated to operation on roadways within West Oakland.

The District’s TRU emissions estimate for West Oakland are about half of CARB’s estimate (Table 6-3). The District plans to investigate this further by contacting the 10 large- and medium-sized facilities in West Oakland identified by CARB to obtain more information regarding their TRU activity. TRU emissions may then be refined and/or included in future community-scale modeling.

Table 6-3. 2017 TRU emissions for Alameda County and West Oakland.

Estimated by	Area	PM _{2.5} (tpy)	DPM (tpy)
CARB	Alameda County	6.57	7.30
	West Oakland	0.49	0.53
District	West Oakland	0.24	0.26

⁷⁸ <https://www.arb.ca.gov/app/emsinv/2016ozsip/2016ozsip/>.

⁷⁹ As documented in a memo, *Spatial Allocation Methodology of Transportation Refrigeration Unit (TRU) Emissions for AB617 Communities*, provided to the District by CARB on May 30, 2019.

(d) Residential Wood Combustion

The District developed a top-down emission inventory for residential fuel combustion in West Oakland by disaggregating county-level emissions estimates using the proportion of primary heating fuel used by households assigned to wood combustion from the 2010 Census data. This approach results in uncertainties for wood combustion emissions, as some homes may burn wood in fireplaces recreationally, but not report wood as the primary heating fuel.

Past residential wood combustion surveys conducted by the District did not include homes in West Oakland. In addition, community members have reported backyard burning that may not be reflected in the District's residential wood combustion emissions estimates. Due to these uncertainties, and especially given the lack of spatial information, this source category warrants further investigation and was not included in community-scale modeling efforts.

6.2 Air Dispersion Modeling

While AERMOD is a state-of-the-art dispersion model for near-field applications, there are still inherent uncertainties associated with the model calculations.

6.2.1 Model Formulation

Generally, a model is a (often) simplified representation of a real-world system, where complex processes are parameterized and characterized using equations that are solved by a computer. Some uncertainties in the results are inherent to a model itself, and thus may be referred to as “irreducible” errors or uncertainties. The District used the AERMOD dispersion model to estimate the dispersion factors and consequently pollutant concentrations in West Oakland to which the population could be exposed. AERMOD uses simplified atmospheric physics and scaling concepts to simulate air pollutant dispersion. Some uncertainties in the results arise from the model's inability to represent the complex aerodynamic and dispersion processes.

Specifically, AERMOD is a steady-state plume model; this means that only a single set of temporally averaged (usually 1 h) meteorological parameters are used to represent the atmospheric state over the averaging time at any point in space, i.e., meteorological conditions are spatially homogeneous. This can potentially be problematic in coastal areas or in areas of complex terrain, where wind fields can have high spatiotemporal variability. Given the proximity and orientation of the Bay surrounding the West Oakland community, only using a single meteorological dataset introduces uncertainties to the potential dispersion of pollutants. Wind directions from the meteorological dataset from OST, located to the northwest of the modeling domain, used in AERMOD were predominantly from the northwest (Figure 3-2). These winds influence the dispersion from emissions sources at any location within the domain, though winds likely have a more southerly component at locations along the channel and Inner Harbor. As a result, dispersion to locations in the northeastern section of the domain may be slightly underestimated. And, while AERMOD uses a dividing-streamline concept to model dispersion of plumes around topographic features (Cimorelli *et al.* 2004, Snyder *et al.* 1985), the inherent uncertainties in this formulation are likely less important for dispersion modeling in West Oakland, as the area is relatively flat (Figure 3-19).

AERMOD also does not account for small-scale flow patterns and dispersion around structures or recirculation and channeling in urban canyons, as is typical in urban areas with multi-story buildings. While AERMOD can include some of the influence of building wakes on plume rise and dispersion (using the Plume Rise Model Enhancements [PRIME] model downwash algorithm [Schulman *et al.* 2000]), this calculation feature can only be used for point sources (Cimorelli *et al.* 2004); most of the emissions sources in this analysis were modeled as area and volume sources.

The performance of the AERMOD modeling system has been evaluated against several observational datasets (Perry *et al.* 2005); the accuracy of the output depends on the pollutant, type of source modeled, terrain (flat or complex), whether or not wake effects are accounted for, and the averaging period of results compared to observations (e.g., 3 h, 24 h). AERMOD tends to perform well, especially in reproducing the highest concentrations of pollutant distributions (Perry *et al.* 2005), which are often used to assess compliance with air quality regulations (e.g., National Ambient Air Quality Standards [NAAQS]) or investigate “worst-case scenarios.” However, if there are additional “reducible” uncertainties associated with input data (e.g., wind direction), “composite errors in the highest estimated concentrations of 10 to 40 percent are found to be typical,” (U.S. Environmental Protection Agency 2017, paragraph 4.1(e)). AERMOD may also underestimate lower concentrations, which can namely impact annual average estimates (Perry *et al.* 2005). While the overall distribution of pollutant concentrations may be well captured by AERMOD, the exact time and location of the concentrations may be less certain (Cimorelli *et al.* 2004, Perry *et al.* 2005), especially given the steady-state formulation.

That being said, AERMOD is currently the preferred model for near-field (≤ 50 km) dispersion of emissions, as listed in EPA’s Guideline on Air Quality Models (“Appendix W” to 40 CFR Part 51; U.S. Environmental Protection Agency 2017). AERMOD is routinely used in research and regulator frameworks, performs better than similar models (e.g., Perry *et al.* 2005), and has been applied to estimate pollutant concentrations in similar studies (e.g., California Air Resources Board 2008b). The District has evaluated and used an appropriate meteorological dataset such that “reducible” uncertainties are limited (see Section 3.2.1). As future modeling efforts are implemented, the District will ensure that the latest versions of each model in the AERMOD modeling framework are used to reduce some of the inherent uncertainty.

6.2.2 Dispersion Modeling and Emissions Source Parameters

The selection dispersion modeling and emissions source parameters use for AERMOD dispersion modeling also introduce limitations and uncertainties to the results. Some of these are discussed below:

- **Urban surface roughness length:** All sources were modeled as urban sources with a surface roughness length set to 1.0 m. While this is the default value for regulatory applications in AERMOD (U.S. Environmental Protection Agency 2018b), and is considered appropriate for most applications (U.S. Environmental Protection Agency 2015a) as it is representative of centers of large towns and cities or landscapes with regularly-spaced large elements, a more representative value could be derived and used West Oakland. Though, the default value was used in this analysis to be consistent with other permit modeling performed by the District.

- **Building downwash:** The effects of building downwash were not accounted for. The building downwash option in AERMOD, using the PRIME algorithm, accounts for the buildup of air pollution in a building's cavity due to recirculating winds created by nearby buildings; the effects are governed by the building geometry and the wind direction. Typically, building downwash leads to higher concentrations downwind of the (stack) emission source. Parameters required to use this feature include the building height and dimensions; for West Oakland, these parameters could be derived from the lidar dataset used (Section 3.4.3(b)) or similar dataset. However, the building downwash algorithms can only be applied to point sources; they do not apply to volume or area sources, which were the primary source types used in this analysis. The District did not apply building downwash to point sources for consistency.
- **AERMOD source type selection:** Source types must be selected by the modeler to represent the physical geometry and emission characteristics of emission sources. In AERMOD, these are generally point, area, or volume sources. While the District selected source types based on general modeling guidance, previous studies, and/or engineering judgements, some AERMOD source types may not adequately capture the emissions characteristics of certain sources, while the District did not have necessary configuration information for others (e.g., see the discussion below for permitted stationary sources).
- **Missing parameters:** When modeling parameters were not known, the District used default model values or values based on general modeling guidance, previous studies, and/or engineering judgements. Modeling parameters were often selected so that the modeling would produce more conservative results.

While there are uncertainties related to dispersion modeling parameters used for all emissions source categories, those that could be improved upon in future modeling analyses are discussed below:

Permitted Stationary Sources: Only a limited number of facilities had complete release parameter information (Table 2-5). Missing parameters, such as stack height and diameter, were assigned “default” values (Table 3-2), which were based on previous modeling studies conducted by the District. Moreover, in spite of significant effort expended to improve the exact location of stacks and emission sources at permitted facilities, errors and uncertainties persist due to the complex arrangement of the facilities. The District also had to use either a single volume source or point source for each permitted stationary source; however, the District recognizes that some sources, particularly fugitives, tanks, and waste piles, may be more accurately modeled as area sources. In future modeling analyses, the District may seek to remove this restriction and include more site-specific emissions release parameters, where available.

On-road mobile sources: The main uncertainties in the modeling parameters for on-road mobile sources is related the source (roadway) width (W), and the release heights ($Relhgt$) assigned to each volume source. First, the width determines the initial horizontal dispersion coefficient ($Syinit$), the size of the exclusion zone (r_{EZ}), and therefore which receptors from the “master grid” must be excluded (Section 3.4.1, 3.5) and where dispersion factors

must be imputed (Section 4.1.1). In this analysis, the roadway width was based on road type class (originally based on the Citilabs dataset) and FHWA guidance. The highest degree of uncertainty likely applies to on- and off-ramps, since they were distributed among multiple road type classes. Second, since current EPA guidance (U.S. Environmental Protection Agency 2015b) does not include recommendations on how to model on-road mobile source emissions on elevation roadways in AERMOD, the District adjusted the release heights to account for the elevation of roadways. The structure elevation data was based on a lidar dataset (Section 3.4.3(b)). The resulting structure heights appeared to be overestimated (and “noisy,” with a higher degree of spatial variability than expected) on surface streets (Figure 3-5), where it is assumed that roadways are generally at grade. An improvement or further assumption could be that structure elevation data should only be assigned to freeways and on- and off-ramps, since they are the largest source of on-road mobile source emissions, and are most likely to be above grade. This would require further refinement of the road type classes assigned to each roadway segment. Otherwise, an alternative dataset could be used, such as the Caltrans automated pavement condition survey (APCS).⁸⁰ This dataset contains the start and end elevations of roadway segments for freeways in California. As such, the elevation along each segment could be interpolated to volume source locations. However, since the primary purpose of the APCS data is to assess pavement conditions, the data is not necessarily well calibrated. Using the dataset would also require more refined geospatial processing techniques to properly match segments from the APCS shapefile to those in the Citilabs dataset. The APCS dataset also does not include all elevated roads and on- and off-ramps in West Oakland. In summary, both the width and release heights of the volume sources used to model emissions from on-road mobile sources could be improved with further refinement of road type classification, especially for on- and off-ramps.

Since there can be discrepancies between real-world emissions characteristics from a source and how they are represented in AERMOD, exposure concentrations derived in this analysis should be taken to represent approximate exposure concentrations.

6.2.3 Receptors

Receptors were placed at a height of 1.8 m agl; this parameter is used to conservatively model exposures within an individual’s “breathing zone.” Using the flagpole receptors may not always capture the highest predicted concentration, especially in cases where both the source and the receptors are elevated above the surface terrain. Concentrations estimated at receptors also only represent those that an individual may be exposed to outdoors (indoor air quality and exposure is not assessed).

⁸⁰ Currently, the most recent dataset is the 2016 Elevation APCS dataset (“Elevation2016APCS”, created July 27, 2016, by the Caltrans Office of Pavement Management and Performance; available at: <http://www.dot.ca.gov/hq/tsip/gis/datalibrary/Metadata/Elevation.html>).

6.3 Risk Assessment Methodology

A risk assessment is a decision-making tool that can be used to estimate the probability of adverse health effects in humans exposed to pollutants in the environment. Risk assessment methodology uses an estimated level of contamination in the environment (concentration) while assuming a constant rate of intake and length of exposure, combined with chemical effect factors, to produce cancer risks. While mean parameters values derived from scientifically defensible studies are a reasonable estimate of central tendency, the exposure variables used in this assessment are only estimates. Therefore, that is to say, the resulting cancer risk estimated in this analysis is not the expected rate of illness in West Oakland, but is rather an estimate of potential risk that can be used to compared to risk from other sources or in communities if using a similar methodology.

Risk assessments are designed to be overly conservative to ensure that the probability, expressed as the chance of developing cancer for one million people that are exposed at a specific location, are health protective of the most sensitive population. EPA notes that the conservative assumptions used in a risk assessment are intended to assure that the estimated risks do not underestimate the actual risks posed by an emissions source, and that the estimated risks do not necessarily represent actual risks experienced by populations at or near a source (Environmental Protection Agency 1989). The methodology and parameters used in risk assessments have long been established and are accepted practice for comparing exposure and health impacts between sources. The main assumptions within the risk assessment methodology (based on OEHHA's guidance) are:

- (1) Ambient pollutant concentrations (estimated from dispersion modeling in this analysis) are constant over the exposure period (30 years), while in reality, average pollutant concentrations vary on many time scales, including daily, seasonally, and inter-annually.
- (2) An individual is exposed *in vitro* starting from the last trimester of pregnancy and continues to reside at the same location into adulthood and only nominally absent from the location of exposure.
- (3) Some chemical toxicity values are estimated based on *in vivo* studies using animals that are extrapolated to estimate effects on humans. High chemical doses administered to these animals are often much higher than what human are exposed to in the environment.

All of these factors are designed to overestimate exposure, cancer risk, and health effects to humans. Thus, while resulting in conservative cancer risk estimates, each assumption contributes to inherent uncertainties in the results. Further uncertainties lie within the variability of in emissions from different emissions sources (which result in fluctuations of pollutant concentrations over time), changes in daily human activity patterns and therefore location of exposure (i.e., not always at the place of residence), and range of individual responses to chemical exposures (which could depend on genetics, immune system response, metabolism, etc.).

ASF values, as recommended by OEHHA, increase the effective CPF to account for increased sensitivity of younger individuals to cancer-causing pollutants. However, there may be pollutants in the urban environment whose cancer toxicity is amplified due to the presence of other pollutants (synergic effects) or because of pre-existing conditions or sensitivities; these effects are not accounted for. Furthermore, there may be pollutants whose toxicity is not yet recognized or quantified and, as such, is unaccounted for in this analysis.

While the District used CPF values recommended by OEHHA to estimate cancer risk associated with pollutant exposures from the modeled emissions sources, these values are uncertain in both the estimation of response and dose for many pollutants. For example, the level of risk for DPM is uncertain; public health and regulatory organizations, such as the International Agency for Research on Cancer (IARC), World Health Organization (WHO), and EPA, agree that diesel exhaust may cause cancer in humans, though there is uncertainty in the CPF value (see Scientific Review Panel 1998, Office of Environmental Health Hazard Assessment 2011). As such, any adopted changes to CPFs or exposure factors will be incorporated in future risk assessments for West Oakland.

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Attachment 1. Toxic Air Contaminants

Table A-1-1. Inhalation CPF by Chemical Abstract Service (CAS) number. Inhalation CPFs are adjusted to account for multi-pathway slope factor and/or chronic REL, where applicable (consistent with Regulation 2-5). Chemicals listed are those that were emitted from one or more sources in the West Oakland emissions inventory (Section 2). Only those chemicals with an associated inhalation CPF were modeled and therefore included in the calculation of cancer risk (Section 4).

CAS number	Chemical name	Inhalation CPF [(mg/(kg day)) ⁻¹]
71-55-6	1,1,1-Trichloroethane	–
75-35-4	1,1-Dichloroethylene	–
107-06-2	1,2-Dichloroethane	0.072
106-99-0	1,3-Butadiene	0.6
542-75-6	1,3-Dichloropropene	0.055
106-46-7	1,4-Dichlorobenzene	0.04
12391-1	1,4-Dioxane	0.027
1746-01-6	Chlorinated dioxins and furans (2,3,7,8-Tetrachlorodibenzo-p-dioxin and related compounds; California TCDD equivalent)	650000
75-07-0	Acetaldehyde	0.01
67-64-1	Acetone	–
10-702-8	Acrolein	–
7664-41-7	Ammonia	–
7440-38-2	Arsenic	180
71-43-2	Benzene	0.1
7440-41-7	Beryllium	8.4
7440-43-9	Cadmium	15
75-15-0	Carbon Disulfide	–
124-38-9	Carbon Dioxide (CO ₂) (non-biogenic)	–
630-08-0	Carbon Monoxide (CO)	–
67-66-3	Chloroform	0.019
7440-50-8	Copper and Copper Compounds	–
18540-29-9	Chromium (hexavalent, 6)	560
9-90-1	DPM (Diesel Exhaust Particulate)	1.1
107-21-1	Ethylene Glycol	–
111-76-2	Ethylene Glycol Monobutyl Ether	–
100-41-4	Ethylbenzene	0.0087
50-00-0	Formaldehyde (gas)	0.021
7647-01-0	Hydrogen Chloride	–
7664-39-3	Hydrogen Fluoride	–
7783-06-4	Hydrogen Sulfide	–

CAS number	Chemical name	Inhalation CPF [(mg/(kg day))⁻¹]
64742-48-9	Isoparaffinic solvents C10+	–
67-63-0	Isopropyl Alcohol	–
7439-92-1	Lead and Lead Compounds	0.98
7439965	Manganese & Manganese Compounds	–
7439976	Mercury (Inorganic)	–
74-82-8	Methane (CH ₄)	–
67-56-1	Methanol	–
74-83-9	Methyl Bromide	–
78-93-3	Methyl Ethyl Ketone	–
75-09-2	Methylene Chloride (Dichloromethane)	0.0035
91-20-3	Naphthalene	0.12
7440-02-0	Nickel and Nickel Compounds	0.91
10024-97-2	Nitrous Oxide (N ₂ O)	–
110-54-3	n-Hexane	–
98-56-6	Parachlorobenzotrifluoride (PCBTF)	–
50-32-8	Polycyclic aromatic hydrocarbons (PAH) (as benzo(a)pyrene equivalent)	86
108-95-2	Phenol	–
1336-36-3	Polychlorinated Biphenyls (PCB)	74
7782-49-2	Selenium	–
127-18-4	Tetrachloroethylene (Perchloroethylene)	0.021
108-88-3	Toluene	–
79-01-6	Trichloroethylene	0.007
1330-20-7	Xylenes (technical mixture of m, o, p-isomers)	–

Attachment 2. Permitted Stationary Sources

Table A-2-1. Permitted stationary sources in the West Oakland Source Domain. “M” indicates whether the facility was modeled (×) or not (–); facilities were not modeled if either (a) there were no PM_{2.5} or TAC emissions available in the database for the base year, or (b) all TAC emissions were associated with pollutants that did not have associated cancer risk toxicities. The plant number (Plant No.) indicates a unique facility. Cities are abbreviated as “O” for Oakland, “A” for Alameda, and “E” for Emeryville. The SIC code indicates the Standard Industrial Classification code. The values of *x* and *y* are the coordinates of the source centroid in UTM zone 10 North (NAD83).

M	Plant No.	Facility Name	Address	City	SIC code	<i>x</i>	<i>y</i>	Source Category
×	24024	2150 Webster Holdings VII	2150 Webster Street	O	9631	564648.165924	4185022.458960	Generator
×	111616	AAA San Pablo Fuel Inc.	3420 San Pablo Ave	O	5411	563549.336623	4186746.924690	Gas station
×	14532	AC Transit General Office	1600 Franklin Street	O	9621	564409.165973	4184484.458940	Generator
–	23085	Acorn Restoration	2914 Poplar Street	O	7641	562956.166026	4186300.458690	Spray booth
×	16713	Alameda County Employees Retirement Assn (ACERA)	475 14th Street	O	4812	564069.166042	4184376.458890	Generator
×	20828	Alameda County General Services Agency	1111 Jackson Street	O	9199	564574.165975	4183921.459000	Generator
×	107875	Alameda County General Services Agency	165 13th Street	O	5411	564684.165951	4183963.459030	Gas station
×	10997	Alameda County GSA	661 Washington St	O	9199	563718.490000	4183843.070000	Generator and boiler
×	10998	Alameda County GSA	400 Broadway Avenue	O	9299	563845.760000	4183606.200000	Standby generator
×	13929	Alameda County GSA	1106 Madison Street	O	9199	564717.040000	4183834.660000	Standby generator
×	17114	Alameda County Public Works Agency	3455 Ettie Street	O	9532	562573.165973	4186712.458690	Generator
×	19321	Alameda Cremations	2900 Main Street, Suite 116	A	7261	562363.166189	4182717.459020	Crematory
×	3676	Alta Bates Summit Medical Center	450 30th Street	O	8062	564611.165840	4186083.458850	Generator and boiler
–	22763	Amber Flooring Inc	3441 Louise Street	O	1752	562851.080000	4186802.130000	Coatings
×	200693	Amtrak	120 Magnolia Street	O		562481.166186	4183885.458960	Generator
×	2112	Aramark Uniform Services	330 Chestnut Street	O	7218	562723.166109	4183993.458910	Boiler
×	18668	AT&T Corp	344 20th Street	O	4899	564670.058785	4184834.236440	Generator
–	200827	Automotive Collision Repair	365 26th Street	O	7532	564651.165873	4185526.458920	Autobody
–	3069	B and T One Hour Cleaners	190 14th Street	O	7216	564726.165955	4184100.459030	Petroleum dry cleaning
×	200393	BA1 1330 Broadway LLC	420 13th Street	O		564191.165976	4184276.458970	Generator
×	200620	BA1 2201 Broadway LLC	2201 Broadway	O		564482.165923	4185116.458900	Generator and boiler

M	Plant No.	Facility Name	Address	City	SIC code	x	y	Source Category
×	112534	Bart Gas & Food	1395 7th St	O	5411	562206.166118	4184385.458900	Gas Station
×	20703	Bay Area Rapid Transit Dist. (BART)	418 Clay Street	O	4911	563677.166072	4183706.459010	Generator
×	22703	Bay Area Rapid Transit	550 W MacArthur Blvd	O	6512	564569.165800	4186899.458770	Generator
×	9684	Bay Ship and Yacht Co	2900 Main Street, Suite 2100	A	3731	562367.166212	4182722.458960	Coatings/blasting
×	12691	Berkeley Millwork & Furniture Co	2279 Poplar Street	O	2511	562731.018032	4185768.066460	Finishing with heater
-	17822	Berkeley Repertory Theatre	2526 Wood Street	O	5812	562399.166012	4186237.458670	Painting operations
×	21949	Bicycle Coffee LLC	364 2nd Street	O	2043	563894.166042	4183377.459030	Coffee roaster
×	21713	Blue Bottle Coffee Company	300 Webster Street	O	2095	563994.323692	4183422.851580	Coffee roaster
×	111014	BNSF Intermodal	333 Maritime St	O	5411	560377.166300	4184470.458710	Gas station
×	15538	BNSF Railway Co	333 Maritime Street	O	4013	562230.166190	4184011.458950	Generator
-	10987	Bolero Co	2905 Union Street	O	7532	562984.165983	4186288.458700	Autobody
×	22884	Broadway Franklin LLC	1111 Broadway	O	6512	564043.166022	4184189.458930	Generator
×	210258	Burger King	1240 Broadway	O	5812	564138.165974	4184245.458950	Charbroiler
×	24153	Cafe Tartine LLC	325 Martin Luther King Way	O	2095	563327.1661	4183779.459	Coffee roaster
×	10131	California Cereal Products Inc.	1267 14th Street	O	2043	562586.166136	4184922.458790	Grain system
-	20665	California Finest Body & Frame	1415 18th St	O	7532	562386.166089	4185378.458730	Spray booth
×	111397	California Highway Patrol	3601 Telegraph Ave	O	5411	564529.375244	4186675.889090	Gas station
×	14572	California Highway Patrol-Telecommunications	3601 Telegraph Ave	O	9221	564569.885283	4186642.089800	Generator
×	21295	California Hotel	3501 San Pablo Ave	O	6513	563493.165960	4186770.458660	Generator
×	15740	California Waste Solutions - Wood Street	3300 Wood Street	O	5093	562495.166064	4186548.458720	Recycling
×	15739	California Waste Solutions-10St Street	1820 10th Street	O	5093	561475.166213	4185141.458710	Recycling
×	22649	Caltrans	200 Burma Road	O	4111	560738.166175	4186460.458630	Generator
×	100210	Caltrans - East Bay Yard	Burma Road	O	5411	560755.166135	4186467.458670	Gas station
×	200062	Caltrans SFOBB Maintenance Complex	200 BURMA RD	O	5411	560733.166177	4186456.458660	Gas station
×	146	CASS Inc,	2730 Peralta Street	O	5093	562822.166009	4186107.458720	Furnace
×	21941	Cathedral Gardens Oakland	638 21st Street	O	3679	564035.165958	4185114.458850	Generator
×	1253	Central Concrete Supply A U.S. Concrete Company	2400 Peralta Street	O	3273	562704.166064	4185937.458700	Cement Silo
-	21947	Chevron Environmental Management Company	706 Harrison Street	O	1522	564240.166026	4183668.459020	Soil vapor extraction

M	Plant No.	Facility Name	Address	City	SIC code	x	y	Source Category
×	107693	Chevron SS #9-4800	1700 Castro St	O	5411	563781.373230	4184857.894450	Gas station
×	111947	China Town 76 Unocal #0752	800 Harrison St	O	5411	564281.166049	4183753.458990	Gas Station
×	20248	CIM Group Properties	1901 Harrison Street	O	6512	564679.140000	4184629.770000	Generator and fire pump
×	20345	CIM Properties	1333 Broadway	O	6512	564093.994123	4184334.960920	Generator and boiler
×	23838	City Center 1300 LLC	1300 Clay Street	O	6531	563966.165972	4184412.458950	Generator
×	20438	City of Alameda Northside Pump Station	1253 Marina Village Parkway	A	4911	563904.166063	4182438.459100	Generator
×	14502	City of Oakland, Environmental Services Division	150 Frank Ogawa Plaza	O	9199	564173.165992	4184440.458930	Generator
×	21819	City of Oakland	455 27th St, Fire Station 15	O	9229	564573.165885	4185607.458900	Generator
×	201072	City of Oakland	1111 Broadway	O	9224	564046.420000	4184190.710000	Generator
×	14503	City of Oakland, Environmental Services Division	1 Frank Ogawa Plaza	O	9199	564064.166028	4184463.458910	Generator
×	14291	City of Oakland, Public Works Facilities	455 7th Street	O	9221	563833.166039	4183787.459030	Generator
×	14301	City of Oakland, Environmental Services Division	1605 Martin Luther King Jr Way	O	9224	563758.972178	4184774.902360	Generator
×	14302	City of Oakland, Environmental Services Division	14th & Mandela Way	O	9224	562266.166084	4185050.458770	Generator
×	109646	City of Oakland Fire Station 1	1605 Martin Luther King Way	O	5411	563796.165984	4184760.458890	Gas station
×	107940	City of Oakland-Fire Department Drill Tower	250 Fallon St	O	5411	564794.166029	4182969.459090	Gas Station
×	106473	City of Oakland-Police Admin Building	495 6th Street	O	5411	563821.166076	4183803.458970	Gas Station
-	17439	Clear Channel Outdoor	2865 Hannah Street	O	5199	562755.165971	4186373.458720	Coatings
×	111913	Clear Channel Outdoor	2857 Hannah St	O	5411	562751.166014	4186335.458710	Gas station
×	18641	Color Folio Design	1467 Park Avenue	E	7389	562617.166008	4187249.458660	Coatings
-	20821	ConGlobal Industries	555A Maritime Street	O	5085	560475.166256	4184659.458700	Roller coater
-	18431	Continental Auto Body	1355 Park Ave	E	7532	562817.165947	4187280.458640	Autobody
-	23039	Cooks Collision	1900 Martin Luther King Way	O	7532	563928.165958	4184901.458940	Autobody
-	23040	Cooks Collision	149 11th St	O	7532	564697.165942	4183778.459030	Spray booth
×	201187	Coolport LLC	575 Maritime Street	O	9224	560017.110000	4184626.200000	Generator
×	17190	County of Alameda	1221 Oak Street	O	9229	564784.165962	4183908.459030	Generator
×	13908	County of Alameda - GSA	1401 Lakeside Drive	O	9199	564725.165954	4183831.458990	Generator and boiler

M	Plant No.	Facility Name	Address	City	SIC code	x	y	Source Category
×	18947	County of Alameda - Public Works Agency	8th Ave & Between Fallon St	O	9229	564622.166034	4183582.459050	Generator
×	17739	Cushman & Wakefield	Jack London Square	O	6531	563565.166106	4183351.458960	Generator
–	20526	Custom Wood Finishing	2311 Adeline Street	O	5712	563032.165995	4185688.458740	Generator
–	22272	Dawit Auto Body	4101 Martin Luther King Way	O	7532	564365.165829	4187302.458680	Autobody
×	20537	Department of Transportation	Toll Operations Building, SF Oakland Bay Bridge	O	4911	560392.166186	4186542.458540	Generator
×	20586	Digital 720 2nd LLC	720 2nd Street	O	4813	563160.166139	4183761.458900	Generator
×	20802	Domain Residences, LLC	1389 Jefferson St	O	6512	563805.166051	4184475.458910	Generator
×	19997	DWFIU 1999 Harrison, LLC	1999 Harrison Street	O	6531	564708.984401	4184731.933590	Generator
×	11887	Dynegy Oakland LLC	50 Martin Luther King Jr Way	O	4931	563278.166088	4183491.458950	Turbines
×	8001	East Bay Municipal Utility District	1200 21st Street	O	4941	562895.166049	4185545.458780	Spray booth
×	13712	East Bay Municipal Utility District	1100 21st Street	O	4941	563100.165995	4185500.458840	Generator
×	13728	East Bay Municipal Utility District	375 11th Street	O	4941	564204.165985	4184024.458980	Microturbine
×	109891	East Bay Municipal Utility District	2144 Poplar St	O	5411	562740.166030	4185560.458750	Gas Station
×	13737	East Bay Municipal Utility District PSK	2101 7th Street	O	4941	560669.166256	4184799.458780	Generator
×	591	East Bay Municipal Utility District	2020 Wake Avenue	O	4952	562060.166061	4186640.458610	Generator
×	14238	East Bay Municipal Utility District	1001 W Red Line Ave	A	4941	561168.166359	4182649.458950	Generator
–	20061	Englund Studio	1850 Campbell Street	O	3369	562304.166125	4185571.458820	Spray booth
×	19971	Essex Portfolio LLC DBA The Grand Apartments	100 Grand Avenue	O	1522	564718.017588	4185172.851520	Generator
×	20724	FEMA	1111 Broadway	O	9111	564046.420000	4184190.710000	Generator
×	24194	Former Mobil and Ashland Bulk Fuel Terminals	909 Ferry Street (Port of Oakland, Berth 23)	O	4953	560392.166189	4185875.458610	Soil Vapor Extraction
×	22746	Fox Television Stations Inc. on behalf of KTVU	2 Jack London Square	O	4833	564257.166075	4182885.459060	Generator
×	16749	General Services Administration-East Bay Office	1301 Clay Street	O	9199	563912.165967	4184445.458890	Generator and boiler
–	3737	George V Arth & Son	110 10th St	O	7532	564726.165981	4183733.459040	Spray Booth

M	Plant No.	Facility Name	Address	City	SIC code	x	y	Source Category
×	17588	Global Power Group, Inc	3938 Horton Street	E	5311	562750.510967	4187105.463270	Generator
×	111475	Golden Bay Gas and Food	2200 Telegraph	O	5411	564367.165953	4185153.458910	Gas station
–	5776	Harold's Auto Body & Paint Shop	2126 Market Street	O	7532	563487.166011	4185366.458800	Spray booth
–	10587	HC Fine Finishes	1231 24th Street	O	7641	562909.166023	4185797.458780	Spray booth
–	200331	High End Custom and Collision	1649 28th Street	O	7532	562714.166025	4186218.458670	Autobody
×	19039	Hotel Oakland	270 13th Street	O	7011	564549.987799	4184129.882810	Generator
–	20036	Hustead's Collision Center Inc	2915 Market Street	O	7532	563630.165961	4186090.458730	Autobody
–	378	Ideal Cleaners	322 14th Street	O	7216	564436.165966	4184245.458950	Petroleum dry cleaning
×	16965	Ikea US West Inc - 165 Emeryville	4400 Shellmound Street	E	5021	562311.166002	4187352.458640	Generator
×	112176	J and O Tire	2236 Poplar St	O	5411	562850.165989	4185865.458780	Gas Station
×	20823	Jefferson Oaks Housing	1424 Jefferson St	O	9531	563894.166034	4184557.458880	Generator
×	21940	John Hansen & Sons Inc	327 Clay Street	O	5149	563545.166086	4183682.458970	Coffee roaster
×	3490	Johnson Plating Works Inc	2526 Telegraph Ave	O	3471	564430.165947	4185542.458900	Chrome plating and spray booth
×	23430	Kaiser Permanente	1950 Franklin Street	O	8063	564555.165907	4184744.458970	Generator
×	23431	Kaiser Permanente	1800 Harrison Street	O	8063	564727.165920	4184544.459000	Generator
×	23433	Kaiser Permanente	410 19th Street	O	8063	564328.165955	4184763.458920	Generator
×	24068	KBS SOR II Oakland City Center	505 14th Street	O	6512	564019.165980	4184397.458960	Generator
–	10397	Le Magic Cleaners	1706 Franklin Street	O	7216	564418.165953	4184573.458930	Closed loop dry cleaner
×	18110	Level 3 Communications LLC	1330 Broadway	O	4813	564091.979994	4184356.933650	Generator
×	23231	Level 3 Communications LLC	1970 Broadway	O	4813	564449.165974	4184842.458890	Generator
–	12569	Lithograph Reproductions Inc	4120 Martin Luther King Jr Way	O	2752	564430.165808	4187306.458740	Lithography printing
×	8511	Madison Street Press	614 Madison Street	O	2752	564529.166012	4183455.459030	Printing press
×	109725	Market Street Shell #135692	610 Market St	O	5411	563156.166075	4184124.458940	Gas station
×	12765	MCI,dba Verizon Business	1330 Broadway	O	4813	564223.165967	4184305.458950	Generator
×	13299	MetroPCS California/Florida Inc	720 2nd Street	O	4911	563163.166110	4183762.458900	Generator
×	110209	Mobile SS#63049	3400 San Pablo	O	5411	563557.165952	4186699.458730	Gas station
×	20742	Modern Coffee Enterprises Inc	4059 Emery Street	E	2095	563233.165888	4187309.458620	Coffee roaster
×	5133	Mr. Espresso	696 3rd Street	O	2095	563275.166087	4183767.458960	Coffee roaster
×	2650	Nor-Cal Metal Fabricators	1121 3rd Street	O	3479	562614.166145	4183939.458950	Sandblaster
×	1500	Northern California Power Agency	2900 Main Street, Site 1	A	4911	562350.166214	4182722.459010	Turbines
×	14423	Oakland 14th Office	475 14th Street	O	6512	564070.166005	4184375.458960	Generator
×	19514	Oakland Center 21	2101 Webster Street	O	6512	564602.165884	4185023.458930	Generator and boiler

M	Plant No.	Facility Name	Address	City	SIC code	x	y	Source Category
×	111332	Oakland Marinas	2 Webster St	O	5411	563852.166087	4183149.459000	Gas Station
×	22781	Oakland Marriott City Center	1001 Broadway	O	7011	564012.166045	4184110.459010	Generator
×	22033	Oakland Museum of California	1000 Oak Street	O	9199	564818.165994	4183721.459080	Spray Booth
×	20527	Oakland Unified School District	1011 Union Street	O	8211	562519.166083	4184691.458810	Generator
×	110551	Oakland Valero Service Center	2225 Telegraph Ave	O	5411	564314.165906	4185166.458910	Gas station
×	109903	OFD Fire Station #2	100 Jack London Square	O	5411	563393.166112	4183400.458970	Gas Station
×	109994	OFD Fire Station #3	1445 14th St	O	5411	562259.166096	4185053.458770	Gas Station
×	20093	Olympic Tug and Barge Co Inc	321 A Avenue	A	5171	562965.166147	4182944.458960	Generator
×	13494	Pacific Bell	1587 Franklin Street	O	4813	564362.165940	4184509.458900	Generator
×	14173	Pacific Gas and Electric	1919 Webster Street	O	4931	564560.165977	4184740.458900	Generator
×	14551	Pacific Gas and Electric	689 2nd Street	O	4931	563202.166106	4183633.458910	Generator
×	8227	Pacific Interment Service	1094 Yerba Buena Ave	E	7261	563548.165902	4187269.458640	Cremator
×	21029	Pacific Renaissance Plaza	388 9th St Ste 229	O	6512	564147.165974	4183921.458950	Generator
×	12318	Peerless Coffee Co	260 Oak Street	O	2095	564511.166029	4183116.459040	Coffee roaster
×	23722	Pinnacle Ag Services	2440 W 14th Street	O	3711	561300.166191	4185579.458760	Generator
×	13682	Port of Oakland	Clay & Water Street at Jack London Square	O	9621	563468.166074	4183346.458990	Generator
×	16715	Port of Oakland	651 Maritime Street	O	1799	560444.166280	4184718.458760	Generator
×	23577	Port of Oakland	1599 Maritime Street	O	4491	560760.166236	4185498.458690	Generator
×	111027	Port of Oakland	651 Maritime St	O	5411	560444.166314	4184583.458760	Gas station
×	3791	Prime Smoked Meats Inc	220 Alice Street	O	5049	564174.166067	4183265.459000	Smoke house
×	200462	Prologis	2420 West 21st Street	O		561611.166143	4186200.458680	Generator
-	18373	PS Printing LLC	2861 Mandela Parkway	O	2752	562528.166041	4186330.458750	Print press
-	6191	Quality Body and Fender	2510 Martin Luther King Way	O	7532	564096.165965	4185558.458880	Autobody
×	23547	Radio Mirchi	Pole Plaza AHN 18, Pole #110141241	O	7812	559827.166257	4186509.458600	Generator
-	15931	Redline Import - Auto Collision	2300 Market Street #C	O	7532	563540.165986	4185575.458840	Spray area
×	106875	Rino Pacific	1107 5th St	O	5411	562682.166122	4184104.458920	Gas station
×	14607	Rotunda Partners II	300 Frank Ogawa Plaza	O	6552	564150.024407	4184549.804730	Generator
×	23098	Royal Coffee Company	2523 Broadway	O	5812	564682.165897	4185486.458840	coffee roaster
×	14068	S F Bay Area Rapid Transit District	101 8th Street	O	9621	564606.166019	4183538.459010	Generator
×	19696	Safety-Kleen Systems Inc.	400 Market Street	O	4953	563110.166078	4183947.458990	Soil vapor extraction
×	23208	Safeway #3125	3889 San Pablo Ave	E	5141	563353.165963	4187112.458680	Generator
×	18658	San Francisco Bay Bridge Toll Plaza	Bay Bridge East	O	9229	560407.166233	4186541.458600	Generator
-	12725	San Pablo Auto Body	2926 San Pablo Ave	O	7532	563730.165966	4186076.458770	Spray booth

M	Plant No.	Facility Name	Address	City	SIC code	x	y	Source Category
×	20386	Satellite First Communities, L P	540 21st Street	O	8361	564210.165960	4185069.458930	Generator
×	112517	Sausal Corporation	Bay Bridge Toll Plaza	O	5411	560399.166202	4186546.458570	Gas station
×	208	Schnitzer Steel Products Company	Adeline Street	O	5093	562499.999966	4183475.097660	Electric shredder
–	16860	SFPP, L P	Bay Street, off 7th	O	4613	560823.090000	4184843.250000	Diesel additive tank
×	18268	Sierra Pacific	3213 Wood Street	O	3272	562424.166075	4186446.458730	Aggregate
–	23904	Sila Nanotechnologies Inc	2450 Mariner Square Loop	A	2819	563636.166150	4182428.459110	Wipe cleaning
–	22778	Solstice Press	113 Filbert Street	O	2752	562802.166129	4183786.458940	Lithography printing
×	112577	Southern Counties Oil Company LP	105 5th St	O	5411	564515.165988	4183298.459090	Gas station
×	16848	SPRINT	1075 7th Street	O	4812	562783.166090	4184227.458860	Generator
×	16850	SPRINT	114 Brush Street	O	4812	563080.166080	4183689.458930	Generator
×	15760	SSA Terminals (Oakland) LLC	1999 Middle Harbor Rd	O	4731	560385.166356	4183504.458880	Generator
×	111133	SSA Terminals-Oakland LLC	1999 Middle Harbor Rd	O	5411	560352.166317	4184036.458820	Gas station
–	200748	Stanford Cleaners	2134 MARKET ST	O	7389	563492.165996	4185376.458810	Dry cleaning
×	109165	State of CA - Caltrans	Oak Bay Bridge, E Side, Toll Plaza	O	5411	560420.740000	4186547.050000	Gas Station
×	19281	State of California	1515 Clay St, Elihu Harris Building	O	9441	563982.971169	4184583.007780	Generator and boiler
×	14195	State of California Department of Transportation	111 Grand Avenue	O	9621	564732.570000	4185092.270000	Generator and boiler
×	201213	SVF Latham Square Owner LLC	1611 Telegraph Avenue	O		564207.165993	4184578.458940	Boiler
–	21159	Tam's Auto Body	2300 Market Street Ste B	O	7532	563536.165942	4185564.458800	Spray booth
×	20487	Target Corporation Store #T2767	1555 40th Street	O	5311	562487.166001	4187011.458690	Generator
×	21790	Target Corporation Store #T2829	2700 5th Street	A	5311	563474.166162	4182610.459060	Generator
×	112426	Tfuels Inc. dba Grand Arco AMPM-C Kim	889 West Grand Ave	O	5411	563515.165961	4185422.458780	Gas station
×	20987	The Ellington Community Association	222 Broadway	O	6531	563773.166110	4183461.459050	Generator
×	17703	The Home Depot (Store #0627)	3838 Hollis Street	E	5311	563036.124968	4187011.436650	Generator
×	17073	T-Mobile	720 2nd Street	O	4812	563192.166114	4183660.458950	Generator
×	14837	Trans Pacific Centre	1000 Broadway	O	6512	564090.166016	4184053.459000	Generator
×	200278	Trapac	2800 7TH ST	O	5411	559401.166329	4184726.458700	Gas station
×	17431	Union Pacific Railroad	1400 Middle Harbor Road	O	4011	561766.166221	4183829.458870	Generator
×	100583	Union Pacific Railroad	1400 Middle Harbor Road	O	5411	561771.166175	4183835.458880	Gas station

M	Plant No.	Facility Name	Address	City	SIC code	x	y	Source Category
-	200538	Uptown Body and Fender	401 26th Street	O	7532	564580.165868	4185529.458890	Autobody
×	21130	US Postal Service - Building Maintenance	1675 7th Street	O	4311	561587.340000	4184448.030000	Generator and fire pump
×	23711	USPA City Center LLC	555 12th Street	O	6512	563819.165993	4184285.458950	Generator and boiler
×	14711	Verizon Business	1999 Harrison Street	O	4813	564743.165909	4184727.458960	Generator
×	22412	Verizon Wireless	1404 Franklin Street	O	4812	564296.165973	4184311.458980	Generator
×	16284	Verizon Wireless (Alameda Perm)	114 Brush Street	O	4812	563080.166085	4183688.458990	Generator
×	18297	Verizon Wireless (Bay Bridge East)	107 Burma Road	O	4812	559595.580000	4186253.340000	Standby generator
×	23143	Viridis Fuels	2040 Wake Avenue	O	2861	561701.520000	4186478.240000	Boiler
×	22483	Watermark Bayside, LLC dba Bayside Park	1440 40th Street	E	8051	562722.165936	4187177.458620	Generator
×	5385	Weatherford BMW	575 West Grand Avenue	O	7532	564168.165947	4185174.458840	Spray booth
×	112042	Westco Gas	731 West Macarthur Blvd	O	5411	564109.914073	4186891.051810	Gas station
×	22058	Westcore City Properties, LLC	1221 Broadway	O	2812	564098.166021	4184261.458990	Generator
-	2620	WH Strehle Company	494 36th Street	O	7532	564686.165809	4186614.458780	Autobody
×	23954	Windstream	427 14th Street	O	6531	564224.165990	4184308.458940	Generator

Attachment 3. Truck-Related Businesses

Table A-3-1. Businesses with truck fleet activity operating in the West Oakland Source Domain. Only businesses with an assigned ID were included in this analysis; those excluded were either missing information or had < 4 vehicles per day (VPD). The reference (“Ref.”) of the activity information was collected from either a 2019 survey (S19), a 2009 survey (S09), or assumed parameters (A, where a number in parentheses indicates the ID from which the information is based on). A hyphen (–) indicates that the business was excluded from the analysis due to inappropriate business or activity type, and “n/a” indicates that no information was available. The fleet assumed for each business was either HHDT only (all EMFAC2017-based HHDT vehicles except Port Trucks), MHDT only, bus only (BUS), or a mixed fleet (mix) with 0.265 HHDT (Non-Port Truck), 0.10 LHDT, 0.135 MHDT, 0.50 Port Trucks (T7 POAK). All business addresses are located in Oakland, except those with an asterisk (located in Emeryville).

ID	Business Name	Address	VPD	Ref.	Fleet	Activity Type
	All Star Moving & Storage	1468 14th Street	0	–	–	Storage only
	Alpi International Ltd.	1685 34th Street	< 4	–	–	Wholesale product supplier
	American President Lines Ltd	1579 Middle Harbor Road	< 4	–	–	Shipment management
1	AM&S Transportation Co/ Trade Winds Import Export	1700 24th Street	70	S19	mix	Trucking
54	AMPCO Adeline	1599 Adeline Street	1000	S19	mix	Parking facility
53	AMPCO MLK	1 Martin Luther King Jr Way	1000	S19	mix	Parking facility
36	Aramark Uniform Services	330 Chestnut Street	5	A	MHDT	Uniform rental services
2	Atthowe Transportation Co Inc.	3924 Market Street	5	S19	mix	Carrier/broker
24	AV Trucking Co Inc.	1155 3rd Street	41	S19	mix	Office
3	Bay Area Container Transport	3427 Ettie Street	19	S19	mix	Broker
55	Best Bay Trucking	1 Market Street	50	S19	mix	Trucking
4	Cademartori Trucking	1833 Peralta Street	22	S19	mix	Shipping/trucking
5	California Cereal Products	1267 14th Street	5	S19	mix	Food processing
6	California Waste Solutions Inc. - 10th	1820 10th Street	50	S19	mix	Recycling
37	California Waste Solutions Inc. - Wood	3300 Wood Street	50	A (6)	mix	Recycling
7	CASS, Inc	2730 Peralta Street	6	S19	mix	Recycling
38	CCY Inc.	2505 Poplar Street	5	A	mix	Importers
8	Central Concrete	2400 Peralta Street	13	S19	mix	Concrete

ID	Business Name	Address	VPD	Ref.	Fleet	Activity Type
59	CFN Fuel Station	2236 Poplar Street	80	A (63)	mix	Gas station
	Commander Moving	1829 Mandela Pkwy	< 4	-	-	Moving/storage
	Dusty & Sons Truck Tire Center	2201 Mandela Pkwy	< 4	-	-	Tire sales
9	East Bay Resources	2430 Willow Street	5	S19	mix	Recycling
60	EBMUD Adeline	2127 Adeline Street	84	S09	mix	Office and yard
61	EMBUD Wake	2020 Wake Avenue	84	A (60)	mix	Yard
	FBC International Co.		-	-	-	Marketing company
10	Form and Reform	2601 Adeline Street	3	S19	mix	Light manufacturing
40	Golden Bear Produce	315 Franklin Street	112	S09	mix	Carrier
	Green Pro Tech (DPF Cleaning)	18th & Campbell	< 4	-	-	Diesel particulate filter cleaning
41	Green Tech Imports	2811 Adeline Street	5	A	mix	Shipping
42	Greyhound Bus	2103 San Pablo Avenue	55	S09	BUS	Bus
56	GST Transport	1 Market Street	50	S19	mix	Shipping/inspection
57	High Mountain Transport LLC	2505 Bataan Avenue	20	S19	mix	Trucking
43	Iron Mountain Information Management	1350 West Grand Ave	5	A	MHDT	Shredding/storage
11	ISSA Transportation Services, LLC (JB Truck Repair)	1639 18th St	10	S19	mix	Truck repair
	JB Truck Electrical Repair	1433 18th St	< 4	-	-	Truck services
12	J&A Truck Repair	2300 Poplar Street	14	S19	mix	Truck repair
44	J&O Tires/Scales	2401 Union Street	5	S09	mix	Truck services
13	JH Fitzmaurice	2857 Hannah Street *	4	S19	mix	Home construction and improvement
14	Kamal Trucking Corp	526 2nd Street	56	S19	mix	Carrier
	KMC Trading (Chang's)	2505 Poplar St	< 4	-	-	Recycling
15	Lange Trucking/Hoovestol	2226 Campbell Street	26	S19	mix	Trucking
62	Lenger & Sons Produce Express	2565 Buna Street #90	5	A	MHDT	Trucking (food)
45	Matheson Mail Transportation	2500 Poplar Street	30	S09	mix	Local general freight trucking
46	Mayway Corporation	1338 Mandela Pkwy	5	A	mix	Distribution
16	Mindful Distribution	2935 Adeline Street	4	S19	MHDT	Beer distributor

ID	Business Name	Address	VPD	Ref.	Fleet	Activity Type
	MK Enterprises	2225 Campbell St	< 4	–	–	Print advertising
	Mueller Nicholls	2400 Union St	< 4	–	–	Carrier
17	Mutual Express Company	1700 West Grand Avenue	40	S19	mix	Trucking
18	Narayan's Trucking Inc.	1155 3rd Street, Suite 260	41	S19	mix	Office
19	National Recycling	1312 Kirkham Ct	5	S19	mix	Recycling
20	Natural Logistics	Beach Street *	14	S19	mix	Shipping/trucking
58	Oakland Port Trucking	1 Market Street	25	S19	mix	Trucking
21	OMSS	10 Burma Road	1200	S19	mix	Truck parking
22	PACE Supply (Morgan Southern)	425 Market Street	75	S19	mix	Plumbing wholesale
23	Pacific Coast Container (PCC Logistics)	2498 16th Street	58	S19	mix	Broker
25	Pacific Coast Supply	1735 24th Street	10	S19	mix	Building materials
	Pacific Rail Services	1408 Middle Harbor Road	n/a	–	–	Repair
26	Portillo Trucking Company	160 Franklin Street	16	S19	mix	Trucking
27	Quintero Trucking	2270 Poplar Street	21	S19	mix	Trucking
63	Rinehart Oil Truck Fueling Station	1107 5th Street	80	S19	mix	Gas station
	RCM International (Martin Construction)	2850 Poplar Street	< 4	–	–	Concrete mixing
28	S.F. Enterprises (Modern Express and Courier)	2525 Mandela Pkwy	7	S19	mix	Yard
29	Saroni Food Services	1301 26th Street	12	S19	mix	Food (cold storage facility)
30	Sea Logix	1425 Maritime Street Bldg 319	5	A	mix	Trucking/drayage
47	Sierra Concrete	3211 Wood Street	10	A	mix	Concrete
	Skasol	1696 W Grand Avenue	< 4	–	–	Manufacturer
31	Starline Supply Company	2401 Peralta Street	8	S19	mix	Carrier
	Starving Student Movers	2850 Poplar Street	4	–	–	Moving company
	Steel Company (name unknown)	1699 W Grand Avenue	n/a	–	–	Steel
48	Sutta Shredding Company	1221 3rd Street	5	A	MHDT	Recycling
	Sweet Maria's Coffee Warehouse	2823 Adeline Street	< 4	–	–	Retail
	Terminal Maintenance Company	2502 Middle Harbor Drive	n/a	–	–	Carrier
49	TFS Trucking	2226 Myrtle Street	10	A	mix	Yard

ID	Business Name	Address	VPD	Ref.	Fleet	Activity Type
32	Tighe Transportation & Wisle	2230 Willow Street	2	S19	mix	Trucking
	Transpacific Trading	2433 Poplar St	< 4	-	-	Tire sales
50	U.S. Freight Systems	1819 10th Street	10	A	mix	Shipping/trucking
51	U.S. Postal Service Depot	1675 7th Street	1034	S09	HHDT	Postal depot
33	VA Transportation Inc.	1340 Mandela Pkwy	47	S19	mix	Shipping/trucking
	Western Seafare	1297 26th Street	n/a	-	-	Refrigerated warehouse
	Western States Teleport Inc.	2303 Poplar Street	-	-	-	Telephone company
34	Wings Century Trucking	1599 Maritime Street	50	S19	mix	Trucking
35	Wyse Logistics	1301 24th Street	56	S19	mix	Drayage, warehouse, transloading, bulk trucks

Appendix B – Summary of Attendance at Steering Committee Meetings

	Meeting Date	Meeting Time	Meeting Location	Number of Participants
Kick-off	Friday, July 27, 2018	10:00 AM - 1:00 PM	Oakland City Hall, Hearing Room 3 1 Frank H Ogawa Plaza, Oakland, CA 94612	Approximately 50
1	Wednesday, September 5, 2018	6:00 PM - 8:30 PM	Alameda County Department of Public Health, 5th Floor 1000 Broadway, Oakland, CA 94607	Approximately 50
2	Wednesday, October 3, 2018	6:00 PM - 8:30 PM	West Oakland Senior Center 1724 Adeline Street, Oakland, CA 94607	51
3	Wednesday, November 7, 2018	6:00 PM - 8:30 PM	West Oakland Senior Center 1724 Adeline Street, Oakland, CA 94607	55
4	Wednesday, December 5, 2018	6:00 PM - 8:30 PM	West Oakland Senior Center 1724 Adeline Street, Oakland, CA 94607	54
5	Wednesday, January 9, 2019	6:00 PM - 8:30 PM	West Oakland Senior Center 1724 Adeline Street, Oakland, CA 94607	54
6	Wednesday, February 6, 2019	6:00 PM - 8:30 PM	West Oakland Senior Center 1724 Adeline Street, Oakland, CA 94607	52
7	Wednesday, March 6, 2019	6:00 PM - 8:30 PM	West Oakland Senior Center 1724 Adeline Street, Oakland, CA 94607	66

	Meeting Date	Meeting Time	Meeting Location	Number of Participants
8	Monday, March 11, 2019	6:00 PM - 9:00 PM	Alameda County Department of Public Health, 5th Floor 1000 Broadway, Oakland, CA 94607	47
9	Wednesday, April 3, 2019	6:00 PM - 8:30 PM	West Oakland Senior Center 1724 Adeline Street, Oakland, CA 94607	51
10	Wednesday, May 1, 2019	6:00 PM - 8:30 PM	West Oakland Senior Center 1724 Adeline Street, Oakland, CA 94607	58
11	Wednesday, June 5, 2019	6:00 PM - 8:30 PM	West Oakland Senior Center 1724 Adeline Street, Oakland, CA 94607	67
12	Wednesday, June 26, 2019	6:00 PM - 8:30 PM	Alameda County Department of Public Health, 5th Floor 1000 Broadway, Oakland, CA 94607	48
13	Wednesday, July 10, 2019	6:00 PM - 8:30 PM	West Oakland Senior Center 1724 Adeline Street, Oakland, CA 94607	48

Appendix C – Steering Committee Charter and Participation Agreement

WEST OAKLAND COMMUNITY AIR ACTION PLAN
STEERING COMMITTEE CHARTER AND PARTICIPATION AGREEMENT
Amended August 29, 2018

1. Mission Statement

Assembly Bill 617 (Garcia, C., Chapter 136, Statutes of 2017) is a State-mandated program that uses a community-based approach to reduce local air pollution in communities around the State that continue to experience disproportionate impacts from air pollution. West Oakland— which includes the Port of Oakland, Oakland Army Base, East Bay Municipal Utility District's (EBMUD) waste treatment facility, surrounding freeways and various industrial facilities—is the region's initial focus under the AB 617 program to develop an action plan to reduce air pollution and exposure in the West Oakland community.

The steering committee will be responsible for advising the development of the community plan as well as disseminate information and transmit input from your representative sectors as appropriate. The key elements of the West Oakland Community Air Action Plan (Plan) will need to be completed by early 2019 in preparation for State adoption in October 2019.

2. Committee Objectives

The West Oakland Community Air Action Plan Steering Committee is a special committee that will serve for the designated purpose outlined in the mission statement. Committee objectives include identifying the West Oakland community boundary, identifying areas of concern for air pollution sources and sensitive receptor sites, reviewing existing plans, studies and reports on air quality to provide strategic input towards Plan development. Committee objectives also include disseminating and soliciting information with community stakeholders for which the committee members represent. The goal is for the Plan to be adopted by the Bay Area Air Quality Management District Board by October 2019. Upon adoption of the Plan, the steering committee may elect to continue to meet quarterly to support and provide guidance on implementation, and develop progress reports.

3. Membership

Criteria for Community Steering Committee Membership

To ensure the Plan focuses on the impacts to people and businesses within the defined study area, steering committee membership is limited to residents or businesses with street addresses within the West Oakland study area. Additional members may include city/county officials, land use planning agencies, transportation agencies and local health departments. Interested stakeholders, and larger representation groups such as regional associations, are encouraged to participate as non-voting members at all open meetings.

The official roster will contain one primary name for each affiliation to be represented on the committee. One alternate name can substitute for the primary member if the primary member is unable to attend a meeting. However, only one member from each affiliation will be allowed to deliberate at meetings to reach consensus. The committee meetings are open to the public and additional members may be added to the roster if agreed upon by the West Oakland Environmental Indicators Project and the Bay Area Air Quality Management District who will serve as co-leads of the Steering Committee.

4. Roles and Responsibilities

Community Steering Committee Members

Steering committee members will be responsible for assisting Air District and WOEIP staff in identifying all air pollution issues and sources of air pollution in the West Oakland community and the development of the West Oakland Community Air Action Plan. Committee members may be asked to review local community plans, health impact studies, and air quality data to assist in developing the Plan. Committee members will help develop emission reduction goals or targets that will be used to evaluate the success of the Plan in reducing emissions and exposure.

Steering committee members are expected to attend a minimum of ten committee meetings (in their entirety) and to participate in 2-4 community townhall meetings throughout the course of the year prior to the Plan adoption.

Steering Committee members who participate in this process are expected to sign the West Oakland Air Action Plan Committee Participation Agreement (Page 5 of this Charter) which outlines the expected conduct of all Steering Committee members.

Co-leads

The West Oakland Environmental Indicators Projects and Bay Area Air Quality Management District serve as partnering co-leads for the development of the West Oakland Community Steering Committee. As co-leads, they will be responsible for providing necessary background materials for committee members, developing meeting

agendas, coordination with the meeting facilitator and establishing and maintaining a community website for Steering Committee activities. Co-leads will also be responsible for providing technical support and other relevant technical assessment information to the Committee.

Facilitator

A professional and impartial facilitator will be used for moderating the steering committee meetings and for helping the committee reach consensus on issues.

5. Standard Committee Meeting Procedures

Deliberation and Consensus

A professional and impartial facilitator(s) will be employed to support the steering committee in the overall organization, order and focus of the meeting, resolve conflicts and help reach consensus to ensure the goals and objectives of this charter are met. Achieving full consensus of the steering committee may not always be possible. In the event of an impasse, the co-leads shall be the final decision-makers, carefully weighing the consequences of any decision where there is a lack of consensus. If the co-leads cannot agree, then the action in question will not proceed. Community Steering Committee members who do not agree with a majority consensus on a decision may submit a minority position statement.

Member Participation

Only one member from each affiliation may participate as part of the steering committee deliberative process in any individual meeting. If the primary member is unable to attend, the designated alternate on the steering committee roster may attend in their absence and deliberate on the primary member's behalf.

If a primary member or their alternate is not able to attend a scheduled meeting, they may submit written comments for consideration on relevant agenda topics to the Committee chair or the co-leads prior to the scheduled meeting. Written communications may inform, but not substitute, for being physically present during deliberations of the committee. If a primary member or their alternate has not attended three consecutive steering committee meetings, their membership may be revoked as determined by the co-leads.

Open Meetings

All meetings are open to the general public and will provide a formal opportunity for members of the public to provide their perspective on the development of the Plan. Stakeholder input is welcome and encouraged.

Meeting Schedule and Agendas

Steering committee members are expected to attend monthly meetings. Upon consensus agreement of the committee, meeting schedules may be adjusted with adequate advance notice. Agenda topics will be developed by the co-leads and will include the time, date, duration, location and topics to be discussed. Individual committee members may request relevant items be added to an agenda at least one week prior to the schedule meeting.

Subcommittees

Members who wish to be further involved may choose to participate in ad-hoc subcommittees such as technical assessment, community surveys and outreach or other relevant topics. Subcommittees would meet every other month between full steering committee meetings and will report back their findings and/or recommendations at the next full steering committee.

6. Accessibility/Accommodation

The steering committee meetings and other outreach events associated with the committee must be held at facilities that can accommodate members covered by the Americans with Disabilities Act. Language interpretation services will be provided as needed with a minimum 48-hour advance request.

7. Dissemination of Materials

Any materials, presentations, documents, correspondence or other written communications generated or disseminated by the committee, or on behalf of the committee or its members, must be approved by the co-leads prior to release. All final correspondence will include the logos of West Oakland Environmental Indicators Project and Bay Area Air Quality Management District.

8. Website

A website will be developed and maintained by the co-leads to provide information to the community on the Steering Committee actions and development of the Plan.

Appendix D – Strategies and Implementation Background

GOVERNMENT COLLABORATION

This Plan requires collaboration among government agencies. This section of Appendix D describes agencies and their recent planning activities. As noted in Chapter 1, the Steering Committee reviewed past and ongoing planning efforts while creating this Plan, and the Plan builds on these existing efforts. Past plans seek to bring jobs, retail, and services to the community; to address blighted properties and incompatible land uses; to improve transit, bike, and pedestrian access; to increase mixed-use development; to preserve the existing housing stock; to increase the supply of affordable housing; and to reduce the community's exposure to diesel PM and other air pollutants.

Air District

The Air District is the regional agency responsible for assuring clean air in the nine counties that surround the San Francisco Bay (except in northeastern Solano and northern Sonoma counties). The Air District writes and implements air quality plans, adopts and enforces regulations to control air pollution from stationary sources, offers incentives to government, businesses, and individuals to voluntarily reduce air pollution, engages with communities and provides technical and policy guidance regarding air quality, and manages the Spare the Air program.

The Air District's current air quality management plan is the 2017 Clean Air Plan: Spare the Air, Cool the Climate. The Plan provides a regional strategy to protect public health and protect the climate. To protect public health, the plan describes how the Air District will continue our progress toward attaining all state and federal air quality standards and eliminating health risk disparities from exposure to air pollution among Bay Area communities. To protect the climate, the plan defines a vision for transitioning the region to a post-carbon economy needed to achieve ambitious greenhouse gas (GHG) reduction targets for 2030 and 2050, and provides a regional climate protection strategy that will put the Bay Area on a pathway to achieve those GHG reduction targets.

The 2017 Plan includes a wide range of control measures designed to decrease emissions of the air pollutants that are most harmful to Bay Area residents, such as particulate matter, ozone, and toxic air contaminants; to reduce emissions of methane and other "super-GHGs" that are potent climate pollutants in the near-term; and to decrease emissions of carbon dioxide by reducing fossil fuel combustion.

City of Oakland

The City of Oakland is the local agency responsible for land-use and transportation decisions. The City Council makes land-use decisions by adopting general and specific plans, zoning regulations, and certifying environmental reports for land-use projects, such as housing, commercial, and industrial developments. The West Oakland Specific Plan is an example of a land-use plan that the City has adopted. The West Oakland Truck Management Plan is an example of a measure required by an environmental report on a land-use development project

and an example of City transportation authority. For the Plan, the City of Oakland will implement strategies that address air pollution impacts from land use and transportation.

The City and Port of Oakland approved the [West Oakland Truck Management Plan](#) in April 2019. The goal of the Plan is to reduce the effects of transport trucks on local streets in West Oakland. The Plan reflects extensive outreach and input from the West Oakland residential and business community. In the Plan, the City and Port commit to ten strategies. The strategies commit to improving safety at street intersections near the Port; updating truck routes, truck prohibited streets, truck parking regulations and signage; conducting targeted traffic enforcement spot-checks and parking enforcement; improved training for issuing parking tickets; and considering increasing truck parking fines.

The [West Oakland Specific Plan](#) (2014) seeks to build on the existing vitality, cultural and social diversity, industry and transportation assets in West Oakland, while creating a community with clean industries, living-wage jobs, successful small businesses, mixed-use transit-oriented development and mixed-income housing, where environmental quality and community health are improved. Developed in partnership by the City, affected property owners, and adjacent business and residential communities, the Plan is a tool for developing commercial and industrial enterprises in West Oakland.

[Metropolitan Transportation Commission \(MTC\)](#)

The Metropolitan Transportation Commission (MTC) is the regional agency responsible for transportation planning, financing, and coordinating for the nine-county San Francisco Bay Area. The San Francisco Bay Area Goods Movement Plan and MTC Resolution No. 4244: Goods Movement Investment Strategy are examples of MTC's effort to plan, finance, and coordinate transportation in the Bay Area. For the Plan, MTC will help implement Strategies that address air pollution from mobile sources such as heavy-duty trucks and light-duty vehicles that travel through West Oakland and on the surrounding roadways and freeways, and air pollution from Port and Port tenant goods movement activities, for example through electric vehicle charging infrastructure, and improved bicycling and pedestrian infrastructure.

In 2016, MTC adopted the [San Francisco Bay Area Goods Movement Plan](#). In 2018, the Commission passed [MTC Resolution No. 4244: Goods Movement Investment Strategy](#). The Strategy addresses the Plan's freight movement impacts in communities like West Oakland. By adopting the Strategy, MTC made a commitment to work with the Air District, the Alameda County Transportation Commission, the Port of Oakland, and public health and environmental groups to reduce the impacts of pollution on communities from freight activities. The Strategy includes a list of potential projects to protect communities from air pollution.

The Strategy will direct \$3.8 billion over 10 years to 20 different projects in the Bay Area, with a strong focus on Interstate Corridors and the Port of Oakland in Alameda County. Approximately \$1.2 billion of this investment will be directed to Rail Strategy projects and \$350 million will be directed to Community Protection projects which will reduce emissions from equipment,

facilities, and vehicles in communities that are heavily impacted by goods movement activities such as West Oakland. Over 50% of the funds will come from state and regional sources while the remaining funds will come from federal, local, and other sources. In the near term, it is probable that financial support for the Community Protection projects will come from SB 1 – Trade Corridors funds and will come from future bridge toll increases in later years (Regional Measure 3).

Port of Oakland

The Port of Oakland is the local agency responsible for managing the Oakland Seaport, Oakland International Airport, and Jack London Square. The City of Oakland's Charter establishes the Port of Oakland as an independent department with its own governing board.

In 2009, the Port of Oakland adopted the Maritime Air Quality Improvement Plan (MAQIP) to guide their response to community concerns over existing exposure to pollution and proposed development at the Port, rule-making by CARB to control emissions from marine vessels, drayage trucks and other port-based engines, and the publication of a health risk assessment of the West Oakland area by CARB and Air District showing very high cancer risk levels due to exposure to diesel PM.

The MAQIP committed the Port and its tenants to an 85% reduction in diesel PM emissions by 2020. In 2018, recognizing the need to identify additional strategies to achieve the 85% reduction goal and to incorporate the Bay Area's and State of California's climate goals, the Port reconvened the Task Force to assist in updating the air quality plan for the Seaport. This work resulted in the adoption of the [Seaport Air Quality 2020 and Beyond Plan](#) in 2019.

The Seaport Air Quality 2020 and Beyond Plan is an example of the Port's effort to manage operations and air pollution from the Port. For the Plan, the Port will implement strategies that address air pollution from Port and Port tenant activities, such as the movement of inbound and outbound freight on cargo equipment, port trucks, locomotives, and ocean-going ships and harbor craft in the San Francisco Bay. The goals of the Plan are to keep the Port competitive, financially sustainable, and a source of jobs and economic development; minimize air pollution from Port activities; build partnerships among Port, tenants, government agencies, community organizers, and other stakeholders; and provide meaningful stakeholder engagement. The Plan commits to deploying certain levels of zero-emission trucks, cargo handling equipment, and other equipment by certain deadlines. In response to advocacy by community members, the Air District and others, the Port Commissioners adopted the 2020 and Beyond Plan in 2019 with the condition that the Port would review and incorporate applicable measures from this Community Action Plan.

Alameda County Public Health Department

The Alameda County Public Health Department is the county department responsible for providing public health services. The Health Department delivers services such as access to quality medical care services, disease prevention education and control, community education

and outreach, and health policy development. The Healthy Development Guidelines is an example of the policy work that the Public Health Department delivers. For the Plan, the Public Health Department will implement strategies such as those that help the community access health services and educate the community about health risks, treatment, and prevention.

The Healthy Development Guidelines (2018), developed in collaboration with the City of Oakland and East Oakland Building Healthy Communities, is a reference tool of current and potential policies in the City of Oakland. The policies address a broad range of health and equity-related issues, including preventing human exposure to air pollution.

California Air Resources Board (CARB)

CARB is the state agency responsible for controlling emissions from mobile sources and consumer products (except where federal law preempts CARB's authority), controlling toxic emissions from mobile and stationary sources, controlling greenhouse gases from mobile and stationary sources, developing fuel specifications, and coordinating State-level air quality planning strategies with other agencies. CARB is also responsible for establishing the state's air quality standards to protect human health.

AB 617 directs CARB to work with local air districts in California to address the disproportionate air quality and health challenges in communities like West Oakland. For the Plan, CARB will adopt and enforce regulations for mobile sources such as heavy-duty trucks and light-duty vehicles that travel through West Oakland and on the surrounding roadways and freeways, and sources at the Port of Oakland, such as cargo equipment, port trucks, locomotives, and ocean-going ships and harbor craft in the San Francisco Bay.

CARB staff develop, and the CARB board considers and adopts, regulatory programs designed to reduce emissions to protect public health, achieve air quality standards, reduce greenhouse gas emissions, and reduce exposure to toxic air contaminants. CARB establishes regulatory requirements for cleaner technologies (both zero and near-zero emissions) and their deployment into the fleet, for cleaner fuels, and to ensure in-use performance. CARB's regulatory programs are broad, impacting mobile sources and multiple points within product supply chains from manufacturers to distributors, retailers, and end-users. CARB's regulations affect cars, trucks, ships, off-road equipment, consumer products, fuels, and stationary sources.

One of CARB's important and relevant regulatory authorities is to adopt measures to reduce emissions of toxic air contaminants from mobile sources, known as Airborne Toxic Control Measures (ATCM).¹ These regulatory measures include emissions limits and/or specify low emission technology. Much of the progress to-date in improving air quality in West Oakland is due to compliance with CARB's existing diesel PM ATCMs and new engine standards. CARB is proposing a suite of amendments to existing ATCMs and adoption of new programs to further

¹ California Health and Safety Code § 39650 et seq.

reduce emissions of diesel PM. CARB's schedule for their programs dealing with many of the main sources of diesel PM emissions in West Oakland is shown in Figure D-1.

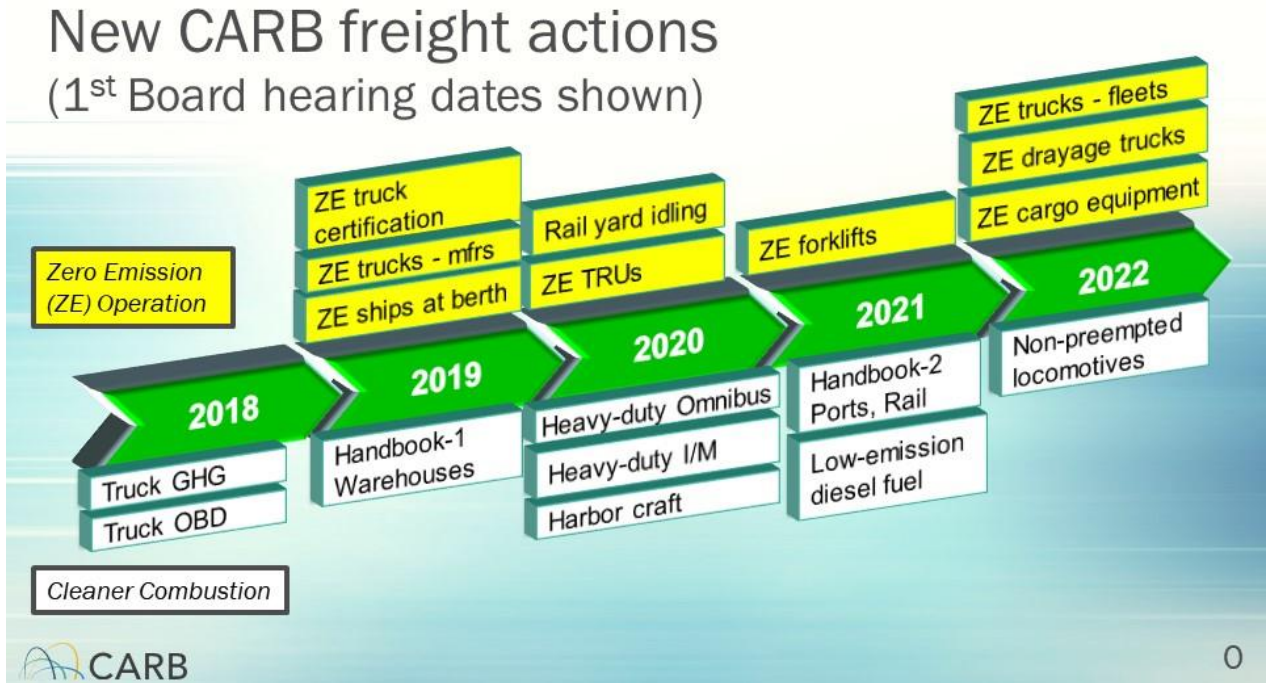


Figure D-1. CARB Freight Actions Benefiting West Oakland. Presented to the BAAQMD Board of Directors on May 1, 2019.

Additionally, CARB has pursued agreements with industry that result in voluntary adoption of the cleanest technologies or practices and provide assurance that emissions reductions will be realized. CARB’s agreement with the Union Pacific Railroad Company and BNSF Railway Company to accelerate introduction of cleaner locomotives in the South Coast Air Basin is an example of such a voluntary agreement.

Each of the Plan Strategies will require CARB to consider and to adopt new or amended regulations. Prior to starting formal regulatory proceeding, CARB staff will be undertaking studies of some of these Strategies. For instance, given the community concerns with truck idling, CARB will work with the West Oakland community and the Steering Committee to collect data to better understand idling activity. CARB, with technical assistance from the Air District, will integrate the community-level activity data with updated emissions data to evaluate whether the current idling regulations provide adequate health protection. As shown in Figure D-1 above, CARB will consider regulations requiring zero-emission drayage trucks and cargo-handling equipment in 2022. It is unclear at this time if the regulations will begin requiring phase-in of the zero-emission equipment and trucks prior to 2025.

Alameda County Transportation Commission

The Alameda County Transportation Commission is the county agency responsible for managing the county's one-cent transportation sales tax funds and funding transportation projects and programs. The Alameda CTC is responsible for delivering the County's bicycle, pedestrian, highway improvements, road, and transit projects. For the Plan, the Alameda CTC will implement transportation-related Plan Strategies, including those that advocate for improved bicycling and pedestrian infrastructure in West Oakland.

California Department of Transportation (Caltrans)

The California Department of Transportation (Caltrans) is the state agency responsible for maintaining and improving state highways and transportation projects. For the Plan, Caltrans will implement Plan Strategies such as studies to determine the feasibility of vegetative biofilters between the Prescott neighborhood and Interstate 880 and work with WOEIP and the Air District to address air quality issues from truck parking leases on Caltrans right-of-way.

INCENTIVE FUNDING

Listed below are brief descriptions of current ongoing funding opportunities. Figure D-2 presents a matrix of air quality incentive funding programs and the types of projects the program will fund. Table D-1 presents a sample of emissions reduction projects that will reduce emissions in West Oakland. The Air District is funding these projects through existing incentive programs.

Air District administered incentive programs

Carl Moyer Program - The Bay Area Air Quality Management District (Air District) has participated in the Carl Moyer Program (CMP), in cooperation with the CARB, since the program began in fiscal year 1998-1999. The CMP provides grants to public and private entities to reduce emissions of oxides of nitrogen (NOx), reactive organic gases (ROG) and particulate matter (PM) from existing heavy-duty engines by either replacing or retrofitting them. Eligible heavy-duty diesel engine applications include on-road trucks and buses, off-road equipment, marine vessels, locomotives, and stationary agricultural pump engines.

www.baaqmd.gov/moyer

Assembly Bill 923 (AB 923 - Firebaugh), enacted in 2004 (codified as Health and Safety Code (HSC) Section 44225), authorized local air districts to increase their motor vehicle registration surcharge up to an additional \$2 per vehicle. The revenues from the additional \$2 surcharge are deposited in the Air District's Mobile Source Incentive Fund (MSIF). AB 923 stipulates that air districts may use the revenues generated by the additional \$2 surcharge for projects eligible under the CMP.

Community Health Protection Grant Program - In 2017, Assembly Bill (AB) 617 directed CARB, in conjunction with local air districts to establish the Community Air Protection Program. AB 617 provides a new community-focused action framework to improve air quality and reduce

exposure to criteria air pollutants and toxic air contaminants in communities most impacted by air pollution. In advance of the development of the Community Air Protection Program, the Governor and legislature established an early action component to AB 617 to use existing incentive programs to get immediate emission reductions in the communities most affected by air pollution. AB 134 appropriated \$250 million from the Greenhouse Gas Reduction Fund (GGRF) to reduce mobile source emissions including criteria pollutants, toxic air contaminants, and greenhouse gases in those communities. The Bay Area has been allocated \$50 million of these funds for emission reduction projects. These funds will be used to implement projects under the CMP, and optionally on-road truck replacements under the Proposition 1B Goods Movement Emission Reduction Program.

In 2018, Senate Bill (SB) 856 appropriated an additional \$245 million in incentives to reduce emissions from both mobile and stationary sources. The Air District will receive about \$40 million of these funds for Bay Area projects. Mobile sources will follow the Carl Moyer Program and Proposition 1B Goods Movement Emission Reduction Program guidelines like Program Year 1. Funding will also be available for stationary source projects as defined by CARB Community Air Protection Grant Program guidelines and other programs/projects consistent with the actions identified in the applicable AB 617 community emission reduction program.

www.baaqmd.gov/ab617grants

Transportation Fund for Clean Air - In 1991, the California State Legislature authorized the Air District to impose a \$4 surcharge on motor vehicles registered within the nine-county Bay Area to fund projects that reduce on-road motor vehicle emissions within the Air District's jurisdiction. The statutory authority for the Transportation Fund for Clean Air (TFCA) and requirements of the program are set forth in the HSC Sections 44241 and 44242. Sixty percent of TFCA funds are awarded by the Air District to eligible projects and programs implemented directly by the Air District (e.g., Spare the Air, electric vehicle charging station program) and to a program referred to as the TFCA Regional Fund. Each year, the Board allocates funding and adopts policies and evaluation criteria that govern the expenditure of TFCA funding. The primary Air District administered incentive programs include:

- Trip reduction projects - www.baaqmd.gov/PTR
- Public electric vehicle charging stations - www.baaqmd.gov/charge
- Light & Medium Duty zero-emission vehicles - www.baaqmd.gov/cleanfleets
- Electronic bicycle lockers – www.baaqmd.gov/funding-and-incentives/public-agencies/bike-racks-and-lockers
- Bikeways, roads, lanes, paths – www.baaqmd.gov/bikeways

VW Environmental Mitigation Trust - CARB has been designated as Lead Agency to act on the State's behalf in implementing California's allocation of the VW Environmental Mitigation Trust (VW Trust). On May 25, 2018, the ARB approved the Beneficiary Mitigation Plan (Plan) which, through the VW Trust, will provide about \$423 million for projects in California to mitigate the

excess nitrogen oxide (NOx) emissions caused by VW's use of illegal defeat devices in certain diesel vehicles. The VW Trust funding will provide funding opportunities for settlement specified eligible actions that are focused mostly on "scrap and replace" projects for the heavy-duty sector, including on-road freight trucks, transit and shuttle buses, school buses, forklifts and port cargo-handling equipment, commercial marine vessels, and freight switcher locomotives. CARB staff estimates the Plan's funding actions in aggregate will reduce about 10,000 tons of NOx statewide over a 10-year period. <https://ww2.arb.ca.gov/our-work/programs/volkswagen-environmental-mitigation-trust-california>

Climate Tech Finance - The Air District's Climate Tech Finance program offers subsidized financing and technical guidance to spur the adoption of emerging technologies that reduce greenhouse gas emissions. The Air District also provides engineering evaluation and technical assistance to borrowers to evaluate proposed projects. This program is being offered through a partnership with the California Infrastructure and Economic Development Bank (IBank). www.baagmd.gov/ctf

Other incentive programs

U.S. EPA Diesel Emission Reduction Act - The United States Environmental Protection Agency (U.S. EPA) Clean Diesel Program provides support for projects that protect human health and improve air quality by reducing harmful emissions from diesel engines. This program includes grants and rebates funded under the Diesel Emissions Reduction Act (DERA). Funding is typically available annually on a competitive basis. The Air District has successfully implemented several DERA grants over the past decade. <https://www.epa.gov/cleandiesel/clean-diesel-national-grants>

CARB Low Carbon Transportation Program - The Low Carbon Transportation Program is part of California Climate Investments, a statewide program that puts billions of Cap-and-Trade dollars to work reducing GHG emissions, strengthening the economy, and improving public health and the environment—particularly in disadvantaged communities. CARB's Low Carbon Transportation Program is designed to accelerate the transition to advanced technology low carbon freight and passenger transportation with a priority on providing health and economic benefits to California's most disadvantaged communities. These investments support the state's climate change, air quality, ZEV deployment, and petroleum reduction goals. <https://www.arb.ca.gov/msprog/aqip/fundplan/fundplan.htm>

CARB Clean Vehicle Rebate Project - The Clean Vehicle Rebate Project (CVRP) promotes clean vehicle adoption in California by offering rebates of up to \$7,000 for the purchase or lease of new, eligible zero-emission vehicles, including electric, plug-in hybrid electric and fuel cell vehicles. The Center for Sustainable Energy (CSE) administers CVRP throughout the state for CARB. <https://cleanvehiclerebate.org/eng>

CARB Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) - The Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) and Low NOx Engine Incentives was formed by CARB as a result of the Air Quality Improvement Program (AQIP) following the passing of the California Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act of 2007 (AB 118, Statutes of 2007, Chapter 750). AQIP offers funding for projects and initiatives focused on supporting the development and deployment of the advanced technologies needed to meet California’s longer-term, post-2020 air quality goals. The fuel efficiency and zero- to low-emission benefits of zero-emission, hybrid, and natural gas vehicle technologies provide a strong public health benefit by reducing harmful greenhouse gas (GHG) and criteria emissions. <https://www.californiahvip.org/>

Equipment / Project Type →	Heavy-duty vehicles (trucks, buses, school buses, shuttles)	Light-duty/ passenger vehicles	Trip reduction program	Transportation programs/ projects	Marine vessels	Locomotives	Agriculture equipment	Industrial/ Port/ Cargo handling equipment	Construction equipment	Portable engines	Supporting infrastructure (charging/fueling)	Bikeways, roads, lanes, paths, lockers	Stationary sources	Fireplaces and wood stoves
Carl Moyer Program (CMP)	•				•	•	•	•	•	•	•			
Community Health Protection Grant Program	•				•	•	•	•	•	•	•		•	
Transportation Fund for Clean Air	•	•	•	•							•	•		
Volkswagen (VW) Settlement Funds	•				•	•		•	•		•			
Clean cars for all		•												
Vehicle buyback program (VBB)		•												
FARMER Program	•						•							
Woodsmoke rebate program														•
Climate Tech Finance													•	
CARB Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)	•													
CARB Clean Vehicle Rebate Project (CVRP)		•												
CARB Low Carbon Transportation Program	•				•	•	•	•	•		•			
CA Energy Commission (CEC) funding opportunities	•										•			
CA State Transportation Agency	•					•					•			
U.S. Environmental Protection Agency's (EPA) Diesel Emissions Reduction Act (DERA) Program	•				•	•	•	•	•		•			
Federal Highway Administration's (FHWA) Congestion Mitigation and Air Quality Program (CMAQ)			•									•		
Federal Transit Authority (FTA)	•													
Pacific Gas & Electric (PG&E) Funds										•				
Air District administered funding sources	•													
Non-Air District funding sources	•													

Figure D-2. Incentive Programs

Table D-1: A sample of upcoming emissions reduction projects

Project	Grantee Name	Incentive Funds Awarded	Grantee Contribution	Total Project Cost	PM2.5 Emissions Reduced (tpy)
One switcher locomotive	Oakland Global Rail Enterprise	\$1,080,500	\$1,139,500	\$2,220,000	0.040
Two main engines in a tugboat (Sandra Hugh)	Amnav Maritime Corporation	\$743,000	\$743,656	\$ 1,486,656	1.130
Two main engines in a tugboat (Revolution)	Amnav Maritime Corporation	\$743,000	\$743,656	\$ 1,486,656	1.130
Two auxiliary engines in a tugboat (Sandra Hugh)	Amnav Maritime Corporation	\$134,000	\$16,068	\$150,068	0.019
Two auxiliary engines in a tugboat (Revolution)	Amnav Maritime Corporation	\$134,000	\$16,068	\$150,068	0.019
13 hybrid cranes	SSA Terminals	\$5,011,500	\$885,183	\$ 5,896,683	0.166
On-road	Alameda-Contra Costa Transit District	\$1,011,000	\$5,464,000	\$ 6,475,000	0.002
Two main and two auxiliary engines in a tugboat (Z-3)	Harley Marine Services, Inc. Vessel: Z-Three	\$1,613,500	\$186,943	\$1,800,443	0.364
Two main and two auxiliary engines in a tugboat (Z-5)	Harley Marine Services, Inc. Vessel Z-Four	\$1,613,500	\$186,943	\$1,800,443	0.364
Two main and two auxiliary engines in a tugboat	Harley Marine Services, Inc. Vessel Z-Five	\$1,613,500	\$186,943	\$1,800,443	0.364
Totals		\$13,697,500	\$9,568,960	\$23,266,460	3.598

Appendix E – Enforcement Support Document

LIST OF PERMITTED FACILITIES IN WEST OAKLAND

Name	Address	City	Zip Code	Permit Type	Source Type
AAA San Pablo Fuel Inc.	3420 San Pablo Avenue	Oakland	94608	Air District	Gas Station
Acorn Restoration	2914 Poplar Street	Oakland	94608	Air District	Paint Operation
Alameda County Public Works Agency	3455 Ettie Street	Oakland	94608	Air District	Emergency Generator
Amber Flooring Inc	3441 Louise Street	Oakland	94608	Air District	Paint Operation
Amtrak	120 Magnolia Street	Oakland	94607	Air District	Emergency Generator
Aramark Uniform Services	330 Chestnut Street	Oakland	94607	Air District	Boiler
Bart Gas & Food	1395 7th Street	Oakland	94607	Air District	Gas Station
Berkeley Millwork & Furniture Co	2279 Poplar Street	Oakland	94607	Air District	Paint Operation
Berkeley Repertory Theatre	2526 Wood Street	Oakland	94607	Air District	Paint Operation
BNSF Intermodal	333 Maritime Street	Oakland	94607	Air District	Gas Station
BNSF Railway Co	333 Maritime Street	Oakland	94607	Air District	Emergency Generator
Bolero Co	2905 Union Street	Oakland	94608	Air District	Auto Body
California Cereal Products Inc	1267 14th Street	Oakland	94607	Air District	Food Processing
California Finest Body & Frame	1415 18th Street	Oakland	94607	Air District	Auto Body
California Hotel	3501 San Pablo Avenue	Oakland	94608	Air District	Emergency Generator
California Waste Solutions - Wood Street	3300 Wood Street	Oakland	94607	Air District	Recycling Plant
California Waste Solutions-10St Street	1820 10th Street	Oakland	94607	Air District	Recycling Plant
Caltrans	200 Burma Road	Oakland	94607	Air District	Emergency Generator
Caltrans - East Bay Yard	Burma Road	Oakland	94608	Air District	Gas Station
CalTrans SFOBB Maintenance Complex	200 Burma Road	Oakland	94607	Air District	Gas Station
CASS Inc	2730 Peralta Street	Oakland	94607	Air District	Metal Facility
Cathedral Gardens Oakland	638 21st Street	Oakland	94612	Air District	Emergency Generator
Central Concrete Supply A U S Concrete Company	2400 Peralta Street	Oakland	94607	Air District	Cement Plant
Chevron SS #9-4800	1700 Castro Street	Oakland	94612	Air District	Gas Station
City of Oakland Envr Scvs Division	1605 Martin Luther King Jr Way	Oakland	94612	Air District	Emergency Generator
City of Oakland Envr Scvs Division	14th & Mandela Way	Oakland	94607	Air District	Emergency Generator
City of Oakland Fire Station 1	1605 Martin Luther King Way	Oakland	94612	Air District	Gas Station
Clear Channel Outdoor	2857 Hannah Street	Oakland	94608	Air District	Gas Station
Clear Channel Outdoor	2865 Hannah Street	Oakland	94608	Air District	Paint Operation
Color Folio Design	1467 Park Avenue	Emeryville	94608	Air District	Paint Operation
ConGlobal Industries	555A Maritime Street	Oakland	94607	Air District	Auto Body

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Name	Address	City	Zip Code	Permit Type	Source Type
Continental Auto Body	1355 Park Ave	Emeryville	94608	Air District	Auto Body
Coolport LLC	575 Maritime Street	Oakland	94607	Air District	Emergency Generator
Custom Wood Finishing	2311 Adeline Street	Oakland	94607	Air District	Emergency Generator
Department of Transportation	Toll Operations Bldg, SF-Oakland Bay Bridge	Oakland	94608	Air District	Emergency Generator
Digital 720 2nd LLC	720 2nd Street	Oakland	94607	Air District	Emergency Generator
Dyneyg Oakland LLC	50 Martin Luther King Jr Way	Oakland	94607	Title V	Power Plant
East Bay Municipal Utility District	1100 21st Street	Oakland	94607	Air District	Emergency Generator
East Bay Municipal Utility District	1200 21st Street	Oakland	94607	Air District	Paint Operation
East Bay Municipal Utility District	2144 Poplar Street	Oakland	94607	Air District	Gas Station
East Bay Municipal Utility District PSK	2101 7th Street	Oakland	94607	Air District	Emergency Generator
East Bay Municipal Utility District	2020 Wake Avenue	Oakland	94607	Title V	Sewage Treatment
Englund Studio	1850 Campbell Street	Oakland	94607	Air District	Paint Operation
ExxonMobil c/o Acton Mickelson Environmental	909 Ferry Street (Port of Berth 23	Oakland	94607	Air District	Soil Vapor Extraction
Four Barrel Coffee Co	325 Martin Luther King Way	Oakland	94607	Air District	Coffee Roaster
Global Power Group, Inc	3938 Horton Street	Emeryville	94608	Air District	Emergency Generator
Harold's Auto Body & Paint Shop	2126 Market Street	Oakland	94607	Air District	Auto Body
HC Fine Finishes	1231 24th Street	Oakland	94607	Air District	Spray Booth
High End Custom and Collision	1649 28th Street	Oakland	94608	Air District	Auto Body
Hustead's Collision Center Inc	2915 Market Street	Oakland	94608	Air District	Auto Body
J and O Tire	2236 Poplar Street	Oakland	94607	Air District	Gas Station
Market Street Shell #135692	610 Market Street	Oakland	94607	Air District	Gas Station
MetroPCS California/Florida Inc	720 2nd Street	Oakland	94607	Air District	Emergency Generator
Mobile SS#63049	3400 San Pablo Avenue	Oakland	94608	Air District	Gas Station
Mr Espresso	696 3rd Street	Oakland	94607	Air District	Coffee Roaster
Nor-Cal Metal Fabricators	1121 3rd Street	Oakland	94607	Air District	Sandblasting
Oakland Unified School District	1011 Union Street	Oakland	94607	Air District	Emergency Generator
OFD Fire Station #3	1445 14th Street	Oakland	94607	Air District	Gas Station
Pacific Gas and Electric	689 2nd Street	Oakland	94607	Air District	Emergency Generator
Pinnacle Ag Services	2440 W 14th Street	Oakland	94607	Air District	Emergency Generator
Port of Oakland	651 Maritime Street	Oakland	94607	Air District	Gas Station
Port of Oakland	651 Maritime Street	Oakland	94607	Air District	Emergency Generator
Port of Oakland	1599 Maritime Street	Oakland	94607	Air District	Emergency Generator
Prologis	2420 West 21st Street	Oakland	94607	Air District	Emergency Generator

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Name	Address	City	Zip Code	Permit Type	Source Type
PS Printing LLC	2861 Mandela Parkway	Oakland	94608	Air District	Print Shop
Quality Body and Fender	2510 Martin Luther King Way	Oakland	94612	Air District	Auto Body
Radio Mirchi	Pole Plaza AHN 18, Pole #110141241	Oakland	94608	Air District	Emergency Generator
Redline Import - Auto Collision	2300 Market Street #C	Oakland	94607	Air District	Auto Body
Rino Pacific	1107 5th Street	Oakland	94607	Air District	Gas Station
Safety-Kleen Systems Inc	400 Market Street	Oakland	94607	Air District	Soil Vapor Extraction
San Francisco Bay Bridge Toll Plaza	Bay Bridge East	Oakland	94607	Air District	Emergency Generator
San Pablo Auto Body	2926 San Pablo Avenue	Oakland	94612	Air District	Auto Body
Sausal Corporation	Bay Bridge Toll Plaza	Oakland	94608	Air District	Gas Station
Schnitzer Steel Products Company	Adeline Street, Foot of	Oakland	94607	Air District	Metal Facility
SFPP, L P	Bay Street, off 7 th Street	Oakland	94666	Air District	Fuel Storage
Sierra Pacific	3213 Wood Street	Oakland	94608	Air District	Cement Plant
Solstice Press	113 Filbert Street	Oakland	94607	Air District	Print Shop
SPRINT	114 Brush Street	Oakland	94607	Air District	Emergency Generator
SPRINT	1075 7th Street	Oakland	94607	Air District	Emergency Generator
SSA Terminals (Oakland) LLC	1999 Middle Harbor Road	Oakland	94607	Air District	Emergency Generator
SSA Terminals-Oakland LLC	1999 Middle Harbor Road	Oakland	94607	Air District	Gas Station
Stanford Cleaners	2134 Market Street	Oakland	94607	Air District	Dry Cleaning
State of CA - Caltrans	Oak Bay Bridge, E Side, Toll Plaza	Oakland	94608	Air District	Gas Station
Tam's Auto Body	2300 Market Street Suite B	Oakland	94607	Air District	Auto Body
Target Corporation Store #T2767	1555 40th Street	Oakland	94608	Air District	Emergency Generator
T-fuels Inc dba Grand Arco AMPM-C Kim	889 W Grand Avenue	Oakland	94607	Air District	Gas Station
The Home Depot (Store #0627)	3838 Hollis Street	Emeryville	94608	Air District	Emergency Generator
T-Mobile	720 2nd Street	Oakland	94607	Air District	Emergency Generator
Trapac	2800 7th Street	Oakland	94607	Air District	Gas Station
Union Pacific Railroad	1400 Middle Harbor Road	Oakland	94607	Air District	Emergency Generator
Union Pacific Railroad	1400 Middle Harbor Road	Oakland	94607	Air District	Gas Station
US Postal Service - Building Maintenance	1675 7th Street	Oakland	94615	Air District	Emergency Generator
Verizon Wireless (Alameda Perm)	114 Brush Street	Oakland	94607	Air District	Emergency Generator
Verizon Wireless (Bay Bridge East)	107 Burma Road	Oakland	94617	Air District	Emergency Generator
Viridis Fuels	2040 Wake Avenue	Oakland	94607	Air District	Boiler
Watermark Bayside, LLC dba Bayside Park	1440 40th Street	Emeryville	94608	Air District	Emergency Generator

LIST OF COMPLAINTS RECEIVED IN WEST OAKLAND (JANUARY 2016 – DECEMBER 2018)

Complaint Number	Complaint Type	Date Received	Alleged Site	Address	City	Description	Pertinent Information	Investigation Result ²
224172	Odor	1/8/2016	Custom Alloy	2730 Peralta Street	Oakland			No Violation Documented
224220	Odor	1/13/2016	Custom Alloy	2730 Peralta Street	Oakland			No Violation Documented
224267	Odor	1/19/2016	NONE	NONE	Oakland	bad		No Violation Documented
224433	Odor	2/2/2016	Warehouse	1448 3rd Street	Oakland	skunk		No Violation Documented
224468	Odor	2/4/2016	California Waste Solutions	1820 10th Street	Oakland			No Violation Documented
224473	Odor	2/4/2016	California Waste Solutions	1820 10th Street	Oakland	garbage		No Violation Documented
224474	Odor	2/4/2016	California Waste Solutions	1820 10th Street	Oakland	garbage		No Violation Documented
224475	Odor	2/4/2016	NONE	NONE	Oakland			No Violation Documented
224476	Odor	2/4/2016	California Waste Solutions	1820 10th Street	Oakland	dead fish		No Violation Documented
224477	Odor	2/4/2016	California Waste Solutions	1820 10th Street	Oakland	nauseating		No Violation Documented
224491	Odor	2/5/2016	California Waste Solutions	1820 10th Street	Oakland			No Violation Documented
224492	Odor	2/5/2016	NONE	NONE	Oakland	bad dairy		No Violation Documented
224580	Odor	2/9/2016	California Waste Solutions	1820 10th Street	Oakland	sour garbage		No Violation Documented
224581	Odor	2/9/2016	California Waste Solutions	1820 10th Street	Oakland	unbearable		No Violation Documented
224604	Odor	2/10/2016	California Waste Solutions	1820 10th Street	Oakland		smelled at wood street	No Violation Documented
225033	Odor	2/25/2016	NONE	NONE	Oakland	chemical		No Violation Documented
225034	Odor	2/25/2016	Unknown Business	1448 3rd Street	Oakland	smoke	Caller from City of Oakland Admin reporting loads of smoke coming from businesses yard	No Violation Documented

² No Violation Documented: This refers to the result of a complaint investigations. In this situation, an inspector investigated, and no violation of an air pollution regulation or permit condition was established. The Air District receives a wide variety of complaints and for each situation, the inspector attempts to verify the source of the complaint and determine whether that source is violating an air pollution regulation. In many situations, even if a violation cannot be established, the inspector attempts to work with the owner/operator of the source of the complaint to resolve the issue.

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Complaint Number	Complaint Type	Date Received	Alleged Site	Address	City	Description	Pertinent Information	Investigation Result ²
225587	Odor	3/26/2016	Custom Alloy	2730 Peralta Street	Oakland	disgusting		No Violation Documented
225769	Odor	4/7/2016	Parking Lot	351 Mandela Pkwy	Oakland	paint solvent		No Violation Documented
225892	Odor	4/16/2016	Custom Alloy	2730 Peralta Street	Oakland	burning metal		No Violation Documented
226026	Smoke	4/21/2016	Business	291 3rd Street	Oakland	heavy black	Intermittent smoke but very heavy	No Violation Documented
226378	Odor	5/5/2016	California Waste Solutions	1820 10th Street	Oakland			No Violation Documented
226887	Odor	6/8/2016	Ant's Body Shop	2300 Market Street	Oakland	paint fumes		No Violation Documented
226900	Asbestos	6/9/2016	MFD	392 11th Street	Oakland	construction	improper removal and containment	No Violation Documented
227017	Odor	6/27/2016	Custom Alloy	2730 Peralta Street	Oakland	metallic		No Violation Documented
227159	Asbestos	7/7/2016	MFD	7 Embarcadero West Unit 202	Oakland	improper removal	no containment and when asked the contractor said they didn't need to	No Violation Documented
227331	Asbestos	7/28/2016	Construction Site	1919 Market Street	Oakland	dust everywhere		No Violation Documented
227488	Asbestos	8/17/2016	Construction Site	1919 Market Street	Oakland	no containment		No Violation Documented
1116959	Wood Smoke	8/24/2016	SFD	1425 Myrtle Street	Oakland	Heavy - cannot see through smoke	Outside backyard fire or firepit; Fire next door to complainant, ashes left uncleaned, property built in 1940, concerned about asbestos and airborne inhalation	No Violation Documented
227585	Odor	8/28/2016	Custom Alloy	2730 Peralta Street	Oakland	burning metal		No Violation Documented
227590	Odor	8/29/2016	Custom Alloy	2730 Peralta Street	Oakland	burning metal		No Violation Documented
227607	Odor	8/30/2016	Custom Alloy	2730 Peralta Street	Oakland	metallic/chlorine		No Violation Documented
227679	Dust	9/7/2016	Warehouse	1919 Market Street	Oakland	not watering down	No containment, dust & debris flying all over neighborhood, tearing down part of the building	No Violation Documented

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Complaint Number	Complaint Type	Date Received	Alleged Site	Address	City	Description	Pertinent Information	Investigation Result ²
227730	Odor	9/12/2016	NONE	NONE	Oakland	burning bread	smells it mostly in the morning but smells it again now at Laney College	No Violation Documented
227741	Dust	9/14/2016	Construction Site	1919 Market Street	Oakland			No Violation Documented
227786	Odor	9/17/2016	Custom Alloy	2730 Peralta Street	Oakland	metallic		No Violation Documented
228039	Odor	9/26/2016	MFD	2407 Adeline Street	Oakland	noxious	spraying foam on roof / noxious odor	No Violation Documented
228152	Odor	9/28/2016	NONE	NONE	Oakland	bad plastic		No Violation Documented
228421	Odor	10/10/2016	Custom Alloy	2730 Peralta Street	Oakland	burnt metal		No Violation Documented
228920	Odor	11/23/2016	Construction	311 Burma Road	Oakland	burning/smoke		No Violation Documented
229220	Odor	12/22/2016	NONE	Fallon St/7th Street	Oakland	burnt metal		No Violation Documented
229477	Odor	1/9/2017	NONE	NONE	Oakland	burning		No Violation Documented
229618	Odor	1/23/2017	Warehouse	1448 3rd Street	Oakland	Clorox		No Violation Documented
229710	Odor	1/28/2017	NONE	NONE	Oakland	Clorox	says smell is coming from Warehouses on 3rd/Center St, Oakland	No Violation Documented
229843	Odor	2/3/2017	Yang Auto Repair	1101 7th Street	Oakland	spray paint	sometimes can even smell it until 10pm (smelled it last night and again this morning)	No Violation Documented
229857	Odor	2/6/2017	NONE	3rd St / Center Street	Oakland	Clorox		No Violation Documented
229912	Odor	2/13/2017	NONE	NONE	Oakland	Clorox	1448 3rd and Center St	No Violation Documented
230255	Odor	2/27/2017	NONE	NONE	Oakland	burning		No Violation Documented
230876	Odor	3/24/2017	NONE	NONE	Oakland	bleach		No Violation Documented
231225	Odor	4/23/2017	Custom Alloy	2730 Peralta Street	Oakland			No Violation Documented
231331	Odor	4/30/2017	Custom Alloy	2730 Peralta Street	Oakland			No Violation Documented
231574	Dust	5/13/2017	Construction Site	Frontage Rd/14th Street	Oakland	not watering down		No Violation Documented
231597	Odor	5/16/2017	Custom Alloy	2730 Peralta Street	Oakland	metallic		No Violation Documented
231949	Odor	6/24/2017	LJP Construction Services	121 Pine St	Oakland	chemical		No Violation Documented
231950	Odor	6/24/2017	Construction Site	Frontage Rd/14th Street	Oakland	exhaust		No Violation Documented

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Complaint Number	Complaint Type	Date Received	Alleged Site	Address	City	Description	Pertinent Information	Investigation Result ²
231960	Odor	6/26/2017	Construction	11th St & Frontage Road	Oakland	fumes	Complained by leaving VM with our Public Info office	No Violation Documented
231961	Gas Station	6/26/2017	Arco	899 West Grand Avenue	Oakland	no latches		No Violation Documented
231968	Idling Commercial Vehicle	6/27/2017	Garbage Trucks	Pine & 11th Street	Oakland	many trucks		No Violation Documented
231970	Idling Commercial Vehicle	6/27/2017	California Waste Solutions	1820 10th Street	Oakland	trucks		No Violation Documented
232143	Asbestos	7/19/2017	Old American Steel Factory	1900 Mandela Parkway	Oakland	possible illegal removal	Workers on scene in rear warehouse tearing down walls, no containment, fans blowing dust all around	No Violation Documented
232232	Odor	7/27/2017	NONE	NONE	Oakland	burning pot handles		No Violation Documented
232240	Odor	7/28/2017	Custom Alloy	2730 Peralta Street	Oakland	bad		No Violation Documented
232242	Odor	7/28/2017	Custom Alloy	2730 Peralta Street	Oakland	burning smell	had also noticed the odor this morning	No Violation Documented
232362	Odor	8/6/2017	Custom Alloy	2730 Peralta Street	Oakland	burning metal		No Violation Documented
232537	Odor	8/28/2017	NONE	3rd St / Center Street	Oakland	Chemicals		No Violation Documented
232581	Odor	8/31/2017	NONE	NONE	Oakland	chemical like	She had stated odor is coming from the west of her...	No Violation Documented
232628	Smoke	9/5/2017	California Cereal Products	1267 14th Street	Oakland	black		No Violation Documented
232661	Dust	9/6/2017	NONE	15th and Center Street	Oakland	Dust from construction		No Violation Documented
232676	Dust	9/7/2017	Construction Site	West St/West Grand Street	Oakland	not watering down		No Violation Documented
232695	Dust	9/8/2017	Construction Site	Filbert St/Myrtle Street	Oakland	not watering down		No Violation Documented
232732	Dust	9/11/2017	NONE	305 Center Street	Oakland	Dust & gas odors		No Violation Documented
232755	Dust	9/14/2017	Blue Bottle Coffee	300 Webster Street	Oakland	Heavy dust		No Violation Documented
232800	Idling Port Truck	9/21/2017	Trapac Terminal	2800 7th Street	Oakland	Idling trucks	Trucks are seen lined up and idled for	No Violation Documented

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Complaint Number	Complaint Type	Date Received	Alleged Site	Address	City	Description	Pertinent Information	Investigation Result ²
							hours at a time	
232814	Odor	9/24/2017	Custom Alloy	2730 Peralta Street	Oakland	melting metal		No Violation Documented
233114	Odor	10/20/2017	Custom Alloy	2730 Peralta Street	Oakland	metal		No Violation Documented
233148	Odor	10/23/2017	Jac Truck Repair	West Avenue	Oakland	exhaust		No Violation Documented
233219	Odor	10/25/2017	NONE	NONE	Oakland	bleach		No Violation Documented
233749	Odor	12/10/2017	Custom Alloy	2730 Peralta Street	Oakland	burning metal		No Violation Documented
233837	Odor	12/17/2017	Custom Alloy	2730 Peralta Street	Oakland	melting		No Violation Documented
233942	Dust	1/2/2018	Pipe Spy	1108 26th Street	Oakland	soil/concrete	from excavated soil/concrete	No Violation Documented
234005	Odor	1/9/2018	NONE	3rd Street / Center Street	Oakland	Chemical smell		No Violation Documented
234011	Odor	1/9/2018	Cafe Tartine	55 Harrison Street	Oakland	burnt		No Violation Documented
234018	Odor	1/10/2018	NONE	3rd Street / Center Street	Oakland			No Violation Documented
234024	Odor	1/11/2018	NONE	NONE	Oakland	chlorine/bleach		No Violation Documented
234046	Dust	1/16/2018	Cafe Tartine	55 Harrison Street	Oakland	particulate matter		No Violation Documented
234568	Dust	3/7/2018	SFD	1480 8th Street	Oakland	construction	lots of dust, odor and debris from a basement renovation of this residence	No Violation Documented
234800	Odor	3/28/2018	Custom Alloy	2730 Peralta Street	Oakland	burning metal		No Violation Documented
235033	Odor	4/9/2018	NONE	3rd Street / Center Street	Oakland	bleach	Complaint #68 Chemical or bleach odor from a warehouse across the street coming into apt	No Violation Documented
234990	Odor	4/10/2018	Warehouse	3rd Street /Center Street	Oakland	bleach		No Violation Documented
235174	Odor	4/19/2018	Custom Alloy	2730 Peralta Street	Oakland	acid/burnt plastic		No Violation Documented
235186	Odor	4/20/2018	Custom Alloy	2730 Peralta Street	Oakland	chlorine, bleach		No Violation Documented
235202	Odor	4/22/2018	Custom Alloy	2730 Peralta Street	Oakland	chlorine		No Violation Documented
235203	Odor	4/22/2018	California Waste Solutions	10th Street/Pine Street	Oakland	burning plastic		No Violation Documented
235242	Odor	4/25/2018	Custom Alloy	2730 Peralta Street	Oakland	burning metal		No Violation Documented

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235243	Dust	4/25/2018	Road Construction	Peralta Street /9th Street	Oakland	dust		No Violation Documented
235265	Odor	4/27/2018	Custom Alloy	2730 Peralta Street	Oakland	plastic/chlorine		No Violation Documented
235271	Odor	4/28/2018	Custom Alloy	2730 Peralta Street	Oakland	burning metal		No Violation Documented
235276	Odor	4/29/2018	Custom Alloy	2730 Peralta Street	Oakland	chemical	THERE ARE WHITE CLOUDS OF SMOKE THAT SMELL LIKE CHLORINE COMING FROM RECYCLE PLANT	No Violation Documented
235283	Odor	4/30/2018	Custom Alloy	2730 Peralta Street	Oakland	burnt circuit boards	occurs in the afternoon; 3-7pm; if c doesn't answer call again	No Violation Documented
235682	Odor	5/29/2018	Custom Alloy	2730 Peralta Street	Oakland	CHLORINE BITTER CHEM		No Violation Documented
235685	Dust	5/30/2018	NONE	1600 block 10th Street	Oakland	white		No Violation Documented
235687	Soot	5/30/2018	NONE	NONE	Oakland			No Violation Documented
235709	Odor	5/31/2018	Custom Alloy	2730 Peralta Street	Oakland	burning metal		No Violation Documented
235715	Odor	6/1/2018	Custom Alloy	2730 Peralta Street	Oakland	burnt plastic		No Violation Documented
235776	Smoke	6/4/2018	Schnitzer Steel	1101 Embarcadero West	Oakland	black	Black smoke - big fire. Concerned about our health and potential respiratory issues.	No Violation Documented
235777	Odor	6/4/2018	Custom Alloy	2430 Peralta Street	Oakland	burning metal	burning metal odor - burning after 7p when not supposed to	No Violation Documented
235991	Dust	6/25/2018	NONE	Wood Street / 17th Street	Oakland	demo no watering		No Violation Documented
235995	Dust	6/25/2018	Construction Site	17th Street & Campbell Street	Oakland			No Violation Documented
236297	Odor	7/13/2018	NONE	W Grand Avenue & Linden Street	Oakland	sulfur		No Violation Documented
236312	Odor	7/13/2018	Custom Alloy	2730 Peralta Street	Oakland	chemical		No Violation Documented
236378	Odor	7/18/2018	Custom Alloy	2730 Peralta Street	Oakland	burnt chlorine		No Violation Documented

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236563	Odor	7/25/2018	Smart Foodservice Warehouse Stores	400 Oak Street	Oakland	diesel, gas	generator runs midday, everyday for about 2 hours	No Violation Documented
236592	Odor	7/25/2018	Custom Alloy	2730 Peralta Street	Oakland			No Violation Documented
WSC40895 1	Wood Smoke	9/3/2018	SFD	1618 12th Street	Oakland	White smoke - can partially see through smoke	neighbor burning backyard, wood toxins, garbage	No Violation Documented
237249	Odor	9/8/2018	Custom Alloy	2730 Peralta Street	Oakland	bad		No Violation Documented
237527	Odor	9/26/2018	NONE	Adeline Street & 24th Street	Oakland	burning		No Violation Documented
237629	Odor	10/4/2018	Custom Alloy	2730 Peralta Street	Oakland	burning plastic		No Violation Documented
237631	Odor	10/4/2018	Custom Alloy	2730 Peralta Street	Oakland	acid		No Violation Documented
237672	Dust	10/8/2018	NONE	NONE	Oakland	black dust		No Violation Documented
237752	Odor	10/15/2018	Custom Alloy	2730 Peralta Street	Oakland	chemical		No Violation Documented
237830	Odor	10/17/2018	West Oakland Bart Station	1451 7th Street	Oakland	burning tires		No Violation Documented
238281	Odor	11/5/2018	NONE	3rd Street / Center Street	Oakland	chemical burning		No Violation Documented
WSC40980 6	Wood Smoke	11/17/2018	SFD	1131 Wood Street	Oakland	White smoke - can partially see through smoke	Backyard fire pit, burning on no burn day	No Violation Documented
238505	Odor	11/27/2018	Jack Truck Repair	2226 Myrtle Street	Oakland	repair fumes		No Violation Documented

LIST OF NOTICES OF VIOLATIONS ISSUED IN WEST OAKLAND (JANUARY 2016 – DECEMBER 2018)

NOV Number	Regulation	Type	Date Issued	Site	Address	City	Zip	Status
A54387	Rule 11-2-401	Administrative Requirement	2/4/2016	Asbestos Management Group of California	3438 Helen Street	Oakland	94607	Closed
A56328	Rule 2-6-307	Operational Requirement	7/1/2016	East Bay Municipal Utility District	2020 Wake Avenue	Oakland	94607	Closed
A56003	Rule 11-2-401	Administrative Requirement	7/29/2016	Construction Site	1919 Market Street	Oakland	94607	Closed
A56329	Rule 2-1-301	Administrative Requirement	8/29/2016	Pinnacle Ag Services	2440 W 14th Street	Oakland	94607	Closed
A56005	Rule 11-2-303	Operational Requirement	9/8/2016	Construction Site	1919 Market Street	Oakland	94607	Closed
A56006	Rule 11-2-401	Administrative Requirement	9/8/2016	Construction Site	1919 Market Street	Oakland	94607	Closed
A56330	Rule 2-6-307	Operational Requirement	9/27/2016	East Bay Municipal Utility District	2020 Wake Avenue	Oakland	94607	Closed
A56331	Rule 2-6-307	Operational Requirement	9/27/2016	East Bay Municipal Utility District	2020 Wake Avenue	Oakland	94607	Closed
A56686	Rule 2-1-302	Administrative Requirement	11/8/2016	San Pablo Auto Body	2926 San Pablo Avenue	Oakland	94608	Pending
A56332	Rule 2-6-307	Operational Requirement	12/2/2016	East Bay Municipal Utility District	2020 Wake Avenue	Oakland	94607	Closed
A56333	Rule 2-1-302	Administrative Requirement	12/5/2016	Department of Transportation	Toll Operations Bldg, SF-Oakland Bay Bridge	Oakland	94608	Closed
A56334	Rule 2-6-307	Operational Requirement	2/7/2017	East Bay Municipal Utility District	2020 Wake Avenue	Oakland	94607	Closed
A56389	Rule 2-1-307	Operational Requirement	7/24/2017	Schnitzer Steel Products Company	Adeline St, Foot of	Oakland	94607	Closed
A56391	Rule 2-6-307	Operational Requirement	8/22/2017	East Bay Municipal Utility District	2020 Wake Avenue	Oakland	94607	Pending
A57908	Rule 8-7-301	Operational Requirement	1/26/2018	Trapac	2800 7th Street	Oakland	94607	Closed
A56067	Rule 2-1-307	Operational Requirement	4/26/2018	East Bay Municipal Utility District	2020 Wake Avenue	Oakland	94607	Pending
A58204	Rule 11-2-401	Administrative Requirement	5/3/2018	Silverado Contractors	2855 Mandela Parkway	Oakland	94608	Closed
A58247	Rule 8-7-302	Operational Requirement	7/12/2018	East Bay Municipal Utility District	2020 Wake Avenue	Oakland	94607	Closed
A56069	Rule 5-301, Rule 6-4-301 & 501	Administrative & Operational Requirement	8/24/2018	Schnitzer Steel Products Company	Adeline St, Foot of	Oakland	94607	Pending
A58487	Rule 11-2-401	Administrative Requirement	9/4/2018	Silverado Contractors	2855 Mandela Pkwy, 2nd Fl.	Oakland	94608	Pending
A56070	Rule 2-1-307	Operational Requirement	9/17/2018	East Bay Municipal Utility District	2020 Wake Avenue	Oakland	94607	Pending
NTC Number	Regulation	Type	Date Issued	Site	Address	City	Zip	Status
A46659	Rule 8-7-301	Administrative Requirement	3/9/2018	Mobil SS #63049	3400 San Pablo Avenue	Oakland	94608	Violation Resolved